ISEE

ISEE 2022
ATHENS-GREECE

34th Annual Conference of the International Society for Environmental Epidemiology

Hybrid Event

18-21 sept. 2022

Megaron Athens International Conference Centre

Abstract book

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SYMPOSIA PRESENTATIONS

Monday, September 19

SYMPOSIUM 01: Climate disasters, human health, and public health responses

O-SY-001 Building community and health system resilience to climate disasters in Australia

Sotiris Vardoulakis

Australia has recently experienced severe climate disasters, ranging from bushfires and droughts to floods and vector borne disease outbreaks. IPCC identified the inability of institutions to manage climate risks as a key risk for Australia. The unprecedented 2019-20 wildfires and the 2022 floods have raised questions about the resilience of the Australian health system and communities to intensifying extreme events in the context of climate change.

The 2022 floods caused 23 deaths, large-scale community devastation, and disrupted health services. They increased COVID-19 and other infectious disease risks and long-lasting mental health consequences. Furthermore, they exposed health inequities and vulnerabilities related to non-communicable diseases in Aboriginal and low socio-economic communities.

The Black Summer (2019-20) wildfires caused 33 fatalities, extensive damage to property, and destruction of flora and fauna, as well as exposing millions of people to extreme levels of air pollution. Bushfire smoke, a complex mixture of particles and gases, was transported by the wind over long distances affecting populated areas for several weeks.

Public health interventions at both community, household and personal levels can mitigate the impact of climate disasters. The effectiveness, feasibility and scalability of these interventions, as well as any potential health co-benefits or other unintended consequences, need to be evaluated holistically taking into account quantitative and qualitative evidence. The impact of these interventions on health equity, particularly in relation to First Nations, at-risk and socioeconomically marginalized groups needs to be assessed, as these groups are typically more vulnerable to climate extremes.

Strengthening the long-term resilience of the health sector and communities to climate disasters is crucial. The HEAL (Healthy Environments and Lives) Network is taking leadership in environmental change and health research that will provide the evidence, capacity and capability, and tools urgently needed to build community and health system resilience to intensifying climate disasters in Australia.

O-SY-002 California wildfires: mental and physical health, unmet needs, and future directions

Irva Hertz-Picciotto

BACKGROUND: California's wildfires annually break records in size, fatalities, or buildings destroyed. Every year since 2017, records have been broken for deaths, structures destroyed, or area burned. The toll on mental health, respiratory conditions, and other outcomes constitutes a major public health challenge.

METHODS: Online surveys of households in counties affected by fires or smoke collected information about experiences during wildfires, unmet needs, and health conditions before, during and after the fires. Both a convenience sample, and a probability sample of households were recruited. One respondent replied for all household members. Lack of access to shelter, food, electricity, cell phone service, and other basic necessities was documented. Separate multinomial models were fit to the incident respiratory and mental health outcomes that occurred during and after the fires, with the goal to identify major independent predictors of symptoms in those time periods. All models hierarchically adjusted for intra-household correlations. Potential predictors included sociodemographic characteristics, cumulative PM2.5 exposure during wildfires, prior health, and fire-related experiences (evacuations; loss of home, job, loved one; etc.).

RESULTS: The sociodemographics, prior asthma, and wildfire PM2.5 exposure predicted increases in respiratory symptoms. Different factors associated with greater mental health disturbances. The study demonstrated how needs changed over time. Multivariate models showed that people of color had higher risks for respiratory symptoms, both as a direct association and through their greater prevalence of prior asthma, indicating a particularly high health burden from wildfire smoke.

CONCLUSIONS: Climate change challenges epidemiology to identify specific high risk subgroups; determine factors that mediate or buffer adverse health impacts; investigate synergies across multiple extreme events/disasters or multiple health consequences; clarify differences in health risks from traffic or industrial versus wildfire air pollution; and work with communities to develop culturally appropriate protective strategies and to evaluate feasibility, effectiveness, co-benefits or negative effects of interventions.

O-SY-003 Climate change in the Caribbean: transforming vulnerabilities into resiliency

Jose Cordero

Significant climate events, such as hurricanes, have increased in frequency and intensity in the Caribbean during the 21st century. In 2017, two Class 5 hurricanes, Irma and Maria, hit Puerto Rico within two weeks, leaving a trail of devastation and death. Over 4,000 people died, most during the post-event period impacting mainly the vulnerable population, the elderly, those with chronic diseases, and the poor.

We conducted a rapid needs assessment in six targeted municipalities in Puerto Rico that Hurricane Maria severely impacted. We conducted 14 focus groups that included 110 persons and interviewed 15 key informants to examine the impact of hurricanes on their daily lives. These interviews, conducted about six months post-hurricane Maria, focused on how their key priorities changed from before to after the disaster.

We found access to health care was a significant priority post-disaster but the barriers to access were directly related to social determinants of health, including transportation, lack of communication services, food insecurity, access to safe water, and housing. We developed a community health promoter program to connect the vulnerable population to health care access and preparedness agencies. The program targeted the elderly and those with chronic diseases such as diabetes, hypertension and others.

We demonstrated that community health promoters were instrumental in connecting their patients to health care resulting in the improved health status of their chronic conditions. Similarly, the community health promoters established connections between patients and disaster planning agencies to identify suitable shelters to manage the health care needs of persons with chronic diseases post-disaster.

Deployment of community health workers can be an approach to reducing morbidity and mortality among persons with chronic diseases in the post-disaster situation. Deployment of community health workers can be an approach to reduce morbidity and mortality among persons with chronic diseases in the post-disaster situation.

O-SY-004 Heatwaves and forest fires and their combined effects in the Greater Athens area

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BACKGROUND: Previous severe heatwaves in Athens were associated with excess mortality. As example, the heatwave in July 1987 led to 100% increase in the monthly number of deaths. Also, the occurrence of forest fires burning more than 30km2 of land are associated with increased mortality (>90% increase in respiratory deaths). The aim of the present work is to quantify the effects of a heatwave combined with a forest fire event in July-August 2021.

METHODS: Data for weekly and daily temperature, particulate air pollution and number of deaths were recorded for the summer 2021 and the 10 previous years. for the 2020-21 period the daily number of deaths due to COVID-19 was also available. A Poisson regression analysis was applied to estimate the effect of the heatwave and forest fire episode on mortality. A comparison with what would be expected in terms of excess deaths, if the same associations observed in the 1987 heatwave were still applicable, was undertaken.

RESULTS: PM2.5 concentrations were increased to 73μg/m3 on the 9th heatwave day (2nd forest fire day). The weekly number of deaths increased up to 80% compared to the observed number of deaths during the same time period in 2017-2020. However, the observed impact in 2021 was smaller to what would be expected based on projections using exposure-response functions estimated for the 1987 heat wave. The increase in mortality during the 2021 heatwave could not be explained by an increase in COVID-19 related deaths.

CONCLUSIONS: The impact of the 2021 heatwave–forest fire event on the number of deaths for the Athens population was very severe. However, it was less than expected based on observations from an important heatwave in the same period in 1987. The difference is probably due to raised awareness and behavioral adaptation.

KEYWORDS: heatwave, forest fire, mortality, Athens

O-SY-005 Mortality burden of heatwaves in Sydney Australia is exacerbated by the urban heat island and climate change: can tree cover help mitigate the health impacts?

Geoffrey Morgan

Health Impact Assessment methods were applied to quantify the mortality burden of heatwaves in Sydney Australia, and assess the contribution of the Urban Health Island (UHI) effect to this burden. Using high resolution satellite observations to calculate UHI air temperature excesses and green cover, effects on heat-related mortality were determined. From future climate projections, mortality reduction benefits were estimated from green tree cover. Results show that >90% of heatwave-deaths could be prevented by removing the UHI. Tree canopy reduces urban heat and widespread tree planting could offset the increases in heat attributable deaths as climate warming.

SYMPOSIUM 02: Multimodal environmental influences on children and adolescent's brain, cognitive, and mental health outcomes

O-SY-006 Early-life urban exposome and brain structural connectivity and morphology in preadolescents

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Recent studies have linked air pollution to brain characteristics in children, but few studies have considered associations with other urban exposures. We investigated the associations between urban exposome and white matter microstructure and brain volumes in preadolescents.

We used data from 3,315 children of the Generation R cohort, The Netherlands. Residential levels of 20 built environment metrics, 6 natural spaces indicators, 12 air pollutants, and road-traffic noise were assessed during pregnancy and childhood. Diffusion tensor and structural brain images were obtained at 9–12 years. We estimated fractional anisotropy (FA) and mean diffusivity (MD) and several brain structure volumes. We ran multi-pollutant analysis between built environment and natural spaces indicators and each outcome using Deletion/Substitution/Addition algorithm. When an association was found, we ran mediation analyses to estimate whether the association was mediated by air pollution or noise.

Built environment and natural spaces indicators during pregnancy were not associated with FA nor MD. During childhood, building density and industrial or commercial land use (LU) were related to higher MD, and LU diversity was associated with lower MD (e.g., -0.02 95%CI (0,03; -0,01)). Total effects of building density and LU diversity were partially mediated by fine particulate matter elemental zinc (9.0% and 23.2%, respectively). Surrounding greenness during pregnancy was associated with smaller subcortical gray matter, pallidum and thalamus volumes, with no mediation by air pollution nor noise. Built environment indicators, including LU diversity and unhealthy food facilities density during pregnancy or childhood were associated with smaller hippocampus, larger amygdala and nucleus accumbens volumes, with a mediation up to 6.9% by elemental zinc or polycyclic aromatic hydrocarbons.

Early-life built environment and natural space indicators were related to brain structural connectivity and morphology in preadolescence, with a partial mediation by air pollution levels.

Birth cohort, urban exposome, air pollution, natural spaces, neuroimaging, child development

O-SY-007 Approaches to identify the contribution of understudied toxicants in complex metal mixtures

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BACKGROUND AND AIM: Exposures to complex mixtures are increasingly acknowledged to contribute to adverse health outcomes through complex joint or interactive effects. Emerging advanced statistical approaches facilitate appropriate analyses of complex mixtures by incorporating high correlations, nonlinearities, and interactions among individual exposures. Selection of appropriate analytical approaches for complex mixture analysis, and the interpretation of results, is dependent on the specific scientific goals. This presentation discusses and compares the use of complementary and combined approaches in analyses of metal mixture exposures in the Navajo Birth Cohort Study (NBCS).

METHODS: We compare results and interpretation from 1) Clustering methods that assess the study participant's co-occurring exposure patterns; 2) Regression methods with shrinkage and variable selection that identify a subset of exposure mixtures associated with the outcome of interest; 3) Kernel machine regression approaches that model mixture effects by incorporating interaction and nonlinear relationships; 4) Ensemble learning methods that provide outcome prediction by ranking each variable's predictive power, thereby handling a large number of variables; and 5) Causal analysis methods that provide inference that mimics interventional effects to control for confounders, reducing biased estimates that may limit generalizability.

RESULTS: Different approaches used have helped to identify not only the patterns of exposures in the population, but also understudied metals that, in mixtures, are significant contributors to birth outcomes and developmental delays in NBCS. The results obtained from different approaches have affected the interpretation and opened new avenues of investigation for understudied toxicants.

CONCLUSIONS: Using complex analytic strategies to parse effects of complex exposures supports both understanding of population-specific exposure-response relationships, and also the specific contributors to those responses and associated mechanisms that are generalizable to populations where metal-mixture mineralogic composition, chemistry, doses, and patterns of exposure will vary.

KEYWORDS: clustering, penalized regression, kernel machine regression, ensemble learning, causal analysis, mixtures, metals

O-SY-008 Do complex mixtures of prenatal environmental and social exposures explain variation in risk for behavioral symptoms in adolescence?

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BACKGROUND AND AIM: Prenatal exposure to environmental chemicals is associated with behavioral symptoms of mental health. These symptoms often emerge across adolescence and frequently co-occur, suggesting shared etiologic pathways. Prenatal chemical exposures are often correlated with each other and with social exposures such as maternal demoralization that are also associated with elevated behavioral symptoms. We aimed to identify how complex patterns of prenatal co-exposure to chemicals and social factors are associated with symptoms of psychiatric outcomes common in adolescence, such as attention problems, substance abuse, and psychotic symptoms.

METHODS: We used exposure and behavioral symptoms data from the Columbia Center for Children's Environmental Health Mothers and Newborns birth cohort (age 14-21). We use principal components pursuit (PCP) to decompose the exposure matrix into a low-rank matrix to identify consistent exposure patterns and a sparse matrix to isolate unique exposure events. To identify profiles of exposures (N=550), after running PCP, we used principal components analysis (PCA). We use multiple linear regression to test interactions between prenatal exposures and behavioral outcomes in adolescence (age 14-21) in N=253 participants.

RESULTS: We observed two subgroups of strong correlation among phthalate exposures and maternal demoralization. We identified similar patterns using PCA on the raw data. Prenatal Polycyclic Aromatic Hydrocarbons (PAH) exposure modified effects of early life stress (ELS) on underage alcohol use (interaction: z=1.95, p=.05). Relative to those with lower exposure, those with higher prenatal PAH and ELS had the highest risk for underage alcohol use.

CONCLUSIONS: Variability in phthalates and maternal demoralization within the cohort describe unique profiles of exposure. PCP analysis will more precisely identify consistent and interpretable prenatal exposure patterns while dealing with data missingness and outliers. Interactions between prenatal chemical and social exposures increase risk for psychiatric problems in adolescence pointing to modifiable pathways to reduce risk.

O-SY-009 Prenatal exposure to mixtures of replacement flame retardant chemicals and children's neuro-behavioral outcomes in a sample of children from socioeconomically disadvantaged communities

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BACKGROUND: Organophosphate ester flame retardants (OPFRs) are persistent organic chemicals that are commercially applied to a wide variety of consumer products including electronics, building materials, foam-based furniture and children's clothing that have individually been shown to adversely impact neurodevelopmental outcomes including hyperactivity symptoms, working memory, IQ and depressive symptoms.

METHODS: We quantified nine prenatal OPFR urinary metabolites [DPHP, DNBP+DIBP, BDCIPP, BCEP, BBOEP, BCIPP, BMPP, BEHP and DPRP] by HPLC-MS/MS in samples from participants in the MADRES cohort--an ongoing pregnancy cohort in urban Los Angeles. Detection frequencies ranged from 99.8% for DPHP to 24.2% for DPRP. Specific-gravity adjusted OPFR metabolites detected in 60% or greater samples [DPHP, DNBP+DIBP, BDCIPP, BCEP, and BBOEP] were modeled continuously and log transformed, and values ≤ LOD were imputed as LOD/√2. The remaining four metabolites were modeled as detect/non-detect [BCIPP, BMPP, BEHP, and DPRP]. We assessed prenatal OPFR exposure associations with neurodevelopmental outcomes from the Child Behavior Checklist 1.5/5 in 151 predominantly Hispanic/Latino (~78%) children at age 3 years.

RESULTS: We found significant associations between several OPFR metabolite concentrations and neurobehavioral outcomes in single metabolite adjusted models [e.g., a 10% increase in DNBP+DIBP concentration was associated with a 3.3% (95% CI 0.02%-6.49%) increase in internalizing symptoms score and a 4.8% (0.82%-8.95%) increase in DSM pervasive symptoms score]. However, exposure to a particular compound does not occur in isolation; thus it is critical that multiple exposures be considered jointly in human studies. We will discuss various analytical approaches to quantify the effects of environmental mixtures and apply them to understand multiple OPFR chemical exposure effects on early childhood neurobehavioral outcomes in a highly exposed, socioeconomically disadvantaged population.

CONCLUSIONS: The application of mixtures methods will yield important insight into the conditional associations of co-exposures and enhance health risk assessment for child neurodevelopmental outcomes.

KEYWORDS: Neurodevelopment, children, chemical mixtures

O-SY-010 A life-course approach for examining the impact of air pollutants on adolescent anxiety and depression and the role of DNA methylation

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BACKGROUND AND AIM: Anxiety and depression are common in adolescents; yet, their etiology is poorly understood. Air pollutants are widely recognized for their ability to adversely impact neurodevelopment and elicit changes to the epigenome. It is unclear whether pollution-related epigenome changes impact mental health.

METHODS: The Infinium MethylationEPIC BeadChip was used to assess whole blood DNA methylation from 159 adolescents (age 12). Fine particulate matter (PM2.5) and elemental carbon attributable to traffic (ECAT), a surrogate of diesel exhaust, were measured using validated land use regression and satellite-based spatio-temporally resolved prediction models, respectively. Three exposure windows were investigated: early-life (birth), recent (12 months prior to yr. 12 visit), and lifetime average. Anxiety and depression were assessed by child report with the Spence Children's Anxiety Scale and Child Depression Inventory-2 at age 12. Regression and distributed lag models controlled for sex, race, age, and household income.

RESULTS: Five CpG sites, mapping to 5 genes, were differentially methylated as a result of recent PM2.5 exposure (FDR < 0.05). Distributed lag models suggest significant cumulative effects for most of the CpGs (4 out of 5) with the timing of exposure being an important factor for three CpG sites. The top hit (cg08349910, FDR=0.03) annotates to the gene SRGAP3 which is ubiquitously expressed in the developing nervous system. We observed the methylation status of cg08349910 to be associated with increased symptoms of generalized anxiety, social phobia, and total anxiety. Controlling for ECAT or including an interaction between ECAT and PM2.5 did not change these findings. Additional analyses are being conducted to include nitrogen dioxide and ozone.

CONCLUSIONS: These data suggest methylation at specific CpGs may serve as biomarkers for particulate matter exposure and identify children at increased risk for anxiety and depression.

KEYWORDS: Air pollution, DNA methylation, Mental health

SYMPOSIUM 03: Strengthening the global role of environmental epidemiology in the issue of water, sanitation and public health in Latin American and Caribbean countries

O-SY-011 The role of the University in the formation, discussion and training of researchers in environmental epidemiology. How to strengthen Latin America?

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Since the 1990s, various initiatives have been organized to train persons on environmental health, and epidemiology with the support of the Pan American Health Organization (PAHO), governments, and public health centers. In Latin America and the Caribbean counties (LAC), a high prevalence of smoking, obesity, chronic respiratory and cardiovascular diseases, cancer, social vulnerability, and air and water pollution are reported. The consequences of COVID-19 and the evident biological, social and cultural crisis that Climate Change represents, are added.

This work analyzes the education and training of researchers on environmental epidemiology and its impact on public health actions in LAC.

Training programs in public health, environmental health, and epidemiology in LAC were reviewed, and a training case conducted by the PAHO and the Latin American chapter of the Society for Environmental Epidemiology (ISEE-LAC) is described.

Until March 2022, most of the LAC countries have postgraduate programs in Environmental management and control; a few programs are a focused on Environmental Epidemiology. Brazil, Mexico, Uruguay, Colombia, and Costa Rica stand out, and they have developed Environmental Health programs, including online versions. Given the limitations in the training of people specialized in Environmental Epidemiology, researchers from LAC universities and members of the ISEE-LAC, designed and executed the Basic Self-Learning Course in Environmental Epidemiology, on Campus Virtual Public Health. More than 6,000 participants from various LAC countries have signed up; of them, 932 people from different disciplines and countries have completed their training and are in a position to apply basic knowledge in environmental epidemiology.

Strengthening is required at all levels in the training of people in environmental epidemiology, with the support of governments and international agencies such as PAHO, to address environmental hazards, the health burden due to environmental deterioration, and the impacts due to climate change in LAC populations.

O-SY-012 Waterborne arsenic and fluoride exposure in Mexico: risk assessment and epidemiological research on their health effects

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Many aquifers in Mexico contain toxic levels of arsenic and fluoride; still, 39% of the population relies on groundwater for drinking. Our objectives were to evaluate the health risks of fluoride and arsenic in drinking water in central [Cuenca Alta del Río Laja (CARL)] and northern [Comarca Lagunera (CL)] Mexico, and to compare economic and health trade-offs of different aquifer pumping scenarios.

In two CARL studies, we measured arsenic and fluoride in drinking water and fluoride in children's urine; health risks were estimated through hazard quotients (HQ). In 2018 we assessed dental fluorosis (n=39) and in 2019, we measured intelligence quotient (IQ) (n=74). Another study modeled the revenues, costs, health, and income outcomes from increasing, decreasing, or maintaining the aquifer pumping rates over 100 years. The fourth study assessed cancer and non-cancer risks in CL according to arsenic levels in 91 wells.

In CARL, children who drank groundwater had an increased fluoride risk of health effects (HQ= 1.5); 82% presented dental fluorosis, and their urine fluoride concentrations increased 0.96 mg/L per 1 mg/L increase in water fluoride ($p < 0.001$). Urine fluoride was negatively associated with IQ (β= -1.12, CI 95% -4.1, 1.8). Assuming increasing aquifer pumping rates in the next 100 years, arsenic and fluoride concentrations would increase to 40 µg/L and 2.1 mg/L, respectively, potentially diminishing IQ by 6 and 7 points, respectively. In CL, 90% of the sampled wells exceeded the WHO's arsenic drinking water guidelines; the carcinogenic risk ranged from 2.6×10^{-5} to 6.1×10^{-3}.

Children in CARL and CL are drinking groundwater with toxic fluoride and arsenic concentrations that increase their cancer and non-cancer health risks to unacceptable levels. The health and economic benefits of mitigating exposure to arsenic and fluoride greatly exceed the benefits of increasing pumping for more agricultural production.

KEYWORDS: arsenic, fluoride, water, Mexico

O-SY-013 Diseases and deaths from pesticides in Brazil

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All released! for decades, Brazil has become a great granary and depository of pesticides used in its crops. The situation has worsened since 2008, when Brazil became the world's largest consumer of pesticides and, more recently, in the last 6 years after the release and authorization of registrations of new pesticides, by the governments of Temer and Bolsonaro, with many use of these pesticides in their countries of origin is prohibited. Between 2010 and 2021, 3,474 new pesticides were released, of which 76.5% were only between 2016 and 2021. and as an announced tragedy, the reflection of the general release, are the impacts on health and the environment resulting from the indiscriminate use of these pesticides. Objectives: To analyze data on mortality from cancer, suicide attempts, poisoning and deaths from pesticides for agricultural, domestic, public health, rodenticides and veterinary use between 2010 and 2020.

METHODS: Descriptive cross-sectional study. Data were collected from the database DATA/SUS/Ministry of Health.

RESULTS: There were 135,803 cases of intoxication, 73.2% of intoxications were not due to exposure at work; 70,920 suicide attempts and 3,944 deaths from poisoning, with 48.8% of the deaths being between black/brown and 36% white; 74.6% of intoxications were in urban residents and 21.9% in rural areas and 94.5% of deaths were not related to work. There were 8,099,845 cases of neoplasms, 92,217 of which were malignant neoplasms of the liver and intrahepatic bile ducts; 877,464 of congenital malformations.

CONCLUSIONS: The results point to a relationship between higher mortality rates from cancer, poisoning, suicide attempts and deaths from pesticide poisoning, proportionally increasing, as the consumption and sales of pesticides in Brazil increase annually. Most victims of poisoning are residents of urban areas and belonging to black/brown color/ethnicity and are not exposed to work.

KEYWORDS: Pesticides, intoxications, deaths, cancer, suicide

O-SY-014 Surveillance and epidemiological control network in Latin America – The importance of water and sewage monitoring. Overview of pesticides in water for human consumption in Brazil – Information through the website – Good water to drink “Água Boa de Beber”

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In March 1977, the Plan of Action resulting from the United Nations Conference on Water, Silver Sea: for the first time recognized water as a right by declaring that “All peoples, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in a quantity and quality equal to their basic needs”. This presentation of consultation and information on pesticides in the water for 5,000 municipalities. Through the site, pesticides analyzed in water for human consumption and their levels, some above the limits, are evidenced. Access facilitates analysis and adoption of epidemiological surveillance measures. Date of website: https://agua.mpf.mp.br/. CONCLUSION: Surveillance and epidemiological control network in Latin America, is very important.

KEYWORDS: Water, Quality, Pesticides

O-SY-015 The role of the World Alternative Water Forum (FAMA) and social mobilization

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The fight to guarantee human rights to water and sanitation has a prominent moment during the World Alternative Water Forum (FAMA), organized simultaneously with the World Water Forum (FMA), organized by the World Water Council (CMA), every three years. The FAMA organizers adopt a narrative of concern about the need to "take care" of the planet's water and to ensure sanitation for the entire population, but in these meetings, small spaces of participation are reserved for civil society, whose sole objective is to legitimize decisions that seek to expand its control by the private sector, corporations, and agribusiness.

RESULTS: FAMA, occurs in opposition to the FMA and is configured in a space of democratic debate, exchange of experiences of struggle and resistance in defense of water and public sanitation and against privatizations. It brings together social, popular and trade union movements, the city and the countryside, indigenous populations, and various religiosities, allows discussions around water under the most varied perspectives, under the most varied views and experiences. The themes that have been highlighted in the FAMAs are the fight against privatization; the emphasis on the role of women in the fight for access to water, which in the privatization processes deepen. The need for global organization to cope with the processes of privatization and appropriation of water by capital; the importance of processes of derivatization of sanitation services around the world; the importance of democratic control over companies, and the strengthening of instruments of control and social participation. CONCLUSION: Every achievement of FAMA, which has been held since the first edition of the FMA in 1997, strengthens the ties between popular organizations around the world that fight in defense of water in a view to reaffirming that water is right and not merchandise.

KEYWORDS: Water Forum, Social Mobilization, Human right

SYMPOSIUM 04: PFAS hotspots and highly exposed communities: addressing community needs and advancing global collaborative exposure assessment and epidemiological research

O-SY-016 PFAS exposures in Veneto, Italy: the role of biomonitoring in addressing a serious public health threat

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BACKGROUND AND AIM: In 2013, high levels of perfluoroalkyl substances (PFAS) were identified in the drinking water of the Veneto region, Italy, primarily due to industrial emissions from a nearby PFAS manufacturer. for decades, the factory released wastewater into the ground, contaminating both surface water bodies and groundwater, mainly by perfluorooctanoic acid (PFOA), before charcoal filters were introduced. The groundwater contamination plume extends over 190 km2 and reached public waterworks serving 30 municipalities (roughly 130,000 inhabitants). This presentation will provide an overview of the Veneto health surveillance program and its impact.

METHODS: The health surveillance program started in January 2017 and continues for the prevention, early diagnosis and treatment of chronic disorders possibly associated with PFAS. The target population included 105,000 residents of the contaminated area born between 1951 and 2014. Data are collected through a structured interview on socio-demographic characteristics, personal health history and lifestyle habits; routine blood and urine tests; and the measurements of 12 PFAS. The population is being recruited for a second round, which started in September 2020.

RESULTS: By February 2022 55,597 individuals were recruited (60,5% of invited) in the 1st round, and 2,623 in the 2nd round. The PFAS with the highest serum concentrations was PFOA (median 36.8 ng/mL), about 20 times higher than in the Italian population with background exposures, followed by perfluorooctanesulfonic acid (PFOS) (median 3.8 ng/mL) and perfluorohexanesulfonic acid (PFHxS) (median 3.7 ng/mL).

CONCLUSIONS:This population is unique in that biomonitoring has been offered to the entire highly exposed population. The program includes a thorough assessment of individual exposure as well as behavioural and clinical risk factors for cardiometabolic disorders, providing tailored counselling for exposure and risk reduction, and the referral of subjects with altered biomarkers for subsequent diagnostic and therapeutic evaluation.

KEYWORDS: PFAS, biomonitoring, health surveillance program, PFOA contamination

O-SY-017 Risk assessment in PFAS “hotspot” populations – A challenge

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BACKGROUND: In Ronneby, a Swedish municipality of 30,000 inhabitants, one of the two municipal waterworks had delivered highly PFAS-contaminated water to 1/3 of the households for decades until detected in December 2013. Open serum samplings revealed very high serum PFAS-levels in the exposed population, dominated by PFHxS and PFOS. This prompted an extensive research program, ranging from large registry studies to mother-child cohort observations and studies on mechanistical aspects.
By now, 8 years later, the amount of epidemiological studies on health effects has increased exponentially, however mostly performed at general population with “background serum concentrations”. at substantially higher exposure levels there are still only a few populations studied: PFAS production workers, the PFOA-dominated C8 and Veneto studies, and our own studies with fire-fighting foam contamination. Thus, there remains a substantial lack of studies of exposure levels in the mid-range, of importance since these are precisely the levels now observed in populations next to “hotspots”, which are increasingly detected following environmental investigations around production facilities, firefighting training ranges and airports.

AIM: To discuss both conflicting and supportive findings on associations between PFAS exposure and health outcomes, with emphasis on dose-response relationships.

METHOD: Review of published epidemiological studies, focused on outcomes with evidence in both background and highly-exposed populations

RESULTS: The lack of information about the shape of the dose-response curve and the still limited understanding of PFAS toxicity mechanisms hampers risk assessment for general population groups with modestly elevated PFAS-levels, since extrapolation “upwards” from background levels might often not give the same results as extrapolation “downwards”. Moreover, PFAS mixtures differ.

CONCLUSIONS: There is a need for concerted actions among researchers to fill this knowledge gap by coordinated protocols for studies on PFAS and health outcomes in populations with higher than background exposure.

KEYWORDS: Dose-response, PFAS, epidemiology

O-SY-018 Perspectives in risk communication due to the PFOS pollution case in Korsoer, Denmark

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BACKGROUND: In spring 2021 Denmark identified the first PFOS-pollution case deriving from a firefighting school. Through the last 20 years, members of a local cow grazing association had consumed veal having grazed on the contaminated area. The department of Occupational Medicine in Holbaek was contacted by the chairman of the regional council, and asked to investigate the members. In August 2021 118 of the members were found to have elevated blood levels of PFOS.

AIM: To present our risk communication strategy on individual, group and community level.

METHODS: We gathered knowledge about PFAS by searching the literature and establishing collaboration with experts, research institutions and authorities to be able to perform adequate risk communication based on a risk assessment to the members of the cow grazing association, the Danish authorities and the media.

RESULTS: We provided risk communication at different levels. (1) Individual level on medical consultations and by availability through the phone as needed; (2) group level by oral and written information with members of the cow grazing association; and (3) community level by contact with the media, and participation on an expert group set up by the National Board of Health.

CONCLUSION: Understanding the different 'senders and receivers' in risk communication is important to avoid unnecessary concerns and costs.
Preliminary assessments is required before a proper exposure and risk assessment is done. It is important to consider how to present scientific uncertainties.
Risk perception influences behavior in both individuals, group and public health level often regardless laws, regulations and expert evaluations as risks always are interpreted politically or value-related.
Cooperation across professional groups and sectors is essential to be able to handle these types of cases constructively.

KEYWORDS: Risk communication, PFOS, PFAS, food contamination

O-SY-019 PFAS in serum of residents living in the neighborhood of a major PFAS manufacturer plant in Belgium

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) contamination levels in the environment around a 3M PFAS production plant triggered the concern for health among residents in the neighbourhood. Following this concern, a blood collection was organized to assess residents' exposure levels.

METHODS: During the summer of 2021, 800 residents (+12 years old) living within 3 km of the 3M plant provided serum samples in which 13 PFAS compounds were measured, using ultra-performance liquid chromatography-tandem mass spectrometry. All participants completed a questionnaire.

Results and conclusion: The presentation will report the PFAS fingerprints in serum, the variation in PFAS serum levels within the community, and the key exposure determinants assessed using information retrieved from the questionnaire. PFAS exposure was dominated by PFOS (perfluorooctanesulfonic acid), with an important contribution of branched compounds. Consumption of locally-produced chicken eggs was identified as an important determinant for higher serum levels of several PFAS. Other significant determinants included geographical position of the homes, time living in the area, use of groundwater, contact with chemicals and soil particles and use of consumer products. The study results supported earlier implemented no-regret precautionary measures. We will also address the policy implementation of this study and the communication of the results to the local community, including advices for exposure reduction.

KEYWORDS: PFAS, exposure assessment, determinants, policy

O-SY-020 The PFAS hotspot HBM network: development of a HBM PFAS guidance document for emerging PFAS hotspots, based on shared experiences across PFAS hotspots in EU

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BACKGROUND AND AIM: Several PFAS hotspots have been identified in various regions in Europe and new PFAS hotspots continue to be discovered. In order to address the health concern of citizens living in the neighborhood of PFAS hotspots, human biomonitoring (HBM) programs in hotspot regions have been conducted, are ongoing or planned. So far, HBM initiatives at PFAS hotspots have in nearly all cases been initiated and elaborated at the local or regional scale without structural collaboration across PFAS hotpots. In order to benefit from experiences and good practices on HBM studies at PFAS hotspots, a PFAS hotspot EU network group has been established under the HBM4EU project.

METHODS: Researchers involved in PFAS monitoring studies across several hotspots exchanges experience and views during several online meetings, contributed to an inventory and collaborated in working groups to draft a guidance document.

RESULTS: AND CONCLUSION: An inventory of HBM studies at PFAS hotspots was made according to a structured approach, including fields such as pre-phase, public concern, biomarkers of exposure, biomarkers of effects, information on determinants of exposure, risk communication and impact at societal and policy level. Based on this inventory and following discussions within the network, a guidance document was developed. The guidance document covers the following aspect: 1) identification and monitoring of PFAS hotspots, 2) biomonitoring and health assessment 3) risk communication in PFAS hotspots, and 4) policy recommendations. The guidance document aims to be useful for policy makers and scientist confronted with new PFAS hotpots. The network members recognized the need for more collaboration across hotspots. Development of common protocols and questionnaires for HBM at PFAS hotspots could be a first step, and will enhance the study power for research on PFAS exposure-effect associations.

KEYWORDS: PFAS, hotspots, exposure assessment, human biomonitoring, policy, collaboration

SYMPOSIUM 05: Undermeasured and undervalued: examining social-structural factors in women's and children's global environmental health

O-SY-021 Perinatal and children's environmental epidemiology: what about birth integrity?

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BACKGROUND AND AIM: Birth integrity and violation of birth integrity are concepts that integrate theories of medicalization, risk, embodiment, and intersectionality into a multilevel framework. Violation of birth integrity is experienced widely across the globe and can coincide with environmental exposures and underly or modify many environmentally associated pregnancy, birth, infant, and children's health outcomes. Measuring the phenomenon of violation of birth integrity, such as obstetric violence, is critically important for the studies of the exposome, given the focus on comprehensive exposure assessment during sensitive periods.

METHODS: The aims of this work are to introduce birth integrity into the field of environmental epidemiology, to posit violation of birth integrity as embedded within the broader environmental reproductive justice framework, assess pathways to which violation of birth integrity lead to adverse maternal, infant, and child health, and to put forth research agendas and methodologies to assess and incorporate determinants and measurements of birth integrity into environmental epidemiology.

RESULTS: Birth integrity is embedded within sociocultural norms, local material structures, physiologies, intersectional and transnational powers, among others. Violation of birth integrity can lead to adverse health through several pathways, including epigenetic remodelling, childbirth trauma, among others, potentially leading to factors such as adverse birth outcomes, barriers to breastfeeding, interruption of bonding and attachment, and other adverse maternal and child health. Birth integrity interacts with other determinants of maternal, infant, child environmentally associated health.

CONCLUSIONS: Violation of birth integrity must be considered as a maternal health indicator. Neglecting prenatal/antenatal, birth, and postpartum experiences, particularly those surrounding birth integrity and violation of birth integrity is part of a broader epistemological biases in environmental epidemiology. Multilevel interventions are needed to simultaneously address these injustices, particularly in the areas of preconception health, maternal health, infant and child health.

KEYWORDS: perinatal health, exposome, environmental reproductive justice, birth, children's health

O-SY-022 Adverse childhood events and health-related quality of life among women undergoing hysterectomy for uterine leiomyoma

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BACKGROUND AND AIM: Psychosocial stress may increase fibroid risk, but associations with symptom severity, which often influence clinical management decisions, have been underexamined. Our objective is to examine associations between adverse childhood experiences (ACE) and symptom severity and symptom impact on health-related quality of life (HRQL) among women undergoing hysterectomy for treatment of their leiomyomas (fibroids).

METHODS: We recruited 103 premenopausal women into the Fibroids, Observational Research on Genes and the Environment (FORGE) study who were seeking evaluation of fibroids at the Medical Faculty Associates in Washington D.C. and intending to undergo hysterectomy at the George Washington University Hospital. for exposure classification, we assessed eight ACE categories related to child abuse and household challenges. for outcome classification, we used the Uterine Fibroid Symptom and Quality of Life (UFS-QOL). The five-level Likert scale responses were summed to create composite scores; a lower symptom severity score indicated fewer symptoms, while a higher HRQL score indicated better quality of life. We ran quasi-poisson regressions (log-link) to examine associations between ACE scores and UFS-QOL composite scores adjusting for age, race/ethnicity, and education (N=89).

RESULTS: The majority of participants were Black (73%); about half had private insurance (55%) and a college degree (49%). Cumulative ACE and symptom severity scores were higher among Black compared to non-Black women ($p \leq 0.03$). History of substance abuse in the household was associated with greater symptom severity (relative risk (RR) = 1.31, 95% CI: 1.07, 1.61), and worse HRQL (RR = 0.74, 95% CI: 0.55, 1.00). History of sexual abuse was also associated with worse HRQL (RR = 0.67, 95% CI: 0.48, 0.92).

CONCLUSIONS: Our study adds to the growing evidence that early life exposures to chronic stress may influence gynecologic health, including symptom-related quality of life.

KEYWORDS: Women's health, gynecological health, health disparities, social-structural stressors

O-SY-023 Maternal and newborn health risks of climate change: a call for awareness and global action

Nathalie Roos

Climate change has been identified as the biggest global health threat of the 21st century, with immediate harm in early life and significant lifelong consequences, and major implications for generations to come. Pregnant women and newborns are increasingly recognized as vulnerable populations in the context of climate change. The effects can be direct or indirect through heat stress, extreme weather events and air pollution, potentially impacting both the immediate and long-term health of pregnant women and newborns through a broad range of mechanisms. Low-income countries are particularly vulnerable to climate change because of poverty, poor sanitation, high prevalence of malnutrition, infections, non-communicable diseases, poor quality housing, and weak non-resilient health care systems. Climate adaptation plans need to consider these vulnerable populations and a broad multisectoral approach to improve overall resilience of societies.

O-SY-024 Environmental hazards, social inequality, and fetal loss: implications of live-birth bias for estimation of disparities in birth outcomes

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BACKGROUND: Restricting to live births can induce bias in studies of pregnancy and developmental outcomes, but whether this live-birth bias results in underestimating disparities is unknown. Bias may arise from collider stratification due to an unmeasured common cause of fetal loss and the outcome of interest, or depletion of susceptibles, where exposure differentially causes fetal loss among those with underlying susceptibility.

METHODS: We conducted a simulation study to examine the magnitude of live-birth bias in a population parameterized to resemble one year of conceptions in California (N=625,000). We simulated exposure to a non-time-varying environmental hazard, risk of spontaneous abortion, and time to live birth using 1,000 Monte Carlo simulations. Our outcome of interest was preterm birth. We included a social vulnerability factor to represent social disadvantage, and estimated overall risk differences for exposure and preterm birth using linear probability models and stratified by the social vulnerability factor. We calculated how often confidence intervals included the true point estimate (CI coverage probabilities) to illustrate whether effect estimates differed qualitatively from the truth.

RESULTS: Depletion of susceptibles resulted in a larger magnitude of bias compared with collider stratification, with larger bias among the socially vulnerable group. Coverage probabilities were not adversely affected by bias due to collider stratification. Depletion of susceptibles reduced coverage, especially among the socially vulnerable (coverage among socially vulnerable = 46%, coverage among non-socially vulnerable = 91% in the most extreme scenario).

CONCLUSIONS: In simulations, hazardous environmental exposures induced live birth bias and the bias was larger for socially vulnerable women.

KEYWORDS: live-birth bias; simulation; health disparities; environmental justice; fetal loss

O-SY-025 Federally-assisted housing and blood lead levels in the United States, 1999-2016

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BACKGROUND/AIM: Despite declining blood lead levels (BLLs) in the US, lead exposure remains disproportionately high in older housing and for low-income and non-Hispanic Black households. Federal housing assistance is linked to lower BLLs among children, but has not been evaluated among all US residents and by program type.

METHODS: We used the National Health and Nutrition Examination Survey 1999-2016 data linked to the US Department of Housing and Urban Development (HUD) administrative records to identify HUD-assisted participants. We compared BLLs of those currently-assisted and those on the waitlist (will receive assistance within two years) using multivariable regressions for log-transformed and dichotomous (≥ 3 µg/dL) BLLs. We examined effect modification by program type (project-based: public and multifamily housing vs. housing choice vouchers) and race/ethnicity, and conducted subset analyses for women and children under 12.

RESULTS: Sociodemographic characteristics were similar in the currently-assisted and waitlist groups. BLL geometric means were 1.11 (SE: 1.03) and 1.41 (SE: 1.03), respectively ($p<0.05$). In adjusted models, HUD assistance was associated with 8% lower BLLs (95% CI: -13%, -2%). In stratified models, this association was stronger among project-based housing (-11%, 95% CI: -18%,-4%) compared to housing choice voucher (-5%, 95% CI: -12%, 2%) recipients. Non-Hispanic white participants experienced a stronger protective association (-16%, 95% CI: -25%, -6%) compared to Black participants (-3%, 95% CI: -10%, 5%) and Mexican-Americans (2%, 95% CI: -18%, 28%). The association was significant among women (-9%, 95% CI: -15%, -2%) but attenuated among children (-2%, 95% CI: -9%, 6%). Findings remained consistent for clinically-meaningful BLL cutoff ≥ 3 µg/dL.

CONCLUSIONS: Housing assistance is an important social-structural determinant of health that can reduce residential environmental exposures through better quality housing, routine maintenance practices, and/or compliance with residential lead paint laws. Increasing access to affordable housing for very low-income households advances environmental health equity.

SYMPOSIUM 06: The Multi-Country Multi-City (MCC) Collaborative Research Network: an international collaboration for global studies on environmental risks, climate change, and health

O-SY-026 The MCC Network: an international collaboration for global health research

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BACKGROUND AND AIM: Addressing global environmental threats requires research studies based on large epidemiological assessments covering multiple regions. Multi-centre studies offer an excellent framework for this purpose but present various methodological and logistical issues. This overview contribution illustrates the experience of the Multi-Country Multi-City (MCC) Collaborative Research Network, an international collaboration working on a global research program on the associations between environment, climate, and health.

METHODS: The MCC Network has established an international collaboration based on mutual contribution and data sharing. This partnership has led to the collection of one of the largest databases for environmental health studies, with daily time series of health outcomes and environmental indices from 1,044 locations within 50 countries in the period 1969-2020. A research protocol formalizes a flexible mode of collaboration that offers scientific independence in addressing a variety of research topics, while ensuring collective participation and control on the use of data. The research is supported by intense methodological developments that have provided state-of-the-art study design and statistical techniques.

RESULTS: The MCC Network has contributed key evidence on environmental health risks, with peer-reviewed publications in leading environmental, epidemiological and medical journals. The research scope of the collaboration spans from studies of the health risks of known risk factors such as air pollution and non-optimal temperature, to analyses of more specific environmental stressors such as wildfires and extreme weather events, to projections of health impacts under climate change scenarios.

CONCLUSIONS: The research of the MCC Network has already provided an exceptional contribution to our understanding of environment-health associations and the impacts of climate change. The collaborative framework can be replicated to address other research questions in this area and beyond.

KEYWORDS: time series; pollution; temperature; climate change.

O-SY-027 Global analyses on health effects of temperature and climate change: the contribution of the MCC Network

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Multi-location analyses have proven to be useful settings for assessing the health impact of environmental hazards at regional and global scales. This study design is being widely applied in climate epidemiology since it allows the quantification of health impacts across highly heterogeneous populations and the identification of vulnerability patterns using a common method. Since 2014, the MCC consortium has developed and applied advanced methodologies to provide robust estimations of mortality impacts of non-optimal temperatures at different spatiotemporal scales in the present time and future climate change scenarios. This was possible thanks to the wide geographical coverage and high statistical power of the data collected. In this work, we aimed to review and summarize findings from published global studies on temperature-related mortality impacts using the MCC dataset.

We collected published articles until March 2022 by the MCC Network on health impact assessments of non-optimal temperature and mortality. We included global historical assessments and health impact projections in which heat, cold or both were considered and then combined the estimates by topic and geographical region.

Findings from the 20 publications showed good agreement in terms of both spatial and temporal patterns. We found that heat and cold-related risks have decreased over time, and higher vulnerabilities are mostly found in Southeastern regions of Europe and Asia, and in large and highly urbanized cities. Results from the projection studies suggest that heat-related mortality would steeply increase in all regions, and in most of them, this increase would counteract the decrease in cold-related risks leading to a net increase in temperature-mortality under the most pessimistic scenarios.

The MCC collaborative research network has greatly contributed to advancing knowledge on the impacts of climate change on health by providing valuable and unique epidemiological evidence on the mortality impacts of non-optimal temperatures.

KEYWORDS: climate change, mortality, heat, cold

O-SY-028 Air pollution and daily mortality in the Multi-country Multi-city study: single and joint effect with heat

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BACKGROUND AND AIM: The relationship between air pollution and daily mortality remains to be determined at a global scale. Moreover, few studies reported the interaction between air pollution and heat on mortality.

METHODS: We collected daily air pollution, temperature, and mortality data from the Multi-country Multi-city (MCC) network. The air pollutants included particulate matter (PM) with aerodynamic diameter <= 10 µm (PM10) and <= 2.5 µm (PM2.5), ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), and sulfur dioxide (SO2). We applied a two-stage time-series analysis, with over-dispersed generalized linear models and multilevel meta-analysis. The joint effect between air temperature and pollutants was analyzed in the warm season, with product terms between non-linear air temperature and linear air pollutants.

RESULTS: We observed significant associations of air pollution with daily mortality. for instance, 10 µg/m3 increase in the 2-day moving average of PM2.5 and O3 concentrations were associated with increases of 0.44% (95% confidence interval [CI], 0.39 to 0.50) and 0.18% (95%CI, 0.12 to 0.24) in daily all-cause mortality, respectively. We also found evidence of interaction between heat and air pollution. for example, an increase in mean temperature from 75th to 99th percentile was associated with 9.0% (95%CI: 7.1%, 11.0%), 10.4% (95%CI: 8.4%, 12.4%), and 13.6% (95%CI: 10.6%, 16.6%) increases in mortality when PM10 was equal to 5th, 50th and 95th percentiles. Similarly, 10 µg/m3 increment in PM10 was associated with a 0.24% (95%CI: 0.02%, 0.46%), 0.46% (95%CI: 0.34%, 0.59%), and 0.76% (95%CI: 0.42%, 1.11%) increases in mortality when air temperature was at 5th, 50th and 95th percentiles, respectively.

CONCLUSIONS: We found robust evidence on the short-term effects of air pollution on daily mortality. We also found evidence of effect modification between air temperature and air pollutants on mortality during the warm period.

KEYWORDS: Mortality, Short-term Exposure, Temperature, Air pollution, Effect modification

O-SY-029 Mapping global mortality burden associated with multiple environmental stressors: a new framework by the MCC Network

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BACKGROUND AND AIM: Current knowledge is limited on global burden of mortality associated with short-term exposure to environmental factors, because global observed data of mortality and environmental factors are not available. This presentation aims to illustrate extensions of the analytical framework established within the MCC collaboration to provide global maps of health impacts associated with exposure to environmental factors (e.g., non-optimal temperatures, temperature variability, and tropical cyclones).

METHODS: We used time-series data on mortality and environmental data from 750 locations in 43 countries and meta-predictors at a grid size of 0.5° × 0.5° across the globe. We developed a three-stage analysis strategy. First, a time-series regression was used to estimate the association between environmental factors and mortality for each location by. Second, a multivariate meta-regression model was used to model the association between location-specific estimates and meta-predictors. Finally, the grid-specific exposure–mortality association was predicted by the fitted meta-regression and the grid-specific meta-predictors. Excess deaths due to exposure to environmental factors were then calculated for each grid across the world.

RESULTS: Globally, 5,083,173 deaths (95% empirical CI [eCI] 4,087,967–5,965,520) were associated with non-optimal temperatures per year, accounting for 9.43% (95% eCI 7.58–11.07) of all deaths (8.52% [6.19–10·47] were cold-related and 0.91% [0.56–1.36] were heat-related). Totally 1,753,392 deaths (95% eCI 1,159,901–2,357,718) were associated with temperature variability per year, accounting for 3.4% (2.2–4.6) of all deaths. An overall estimate of 199,740 deaths (95% eCI 185,988–267,278) were due to exposure to tropic cyclones globally from 1980 to 2019. Those estimates show geographical and temporal heterogeneity across region and nation.

CONCLUSIONS: Estimating global, regional and national burden of mortality associated with short-term exposure to environmental factors is essential for developing preparedness and prevention strategies to reduce their impacts.

KEYWORDS: Global mortality burden, temperature, temperature variability, tropical cyclone

O-SY-030 The role of environmental factors in the COVID-19 pandemic: research from the MCC Network

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BACKGROUND AND AIM: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has rapidly spread across the globe, traversing diverse climatic and environmental conditions. From the early phase of the pandemic, there has been speculation that weather conditions could modulate SARS-CoV-2 transmission patterns.

METHODS: In this talk, I will present the current evidence and methodological challenges in evaluating potential drivers of COVID-19 seasonality. I will also present the results of two global studies based on an extensive city-level dataset, collected by the Multi-Country Multi-City MCC Collaborative Research Network, where we studied the relationship between weather conditions and COVID-19 spread using ecological and time-series designs. Finally, I will discuss planned future studies based on data collected until March 2022.

RESULTS: We collected data from 455 cities across 20 countries around the globe over an observation period ranging from 3 February to 31 October 2020. for each location, daily COVID-19 cases were linked with meteorological (mean temperature, relative and absolute humidity and UV radiation) variables derived from the Copernicus ERA5 dataset, and with the Oxford Governmental Stringency Index to account for the effect of lockdown measures. These data were analysed using ecological designs (spatial and time-series approaches) giving evidence of effects of mean temperature and absolute humidity on COVID-19 transmission. However, these studies underline regional heterogeneity of weather-related effects on COVID-19 transmission and the dominant role of non-pharmaceutical interventions. We are extending the data collection until March 2022 to investigate the interdependent role of seasonality, meteorological factors, environmental stressors (air pollution), non-pharmaceutical interventions and vaccination.
Conclusion.
This research activity is an example of the flexibility of the MCC Network in adapting and using its collaborative platform and data collection to address urgent and challenging research questions.

KEYWORDS: Temperature, Humidity, UV Radiation, COVID-19, DLNM, Global Analysis, Meta-Regression

SYMPOSIUM 07: Disparities in US drinking water quality and access

O-SY-031 Racial disparities in access to U.S. community water systems: effects on children's health

Jacqueline Gibson

BACKGROUND AND AIMS: Racial minority communities at the fringes of some U.S. cities and towns lack access to the regulated community water systems afforded to their non-minority neighbors. These communities rely on unregulated water sources that typically are not monitored or treated, leaving residents at risk of exposure to contaminants. This research assessed the effects of exclusion from municipal water service on children's lead (Pb) exposure and of early-life Pb exposure from drinking water on teenage juvenile delinquency.

METHODS: We linked blood Pb measurements for 59,483 children under age six to information about their drinking water sources, demographic characteristics, and household and neighborhood environmental variables. for 13,580 children who reached age 14 by the end of our study period, we also retrieved juvenile delinquency data. We examined associations between blood Pb and water source using a mixed-effects tobit regression model and the effects of Pb in drinking water on teenage juvenile delinquency risks using a two-stage, least-squares regression model.

RESULTS: In the full data set, children relying on unregulated water sources had blood Pb levels that were 20% higher ($p<0.001$) than children with community water service. Further, this early-life increased Pb exposure was significantly associated with an increased risk of juvenile delinquency. Compared to children with community water service, those relying on private wells had a 21% ($p<0.001$) higher risk of being reported for any delinquency and a 38% (($p<0.001$) increased risk of being reported for serious delinquency after age 14.

CONCLUSIONS: Access to a regulated community water supply is associated with decreased exposure to Pb, compared to reliance on unregulated private sources, presumably due to the requirement that community supplies monitor for and control Pb. In turn, decreased Pb exposure is significantly associated with decreased juvenile delinquency. These results underscore the public health benefits of community water supplies.

KEYWORDS: drinking water, lead, juvenile delinquency, children's health

O-SY-032 Safe home water access for low-income families with young children

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BACKGROUND: From 2015-2018, the U.S. Environmental Protection Agency found 7,463 public water systems serving 51 million people in the U.S. reported at least one health-based violation. Communities across the United States have unsafe drinking water due to aging public water supply infrastructure and home wells with unsafe levels of contaminants like arsenic and nitrate.
Aim: This presentation describes the costs, population reach, and considerations for local and state policies and programs that can ensure safe water access for pregnant people and low-income families with young children.

METHODS: This study used a mixed-methods analysis including legal review, case interview, and economic evaluation to identify the activities, resources, and costs associated with actions to provide more equitable access to safe home drinking water strategies for low-income families with children aged 0-5.

RESULTS: Researchers identified six strategies used in state and local settings to improve access to safe drinking water at home via home water quality testing, home well water treatment device installation, filter pitcher distribution, and lead service line replacement. If implemented over 5 years in their respective geographic areas, these strategies could reach 480 to 135,000 households each with annual costs per household of $75 to $1000 (USD).

CONCLUSIONS: Opportunities for improving access to safe drinking water at home should be tailored to features of the local water system, water source, and community context. In particular, policies and programs can be tailored to reach pregnant people and low-income families with young children, who are most at risk.

KEYWORDS: child, infant, drinking water, equity, lead, arsenic, nitrate

O-SY-033 Socioeconomic disparities in exposures to unregulated industrial contaminants in U.S. public drinking water supplies

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BACKGROUND AND AIMS
Communities of color and low-income communities often face disproportionately high burdens of exposure to pollution. Previous studies investigating environmental justice and drinking water quality have focused on regulated contaminants with established standards, but many other unregulated contaminants are also present in drinking water.

METHODS: We evaluated associations between the presence of unregulated industrial contaminants and the demographics of communities served by U.S. public drinking water supplies (PWSs). We compiled data for four unregulated contaminants (1,4-dioxane, 1,1-dichloroethane, HCFC-22, PFAS) from U.S. EPA's Third Unregulated Contaminant Monitoring Rule (UCMR3). We analyzed data collected in 2013-2015 from 4,815 U.S. PWSs, serving 284 million people, that reported concentration data for at least one target contaminant. We also compiled information on PWS characteristics, county-level demographic data from the U.S. Census Bureau, and data on potential sources including airports, fire-training areas, wastewater treatment plants, and relevant contaminant releases reported in the U.S. EPA Toxic Release Inventory.

RESULTS: We found that PWSs serving counties with higher proportions of Hispanic residents and more urban households were more likely to have ≥1 target contaminant detected and were more likely to exceed a federal guideline for PFOA/PFOS or 1,4-dioxane, even after accounting for PWS characteristics and the presence of potential sources. Target contaminants were more frequently detected in large PWSs (>10,000 customers) compared to smaller systems and in groundwater systems compared to surface water systems. We did not find consistent associations between detection of UCMR3 contaminants and proportion of Black residents or proportion of residents considered deprived (according to the U.S. Census Bureau's Multidimensional Deprivation Index).

CONCLUSIONS: Our findings provide new insight into the extent of socioeconomic disparities in exposures to drinking water contaminants and highlight the need to consider cumulative exposures to contaminants in drinking water.

KEYWORDS: Environmental justice, drinking water, contaminants, PFAS, industrial pollution

O-SY-034 Nitrate contamination in Maryland drinking water and policy reforms to safeguard private wells

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Forty-two million Americans get their drinking water from unregulated water sources, primarily private wells. In lieu of federal action, several U.S. states have adopted policies and programs to protect private well owners, who tend to live in rural, underserved areas. The presentation shares the findings of a national policy review of key programs adopted by states, such as providing free water quality test kits and establishing a public database of private well water quality results, to safeguard public health. The presentation will also share a case study of Maryland, where policymakers have sought to enhance resources for well users and transparency regarding well water quality. These strategies provide a model for other states and nations seeking to alleviate disparities in access to safe drinking water.

KEYWORDS: drinking water, nitrate, water access, water pollution

O-SY-035 Lead contamination of drinking water is an EJ issue

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Lead exposures are not distributed evenly, including from US public drinking water. Lead contamination of drinking water is disproportionately reported or uncovered in low income and minority communities. Risk factors include distressed municipalities and rural areas; a history of underinvestment in public infrastructure, including water infrastructure; and old and poorly maintained housing stock combined with high rates of rental housing. Even within average or affluent communities, low income and minority neighborhoods exhibit higher rates of lead contamination of drinking water with disparities in lead pipe removal. The proposed massive US investment in infrastructure improvements is insufficient to equalize those inequities.

O-SY-036 The US Safe Drinking Water Act's systemic failure to equitably safeguard vulnerable Americans from contaminants Including nitrates

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The US Safe Drinking Water Act was intended to protect Americans against tap water contamination. While modest progress has been made, systemic problems exist. Nitrate contamination is a key case in point. US EPA's nitrate standard was set in 1975 at a level of frank health effects; the law was weakened in 1996. Enforcement of the current unprotective standards has been anemic, with widespread noncompliance. Lax enforcement of drinking water standards disproportionately affects low-income communities and communities of color. Resolving these issues requires statutory revisions, strengthened standards, additional funding, restructuring of small non-viable systems, and better compliance and enforcement.

SYMPOSIUM 08: Magnetic Resonance Imaging (MRI); a cross-cutting tool at the intersection of environmental epidemiology and developmental neuroscience

O-SY-037 Pre-natal and neonatal neuroimaging in the BiSC cohort

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BACKGROUND AND AIM: The Barcelona Life Study Cohort (BiSC) aims to evaluate, among others, the effect of pre-natal urbanome on pre- and postnatal brain structure and function in a cohort of 1086 mothers-child pairs recruited during the years 2018-2021.

METHODS: We conducted transvaginal neurosonography at week 32 in 1014 (93%) pregnant women and brain MRI in 132 neonates at day 28 of life, done while the infants were asleep.

RESULTS: Neurosonography reliably captured size of different brain structures, depth and degree of maturation of specific cortical fissures and sulci, and the area of the corpus callosum and lateral ventricles in around 80% of the acquisitions. Complete acquisition of MRI was obtained in 54 of the 132 neonates (41%). Anatomical acquisition was obtained in 104 and 108 babies (3D-T1 and Flair-T2, respectively), fMRI in 74 babies (resting state) and DTI in 63 babies.

CONCLUSIONS: Early-life brain imaging variables, that have been shown to have a predictive value for outcomes in postnatal life, or to be associated with myelination affected by urbanome (such as pre-selected sensorimotor pathways and white matter tracks) could be reliably measured in general population studies.

KEYWORDS: Pregnant women, neonates, brain development.

FUNDING: This project has received funding from the ERC-AdG-2018 AIR-NB project (GA: 785994).

O-SY-038 Resting-state functional connectivity patterns are associated with metal mixture exposure in young adolescents

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BACKGROUND AND AIM: Early-life metal mixture exposure may increase the risk for anxiety and depression in adolescence. The neural circuitry subserving internalizing phenotypes begins developing in utero and is vulnerable to early-life exposures. Resting state functional magnetic resonance imaging (rs-fMRI) provides a novel tool to examine underlying mechanisms of metal-associated neurodevelopmental outcomes. We investigate relationships between early-life metal exposure and functional connectivity in pre-adolescents.

METHODS: In preliminary analysis of 67 children (8-14years; 34 females) enrolled in the Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) study, we estimated weekly exposure (14th week gestation through one year of age) to 15 metals (Ba, Bi, Cd, Co, Cr, Cu, Li, Mg, Mn, Mo, Ni, Pb, Sn, Sr, Zn) in deciduous teeth using laser ablation-inductively coupled plasma-mass spectrometry. Using graph theory analysis of rs-fMRI data, we computed global and local efficiency (GE, LE) and eigenvector centrality (EC) in 111 brain areas (Harvard Oxford Atlas). We used lagged weighted quantile sum (lWQS) regression to examine time-varying associations between metal mixtures and GE, LE or EC in the whole brain and anterior cingulate cortex (ACC), globus pallidus (GP), and insula, adjusting for sex and age.

RESULTS: We observed prenatal and postnatal windows between the metal mixture and LE; -13 to 4 weeks, peak βLE (week -2) = -0.23, 95%CI -0.02, -0.45 and 16 to 43 weeks; peak βLE (week 42) = -0.42, 95%CI -0.13, -0.70 and one prenatal window for GE at -18 to -11 weeks, peak βGE (week -18) = -0.35, 95%CI -0.07, -0.64. The metal mixture was significantly associated with decreased EC in the ACC, GP and insula at different critical windows spanning gestation and infancy.

CONCLUSIONS: Our results combining lWQS modeling with graph theory analysis of rs-fMRI may inform mechanistic understanding of environmentally-associated neurodevelopmental outcomes.

O-SY-039 Prenatal exposure to endocrine disrupting chemicals and brain development in adolescents

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BACKGROUND AND AIM: Despite growing concerns regarding the neurotoxicity of phthalates and bisphenols, brain differences associated with gestational exposure to these chemicals are understudied. We investigated the extent to which prenatal exposures to these endocrine disrupting chemicals are associated with global brain volumetric measures in adolescents and whether brain measures mediate the association of prenatal exposures with child IQ.

METHODS: We included 908 mother-child pairs from Generation R, a population-based birth cohort, with data on maternal gestational phthalate and/or bisphenol concentrations and T1-weighted magnetic resonance imaging in children at age 10 years. Child IQ was assessed at age 14 years. Maternal urinary concentrations of phthalate metabolites and bisphenols were measured at early, mid-, and late pregnancy. We examined the associations of pregnancy-averaged, creatinine-adjusted concentrations of individual phthalate metabolites as well as ∑di-2-ethylhexyl phthalate, phthalic acid, and bisphenol A with and brain volumetric measures using linear regression. We used mediation modelling to identify the proportion mediated by brain measures in the association of prenatal exposures and child IQ.

RESULTS: Higher maternal concentrations of monoethyl phthalate (mEP) were associated with smaller total gray matter volumes in offspring at age 10 years (β per log10 increase in creatinine adjusted mEP=-10.27, 95%CI:-17.85, -2.69). Total gray matter volumes partially mediated the association between higher maternal mEP and lower child IQ (natural indirect effect=-0.27, 95%CI: -0.55,0.00, proportion mediated=20%). An association of higher monoisobutyl phthalate (mIBP) and smaller cerebral white matter volumes was present only in girls, with cerebral white matter volumes mediating the association between higher maternal mIBP and lower IQ in girls. We found no association between maternal prenatal bisphenols and global brain volumetric measures or child IQ.

CONCLUSIONS: Our findings suggest the global impact of prenatal phthalate exposure on the brain that extends into adolescence and underlies impaired general cognition.

KEYWORDS: MRI; Pregnancy, phthalates

O-SY-040 Ambient air pollution and functional brain network development in adolescence

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Air pollution is linked to neurodevelopmental delays, but its association with brain network development has yet to be investigated utilizing a longitudinal cohort. We aimed to characterize the relationship between PM2.5, O3, and NO2 exposure at ages 9-10 years and 2-year longitudinal changes in functional connectivity (FC) in regions important for emotional and cognitive functioning, namely the salience, frontoparietal, and default-mode brain networks as well as the amygdala and hippocampus.

7719 participants from the Adolescent Brain Cognitive Development (ABCD) Study® were included. Annual averages of pollutants were assigned to the child's primary residential address using an ensemble-based exposure modeling approach. Resting-state functional MRI was collected on 3T MRI scanners at baseline and follow-up visits. Single- and multi-pollutant mixed-effect linear models, with subject and study site as random effects, were constructed to examine the putative exposure effect on intra-network, inter-network, and subcortical-to-network FC change, by testing age-by-pollutant interactions and adjusting for sex, race/ethnicity, household income, parental education, handedness, scanner type, and motion during scanning.

After Bonferroni correction, single- and multi-pollutant models revealed inter-network FC increased with age for individuals with higher PM2.5 exposure but decreased with age for those with higher NO2 exposure. Similarly, subcortical-to-network FC increased with age for those with higher PM2.5 exposure but decreased with age for individuals with higher O3 exposure. There were no significant intra-network associations with pollutant-by-age interactions. PM2.5 and O3 were negatively correlated ($r=-0.18$, $p<2.2e-16$); PM2.5 and NO2 were positively correlated ($r=0.20$, $p<2.2e-16$); no correlation existed between O3 and NO2 ($r=-0.02$, $p=0.15$).

In normative development, inter-network segregation is expected. Our findings indicate that higher levels of exposure to PM2.5 in childhood relate to distinct changes in age-related patterns of network segregation, suggesting functional network immaturity. However, functional network segregation does not seem to be hindered by increased exposure to NO2 and O3.

O-SY-041 Outdoor residential air pollution exposure and the development of brain morphology across childhood: a longitudinal study

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BACKGROUND AND AIM: Emerging evidence suggests a relationship between exposure to air pollution and brain morphology in children, but little is known about how air pollution exposure influences the development of brain structures throughout childhood. We aim to study the association of air pollution exposure during pregnancy and childhood with the development of brain morphology from age 6-16 years.

METHODS: We used data from 4,243 children of the Generation R study, a birth cohort in Rotterdam, the Netherlands. We estimated the concentrations of fourteen air pollutants at participant´s home addresses during pregnancy and childhood, using land use regression models. We included structural brain images at three time points, namely at age 6-10 years, 9-12 years, and 13-16 years. We assessed the association between the air pollutants and brain volumes with linear mixed models, fitting an interaction term for age and each pollutant. Models were adjusted for socioeconomic status and lifestyle characteristics.

RESULTS: Higher air pollution exposure during pregnancy was associated with a slower decrease of cortical grey matter volume starting at around age 10 and a slower increase of corpus callosum volume (e.g. -12.7 mm3 increase in corpus callosum volume [95%CI -22.0; -3.3] with each year of age per 10 µg/m3 increase in nitrogen dioxide exposure). Childhood exposure was associated with a faster decrease of putamen and caudate nucleus volume, and a slower increase of hippocampus volume. Higher exposure to air pollution during pregnancy and childhood was associated with a slower increase of thalamus volume. Air pollution exposure was not associated with cerebellum, amygdala, nucleus accumbens or globus pallidus volume.

CONCLUSIONS: Air pollution exposure was associated with region-specific differences in age-related growth trajectories. Air pollution exposure during childhood might affect different brain regions than exposure during pregnancy.

KEYWORDS: air pollution, neurodevelopment, children, traffic

SYMPOSIUM 09: Infections and the environment

O-SY-042 Immunotoxic chemicals, childhood infections, and long-term health effects

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BACKGROUND AND AIM: Environmental chemicals can act as immunotoxicants by dysregulating the immune system, and can modulate the effects of infectious agents. Several studies link exposure to environmental chemicals with susceptibility to infectious diseases in adults and children, but results are inconclusive. Also, the role of subclinical infections in long-term health effects has been little examined. We will present specific results from ongoing analyses in children and also discuss priority areas for research on the immunotoxic effects of environmental chemicals.

METHODS: Results from ongoing analyses in three European birth cohorts [Born in Bradford (BiB), UK; Environment and Childhood (INMA), Spain), and Mother Child cohort study (RHEA), Greece], with information on immunotoxic chemicals in early life, humoral response to common natural infections, and long-term health effects, will be presented. The effects of common infections in children in relation to chemical exposures and their combined effects on the immune system and long-term health effects will be reviewed.

RESULTS: Results from the RHEA cohort showed that maternal levels of polychlorinated biphenyls (PCBs) may increase susceptibility to persistent viral infections in the first years of life. Also, exposure to dichlorodiphenyltrichloroethane (DDT) during pregnancy and in childhood was associated with lower immunoglobulin-G levels against varicella from 6 to 11 years of age. Evidence of the immunotoxic effects of historical persistent organic pollutants such as PCBs and DDT is strong; however, evidence is still limited for the emerging chemicals including per- and polyfluoroalkyl substances and the non-persistent ones such phthalates and phenols.

CONCLUSIONS: Exposure to immunotoxic agents in early-life may modulate humoral response to common natural infections in children. The potential for some of the most widely used chemical compounds to interfere with the developing immune system during critical periods of development is of great concern for public health given the current context of emerging epidemics.

O-SY-043 Ambient air-pollution and COVID-19

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BACKGROUND AND AIMS: The COVID-19 pandemic is challenging the world's economic and health systems, and introduced completely new challenges. The outbreak of COVID-19 highlighted the links between the occurrence of new infections, the environment and climate at a global scale and the need for trans-disciplinary approaches. Emerging evidence links ambient air pollution with COVID-19 disease, an association that is methodologically challenging to investigate.

METHODS: I will review the evidence on ambient air pollution Covid -19 disease and disease severity and discuss potential biases. I will further discuss new research areas on the association of air-pollution with post-COVID-19 condition (long-COVID) and with immune response associated with natural infection and with vaccine response.

RESULTS: More than 100 studies have been published globally on air-pollution and Covid-19 reporting more than 400 separate pollutant-COVID-19 effect estimates. Most studies to date have employed ecological designs, associating group-level air pollution exposures with aggregate COVID-19 outcomes over a broad geographic domain. Many of these studies relied on COVID-19 disease incidence estimated from surveillance data. Differences in the associations between long-term and short term exposures to air pollution and COVID-19 incidence and severity have been poorly evaluated. Studies using individual-level designs, which can avoid the potential for clustering of cases and that did extensive adjustment for potential confounders including contextual variables, convincingly show that exposure to air pollution is associated with COVID-19 disease and mortality. The few existing studies evaluating immune response show an association of air-pollution with higher levels of antibody response among infected and also depressed immune response among non-infected vaccinated. There is still scarce evidence on air pollution and long-COVID.

CONCLUSIONS: The pandemic has highlighted the deep interconnections between the environment and infectious diseases and specifically the association of air pollution with COVID-19 through multiple biological pathways.

KEYWORDS: COVID-19; air pollution; long-COVID; immune response

O-SY-044 Climate change and cascading risks from infectious disease

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BACKGROUND AND AIM: Climate change is considered as one of the greatest threats to human health in the 21st century, with significant increases in temperature extremes, heavy precipitation, and severe droughts. This study examines cascading risk pathways from climate change for vector-, water-, food, and air-borne infectious diseases in a global context.

METHODS: The peer-reviewed literature that examined the specific aims of this study, climate change and cascading risks from infectious disease, was reviewed and assessed the association between climate change and disease transmission. Climatic and other cascading drivers of infectious disease with projections under different climate change scenarios was also assessed.

RESULTS: Weather and climate events, population movement, land use changes, urbanization, global trade, and other drivers can catalyze a succession of secondary, causally connected events, that can disrupt critical infrastructure, vital for a functional society. Climate hazards can activate cascading risk pathways that can lead to a range of health impacts, including infectious disease outbreaks. Cascading effects from climate hazards include stagnant water that serve as breeding ground for mosquitoes after a flood; contamination of drinking water after a storm surge; breakdown of vector control programs after a hurricane; or cholera outbreak after a drought.

CONCLUSIONS: A narrow, siloed, and linear assessment of these risks will misinform decision- and policymakers of the magnitude and pattern of future risks, and of the opportunities to modify policies to reduce inherent vulnerabilities and enhance infectious disease control programs. Elucidating cascading risk pathways from infectious diseases is a first step towards tackling infectious disease threats from climate change.

O-SY-045 Looking forward: COVID-19 and greenhouse gas emissions

Kristie Ebi[1]
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BACKGROUND AND AIM: The COVID-19 pandemic dramatically changed the global economy, thus decreasing carbon dioxide emissions by nearly 7%, raising hopes that a legacy of the pandemic would be a permanent shift in the trajectory of emissions.

METHODS: Greenhouse gas emissions over the course of the pandemic will be reviewed, along with the implications of greenhouse gas emissions along various recovery pathways.

RESULTS: During the first year of the pandemic, surface, especially road, transport was affected the most, primary the result of restrictions aimed at reducing infection rates. These changes altered exposures to PM2.5 (increase) and ozone (decrease), potentially reducing premature mortality and avoiding hospital admissions. Scenarios of possible recovery pathways include focusing on returning to the “old” economy, decoupling GDP growth from CO2 emissions, and focusing on achieving a more sustainable and inclusive climate-resilient pathway. Incorporating health co-benefits into estimates of the cost of mitigation policies and technologies could help motivate individuals to countries to shift to climate-resilient and environmentally sustainable pathways.

CONCLUSIONS: Achieving the Paris Agreement goal of keeping warming at less than 2□C above pre-industrial temperatures requires rapid reduction of greenhouse gas emissions, more rapid than occurred during the COVID-19 pandemic. Quantifying health co-benefits of mitigation can be a key element in achieving a more sustainable and resilient future.

KEYWORDS: climate change; greenhouse gas emissions

Tuesday, September 20

SYMPOSIUM 10: A new era in global climate change and human health research funding and action

O-SY-046 A new era in global climate change and human health research funding and action – NIH

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BACKGROUND: The U.S. National Institutes of Health (NIH) have supported climate change and health-relevant research for decades. Through the years 2010 to 2020, annual NIH support for climate change and health research hovered around $10 million funded by 21 NIH components. The NIH Climate Change and Health Initiative, launched in 2021, is an NIH-wide effort to develop the first coordinated NIH plan for research on the impacts of climate change on human health.

METHODS: The Initiative created a core framework in 2021 that was informed by a month's long planning and engagement process. Directors of seven Institutes and Centers at the NIH have joined together to create a strategic framework document that highlights the core focus areas of the work. The group released a Public Request for Information to gather input from community organizations and academic scientists and conducted a federal and international landscape assessment to map out organizations working in the space. Internally, NIH conducted a portfolio analysis of funded climate research from the past decade, engaged staff through workshops, and developed an internal data call for planned climate related programs.

RESULTS: The strategic framework will guide a community of practice comprising outstanding and committed scientists, trainees, and specialists. Key areas of interest outlined include: Health Effects Research, Health Equity, Intervention Research and Training and Capacity Building. The framework also identifies nine key areas of supporting science for climate change and health research.

CONCLUSIONS: Climate change is impacting health and communities around the world but there remain many key research knowledge gaps. NIH's role as a leading funder of biomedical and human health research can play an important role in coordinating research to better understand health impacts, health adaptation, and outcomes in communities impacted related to climate change. There is perhaps no greater opportunity for NIH to fulfill its mission than by providing global leadership in the response to the burgeoning climate change and health crisis.

KEYWORDS: Climate change; public health; research

O-SY-046a A new era in global climate change and human health research funding and action – EPA

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BACKGROUND: The EPA's Air, Climate, and Energy (ACE) research program is responding to climate change and environmental justice priorities through research that addresses multiple dimensions of climate change and health.

METHODS: The ACE program conducts research focusing mainly on cumulative impacts of climate change, air pollution, and non-chemical stressors that impact human health and the environment. ACE utilizes its tools to investigate the health consequences of extreme events including heat, wildfires, and floods, as well as longer-term health impacts associated with overall warming and transformations in the nation's energy and transportation systems and built environment. The ACE program also conducts research to support adaptation and resilience solutions that reduce health impacts and promote equitable outcomes in communities with environmental justice concerns.

RESULTS: ACE research has produced studies showing how future extreme weather and air quality will be impacted by different climate change scenarios, demonstrating that climate change will increase the health burden from ozone and increase the intensity of rainfall events during storms. ACE research has also evaluated the relative air quality and health impacts of prescribed fires and wildfires, showing that well-designed prescribed fires can potentially reduce the overall smoke-related health impacts from wildland fires, which are growing in size and intensity due to climate change. ACE has also funded grants to 12 institutions to evaluate strategies to reduce exposures to smoke during wildland fires.
CONCLUSION: Climate change is having direct and indirect impacts on the health of people. More extreme weather events, heat waves, spread of infectious diseases and detrimental impacts on air and water quality are having impacts on our health. EPA is currently focusing on research and planning to address this issue in their future work.

KEYWORDS: Climate change; public health; environmental justice

O-SY-047 A new era in global climate change and human health research funding and action – CDC

Erik Svendsen
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BACKGROUND: In 2021, the Centers for Disease Control and Prevention (CDC) established an agency-wide Climate and Health Task Force in response to Executive Order 14008, Tackling the Climate Crisis at Home and Abroad. The Task Force's objective is to reduce the health impacts of climate change by developing a comprehensive approach to integrate climate and health activities across CDC programs, coordinate with external partners, and increase capacity to prepare for and respond to the health impacts of climate change, particularly among those disproportionately affected. The new agency-wide climate and health strategy emphasizes health equity, surveillance, preparedness, research and communication.

METHODS: The agency created mission and vision statements that focus on the need to address climate-related health inequities at home and abroad. The Task Force subsequently identified five focus areas for the climate and health strategic framework: Health Equity and Environmental Justice; Surveillance, Analytics, Modeling, and Forecasting; Preparedness, Response, Prevention, and Adaptation; Research, Implementation Science, and Evaluation; and Education and Dissemination.

RESULTS: for each focus area, an overarching goal and several priority outcomes have been developed, along with key implementation actions for each outcome, evaluation metrics and implementation timelines. Several of the focus areas have important intersections with other agency priorities, including health equity, emergency preparedness and data modernization initiatives.
CONCLUSION: Climate change is the biggest environmental public health threat of our time, and its direct and indirect impacts on human health and wellbeing are worsening. By implementing the new strategic approach, CDC aims to address this threat by detecting, investigating, forecasting, tracking, preventing, and responding to the public health threats of climate change, addressing health inequities, and strengthening community resilience.

KEYWORDS: Climate change; public health; health equity; climate resilience

O-SY-048 A new era in global climate change and human health research funding and action – EC

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BACKGROUND: The European Commission has launched several recent initiatives on climate change and health. The European Climate and Health Observatory aims to support Europe in preparing for and adapting to the impacts of climate change on human health by providing access to relevant information and tools. Additionally, the EU Mission Adaptation to Climate Change was recently launched with the goal to support European regions and communities towards climate resilience by 2030.

METHODS: The Observatory aims to provide easy access to a wide range of relevant publications, tools, websites, and other resources related to climate change and human health. The Observatory is a partnership between the European Commission, the European Environment Agency (EEA) and several other organizations. It contributes to the European Green Deal and the EU4Health vision for a healthier European Union.
The Mission will foster the development of innovative solutions to adapt to climate change and encourage regions, cities and communities to lead the societal transformation.
Large-scale demonstrators, a key element of the Mission, will feature examples of breakthrough innovations implemented in real life such as floodplain restoration, vertical farming, or prototyping of insurance approaches. Regions, cities and local authorities will steer the process to build climate resilience “on the ground” in an inclusive way, engaging with local stakeholders, the civil society, the business community, industry, research organizations, and citizens.

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CONCLUSIONS: The EU Mission support will be provided in different ways by helping European regions and communities better understand, prepare for and manage climate risks and opportunities; working with at least 150 European regions and communities to accelerate their transformation toward climate resilience, and delivering at least 75 large-scale demonstrators of systemic transformations on the ground. The Observatory already includes the 38 EEA Member and cooperating countries and hundreds of resources from 1988 through present.

KEYWORDS: Climate change; public health; climate resilience

SYMPOSIUM 11: Impact of exposure measurement error (ME) on the health effect estimates: quantification and correction

O-SY-049 Impact of exposure measurement error (ME) on the health effect estimates: introduction

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BACKGROUND/AIM: Although it is widely accepted that air pollution exposure, at least to pollutants of ambient origin, has adverse health effects, the quantitative effect estimates incorporate considerable uncertainty, especially because the relevant exposure (namely individual or population exposure to pollutants of ambient origin) is so difficult to measure accurately. The resulting exposure Measurement Error (ME) is a neglected but potentially important problem resulting in bias and loss of accuracy in health effect estimates. This Symposium will focus on recently published results on the bias in effect estimates due to exposure measurement error.

METHODS: Measurements of air pollutants concentrations from fixed site monitors or ad-hoc campaigns have been used in epidemiological studies assessing the associations between exposure to pollutants and multiple health outcomes, and also models (statistical, dispersion or hybrid) have been extensively developed and applied. The magnitude and direction of bias resulting from ME in exposure estimation has mainly been evaluated in simulation or validation studies.

RESULTS: Recent publications show that bias from ME of commonly applied exposure models is mainly towards the null and can be substantial. Only under specific and relatively rarely observed values of correlations and variance ratios upward bias is observed. Other studies which use more sophisticated “hybrid” models show smaller bias.
CONCLUSION: In this Symposium we will attempt to quantify the importance of exposure ME in the valid estimation of health effects of air pollutants. We will present results from recent studies which quantified the impact of various types of exposure measurement error on the effect estimates for health outcomes and evaluated correction methods.

KEYWORDS: exposure measurement error; air pollution; bias; effect estimates; correction methods

O-SY-049a Identifying determinants and characterizing the type of exposure measurement error in association with different error-prone exposure assessment methods

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BACKGROUND/AIM: In air pollution epidemiology, error-prone exposures are used to investigate the health effects of exposure to outdoor pollution. This leads to measurement error (ME) bias of varying size and direction. We seek to quantify ME magnitude, type (classical/Berkson/mixture), and determinants, to be able to use the most appropriate methods for error correction. Personal exposure to pollution from ambient origin has been defined as the true exposure and ME as the difference between the latter and any surrogate exposure.

METHODS: Within the MELONS project, we collected personal data from multiple monitoring campaigns in London for $PM_{2.5}$, NO_2, O_3 and BC. We compared those with measurements from the monitoring network, modelled concentrations at fine spatial scales or methods incorporating indirect adjustment of these estimates for the time-activity patterns in the postcode sector of the participants. Individual- and area-level characteristics, e.g. age, sex, socioeconomic status, temperature, were assessed as potential ME determinants.

RESULTS: Preliminary analysis using long-term exposure estimates has shown that personal exposure from outdoor sources to $PM_{2.5}$ and NO_2 (Mean (SD): 6.4 (3.0) μg/m³ and 7.1 (4.2) μg/m³ respectively) was largely overestimated when surrogate exposures were used (up to 9.9 (2.2) μg/m³ and 39.5 (11.0) μg/m³ respectively). Indirect time-activity adjustment for the nearest monitor estimates reduced ME magnitude and variability substantially. The types of error also varied by the surrogate used. Age and proximity to the nearest monitor were found to drive ME. Day-to-day ME variation and potential time-varying error determinants will also be examined.

CONCLUSIONS: The use of surrogate exposures for the investigation of the health effects of long-term exposure to outdoor air pollution can distort the epidemiological estimates. Information about the ME structures and its determinants can be used for correction and the identification of the true exposure-response functions.

KEYWORDS: Air pollution, Measurement error, Mixture error, Error determinants

O-SY-050 Accounting for space and time in measurement error corrections

Joel Schwartz

Measurement error is endemic in epidemiology and arguments over the direction of bias persist. Modern high-accuracy models of ambient concentrations of air pollutants have reduce error. We illustrate the use of machine learning algorithms to estimate the spatial and temporal variation of exposure error in simulation studies to estimate the direction and extent of bias in air pollution epidemiology using linear, nonlinear, and threshold relationships. We also illustrate the use of regression calibration models that account for differences in calibration across space. We also discuss the parallel between using ambient instead of personal exposure and intention to treat analyses.

O-SY-051 Using SIMEX and regression calibration to correct for mixtures of classical and Berkson measurement error

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BACKGROUND AND AIM: Measurement error in modelled air pollution data is complex consisting of classical and Berkson error components. As part of the MELONS project, we investigated the adequacy of regression calibration and SIMEX in correcting health effect estimates when measurement error contains both components and may also be spatially correlated.

METHODS: In a simulation study of 5,000 subjects, we considered scenarios based on the amount of total measurement error (either 20% or 40% of the variance in the true annual average pollutant concentrations); the proportion of error that was classical (0%,20%,40%,60%, 80% or 100%); and whether total measurement error was homoscedastic or heteroscedastic. Within each simulation, we obtained a dataset of true, and error prone annual average pollutant concentrations and outcome data linked to the true by a hazard ratio of 1.041 per 10μg/m³. The error prone pollutant concentrations were then used as the exposure variable in a Cox regression, and for error correction, a 5% hypothetical validation sub-sample of the data were randomly selected and used to estimate the classical and Berkson error variances. Based on 1,600 simulations per scenario we investigated mean percent bias in the estimated log hazard ratio and the ability of regression calibration and SIMEX to correct for this bias.

RESULTS: Mean percent bias in the uncorrected log hazard ratio was typically negative (i.e., towards the null) ranging from -27.4% to +2.0% across scenarios. Mean percent bias in the corrected estimates ranged from -4.0% to +5.7% for regression calibration and -6.0% to +4.2% for SIMEX.

CONCLUSIONS: Across a range of scenarios varying the mix of classical and Berkson error and allowing total measurement error to vary spatially, SIMEX and regression calibration produced corrected log hazard ratios with relatively small mean percent bias.

KEYWORDS: Measurement Error, SIMEX, Regression Calibration

O-SY-052 Empirical measurement error bias correction for the effects of functions of the exposure history: cumulative average PM2.5 in relation to all-cause mortality

Donna Spiegelman

Cohort studies in air pollution epidemiology construct the exposure metric as a cumulative average over a pre-determined time window. We present valid methods for empirically estimating the time window, and simultaneously estimating the exposure effect from this complex variable that is a function of multiple exposure measurements over time, correcting for exposure measurement error bias using validation data. Air pollution validation studies will be briefly presented. Then, methods will be illustrated in the Nurses' Health Study's investigation of PM2.5 on all-cause mortality. Valid confidence interval construction will be considered, and publicly available software for conducting these analyses will be shown.

SYMPOSIUM 12: The project EXHAUSTION – Heat and air pollution effects on cardiopulmonary mortality and morbidity: geographical variability and vulnerable groups in Europe

O-SY-053 Short-term heat effects and effect modification by ambient air pollution on cardiovascular and respiratory mortality across 148 cities from 13 European countries – Results of the EXHAUSTION project

Masna Rai[1,2], Massimo Stafoggia[3], Francesca De'Donato[3], Antonio Gasparrini[4], Pierre Masselot[4], Envangelia Samoli[5], Sofia Zafeiratou[5], Klea Katsouyanni[5], Shilpa Rao[6], Liliana Vazquez Fernandez[6], Siqi Zhang[1], Kristin Aunan[7], Annette Peters[1,8], Alexandra Schneider[1], Susanne Breitner[1,8]

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BACKGROUND AND AIM: Epidemiological evidence on the potential interactive effects of high air temperature and air pollution on cause-specific mortality remains inconclusive and limited to selected locations. We investigated the effects of temperature on cardiovascular and respiratory mortality and its effect modification by particulate matter with a diameter ≤ 2.5 µm [$PM_{2.5}$] and ozone [O_3] during summer months (May-September) in 148 cities across 13 European countries.

METHODS: for these cities, we obtained daily counts of cardiovascular and respiratory mortality and daily exposure data between 2000 and 2018. We used location-specific confounder-adjusted Quasi-Poisson regression with a tensor product between air temperature and the air pollutant. We extracted temperature estimates at low, medium, and high levels of pollutants defined as the 5th, 50th, and 95th percentile of location-specific air pollutant concentrations. A random-effects multilevel meta-analytical model was used to derive the country-specific and overall estimates.

RESULTS: High summer temperatures were associated with increased cardiovascular and respiratory mortality. We further observed modification of the heat effects by elevated levels of $PM_{2.5}$ and O_3 in most locations, with stronger effects for respiratory than cardiovascular mortality. for example, the percent increase in respiratory mortality per increase in the 2-day average summer temperature from the 75th to the 99th percentile was 9.2% (95% Confidence Interval [CI] 8.9-9.4), 13.0% (95% CI 12.8, 13.2), and 19.8% (95% CI 19.5, 20.2) at low, medium, and high levels of $PM_{2.5}$, respectively.

CONCLUSION: We observed significant modification of the heat effects by elevated levels of $PM_{2.5}$ and O_3 leading to an increased risk of cardiovascular and respiratory mortality. With both temperature and air pollutant concentrations foreseen to increase considering climate change, targeted adaptation and mitigation measures are crucial to enhance resilience and sustainable development in alignment with EU climate change policies.

KEYWORDS: Air temperature, air pollution, cause-specific mortality, effect modification, Europe

O-SY-054 Age standardized heat and cold related mortality impacts across European cities

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BACKGROUND AND AIM: Heat and cold are important environmental risk factors for mortality with apparent geographical differences in vulnerability. Factors such as the local climate, topology, demography or the socio-economic situation can all affect the mortality burden of heat and cold. This study aims to comprehensively assess of the heat- and cold-related mortality in European cities, including less represented areas such as Scandinavia and Eastern Europe while accounting for the different demographic and vulnerability factors.

METHODS: We performed a mortality impact assessment related to heat and cold in 801 European cities through a three-stage analysis. First, in a selection of 191 cities, we assessed the exposure-response functions of temperature on mortality for different age groups. Second, these functions were pooled in a meta-analysis model with meta-predictors, including a regional background, age, and 22 vulnerability factors, reduced into a handful of composite indices. Third, this model was used to infer the exposure-response function to the whole 801 city sample, and to compute age-standardized excess mortality rates.

RESULTS: Across all examined European cities, we estimated an overall annual age-standardize excess mortality of 116 deaths (95%CI: 104-132) per 100,000 persons due to cold and 15 deaths (95%CI: 13-17) per 100,000 persons due to heat. The burden widely varied across Europe, being lower in western countries and higher in Eastern Europe for both heat and cold. at the same time, southern countries also experienced an important heat-related burden.

CONCLUSIONS: This study provides a high-resolution assessment of the heat and cold mortality burden across Europe. Results indicate important geographical differences with high vulnerability in the easternmost locations of the continent. These results might give valuable input for designing adaptation policies across Europe.

KEYWORDS: Temperature; Mortality; Europe; Meta-analysis; Time series

O-SY-055 Analysis of short-term heat effects on cardiopulmonary mortality using national and regional small area data – Results of the EXHAUSTION project

Massimo Stafoggia[1], Susanne Breitner[2], Francesca de' Donato[1], Alfonso Diz-Lois Palomares[3], Antonio Gasparrini[4], Pierre Masselot[4], Shilpa Rao[3], Evangelia Samoli[5], Liliana Vazquez Fernandez[3], Sofia Zafeiratou[5], Siqi Zhang[6], Kristin Aunan[7], Alexandra Schneider[6], EXHAUSTION Collaborative Group

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BACKGROUND AND AIM: The adverse effects of extreme air temperatures on mortality have been widely documented in major cities, while little is known about suburban or rural areas. We investigated the association between high air temperature and all-cause and cardiopulmonary mortality in the warm period (May-September) by small area levels in five European countries.

METHODS: We applied a novel two-stage design with two hierarchical aggregation levels, assigning mortality counts and air temperature at the finer level and performing the statistical analyses by using multiple series at the coarser level. The finer level was defined as municipalities in four countries (Norway, Germany, Italy and Greece) and as Lower Layer Super Output Area (LSOA) in England and Wales. The coarser level was defined as provinces (four countries) or Middle Layer Super Output areas (MSOA) (England and Wales). In each country, we applied area-specific Distributed Lag Nonlinear Models Poisson regression. Exposure was modelled at lag 0-1 days. Then, area-specific estimates were pooled in random-effects meta-analysis to obtain national and multi-country effects.

RESULTS: The pooled relative risk (RR) of mean temperature increases from the 75th to 99th percentile on all-cause mortality was 1.15 (95% confidence interval (CI): 1.08, 1.23) with RRs ranging from 1.05 (CI95%. 1.03-1.08) in Norway to 1.22 (95%CI. 1.21-1.24) in Italy. In Norway, England and Wales, and Greece, we detected much higher associations with respiratory mortality. Cause-specific analyses in Germany and Italy are ongoing. We also evaluated effect modification by age and sex, and found a greater risk among the elderly (75+ years, RR: 1.19, 95%CI: 1.10-1.28) and females (RR: 1.20, 95%CI: 1.09-1.32).

CONCLUSIONS: We found evidence of adverse effects of high temperatures on cardiopulmonary mortality in five countries using an innovative approach. Differentials urban/rural are object of current investigation.

KEYWORDS: Mortality, Short-term Exposure, Temperature, Small-area, Europe.

O-SY-056 Long-term effects of air temperature on cardiopulmonary outcomes in prospective European cohort studies

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BACKGROUND AND AIM: Short-term health effects of air temperature have been well recognized. However, little is known about the effects of prolonged exposure to non-optimal air temperatures, particularly at the individual level. This study assessed long-term temperature effects on cardiopulmonary (CPD) outcomes using data collected in four prospective European cohorts.

METHODS: Participants of the KORA (Augsburg, Germany), RoLS (Rome, Italy), CONOR (Norway), and UK Biobank (UK) cohorts were included in the current analysis. Their vital status and incident diseases were identified through death and disease registries as well as follow-up surveys. Annual mean and standard deviation (SD) of air temperature were calculated for each participant and follow-up year based on the daily mean air temperature at residences estimated by spatial-temporal models. We applied cohort-specific Cox proportional hazard models with adjustment for individual characteristics and time trends, using the distributed lag non-linear model approach, to assess the associations of long-term air temperature with CPD mortality and morbidity. Random-effects meta-analysis was used to pool the cohort-specific estimates.

RESULTS: In the RoLS cohort, we observed a monotonically increasing risk for cardiovascular mortality associated with increasing annual mean and SD of temperature. for an increment from the 75th to the 95th percentile in the annual mean and SD, the hazard ratios for cardiovascular mortality were 1.055 (95% CI: 1.029, 1.081) and 1.151 (95% CI: 1.060, 1.251), respectively. Besides, increasing annual SD showed an indication of being associated with increased respiratory mortality risk. In the KORA cohort, no effects were observed for annual mean temperature or SD on CPD mortality and morbidity. Cohort-specific analyses in Norway and UK and the meta-analysis are ongoing.

CONCLUSIONS: This study provides evidence for long-term air temperature effects on CPD outcomes but also indicates heterogeneity in such effects among four European cohorts.

KEYWORDS: Air temperature, long-term, cardiopulmonary mortality, cohorts

O-SY-057 Heat and health prevention in European Region under a changing climate: the urgent need for a faster roll-out of Heat-Health Action Plans (HHAPs)

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BACKGROUND AND AIM: adverse health effects from extreme heat remain a major risk, bound to increase in a changing climate. This paper assesses the status of heat impacts on health and their prevention in the European Region and discusses successes, failures and necessary action.

METHODS: results are based on a survey among the WHO European Region member states, a series of literature reviews intended to inform the update of the WHO Heat Health Action Planning guidance from 2008, and a review of the EEA Climate and Health observatory and Climate Adapt database.

RESULTS: though urbanization, population ageing and climate change are increasing heat vulnerability, heat-related mortality has decreased in several European countries. Heat health action plans (HHAP) progressively adopted since 2003 may have contributed to that reduction, although so far only 17 of the 53 member states of the WHO European Region have a HHAP, most (14) of them EU countries. All plans implemented basic core elements like alert systems and information plans, but most lack M&E, real time surveillance or influence over urban planning to reduce heat exposure. Involvement of subnational authorities remains low, and many plans are inadequately resourced and infrequently reviewed. Despite HHAPs being a prime example of climate change adaptation, their explicit presence in national adaptation plans and strategies in member states is far from generalized.

CONCLUSIONS: our findings suggest limited progress in the adoption and rollout of HHAPs, with many European countries lacking one, particularly outside the EU. Many core HHAP elements are still insufficiently implemented and only better M&E will clarify their effectiveness and allow for improvements. The EU Mission on Adaptation could support progress in HHAPs and contribute to attaining the objectives of the EU climate change adaptation strategy and the WHO Ostrava Declaration.

KEYWORDS: Heat health action plans, Europe, Climate change, Adaptation

SYMPOSIUM 13: Advancing air pollution epidemiology in India: building capacity locally to address questions of context, policy relevance and methodological robustness

O-SY-058 Reconciling methodolatry and policy relevance in air pollution epidemiology: reflections from India

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Indians experience some of the highest exposures to air pollution both within and outside the home, and Indian cities feature prominently on the list of most polluted places on the planet. The most recent sub-national burden of disease estimates note that approximately 1.7 million deaths were associated with household and ambient air pollution exposure in 2019, the highest of any country in the world. However, the evidence base continues to remain relatively scant for a country the size of India.

Recent efforts to strengthen the evidence base in India have involved the use of data from government sources. Examples of such sources in India include registry data and survey data from large-scale representative surveys conducted nationally. However, the use of these data in analyses for air pollution epidemiology presents fundamental challenges including:

1. Access and availability – data are either unavailable in a timely fashion to make meaningful inferences, or their public release involve several layers of complex bureaucracy
2. Quality – registry data are often incomplete and even when complete are replete with coding errors especially related to aspects such as cause of death
3. Periodicity – large-scale surveys are meant to be conducted with a pre-defined periodicity, but this has varied with gaps between iterations ranging from 4-10 years

These challenges are layered with an additional complication for early-career environmental epidemiologists – going the "quick and dirty" route of using tried and tested methods that may be contextually relevant but dated or aligning your methods to appeal to a field in environmental epidemiology that has made rapid advances in recent years.

This talk will focus on these challenges with examples from the author's own perspective as an early-career researcher, and outline steps needed to strengthen the policy-relevant evidence base locally.

O-SY-060 Bootstrapping air pollution epidemiology in the Indian context

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Air pollution is among the largest contributors to the overall burden of disease in India. Very few studies in India to date have assessed the effects of long-term exposure to air pollution on all-cause or cause-specific mortality, at the center of large health burdens and economic costs of air pollution. Furthermore, there is limited geographic coverage to date, and several outcomes with significant health burden in India are often not included in analyses. It is understood that epidemiologic studies of exposures to air pollution and their effects on health are critical to characterize the health burden for India's population and to motivate air quality progress. While the need for rapidly building the evidence base as well as research competencies in the field of air pollution science in India has been discussed in detail, there has been limited discussion regarding practical opportunities to effect this change.

I will discuss concrete examples and models for conduct of research studies based on available data and operating within constraints in the context of low- and middle-income countries. The talk will draw largely on ongoing work in India, including the establishment of a new research network focused on air pollution and health. I will also discuss possible roles for professional societies, funding organisations and experts, especially in the context of improving representation within ISEE and in the field of environmental health.

O-SY-061 Strengthening the evidence base on global air pollution epidemiology: the case for collaboration and engagement

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Increasing interest in expanding the scope of environmental epidemiology to more adequately reflect the diversity of global contexts is converging with calls for reforming global health. This presentation will examine some of the drivers of these converging trends and offer reflections on the key components of sustainable, mutually beneficial research collaborations to support global air pollution epidemiology.

I will discuss the important role of capacity building at the organizational, project, and individual-level for strengthening the evidence base on air pollution epidemiology globally, drawing from the experience of the ISEE Capacity Building and Education Committee (CAPE) and specific projects including the Cardiovascular health effects of Air pollution in Telangana, India (CHAI) project. I will provide an overview of the guiding principles applied in the CHAI project to build capacity of new researchers in India, and increase their participation in international publications and professional networks.

I will reflect on current barriers to publication of environmental exposure science and epidemiology research from low- and middle-income country (LMIC) authors in journals. Finally, I will provide an overview of innovative strategies to facilitate publication of high quality LMIC-led research, including as an example, the CAPE Peer Editing Program.

SYMPOSIUM 14: Perfluoroalkyl and polyfluoroalkyl substances (PFAS) in Indigenous communities: a case of environmental injustice

O-SY-062 Contamination of country foods by perfluoroalkyl acids in the Arctic

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BACKGROUND AND AIM: Perfluoroalkyl acids (PFAAs) are synthetic chemicals used in industrial and consumer applications. They are exceptionally stable and highly mobile in the environment, and have been detected in high concentrations in Nunavik Inuit adults. The study's objectives were to study the associations between dietary profiles in Nunavik and PFAAs concentrations, and the associations between specific foods and PFAAs concentrations.

METHODS: The study used data from the Qanuilirpitaa? 2017 Nunavik Inuit Health Survey. Nine PFAAs congeners were measured in plasma samples, including perfluorooctane sulfonate (PFOS), perfluorohexane sulfonate (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA) and perfluoroundecanoic acid (PFUdA). Dietary profiles were identified using latent profile analysis. Multiple linear regression models regressed log-transformed PFAAs concentrations against the dietary profiles, adjusting for sociodemographic variables. Elastic net was used to look at associations between PFAAs and dietary variables.

RESULTS: We identified strong associations between the dietary profile defined by frequent country food consumption and all PFAAs congeners (PFOA, PFNA, PFDA, PFUdA, PFHxS, and PFOS) compared to the dietary profile defined by frequent market food consumption. Individuals with low consumption of all foods also had higher concentrations of all PFAAs congeners compared to individuals with frequent market food consumption. The associations were stronger with profiles defined by more frequent country food consumption, and particularly those with increased marine mammal consumption. Elastic net identified marine mammal products (seal liver, beluga misirak), wild birds (ptarmigan, goose eggs), Arctic char and fish roe as main exposure sources.

CONCLUSIONS: Increased country food consumption was strongly associated with higher PFAAs concentrations, particularly PFOS and long-chain PFAAs congeners. The results provide further evidence that Arctic communities are disproportionately impacted by PFAAs, and further national and international regulations are required to protect the exceptional quality of country foods.

KEYWORDS: PFAS; exposure; food; Indigenous

O-SY-063 Elevated exposure to long-chain perfluoroalkyl and polyfluoroalkyl substances (PFAS) in Inuit from Nunavik, Arctic Canada: a call for global action

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BACKGROUND AND AIM: The Inuit of Nunavik are exposed to perfluoroalkyl acids (PFAAs) via long-rang transport from southern to northern latitudes and biomagnification of PFAAs in Arctic food webs. Our objective was to document plasma PFAAs levels and compare them to previously documented levels and the general Canadian population.

METHODS: The study included 1326 Nunavimmiut aged 16-82 years from the population representative survey, Qanuilirpitaa? 2017 Nunavik Inuit Health Survey. Concentrations of nine PFAAs were assessed, including perfluorooctane sulfonate (PFOS), perfluorohexane sulfonate (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA) and perfluoroundecanoic acid (PFUdA). Concentrations were compared to Nunavik levels in 2004, other Arctic regions, and the Canadian Health Measures Survey (CHMS) Cycle 5 2016-2017. Multiple linear regression analyses compared concentrations by demographics and lifestyle.

RESULTS: There were elevated concentrations of various PFAAs congeners compared to CHMS, including PFOS, and long-chain PFAS congeners, PFNA, PFDA, and PFUnDA. PFNA and PFUdA concentrations were 7-fold higher than the CHMS concentrations, and PFDA concentrations were almost 4-fold higher than the CHMS concentrations. Short-chain congeners were largely undetected. Concentrations differed by sex, age, region, and indicators of seafood and marine mammal consumption. Males had higher concentrations of PFOA and PFHxS, whereas females had higher concentrations of PFDA and PFUdA. PFAAs concentrations increased with age and were highest among those aged 50+ years, such that serum PFOS concentrations were 2.5 times higher in those aged 50+ years compared to those aged 16-29 years. PFNA concentrations followed a U-shaped curve with increasing age.

CONCLUSIONS: Our findings indicate a decrease in older PFAAs, but concentrations of many PFAAs in Nunavik remain several-fold higher compared to the general Canadian population. Evidence also points to an increase in exposure to long-chain PFAAs, which are an emerging public health concern in the Arctic.

KEYWORDS: PFAS, Indigenous, Environmental justice, Exposure

O-SY-064 Exposure to PFAS in two Alaska Native Communities

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BACKGROUND: Many Arctic Indigenous communities are disproportionately exposed to persistent bioaccumulative toxicants due to global distillation and traditional diets. There is relatively little known about sources of exposure to PFAS in Arctic Indigenous Communities. Aim: The aim of this study was to assess exposure to, and health effects of, PFAS in two Arctic Indigenous communities on Sivuqaq (St. Lawrence Island), Alaska.

METHODS: Working within an established community-based participatory research program we assessed exposure to PFAS using human serum samples, indoor dust, traditional foods, as well as sentinel fish species.

RESULTS: Community members on Sivuqaq have broadly similar PFAS exposures to the U.S. population as measured by NHANES; however, select long chain PFAS such as PFNA and PFUNA appear elevated among Sivuqaq residents. Several PFAS are associated with circulating thyroid hormone concentrations in this this population. PFAS are present in traditional food animals as well as sentinel fish species collected in Sivuqaq. Sentinel fish suggest some aspect of the built environment acts as a point source of PFAS. Fish data also suggest strong species level effects in accumulation of PFAS. Dust concentrations of PFAS are on the low end of those reported and suggest the indoor environment may be a comparatively minor contributor to serum PFAS in this population.

DISCUSSION: Alaska Native communities are exposed to PFAS through multiple routes of exposure. This may result in elevated exposure for select PFAS. Serum PFAS are associated with measures of thyroid function.

O-SY-065 PFAS exposure and immunotoxic effects in children from Greenland

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BACKGROUND AND AIM: Perfluoroalkyl substances (PFAS) have been in production for more than half a century and is still used in numerous consumer products. Humans are exposed to PFAS through contaminated food and water as well as dust from treated materials. These chemicals bioaccumulate and are widespread in the environment, and populations relying on a marine diet are thus often more exposed. The aim of this study was to examine the association between Greenlandic children's exposure to major environmental chemicals and their concentrations of diphtheria and tetanus vaccine antibodies after vaccination.

METHODS: The study is based on cross-sectional data from Greenlandic children aged 7–12 years examined during 2012–2015. Among 175 children with known vaccination records, 169 provided a serum sample with sufficient volume to measure PFAS and specific antibodies against diphtheria and tetanus. Associations were examined in linear and logistic regression models.

RESULTS: We found higher serum-PFAS concentrations to be associated with lower diphtheria antibody concentrations after vaccination and with increased odds of having diphtheria antibody concentrations below the protective level. for each 1 ng/mL increase in serum concentrations of perfluorohexane sulfonic acid (PFHxS), perfluorooctane sulfonic acid (PFOS), perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA), odds of not having protective levels of diphtheria antibodies were increased 6.44 times (95 % CI: 1.51–27.36), 1.14 times (95 % CI: 1.04–1.26), 1.96 times (95 % CI: 1.07–3.60), and 5.08 times (95 % CI: 1.32–19.51, respectively.

CONCLUSIONS: Our findings emphasize the risk of immunotoxicity associated with PFAS exposure also in this Arctic population.

KEYWORDS: PFAS, Children, Vaccine antibodies, Immunotoxicity, Greenland

O-SY-066 Determinants of polyfluoroalkyl substances and perfluoroalkyl substances (PFAS) biomarkers in First Nations Communities of the Northwest Territories and Yukon

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BACKGROUND AND AIM: Polyfluoroalkyl substances and perfluoroalkyl substances (PFAS) include numerous anthropogenic chemicals used in firefighting foams, non-stick cookware, food packaging, and waterproof clothing. Research has shown some PFAS exposures appear to be decreasing in the general population of Canada. In contrast, prior to a human biomonitoring research completed in Old Crow, Yukon and the Mackenzie Valley, Northwest Territories, much less was known on exposure patterns for Dene and Gwich'in populations. This research aims to describe exposure patterns among these populations by identifying determinants and potential sources of PFAS exposure for participants.

METHOD: Nine PFAS (including: perfluorooctanoic acid (PFOA), perfluorooctane sulphonic acid (PFOS), perfluorohexane sulphonic acid (PFHxS), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), and perfluoroundecanoic acid (PFUdA), perfluorobutanoic acid (PFBA), perfluorohexanoic acid (PFHxA), and perfluorobutane sulphonic acid (PFBS)) were quantified using liquid chromatography mass spectrometry in blood samples collected in Old Crow (n=54) and the Dehcho Region, Northwest Territories (n=125).

RESULTS: This research showed that, for most PFAS, levels in Old Crow and the Dehcho Region, Northwest Territories were similar or lower to those observed in the Canadian Health Measures Survey. The key exception to this was perfluorononanoic acid (PFNA) which, relative to the CHMS (0.51 µg/L), was approximately 1.8 times higher in Old Crow (0.94 µg/L) and 2.8 times higher in Dehcho (1.42 µg/L) than observed in the general Canadian population. This presentation will report results describing the associations, using multivariable logistic regression, between PFAS levels and consumption of traditional food, lifestyle factors, and demographics.

CONCLUSIONS: The results highlight the importance of expanding PFAS analytical suites beyond PFOS and PFOA for both human biomonitoring as well as environmental sampling in northern environments.

KEYWORDS: Biomonitoring; Contaminants; Indigenous; Traditional Foods; PFAS; PFNA

O-SY-067 Indigenous lifeblood in land, water, and natural resources: the unknown threat of PFAS contamination

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Bay Mills has a long-standing and critical interest in the waters of the Great Lakes. As a signatory to the 1836 Treaty of Washington, Bay Mills and other Tribal Nations ceded territory to the United States, but in exchange, Bay Mills reserved the right to fish, hunt, and gather throughout the territory, which has been upheld by federal courts.

This treaty right was carefully protected in order to preserve the traditional lifeways of our people – the Anishinaabe of the Great Lakes - and their reliance on the environment's natural resources for food, shelter, medicines, and for trade. Our ancestors understood that by protecting the relationship with land, water, and natural resources, they were also protecting the cultural and spiritual resources of Bay Mills Indian Community as well. Commercial and subsistence fishing continue to be the primary occupation of citizens of the Bay Mills Indian Community. Over half our citizen households rely on fishing for all, or a portion of their annual income. These lifebloods and lifeways are central to an indigenous way of life that goes back to time immemorial for Tribal Nations across the United States, and create a foundation of understanding who we are as a people and how we pass teachings on from elder to child.

In the last few years, PFAS/PFOS contamination has become a growing concern of Bay Mills Indian Community, as well as the impacts PFAS/PFOS will have on fish and wildlife, water, traditional food systems, medicines, and other traditional practices of citizens of Bay Mills Indian Community. Bay Mills Indian Community in partnership with several State agencies has undergone study of water tributaries near reservation, as well as study of the Great Lakes themselves to find point source pollution from PFAS/PFOS so that it can be mitigated and stopped altogether.

SYMPOSIUM 15: Location, Location, Location! The importance of geospatial exposure constructs to assess pesticide exposures and related adverse health outcomes in agricultural settings

O-SY-068 Geographic and record-based pesticide exposure assessment, biologic exposure signatures, and chronic disease modelling in California

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BACKGROUND AND AIMS: for the past 50 years, California has been recording agricultural pesticide applications in a pesticide use reports (PUR) database; i.e. documenting use for several hundred pesticide active ingredients. These data can be employed in exposure assessment purposes targeting specific pesticides and pesticide mixtures and study a range of adverse health outcomes.

METHODS: In collaboration with M. Cockburn at USC, my team at UCLA has generated a geographic information system tool that uses these records in conjunction with land use data to generate spatio-temporal exposure measures for the California population living near agricultural applications. Over the past 2 decades we have used this tool kit to estimate pesticide related health effects including studies of adverse birth outcomes, autism, cerebral palsy, childhood brain cancers, Parkinson's and Alzheimer's disease.

RESULTS: I will present and discuss common as well as special challenges for exposure assessment and the results of the studies we conducted in the past 2 decades. Furthermore, we investigated whether long- or shorter-term exposures to agricultural use pesticides assessed with the PUR tools generate exposure signals in biological systems and bio-fluids, i.e. relying on human blood samples from older adult residents of central California to examine metabolomic patterns, methylation changes, and influences that certain pesticides have on the gut microbiome. Using integrative omics analyses, we also examined overlap between pesticide-associated biologic pathways and pathways known to be perturbed in certain diseases.

CONCLUSIONS: These studies help to systematically identify physiologic responses to chronic pesticide exposures. Eventually this will help to better understand how low-level chronic pesticide exposures may contribute to chronic brain diseases in real world exposure scenarios.

KEYWORDS: pesticides, exposure assessment, Parkinson's disease, neurodevelopment, multi-omics

O-SY-069 Geospatial determinants of urinary insecticide concentrations and internalizing disorders in Ecuadorian adolescents

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BACKGROUND: Depression and anxiety are top 5 contributors of increased disability-adjusted life years. Pesticide exposure has been linked to increased depression and anxiety; evidence in adolescents is limited. This study assesses clustering patterns of mental health symptoms and urinary pesticide metabolites, and their relationships with home proximity to floricultural crops in an Ecuadorean agricultural county.

METHODS: We assessed 514 adolescents (11-17 years) who lived in the 5 parishes of Pedro Moncayo County, Ecuador. We measured 8 urinary metabolites for neonicotinoid, pyrethroid and organophosphate pesticides, and assessed depression and anxiety symptoms using standardized questionnaires. Getis-Ord Gi* evaluated spatial clustering to identify hot and cold spots of pesticide metabolites, depression symptoms and anxiety symptoms. The association between home distance to floricultural greenhouses and anxiety/depression scores were tested using generalized estimating equations, adjusting for confounders.

RESULTS: The floricultural surface areas (% of total land) across parishes were: Tocachi: 0.12 km2 (0.001%), La Esperanza: 0.43 km2 (0.01%), Malchingui: 0.04 km2 (0.05%), Tupigachi: 5.36 km2 (12.5%), and Tabacundo: 9.36 km2 (13.2%). The average scores for anxiety (53.0 [SD=9.31]) and depression (58.8 [SD=9.61]) were in the anticipated range. We observed hotspots for anxiety and depression symptoms in Tupigachi (95-99%C [confidence]) and Tabacundo (90-95%C). There were hotpots for organophosphate and pyrethroid metabolites in Tupigachi, coinciding with anxiety and depression hotspots (malathion dicarboxylic acid [90%-99%C], para-nitrophenol [95%], 2-isopropyl-4-methyl-6-hydroxypyrimidine, trans-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid [90%C], and 3-phenoxybenzoic acid [95%C]). Additionally, greater proximity to greenhouses was associated with greater depression (βper100m=0.94 [95%CI: 0.53, 1.36]) and anxiety (βper100m= 0.32 [95%CI: 0.11, 0.54]) scores.

CONCLUSIONS: We observed hotspots in Tupigachi for both anxiety, depression, and multiple organophosphate/pyrethroid metabolites. Throughout the county, residential proximity to floricultural crops was associated with higher anxiety and depression symptoms. This suggests that off-target pesticide drift from crops may be a contributor to increased internalizing behaviors.

KEYWORDS: Pesticides

O-SY-070 Residential exposure to pesticides and birth outcomes using the Dutch birth registry

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BACKGROUND AND AIM: To explore associations between residential exposure to specific pesticides and birth outcomes using individual level exposure and pregnancy/birth data.

METHODS: From all singleton births from 2009-2013 in the Dutch birth registry we selected mothers >16 years-old living in non-urban areas that had complete address history and changed addresses at most once during pregnancy (N=325,435). We selected 12 active ingredients (AIs) with some evidence of reproductive toxicity and that were used in the Netherlands according to a farmers' survey from 2008 and explored a further 127 AIs. We estimated amount used (kg) within buffers of 50, 100, 250 and 500 meters around each mother's home during pregnancy. We used generalized linear models to investigate associations between AIs and gestational age, birth weight, low birth weight (LBW), small for gestational age (SGA), large for gestational age (LGA), still births/infant mortality, and prematurity, adjusting for individual and area-level confounders. We further used minimax concave penalty with a stability selection step to identify which AIs could further be related to the birth outcomes among the 12 and the additional 127 AIs.

RESULTS: Maternal residential exposure to linuron was associated with increased birth weight [β [95% confidence interval] 296.49 [56.07, 536.90], 74.32 [27.92, 120.72], 13.87 [6.86, 20.88] and 1.93 [0.56, 3.30], in 50m, 100m, 250m and 500m buffers) and higher odds of LGA babies (OR [95% CI] 5.72 [1.04, 31.58], 1.49 [1.06, 2.08], 1.07 [1.02, 1.13], 1.01 [1.00, 1.02], respectively). Variable selection also yielded the same associations, and further identified signals for a relationship between fluroxypir-meptyl and gestational age, picoxystrobin and LGA, and glufosinate and LBW.

CONCLUSIONS: Residential proximity to linuron during pregnancy was associated to increased birth weight and being large for gestational in babies. Other possible associations were identified that need further investigation.

KEYWORDS: residential pesticide exposure, birth registry

O-SY-071 Residential proximity to agricultural pesticide use and respiratory health in the CHAMACOS study

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BACKGROUND AND AIM: We previously observed associations in the Center for the Assessment of Mothers and Children of Salinas (CHAMACOS) cohort study between pesticide exposure (including organophosphate metabolites in children's urine and residential proximity to agricultural sulfur use) and respiratory symptoms and lung function at 7-years of age. In the current analysis, we examined respiratory health in relation to residential proximity to agricultural use of manganese (Mn) containing pesticides while accounting for other pesticide exposures previously associated with these outcomes in this cohort.

METHODS: Our population includes participants with pesticide exposure estimates available that completed the 7-year assessment. We evaluated agricultural use of Mn pesticides within 1 and 3 km of residences during pregnancy, early life (birth to 6y of age) and the year prior to the assessment (6 to 7y of age) using a Geographic Information System to link residential histories with California's Pesticide Use Reporting data. We assessed probable asthma from maternal report of symptoms and conducted lung function measurements using spirometry. The number of participants ranged from 276 – 330 for probable asthma and 204 – 265 for lung function measurements. We adjusted regression models for potential confounders and exposures that have been associated with these outcomes in this cohort.

RESULTS: We observed an association between residential proximity to Mn pesticide use and probable asthma. A two-fold increase in use within 1 km during the year prior to the assessment was associated with a relative risk for probable asthma of 2.1 (95% confidence interval = 1.4, 3.1) after adjusting for other exposures previously related to this outcome in this cohort. We did not observe any associations with proximity to use and lung function impairment at 7-years of age.

CONCLUSIONS: We observed a higher risk of probable asthma with residential proximity to higher Mn pesticide use.

O-SY-072 Residential proximity to pesticide sprayed sites and sex and adrenal hormones in Ecuadorian adolescents

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BACKGROUND: Pesticides frequently used in agriculture, including organophosphates, glyphosate or 2,4-D, have endocrine disrupting potential. We previously found that residential proximity to agricultural crops (pesticide spray sites) can increase the potential for chronic pesticide exposure of children and adolescents, but little is known about whether residential proximity to crops can affect their hormone levels.

METHODS: We examined 523 adolescents (12-17 years, ESPINA cohort) living in Pedro Moncayo, Ecuador, where ~21% of the adult population works in floriculture. Using multiple linear regression, we analyzed the association of hormones (DHEA, testosterone, estradiol, and cortisol) with residential proximity to floricultural greenhouses and greenhouse areas near homes. Multiple linear regression models were stratified by whether participants lived closer or farther than 300m from the nearest plantation.

RESULTS: We found that 10 percent increases in crop areas within 150m and 200m residential buffer regions were associated with reduced concentrations of testosterone by -0.66 (95%CI: -1.27, -0.06) percent and -0.76 (-1.28, -0.23) precent, respectively. Crop areas within 150m and 500m were also significantly associated with lower estradiol, measured in boys only, by -1.21 (-2.27, -0.14) percent and -0.64 (-1.28, -0.01) percent, respectively. Cortisol was significantly associated with areas within 300m among boys but not girls. Residential proximity to crops within 150m and 200m was inversely associated with testosterone among boys.

CONCLUSIONS: This is the first study to evaluate geospatial determinants of off-target pesticide drift from crops to nearby homes, including residential proximity to crops and crop surface areas, in relation to hormone alterations. Endocrine disruption of adolescents growing up in agricultural settings is of concern.

KEYWORDS: Geospatial, drift, agriculture, pesticides, hormones.

O-SY-073 Geospatial analyses as a tool to monitor the implementation of regulation on aerial pesticide spraying in Matina County, Costa Rica

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BACKGROUND AND AIM: Worldwide, governmental agencies define buffer zones to protect agricultural populations from off-target pesticide drift, but its implementation is often unclear, particularly in low- and middle-income countries (LMIC).
In Costa Rica, a 100 meters buffer zone is established for aerial spraying, reduced to 30 meters if a natural barrier is present. Also, windspeed should be less than 15 km/h and workers cannot be in the field during aerial spraying. We aimed to identify potential noncompliance of this regulation by banana companies in Matina County, Costa Rica.

METHODS: Using geographical information systems, field observations and bystanders' reports (n=58), we created maps of Matina County Costa Rica, indicating where regulations for aerial spraying were probably disrespected. We informed an interinstitutional committee that supervises agricultural aerial spraying activities, governmental agencies, as well as community organizations about results, to promote corrective measures.

RESULTS: We identified 44 kilometers (km) of agricultural frontier without buffer zones at less than 100 meters from public areas with reported aerial spraying, of which 55% (24 km) near roads and 45% (20 km) near houses. Twelve out of the 20 km were in more densely populated towns (≥ 128 houses/km2). In three of these towns, aerial spraying was reported at ≤ 30 meters' distance which coincided with information collected by GIS. More than half of bystanders (59%, n=34) reported aerial spraying in windy conditions and 48% (n=28) reported to have observed workers inside banana fields during aerial spraying during the last month. Five community members denounced incompliance, which resulted in corrective actions by the interinstitutional committee for agricultural aerial spraying.

CONCLUSIONS: Our results suggest banana companies only partly fulfil Costa Rica aerial pesticide spraying regulation, that may result in increased environmental exposures from drift. GIS forms a useful tool to monitor the implementation of environmental legislation over time.

SYMPOSIUM 16: Toxicity of air pollutant mixtures: overcoming the toxic mixture of spatial misalignment, collinearity, and measurement error

O-SY-074 Measurement errors in Gaussian mixture models using high-dimensional air pollution constituents data

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BACKGROUND AND AIM: An active area of current interest in air pollution epidemiology is characterizing the impact of air pollution constituents on health outcomes. Statistical analysis of air pollution data suffers from bias due to measurement error of these exposures, and this bias is exacerbated when the exposures are high-dimensional. It is well known that exposure to fine particles (PM2.5) can cause adverse health effects. However, the independent effects of PM2.5 constituents have not been as well investigated.

METHODS: In this work, we develop a novel approach to correcting for the bias due to measurement errors associated with multiple correlated air pollutants with a complex correlated error structure through the use of Gaussian mixture models under the main / external validation design framework. The clusters are corrected for measurement error and then analyzed in a Cox model to investigate the impacts of different air pollutant profiles on time to even outcomes, such as all-cause mortality and cancer incidence.

RESULTS: Extensive simulation studies are carried out to investigate the performance of the proposed method, and to explore sensitivity to departures from Gaussian assumptions. The method is illustrated in a study of air pollutants on all-cause mortality in the Nurses' Health Study, with exposures validated in the RIOPA and MESA studies.

O-SY-075 Impact of exposure measurement error in multi-pollutant models: a simulation study in the time-series framework

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BACKGROUND AND AIM: Exposure measurement error in air pollutants can lead to biased health effect estimates and effect transfer from more poorly to better measured exposures. While some studies have estimated the impact of error in single-exposure models we aimed to quantify the effect of measurement error in multi-pollutant models, specifically in time-series analysis of $PM_{2.5}$, NO_2, and mortality using simulations, under various plausible scenarios for exposure errors.

METHODS: Measurement error was defined as the difference between ambient concentrations and personal exposure from outdoor sources. Error-free exposures with their consequent health outcome and error-prone exposures of various error types (classical/Berkson/mixture) were generated using information from the literature. Bias was quantified as the relative difference in effect estimates of the error-free and error-prone exposures.

RESULTS: NO_2 was assumed to be more prone to error than $PM_{2.2}$, based on separate work, and, thus, its mortality effect estimates were more affected by measurement error bias. The observed bias was up to 37% towards the null, when low ratios of the true exposure variance over the error variance were assumed. Higher ratios resulted in smaller, but still substantial health effect underestimation, up to 19% for both pollutants. Significant effect transfer was observed from NO_2 to $PM_{2.5}$ as the general underestimation due to measurement error was worsened for the former and lessened for the latter compared to single-pollutant model estimates.

CONCLUSIONS: Our results indicated an underestimation of true independent health effects of multiple exposures due to measurement error. Effect transfer showed that less precise measurements for one pollutant yield more bias, while the co-pollutant associations were found closer to the true. Using error parameter information in future epidemiological studies should provide more accurate concentration-response functions for health impact assessment.

KEYWORDS: Air pollution, Measurement error, Mixture error, Effect transfer, Simulations

O-SY-076 Predictive clustering methods to identify differential toxicity of air pollutant mixtures

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BACKGROUND AND AIM: Spatial misalignment between the relatively small number of locations where air pollution mixtures are measured and the locations of cohort members poses a challenge to assessing health effects. This talk presents a clustering-based approach to defining multipollutant exposure profiles that can be well predicted at unobserved locations.

METHODS: Clusters are defined by combining multipollutant measurements with spatial and spatiotemporal characteristics of the monitoring location in a Gaussian mixture model. Cluster membership for cohort locations and times are then predicted using parametric and machine learning classification algorithms.

RESULTS: We demonstrate this approach using PM2.5 components on a national scale and on-road multipollutant measures (including ultrafine particles and volatile organic compounds) on a regional scale. We identify mixtures associated with differing effects of air pollution exposure on atherosclerosis, blood pressure, and cancer risk.

CONCLUSIONS: Cluster-based approaches for defining pollution mixtures provide an effective approach to assessing multipollutant exposures using spatially misaligned data. Incorporating location characteristics can improve predictive accuracy and power for assessing differences in health effects of ambient air pollution exposure.

KEYWORDS: ambient air pollution, fine particulate matter, k-means, multipollutant exposures, spatiotemporal statistics

O-SY-077 Impact of long-term exposures of PM2.5 components and sources on cause-specific mortality in a US Medicare cohort: results from two-stage residual analysis

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BACKGROUND: Our understanding of the impact of long-term exposures to PM2.5 constituents and sources on mortality is limited due in large part to the often strong correlations between individual PM2.5 constituent concentrations.

METHODS: We examined associations between long-term exposures to PM2.5 constituents and sources and cause-specific mortality in US older adults using a two-stage residual method. We did so using demographic and mortality data for 15.4 million Medicare beneficiaries living within the conterminous United States (US) between 2000 and 2008. We assessed PM2.5 constituents exposures for each beneficiary and used factor analysis and residual-based methods to characterize PM2.5 sources and mixtures, respectively. In age-, sex-, race- and site-stratified Cox proportional hazard models adjusted for neighborhood socio-economic status (SES), we assessed associations of individual PM2.5 constituents, sources, and mixtures and cause-specific mortality and examined modification of these associations by participant demographics and location of residence.

RESULTS: Hazard ratios (HR) were highest for all causes of death, except COPD, for coal-related PM2.5 constituents and sources. We found Pb, nitrate, Si, and metal-, traffic-, and soil-related components to be significantly associated with increased HR for most causes of death. Using residual-based methods, we found attenuation in HRs to be greatest for all causes of death when variability from sulfate, Se, or coal-related PM2.5 was removed from the PM2.5 mixture. While attenuated, HRs for mortality from all-cause, CVD, and IHD remained statistically significant and positive when variability from NO3–, OC, Si, and traffic- and soil-related PM2.5 were removed from the analyses. Removal of variability due to oil and metal-related sources had no discernable effect on HRs.

DISCUSSION: PM2.5 components related to coal combustion, traffic, and to a lesser extent, soil were strongly associated with mortality from CVD, respiratory disease, and cancer.

SYMPOSIUM 17: Two-way road: how has the environment affected the Covid-19 pandemic and how the pandemic response affected the environment in the Latin America and Caribbean Region

O-SY-079 Air pollution and post-Covid-19 syndrome

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BACKGROUND AND AIM: Evidence exists linking exposure to air pollution with increased COVID-19 incidence, severity and mortality. However, little is known about the role of air pollution in persisting symptoms among recovering patients. We designed a cohort study of hospitalized COVID-19 survivors in São Paulo, Brazil, to examine whether ambient air pollution is associated with post-COVID-19 syndrome.

METHODS: Patients hospitalized between March to August 2020 who were alive six months after hospitalization were included. We collected individual and clinical characteristics during hospitalization and at follow-up assessed ten symptoms with standardized scales, 19 yes/no symptoms, a functional status and a quality-of-life scale and performed four clinical tests. Individual exposure to air pollution was assessed by averaging satellite gridded estimates of annual mean levels of PM2.5 in a 300 m buffer around each participant´s residential address. We also considered greenspace and neighborhood sociodemographic factors in generalized linear mixed models.

RESULTS: We included 749 patients with a median follow-up of 200 (IQR 185 - 235) days, and 618 (83%) had at least one of the ten symptoms measured with scales. Pain (41%), fatigue (38%) and post-traumatic stress disorder (35%) were the most frequent. Individual exposure to PM2.5 was associated with higher dyspnea and fatigue scores and lower functional status. Clinical and sociodemographic factors exhibited associations with different symptoms while greenspace and neighborhood sociodemographic factors did not show any significant association.

CONCLUSIONS: We identified a high frequency of persistent symptoms among COVID-19 survivors that were associated with clinical and sociodemographic factors. Ambient levels of air pollution were associated with persistent dyspnea, increased fatigue, and lower functional status at follow-up. Potential mechanisms involving oxidative stress and systemic inflammation can explain these associations but further studies are needed to confirm this novel impact of air pollution on health.

KEYWORDS: Air pollution, COVID-19; persistent symptoms

O-SY-080 Built environment, transport, and Covid-19

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BACKGROUND: The COVID-19 pandemic has impacted daily-life activities around the world. Multiple countries and cities are implementing different mitigation strategies to reduce transmission (e.g., physical distancing, stay-at-home orders, avoiding large gatherings).

AIM: Describe the evidence and a framework linking COVID-19 mitigation strategies, the built environment, and transport to health determinants and outcomes.

METHODS: Scoping review

RESULTS: COVID-19 mitigation strategies, in addition to helping reduce disease transmission, have also decreased urban road transport, resulting in indirect benefits on air quality, traffic noise, and traffic incidents. On the other hand, the same mitigation strategies have negatively impacted physical activity, mental health, home isolation, and access to transport options, among others. COVID-19 mitigation strategies are an opportunity to test and implement built environment and transport interventions aimed to maximize health equity and minimize health risks. National and local authorities should systematically integrate a long-term urban health equity vision when designing and implementing COVID-19 mitigation strategies.

CONCLUSIONS: COVID-19 offers an opportunity to rethink the built environment and transport infrastructure to support short-term mitigation strategies and reduce long-term urban health inequities.

KEYWORDS: COVID-19. Built environment. Transport. Equity. Environmental health

O-SY-081 SARS-CoV-2 in wastewater: studies in Latin America

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BACKGROUND AND AIM: Wastewater (WW) based epidemiology has proven a useful epidemiological surveillance tool for the early detection of SARS-CoV-2 outbreaks and for the population-wide and specific area surveillance and has been also used to track the variants of concern. This review aims to summarize the research about SARS-CoV-2 in WW in Latin American countries.

METHODS: We performed a scoping review to examine the literature on the results for SARS-CoV-2 in WW in Latin American countries. We identified relevant studies through an electronic database search (language English), adding other publications identified in reference lists and hand searches.

RESULTS: Results have been published from Argentina, Brazil, Ecuador and Mexico. Different virus concentration and extraction methods have been selected and compared in some cases. All studies used RT-qPCR to detect and quantify genomic copies in most cases using the oligonucleotides targeting N1 and N2 regions, but also S and RdRp regions. SARS-CoV-2 has been detected and quantified in environmental samples from influent and sludge in WW treatment plants, river water from urban and rural areas without sewage collection, sewer network in cities, effluents from specific population areas. The virus was not detected in groundwater from Quintana Roo, Mexico.

CONCLUSIONS: It is necessary to move from pilots to scale to establish a complementary early warning surveillance system to inform the public health actions. Thus, the health sector must be aware of WBE as a useful tool and leader its implementation as a regular surveillance tool for SARS-CoV-2 and also for other biological and chemical agents.

KEYWORDS: SARS-CoV-2, wastewater, surveillance, Latin America

O-SY-082 Covid-19 related waste management in the LAC region

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Globally, the health sector responds to approximately five 5% of carbon dioxide emissions and there is an increasing pressure to reduce its carbon footprint and minimize the amount of waste sent to landfills. However, 3 out of 10 healthcare facilities lack systems to segregate waste and less than 1 in 3 healthcare facilities have a basic healthcare waste management service.

Most countries in the Latin America and the Caribbean (LAC) region do not have data on waste management in healthcare facilities. Data collected in five countries (12% of the LAC population) shows large differences among them related to segregation (from 16% in Haiti to 97% in Peru), and treatment (from 23% in Paraguay to 74% in Nicaragua) of healthcare waste, though wastes could be segregated and not treated and treated without segregation.

COVID-19 has exposed long-lasting weaknesses of healthcare facilities in the management of healthcare wastes. 30% of solid waste generated in LAC ends up in uncontrolled dumpsites, and the increased amount of healthcare waste due to the response to the pandemic became an urgent public health problem. In response to that, some countries are purchasing incinerators as a solution to reduce the volume being disposed of. However, in most countries, there is limited or inexistent capacity to monitor and control hazardous emissions of incineration.

Filling data gaps and setting baselines for healthcare waste generation is a priority for LAC countries. To increase the resilience of the health sector, national emergencies preparedness plans should include waste management as a core public health component. Using the opportunity for a green recovery from the COVID-19 pandemic as proposed by WHO, sustainable solutions should include minimization of waste by imposing rules for the procurement and purchasing processes, and training and implementation of waste segregation and treatment in all healthcare facilities.

O-SY-083 Association between air pollution in Lima and the high incidence of Covid-19: findings from a post hoc analysis

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BACKGROUND: Coronavirus disease (COVID-19) was originated in the People's Republic of China in December 2019. Thereafter, a global logarithmic expansion of the cases occurred and was declared a pandemic by the World Health Organization (WHO) in march 2020. Since some countries had a higher rate of infections despite the early implementation of quarantine, it was suggested that air pollution could be related to the high susceptibility to the virus and the associated case-fatality rates (deaths/cases*100). In June 2020, Lima, Peru has the second-highest incidence of COVID-19 in Latin America, and it is also one of the cities with the highest levels of air pollution in the Region.

METHODS: This study investigated the association of outdoor PM2.5 exposure between 2010 and 2016 in 24 districts of Lima with positive cases, deaths, and case-fatality rates of COVID-19 occurred between March 6 to June 12, 2020. Multiple Linear regression analysis was used to evaluate this association controlled by age, sex, population density, and the number of food markets per district.

RESULTS: On June 12, 2020, there were in Lima 128,700 positive cases, and 2,382 deaths due to COVID-19. The case-fatality rate was 1.93%. Previous exposure to PM2.5 (years 2010—2016) was associated with number of COVID-19 positive-cases (β=0.07; 95% CI: 0.034 – 0.107) and deaths (β = 0.0014; 95% CI: 0.0006 – 0.0.0023), but not with case-fatality rate.

CONCLUSIONS: the higher rates of COVID-19 in Metropolitan Lima are attributable, among others, to the increased PM2.5 exposure in the previous years after adjusting for age, sex, and the number of food markets. Reduction of air pollution since a long-term perspective and social distancing are needed to prevent the spread of virus outbreaks.

SYMPOSIUM 18: Understanding the link between the urban exposome and health

O-SY-084 Characterizing the urban exposome in Europe

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BACKGROUND AND AIM: The EXPANSE project studies the effects of the internal and external exposome on cardiometabolic-pulmonary health of more than 55 million Europeans. The external exposome consists of different environments (built, physico-chemical, social and food) and we aim to apply advance modelling approaches and evaluate and validate geographical data to characterise these different external environments.

METHODS: The latest advances in mapping and modelling are employed to characterise the external exposome at a fine spatiotemporal resolution across Europe. Geospatial, machine learning and propagation methods are being applied; the most recent remote sensing data are being obtained; validation performed and variables extracted.

RESULTS: We completed a first phase of producing several physico-chemical (NO2, PM10, PM2.5 and O3) and built (green, blue, and grey spaces, light at night, and walkability) variables at a high spatiotemporal resolution for 27 EU countries. Specifically, we developed new monthly and annual average concentration maps at a 25*25m resolution between 2000 and 2019, using updated methods to account for spatial heterogeneity improving previous models; built initial models for temperature. Validation of the food environment data showed strong correlation between exposures derived from different data sources, but further quality assessments are still needed. An evaluation of the availability of common social environment variables across Europe is ongoing; we developed a deprivation index at a national level and for some countries at municipality level (Netherland).

CONCLUSIONS: A range of external exposome variables are available to be assigned to the cohorts included in EXPANSE using the geocoded address location and matching the data of the analysed health event in the different EXPANSE working groups investigating cardio-metabolic and pulmonary health outcomes. The external exposome data will be made publically available at a later stage through the purposely built online tool, Exposome Maps, to facilitate and stimulate exposome research across Europe.

O-SY-085 Statistical methods for quantifying the link between the urban exposome and health

Marc Chadeau-Hyam

BACKGROUND AND AIM: High-resolution molecular profiles using omics technologies represent an unprecedented source of information to explore the effective biological effects of external stressors and detect determinants of subsequent risk drivers. In parallel, technological advances in exposure monitoring have enabled the reliable measurement of a large range of exposures at the individual level in large populations.

METHODS: The Exposome concept has been developed as a necessary complement to the genome to better understand the determinants of health and of the risk of chronic diseases. The external exposome combines a large range of external stressors (i.e. non-genetic) factors potentially impacting human health from conception onwards. These external exposures (i) are heterogeneous in nature, scale, and variability, (ii) feature complex correlation patterns and (iii) may operate as mixtures. The internal exposome can be defined as the way these exposures are embodied and its exploration relies on the screening and integration of high-resolution molecular data. While methods for omics data analyses are established, their application in an exposome context is raising specific methodological challenges including the analysis of complex and correlated exposures. Furthermore, the isolated exploration of an omic profile offers the possibility to capture stressor-induced biological/biochemical alterations, potentially impacting individual risk profiles, but this may only yield a fractional picture of the complex molecular events involved, therefore limiting our understanding of the effective mechanisms mediating the effect of the exposome.

RESULTS: Taking examples from real-life exposome projects we will illustrate the use of statistical and machine learning techniques to (i) identify 'expo-types' as defined by pools of co-occurring exposures contributing to population stratification, (ii) explore the links between these and cardiometabolic outcomes, and (iii) investigate the (multi)-omic response to these sets of exposures.

CONCLUSION: This presentation will describe sets of approaches methods (and their extensions) enabling such ambitious explorations of the internal and external exposome to provide novel insights into exposome-triggered molecular mechanisms affecting health.

O-SY-086 Exploring the exposome across the life-course; air pollution, metabolomics and lung function

Olena Gruzieva[1,2], Ayoung Jeong[3,4], Shizhen He[1], Zhebin Yu[1], Jeroen de Bont[1], Maria GM Pinho[5], Ikenna C. Eze[3,4], Sara Kress[6], Craig E Wheelock[7,8,9], Annette Peters[10], Jelle Vlaanderen[11], Kees de Hoogh[3,4], Augustin Scalbert[12], Marc Chadeau-Hyam[11,13], Roel C H Vermeulen[11], Ulrike Gehring[11], Nicole Probst-Hensch[3,4], Erik Melén[14,15]

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BACKGROUND AND AIM: Previous studies have explored relationships of air pollution and metabolic profiles with lung function. However, the metabolites linking air pollution and lung function and associated mechanisms have not been reviewed from a life-course perspective. Accordingly, causal inference regarding health effects of single exposures or mixtures remains limited.

METHODS: We conducted a narrative review summarizing recent evidence on the associations of metabolic profiles with both air pollution exposure and lung function taking different stages of life into consideration (linking metabolites to exposure and outcome).

RESULTS: Thirty-two studies were included with 10 studies analyzing air pollution-related metabolic profiles, and 22 analyzing lung function-related metabolic profiles. A wide range of metabolites were identified being associated with short- and long-term exposure, partly overlapping with those linked to lung function in the general population and respiratory diseases such as asthma and COPD, including compounds of amino acid and lipid metabolism. The existing studies show that metabolomics offers potential to identify biomarkers linked to both environmental exposures and respiratory outcomes, which can improve exposure assessment, causal understanding, and identification of individuals at risk. However, many studies suffer from small sample size, cross-sectional designs, preponderance on adult lung function, heterogeneity in exposure assessment, lack of confounding control and omics integration.

CONCLUSIONS: Studies with prospectively and repeatedly collected biological samples and harmonized exposure assessment are needed to get insights into mechanisms and causality of life-long respiratory effects of air pollution. The ongoing EXposome Powered tools for healthy living in urbAN Settings (EXPANSE) project aims at addressing some of the shortcomings of earlier studies by combining biospecimens from large European cohorts covering different age groups, along with harmonized air pollution exposure and exposome data.

KEYWORDS: metabolomics, lung function, spirometry, Chronic obstructive pulmonary disease (COPD), air pollution

O-SY-087 The urban exposome and mortality: an analysis of European administrative cohorts

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BACKGROUND: EXPANSE collects multiple European cohorts data and applies standardized protocols for exposure assessment to investigate urban exposome effects on health. We evaluated associations of environmental stressors on all-cause mortality in adult administrative cohorts in Greece, Rome, Switzerland, Catalonia, Sweden and the Netherlands.

METHODS: We linked exposures to geocoded residential addresses of >20.9million adult participants followed between 2011 to 2019 including exposure to:PM2.5, NO2, BC, warm season O3, NDVI, distance to water and impervious surfaces and the mean and standard deviation of annual/warm /cold season temperature. We applied Cox proportional hazard models accounting for several cohort-specific individual and contextual variables. We evaluated the associations through single and multi-exposure models considering deviations from linearity, correlations of exposures and interactions between exposures.

RESULTS: In the Greek, Swiss, Rome and Catalan cohorts we observed >1.35million deaths out of ~107,000,000 person-years. High correlations were observed between NO2 and BC, and between temperature variables. Deviations from linearity were indicated for associations with the variance measures of temperature. Increased mortality was associated with increases in PM2.5, NO2, BC and mean temperature exposures. Decreased mortality was associated with increases in NDVI (all but the Catalan cohort) and distance from water (Greece and Rome). PM2.5 and NDVI presented the most consistent adverse associations following co-exposures' adjustment (HRs ~ 1.03 and 0.98 respectively per IQR increase). PM2.5 effects were modified by NDVI levels in a non-consistent pattern between cohorts. The cumulative risk index for air pollutants was ~ 1.03 per IQR in Greece and Rome.

CONCLUSIONS:The wealth of exposure data and the large administrative cohorts in EXAPNSE provide a powerful tool to investigate complex associations between environmental exposures and mortality. Initial results support the consistent effects of particulate pollution irrespective of the interplay with other environmental exposures.

KEYWORDS: Administrative Cohorts, All-cause mortality, Urban exposome, Cox models

O-SY-088 Urban labs – The personalized building block of exposome research

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BACKGROUND AND AIM: The EXPANSE project will provide evidence-based data for urban planners, policy makers, and European citizens on approaches for maximizing health and wellbeing in a modern urban environment. The embedded Urban Labs allow deep phenotyping of the urban exposome as well as assessing its use and perception. The Urban Labs aim to a) improve and personalize CMPD risk prediction by improving exposure assessment and by identifying mediating and modifying behavior/lifestyle factors of importance, b) quantify changes in the urban external exposome from residential relocation, and c) link the urban exposome to intermediate CMPD endpoints including blood biomarkers, BMI, sleep quality, and happiness.

METHODS: The Urban Labs involves 5000 individuals from five diverse urban areas spread across Europe (Amsterdam-Rotterdam area, Barcelona, Basel, Lodz, and Athens). Over a period of 2 years, participants answer to repeated bi-monthly questionnaires as well as to additional exposure-specific challenges over an engaging data capturing Mobile Phone App (ExpanSeeker). Two-week personalized measurement covering different seasons are rolled out over the course of the 1st year and will be repeated post-movement in a subsample of movers. Measurements include tracking of spatial-temporal activity patterns, sensor-based environmental and behavioral measurements, and minimally invasive biological sample collection for metabolomics and (epi-) genetic analyses.

RELEVANCE OF EXPECTED RESULTS: As a downstream goal, the embedded Urban Labs contributes to offering the following opportunities for individual citizens: based on a current or future residential address, based on answers to additional personalized questions on lifestyle/behavior including use and perception of their residential environment, and based on residential relocation plans to predict their expected level of happiness and CMPD risk.

KEYWORDS: Exposome, Urban Health, Cardiovascular Diseases, Diabetes, Respiratory Diseases

SYMPOSIUM 19: Scientist connections with Environmental Justice Communities

O-SY-089 Indigenous community environmental challenges and needs

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Canadian Indigenous research in the past had had a history of deception. However, the European settlers later acknowledged the injustice committed in research and now actively engaged and respect their perspectives. Miawpukek First Nation (MFN) community in Newfoundland and Labrador is considered one of Canada's most well-administered Indigenous communities due to strong leadership and pragmatism in every developmental activities, including research.

MFN has integrated indigenous perspectives in the health and wellbeing of the community. In the health care center, they did not put indigenous medicines into the modern-day clinic. They did not discourage it, but indigenous medicines were done through focusing on the land with hunting and gathering to make these indigenous medicines.

There are many different kinds of health care. The Indigenous people prefer to walk through the woods to gather natural medicines. The community has integrated lighted walking trails, a gym, weight rooms and a community garden to help with their well-being and mental health. They are trappers and hunters and live off the land. Therefore, prefer this way of life over modern medicine when able.

The climate change and planetary health crisis in the world is affecting everyone and everything, lands, oceans and animal migration are all being affected. The Indigenous communities used to do their fishing in the winter when the ice froze but because of the climate change there is no ice to fish on. The animals moved further south, for example, the polar bears to find food as well the fish farms are dying off. Everyone must play their part and work more towards green energy.

O-SY-090 Engagement of communities is critical to environmental health: lessons from some remote Canadian communities

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INTRODUCTION: Indigenous communities in Canada live in the poorest living conditions. Due to the historical legacy of racism and mistrust, their hesitancy in collaborating in research is understandable. However, continuous dialogue and acknowledging their concern and sensitivity can bring the community and researchers closer and ensure a long-term relationship. The current presentation will highlight two research projects (uranium exploration and mine development and water and sanitation) in Labrador Inuit communities and their proactive roles in research design, data collection, data analysis, and knowledge translation.

METHODS: The objective of the first study was to measure the possible radioactive contamination in the local ecosystem surrounding an abandoned uranium development site on Indigenous land in Labrador (Canada). It was an initiative by the Indigenous community, since the Indigenous people regularly visited the mine site for hunting, foraging traditional food and spiritual activities, they were very much concern for their safety. The community leaders contacted the university researchers for exploring the extent of environmental contamination and public safety. The second study explored the water insecurity, coping strategies and associated health risks in a small and isolated sub-Arctic Indigenous (Inuit) community in Canada. The community-based participatory survey was conducted.

RESULTS: Except the surrounding areas of the mining site, the rest of the land was safe for the Indigenous people. The community did not have any piped water supply. Their regular sources of water consisted of several un-monitored local streams, brooks, and ponds. The public water system was not affordable to the majority of community members who solely depended on government aid. Water insecurity has put the community at risk of multiple serious adverse health outcomes.

CONCLUSION: Integration of western science and Indigenous knowledge can yield more effective solutions for the communities.

O-SY-091 Partnering with the community to advocate for clean air: a case study from the South Bronx, NYC

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BACKGROUND/AIM: Improving urban air quality at the neighborhood level benefits from working closely with communities to identify air pollution sources and levers for change. We partnered with South Bronx Unite, a community organization that advocates for environmental justice in the Mott Haven and Port Morris (MHPM) neighborhoods of New York City, and a local middle and high school, to conduct hyper-local air monitoring campaigns.

METHODS: We intermittently measured traffic and air pollution in MHPM from 2017 onwards at several residential, business, and community locations. at select locations, traffic radar devices were collocated with continuous black carbon monitors to assess street-level traffic and pollution. To assess changes in neighborhood-scale traffic congestion, we analyzed crowd-sensed traffic data. We also partnered with a local middle and high school to teach students how to program Arduino electronics platforms to build air quality monitors. A web platform was built to store the student-collected measurements and share them with the public.

RESULTS: Our monitoring campaigns allowed us to quantify increases in traffic and air pollution following the opening of an online grocery delivery warehouse in 2018. Analysis of the crowd-sensed traffic data showed significant increases in traffic congestion in the period 2017-2019 in mixed-use and residential areas, with the greatest increases overnight and in the morning. South Bronx Unite currently uses these data to advocate for measures to mitigate the adverse health impacts of the heavy-truck traffic in MHPM, e.g., improved waterfront access and green buffers. Students were able to build air quality monitors using the Arduino devices; efforts to measure air quality in their communities are underway.

CONCLUSIONS: Partnerships between academic institutions and community organizations are critical for environmental justice work; such relationships promote community ownership and capacity building and can generate powerful tools for advocacy.

KEYWORDS: community-based research; traffic; air pollution; citizen science

O-SY-092 A Community-centered approach to inform change: the Assessing Imperial Valley Respiratory Health and the Environment Study

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BACKGROUND AND AIM: The Assessing Imperial Valley Respiratory Health and the Environment (AIRE) study is an on-going community-academic collaboration with Comité Civico del Valle (CCV) to study the role of exposures to air pollution, drying of a saline lake, pesticides, and agricultural burning on children's respiratory health in the rural U.S/Mexico border community of Imperial Valley, California, USA. Changing weather patterns, droughts and competing water demands are dramatically altering the landscape and creating conditions conducive to the production of wind-blown dust and dust storms. Residents of this predominantly low-income, Mexican-American community have expressed growing concern about the health impacts of these environmental changes.

METHODS: With this community-driven effort we are focusing on the cumulative burden of multiple types of pollutants on children's respiratory health. To date we have leveraged a local air monitoring network to assess particulate matter exposures, we are utilizing publicly available pesticide use registry data to geospatially assess exposure to pesticides and have requested agricultural burning permit data to further assess additional sources of air pollution. Through our partnership with local promotoras and schools we are collecting information on children's respiratory health.

RESULTS: To date, the AIRE cohort has successfully enrolled over 700 elementary school-aged children from seven different schools across five cities in the northern Imperial Valley and identified high rates of asthma and respiratory symptoms.

CONCLUSIONS: Through this multi-partnership effort that is incorporating the principles of environmental justice we are linking multiple environmental pollutants to respiratory health outcomes, centering community members, involving them in the research process, collectively determining the environmental exposure issues of highest concern, creating dissemination plans and discussing sustainable interventions and implementation strategies.

KEYWORDS: Environmental justice, children's health, cumulative burden

O-SY-093 Providing expert witness testimony regarding affected Community impacts of natural gas pipeline proposals

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BACKGROUND AND AIM: Today, most energy project development decisions involve scientific and health impact considerations. Vested interests usually have the financial and scientific resources to support their petitions, but affected communities, and especially underserved minority communities, often lack such experts to counter vested interests' consultants. In this presentation, Thurston will provide case studies of his recent experiences working with public interest groups by providing input to decision-makers and courts.

METHODS: Case studies are presented of real-world examples where expert technical reports and board testimony were provided regarding the adverse human health effects of proposed energy projects.

RESULTS: Processes and outcomes of decision-making proceedings regarding proposed natural gas pipelines are presented and discussed, along with more general insights into effective participation by scientists in providing a balanced consideration of scientific facts in regulatory and policy decision-making settings. This includes written and in-person participation in permit proceedings for natural gas pipeline extensions proposed near underserved minority communities in Virginia. Evidence for the occurrence of adverse health effects from such projects, even at prevailing air pollution levels within the ambient air quality standards, is also presented.

CONCLUSIONS: Significant adverse health impacts can occur from a proposed project that would result in the emission of additional air pollution, even in a locality that presently meets the ambient particulate matter air quality standards. By providing expert reports and testimony, scientists can "level the playing field" between vested interests and communities, enabling more balanced and equitable policy-making decisions.

KEYWORDS: civic engagement, underserved communities, equity, litigation

Wednesday, September 21

SYMPOSIUM 20: Epidemiological studies for preparedness and response to public health and environmental crises and disasters

O-SY-094 Lessons learnt from past nuclear accidents

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The organization of the follow-up of populations after the Chernobyl and Fukushima accidents was very different, as was the scale of the accidents in terms of likely direct somatic effects of radiation. The size of the exposed population and the levels of doses were, fortunately for the residents of Fukushima prefecture, considerably lower than after the Chernobyl accident.

While Chernobyl brought new knowledge about radiation induced somatic effects, both accidents have taught us invaluable lessons about other important health effects of the accidents, including: avoidable loss of life among the evacuated elderly and severely ill patients; and the psycho-social consequences resulting from the response to the accident, evacuations and relocations/resettlements, remediation actions and the presence of radiation. These include serious mental health problems that, in addition to affecting the populations' wellbeing are a large burden on medical services.

Based on a review of the lessons learnt, the SHAMISEN project drew recommendations related to a) evacuation; 2) identification of affected persons and importance of dose assessment and communication at all phases of the accident (including the importance of citizen measurements in order to empower affected populations); 3) need to adapting/designing epidemiological and health surveillance strategies that address the concerns, needs and expectations of affected populations going beyond simple health monitoring and meeting the broader objectives of improving living conditions of affected populations, ideally including engagement of affected populations; 4) improving professional support of affected populations, including training/education of health professionals on radiation effects, post-traumatic stress syndromes, and risk communication; 5)desirability of developing common core epidemiological and surveillance protocols in the preparedness phase that can readily be adapted to different crises when they occur.

Many of the lessons learnt are applicable to the COVID-19 situation and to Public Health and Environmental Crises and Disasters in general.

O-SY-096 Beirut Blast August 2020: lessons learned for environmental epidemiology in low-resource settings

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BACKGROUND AND AIM: On August 4, 2020, Beirut experienced one of the worst non-nuclear explosions in modern history. The Blast happened in the midst of the COVID-19 pandemic and a protracted political and financial crisis. This presentation describes the immediate response to the disaster, shares initial environmental assessments, and proposes a cohort study to assess the environmental and health impacts of the Blast. Obstacles to conducting environmental epidemiology studies are discussed.

METHOD: Within a few days, a handful of professors established Khaddit Beirut (KB, Beirut Shakeup). The Environmental Health team under KB observed the safety measures followed by the respondents to the Blast, collected soil samples for asbestos and air samples for particulate matter, and established a Consortium of environmental health experts to propose a population-based epidemiological study to assess the environmental and health impact of the Blast.

RESULTS: Thousands of young volunteers and poorly-equipped professionals rushed to the site of destruction to support the residents and clean the rubble. Safety measures were not followed. The KB team produced multiple safety guidelines. Environmental assessments by international teams were not accessible. Our assessment showed elevated particulate matter in the affected area as compared to a non-affected area. Soil samples analyzed outside Lebanon were negative for asbestos. The long-term health impacts of the Blast are yet to be assessed through a longitudinal cohort study of residents in the affected areas, as proposed by the Consortium.

CONCLUSIONS: The magnitude of the explosion suggests serious environmental exposures and potentially multiple respiratory, neurological, and mental health outcomes. It will be amiss if the impacts of the Blast are not documented. So far, immediate humanitarian needs are prioritized over funding a study on long-term health effects. Conducting such studies in low-resourced settings requires international action and support and the development of an equitable framework for collaboration.

O-SY-097 Emerging preparedness for major accidents: updates about the 9/11 health consequences and more recent events.

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BACKGROUND AND AIM: Response to disasters and the investigation of their immediate and long-term impact on health population health differ by the social, economic, and political contexts. We analyze three different events and extract key lessons for emergency preparedness and disaster management.

METHOD: This presentation reviews the response to the 9/11 disaster in 2001 and provides updates from the World Trade Center Health Program (WTCHP). It also analyzes two events occurred in: i) Miami Beach, Florida, where the Champlain Tower residential building collapsed on June 24, 2021; ii) Durban, South Africa, where a fire caused by protest-related arson caused a large chemical warehouse to burn down on July 12, 2021.

RESULTS: The WTCHP is revealing emerging impacts on cognitive decline among the responders, signaling the need for long term follow up. Across the three disasters, prevention, response and environmental monitoring was suboptimal. No action has been taken to investigate and control the physical and mental health consequences among responders and impacted community in the aftermath of the chemical fire in Durban, where access to critical exposure information needed to identify risk has been denied. In Florida, there was also some suboptimal preparedness in terms of recognizing the immediate threat posed by exposure to airborne pollutants. The scientific and health communities may be still missing important exposure-outcome relationships needed to address these recent disasters.

CONCLUSIONS: The observation of the health consequences from the WTCHP strengthen the need of long-term health surveillance in populations impacted by disasters. It also reinforces the need of adequate emergency preparedness, which is still largely insufficient, if not ignored, as shown by the cases of most recent disasters.

O-SY-098 Standardized epidemiological protocols for assessment of health impacts in eruption crises

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BACKGROUND AND AIM: Volcanoes produce airborne emissions of ash and gas which may impact public health. Many epidemiological studies have been conducted following eruption crises but they often miss critical periods of highest exposures at eruption onset whilst methodological protocols are being developed and approved. Hence, we still have little understanding of the acute impact of volcanic emissions, particularly on respiratory health. In response to this need, the International Volcanic Health Hazard Network (www.ivhhn.org) developed and published* two standardized epidemiological protocols.

METHODS: Two workshops were held to develop the protocols. The first focused on technical aspects and content of the protocols, ensuring that they were comprehensive and jargon-free. The second, to present and discuss the protocols, took place after peer review and assessed issues of practical implementation.

RESULTS: We developed a 'basic' study protocol to assess the respiratory (and other) health impacts from acute exposures by tallying hospital/clinic visits. This is designed to be used during and/or immediately following a volcanic eruption, at the population level, where syndromic surveillance is not already in place or cannot be adapted for the outcomes expected from exposure to volcanic emissions. We also developed a protocol for a more detailed 'cross-sectional' survey of individuals, to be undertaken if the basic study or syndromic surveillance indicate adverse health effects, to assess the extent to which volcanic exposures may have been causal.

CONCLUSIONS: Advising relatively simple and inexpensive methods, the protocols are applicable in all volcanic contexts, regardless of resource availability or health records systems. The data collection forms included in the protocol can be integrated into, or merged with, existing response protocols, for efficiency and to minimize duplication. Standardized protocols will maximize the opportunity for rapid assessments. Consistent use will generate a strong and comparable evidence base of the health impacts of eruptions.

* https://www.who.int/bulletin/volumes/98/5/19-244509.pdf

SYMPOSIUM 21: Is access to environmental public health monitoring and surveillance an equity and justice issue in low- and middle-income countries?

O-SY-100 Strengthening environmental health surveillance in low- and middle-income countries

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We will describe work to develop and implement actionable frameworks for measuring progress of actions to promote children's environmental health. Active health sector engagement to ensure the use of local data to inform policies and implementation will be described to underscore the value of ensuring sustained investments in surveillance, rather than one-off studies, to direct limited health resources. Applied examples will include 1) integrating and enhancing routinely collected data to quantify the impact of clean air policies in Indonesia and 2) targeting surveillance efforts to identify populations most at risk for increased blood levels in India and the Philippines.

O-SY-101 Interventions to reduce lead (Pb) exposure and value of a broad environmental health monitoring capacity

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BACKGROUND AND AIMS: In recent years, reports of lead (Pb) contamination have dramatically increased in Georgia. In 2018, 41% of the children who participated in the Multiple Indicator Cluster Surveys (MICS), a nationally representative among 2 to 7 years old children (n=1578), had blood Pb levels (BLL) above 5 microgram/dL. The National Centre for Disease Control and Public Health of Georgia (NCDC&PH) implemented written and verbal advice on how to reduce Pb exposure, and a state program of clinical follow-up was implemented. A significant reduction of BLL in children over a relatively short period has been documented. We aimed to identify the most relevant sources of Pb exposure contributing to elevated blood Pb in MICS children.

METHODS: In collaboration with UK Health Security Agency, British Geological Survey, and Georgian agencies, NCDC&PH conducted a Pb isotope ratio study in 36 purposefully selected children from MICS. Environmental samples collected for each included household included dust, soil, paint, spices, milk, drinking water, and toys. Pb isotope ratio analyses were conducted on both blood and environmental samples. Analyses included household level and group level ranking of environmental sources as an explanation of exposure to Pb represented by BILL.

RESULTS: Preliminary results indicate that drinking water and milk are not among Pb exposure sources of concern, while the precise ranking of other Pb sources varies between children and regions of Georgia.

CONCLUSIONS: It is expected that these data will support the design of more detailed public health interventions to reduce exposure to key sources of Pb, thus leading to further reduction of Pb-induced health effects in Georgia. In addition, this experience will clarify elements of ongoing monitoring of environmental factors such as an Environmental Public Health Tracking system, to support the national capacity to manage the risks to public health.

KEYWORDS: Lead, intervention, health surveillance

O-SY-102 The role of field epidemiology in strengthening public health capacity for chemical and environmental hazards in Ghana and Zambia

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BACKGROUND AND AIM: The International Health Regulations (IHR, 2005) require that each country is prepared and able to detect, respond and undertake surveillance for public health risks, irrespective of origin or source. Gaps in relevant capacity can be identified via Joint External Evaluation. Field Epidemiology Training Programmes (FETP) are established in many countries and provide capacity to respond to infectious disease outbreaks and establish appropriate surveillance. Field epidemiology skills are required to assess, respond to, and mitigate the health impact of environmental and chemical hazards. Our training aimed to support capacity building in field environmental epidemiology in Ghana and Zambia.

METHODS: At the request of public health agencies in Ghana and Zambia, an environmental epidemiology module was developed as part of FETP programmes. The design of this module was based on the experience of providing a similar module to FETP trainees in the UK, and adapted to address local objectives and context for each country. The main educational theory underlying the design of the module was problem-based learning. Learning needs assessment identified topics to be prioritised for inclusion in the module.

RESULTS: Between 2018 and 2022, a week-long module in environmental epidemiology was delivered to cohorts of FETP fellows and environmental health practitioners in Ghana and Zambia. Topics addressed included preparedness in relation to chemical hazards, strategies for exposure assessment, risk assessment and communication, choice of design, and surveillance. The evaluation showed that participants consider case-studies in environmental epidemiology as a key element for training in this area, and field visit very valuable.

CONCLUSIONS: An environmental epidemiology module was developed for inclusion in FETP curriculum.
Workforce competencies in field environmental epidemiology for surveillance and response to chemical and environmental hazards were built, and their contribution to global health security and IHR capacity discussed.

KEYWORDS: Field epidemiology, training

O-SY-103 Inequalities in the environmental public health funding in the European region

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BACKGROUND AND AIM: Many societies in low- and middle-income (LMICs) countries face increasing environmental challenges, while also have minimal capacities to monitor and assess their impacts on population health, and therefore to inform decision making and policy. The European Union (EU) has supported the research in Environment and Health (EH) for more than 3 decades through its Framework Programmes of Research and Innovation, resulting in over 500 research projects, and investing close to €2 billion until 2020. The aim was to examine in detail the distribution of such funding across the European region and internationally, and in supporting EH capacities.

METHODS: An analysis of EU Horizon 2020 (2014-20) was carried out initially, assessing 269 funded projects linked to EH, totalling to €1.1 billion. The distribution of funding by country, institution, coordination, provisions for supporting research and policy capacities and capabilities, and how these have changed overtime were examined for EH domains (i.e. air pollution, urban health, climate change, EH Policy).

RESULTS: In all EH funding domains, the majority of the funding and coordination went to just a handful of countries (Spain, UK, Netherlands, Germany, France, Italy) and institutions. Societal Challenges 1 (SC1) and SC5, and Scientific Excellence received 77%, while the Spreading Excellence and Widening Participation projects aimed at building and strengthening capacities in EH only 3% of this funding. There was little indication that the majority of these projects contributed to EH capacity building in LMICs.

CONCLUSIONS: Inequalities in the EU funding distribution for EH research and policy capacities remain stark and persistent overtime. It is difficult to understand how the EU informs strategies to addressing such inequalities, but potential lack of attention to addressing these can lead to environmental and health justice issues across the region and beyond.

KEYWORDS: environment, health, funding, capacities, inequality, justice

O-SY-104 International Network for Public Health and Environmental Tracking (INPHET) and its role to Environmental Epidemiology

Paolo Lauriola

BACKGROUND AND AIM: INPHET was formed by a community of environmental public health practitioners to address common interests and activities that advance environmental public health surveillance (EPHS) and data systems, and their uses to inform public health actions. Our aim is to show how this has supported environmental epidemiology practice.

METHODS: A “Community of Practice”, INPHET main goals focus on sharing experiences and expertise; addressing common challenges to implementation and enhancing the science of EPHS/tracking; improving understanding of the link between the environment and health; and providing the appropriate evidence that informs public policy.

RESULTS: The network, initiated in ISEE meetings in 2012-13 and formally launched in Modena, Italy in 2014, has carried out several activities which aim at sharing expertise and learning from different models of environmental and health data integration and surveillance systems that directly inform policy. These include Twinning cooperation with Euro-Asian and Balkan countries and sharing of expertise with African Public Health Agencies. Some experiences are presented in this Symposium (Georgia, Ghana, Zambia), and highlight the EPHS/Tracking (EPHT) model adopted by several national public health agencies. It promotes that such integration and uses of environmental and health data is key for EPHS, including their accessibility and usability for communities of public health researchers, practitioners and policy makers.

CONCLUSIONS: Environment and health monitoring and information systems are fundamental infrastructure for evidence provision for policy making. INPHET aims to address the vast inequalities across countries and communities in their ability to monitor, assess, inform and mitigate environmental and health issues. Its objectives and work support environmental epidemiology in its role as the pillar science that provides evidence for decision making and intervention aimed at reducing and preventing environmental related diseases, and contributes to an overall vision for public health.

SYMPOSIUM 22: Climate change, heat and maternal health: estimating current and future burdens

O-SY-105 Associations between ambient temperature and risk of preterm birth in Sweden: a comparison of analytical approaches

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BACKGROUND AND AIM: Evidence indicates that high temperatures are a risk factor for preterm birth. However, the large heterogeneity of study designs and statistical methods across previous studies complicate comparisons. We investigated associations of short-term exposure to ambient temperature with preterm birth in Sweden, applying three complementary analytical approaches.

METHODS: We included 560,615 singleton live births between 2014-2019, identified in the Swedish Pregnancy Register. We estimated at residential address weekly mean temperatures at 1-km² spatial resolution using a spatiotemporal model. The main outcomes of the study were gestational age in weeks (GW) and subcategories of preterm birth (<37GW): extremely preterm birth (<28GW), very preterm birth (from 28 to <32GW), and moderately preterm birth (from 32 to<37GW). Case-crossover, quantile regression and time-to-event analyses were applied to estimate the effects of short-term exposure to ambient temperature during the week before birth on preterm births. Furthermore, distributed lag nonlinear models (DLNM) were applied to identify susceptibility windows of exposures throughout pregnancy in relation to preterm birth.

RESULTS: A total of 1,924 births were extremely preterm (0.4%), 2,636 very preterm (0.5%), and 23,664 moderately preterm (4.2%). Consistent across all three analytical approaches (case-crossover, quantile regression and time-to-event analyses), higher ambient temperature (95th vs 50th percentile) demonstrated increased risk of extremely preterm birth, but associations did not reach statistical significance. In DLNM models, we observed no evidence to suggest an increased effect of high temperature on preterm birth risk. Even so, a suggested trend was observed of a higher risk of extremely preterm birth with higher temperature during the last week before birth.

CONCLUSIONS: In Sweden, with high quality data on exposure and outcome, we did not find an association between high ambient temperatures and preterm births. Results were consistent across three complementary analytical approaches.

KEYWORDS: Preterm births; ambient temperature; case-crossover; quantile regression; time-to-event analyses

O-SY-106 Ambient temperature during pregnancy and risk of maternal hypertensive disorders: a time-to-event study in Johannesburg, South Africa

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BACKGROUND AND AIM: Hypertensive disorders in pregnancy are a leading cause of maternal and perinatal mortality. We evaluate the effects of ambient temperature on risk of maternal hypertensive disorders throughout pregnancy.

METHODS: We used birth register data for all singleton births (22-43 weeks' gestation) recorded at a tertiary-level hospital in Johannesburg, South Africa, between July 2017-June 2018. Time-to-event analysis was combined with distributed lag non-linear models to examine the effects of mean weekly temperature, from conception to birth, on risk of (i) high blood pressure, hypertension, or gestational hypertension, and (ii) pre-eclampsia, eclampsia, or HELLP (hemolysis, elevated liver enzymes, low platelets). Low and high temperatures were defined as the 5th and 95th percentiles of daily mean temperature, respectively.

RESULTS: of 7986 women included, 844 (10.6%) had a hypertensive disorder of which 432 (51.2%) had high blood pressure/hypertension/gestational hypertension and 412 (48.8%) had pre-eclampsia/eclampsia/HELLP. High temperature in early pregnancy was associated with an increased risk of pre-eclampsia/eclampsia/HELLP. High temperature (23°C vs 18°C) in the third and fourth weeks of pregnancy posed the greatest risk, with hazard ratios of 1.76 (95% CI 1.12-2.78) and 1.79 (1.19-2.71), respectively. High temperatures in mid-late pregnancy tended to protect against pre-eclampsia/eclampsia/HELLP. Low temperature (11°C) during the third trimester (from 29 weeks' gestation) was associated with an increased risk of high blood pressure/hypertension/gestational hypertension, however the strength and statistical significance of low temperature effects was reduced with model adjustments.

CONCULSIONS: Our findings support the hypothesis that high temperatures in early pregnancy increase risk of severe hypertensive disorders, likely through an effect on placental development. This highlights the need for greater awareness around the impacts of moderately high temperatures in early pregnancy through targeted advice, and for interventions that reduce heat exposure among pregnant women. The potential ameliorating effects of high temperature in mid-late pregnancy requires further exploration.

O-SY-107 Climate and extreme weather impacts on health service delivery in sub-Saharan Africa: a systematic review

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BACKGROUND AND AIMS: Health systems experience shocks and stresses related to climate events. Seasonal weather extremes also disrupt access to and delivery of services. There is very little information on the overall burden of extreme weather to health service disruption.

METHODS: We conducted a systematic review of the impact of weather events (heatwaves, heavy rainfall, flooding) on health service disruption (including access and travel time to services, damage to health facilities) in sub-Saharan Africa, from the six databases [CINAHL, Embase, Global Health; Web of Science; SCOPUS; ECONLIT; DESASTRUS].

RESULTS: We found 26 papers that met our criteria. 15 papers were quantitive analyses of the impacts of rainfall and weather events health service access, accessibility and use. The vast majority of there papers addressed the impacts of heavy rainfall, flooding and windstorms. 11 papers were qualitative studies of barriers to health service access and use that identified particular vulnerable groups and settings. The majority of papers reported a negative impact of weather but in many settings extreme weather is not a barrier to accessing health care. Few papers examined the impact of heatwaves on hospitals, clinics or health services.

CONCLUSIONS: Improving access to quality health services is a recognised factor in reducing maternal mortality. A resilient health care facility is structurally and functionally able to withstand extreme weather events and climate hazards. More research is needed to map and model the impacts of extreme weather on health service delivery in sub-Saharan Africa.

O-SY-108 The effect of high and low ambient temperature on infant health: a systematic review

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BACKGROUND: Climate change poses grave dangers to the health of children. Among infants, in particular, there are physiological, anatomical, immunological, and behavioural factors that could increase vulnerability to temperature extremes. To inform public health strategies for addressing heat and cold risks, we performed a systematic review to explore the association between acute adverse infant outcomes and exposure to high and low ambient temperatures.

METHODS: MEDLINE (Pubmed), Embase, CINAHL Plus and Global Health were searched in July 2020 alongside reference lists of key papers. We included published studies in English that assessed adverse infant outcomes related to short-term ambient temperature exposure. Titles and abstracts of 2396 studies were screened using the inclusion and exclusion criteria. This resulted in a review of 64 full text articles, of which 26 studies were found to be eligible. Data were extracted, appraised using a modified quality appraisal tool, and synthesised using a narrative approach.

RESULTS: Outcomes assessed included: infant mortality (n=9), sudden infant death syndrome (n=5), hospital visits or admissions (n=5), infectious disease (n=5), and other neonatal conditions like jaundice (n=2). Higher temperatures were associated with increased infant mortality, hospital admissions, and hand, foot, and mouth disease. Several studies identified associations between lower temperatures and infant mortality and respiratory disease. Findings on temperature links with sudden infant death syndrome were inconsistent. of the 26 studies, 14 had a probably or definitely high risk of bias, with many studies scoring poorly due to misclassification of temperature exposure. Only five studies were conducted in low- or middle-income countries, where people are most vulnerable to changes in climate; further research here is required.

CONCLUSIONS: Rising global temperatures will have serious health implications for infants, again highlighting the need for major emissions reductions and urgent adaptation interventions.

KEYWORDS: climate change, infant health, neonatal health, heat exposure, cold exposure, heatwaves

O-SY-109 Past and projected climate change impacts on heat-related child mortality in Africa

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BACKGROUND AND AIM: Climate change is likely to impact on the health of children. Children under 5 years are vulnerable to hot weather due to their limited ability to thermoregulate, and because high temperatures can exacerbate other health conditions. We estimated the impacts of past and future anthropogenic warming on child mortality due to higher temperatures.

METHODS: We estimated heat-related child mortality using a linear threshold model. Scenario-based estimates were generated using the CMIP6 global climate scenarios. We estimated heat-related child mortality for the period 1995–2020 in Africa, and apportioned the observed temperature increases to natural variability and anthropogenic climate change (from the DAMIP experiment of CMIP6). We estimated the future burden of child mortality for the period 2020–2050 for three emission scenarios (SSP119, SSP245 and SSP585), and a single scenario of population growth.

RESULTS: By 2009, heat-related child mortality was double what it would have been without climate change. Further, this climate change-related increase was greater than the reduction in heat-related child mortality from improvements in health and development. Under a high emission scenario (SSP585) heat-related child mortality was projected to double by 2049 compared to 2005-2014. If 2050 temperature increases are kept to the Paris target of 1.5ºC (SSP119), approximately 4,000–6,000 heat related child deaths could be avoided annually in Africa, compared with the SSP585 scenario.

CONCLUSIONS: Our findings support the need for urgent mitigation and adaptation measures to save lives now and in the future. Estimating heat related child mortality in Africa is complex due to a lack of epidemiological evidence about how heat effects child mortality across the continent.

SYMPOSIUM 23: The use of epidemiology in risk assessment: challenges and innovations in translating human health research

O-SY-110 Introduction to applying dose-response modeling from epidemiological data to derive toxicity values

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BACKGROUND AND AIM: EPA derives toxicity values based on exposure-response functions from studies meeting adequately reported study quality criteria. EPA rarely has individual-level epidemiology data to model and therefore uses slopes extracted from published studies.

METHODS: EPA selects a benchmark response (BMR) based on biological and statistical considerations to identify points-of-departure (PODs) from the exposure-response functions. for cancer, the POD is often the exposure concentration associated with 1% extra risk of cancer (the BMR) and is identified using the upper-bound of published exposure-response functions (e.g., hazard ratio) and vital statistics data to account for competing causes of death. for an inhaled exposure, the toxicity value is the inhalation unit risk derived as the BMR/POD when the expectation that extra cancer risk is linear at low doses is appropriate. Noncancer effects are assumed to occur above a threshold level of exposure. for non-cancer effects, the POD can be estimated as the lower bound of the benchmark dose (i.e., the BMDL) using the upper-bound on the exposure-response functions for a specific BMR. A reference concentration (RfC) is derived as the POD divided by the product of uncertainty factors.

RESULTS: Challenges may arise over questions of the best-fitting shape of exposure-response functions and unintended consequences regarding low-dose extrapolations of log-transformed exposures. Many published exposure-response functions are only assessed for fit at the mean exposure while toxicity values are derived at the low end of the distribution. Sometimes publications do not provide information on the low end of the exposure distribution to allow EPA to see where estimated PODs may fall within the distribution.

CONCLUSIONS: A better general understanding of how EPA applies exposure-response functions from the epidemiological literature may allow investigators to anticipate some challenges EPA can face when deriving toxicity values, and thus make those publications more impactful for assessing health risks.

O-SY-111 Developments in benchmark modeling of epidemiological data

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Using the benchmark dose (BMD) approach, we have explored joint data from multiple studies of prenatal fluoride exposure and IQ. We also analyzed data from birth cohort studies of children exposed to different perfluorinated alkylate substances (PFASs) at different ages in regard to immunotoxicity in later childhood. We calculated individual and joint study BMDs and their lower confidence bounds (BMDLs) using different curve shapes and including covariate adjustments and mutual adjustments for major PFASs. Health effects of multiple PFASs were modeled by creating exposure indices where the weight of each PFAS was estimated using quantile sum regression.

O-SY-112 Benchmark dose estimation using covariate-controlled epidemiology estimates

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Traditionally, benchmark dose (BMD) estimation and dose-response modeling has focused on modeling exposure-response curves in toxicology experiments. Due to experimental randomization, additional factors that may bias the dose-response are controlled. These factors cannot be controlled using randomization in an observational epidemiologic study, where participants are not randomized. In this situation, their impact is controlled through covariates analyses, and normalized population estimates, adjusted for confounders, of the exposure-response are often reported. Based upon the WHO update of chapter 5 of "Principles and methods for the risk assessment of chemicals in food," or EHC 240, we apply the BMD methodology using Bayesian monotone splines to these normalized estimates to produce covariate controlled for estimates of the BMD to human populations.

O-SY-113 Advances in the meta-regression of heterogeneous studies: lessons learned from EPA's analysis of inorganic arsenic

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Challenges can arise when analyzing a group of published epidemiology studies due to heterogeneity in how effect measures are reported, exposure metrics, and other methodological issues. In this presentation, we will discuss techniques developed in the context of exposure or dose-response modeling of inorganic arsenic (iAs) exposure to facilitate meta-analyses in the presence of heterogeneous study designs and reporting. These methods include (1) effective count derivation, where covariate-adjusted relative risks and odds ratios are used to estimate the counts of cases and controls that would have been observed if covariates in all exposure groups were the same as those in the referent group, i.e., the "effective counts"; (2) dose conversion to convert various study-specific iAs exposure metrics into a uniform measure of intake; and (3) meta-analytic dose response methods, including both Bayesian hierarchical modeling for bladder cancer and categorical regression, where health outcomes are grouped into severity categories to facilitate meta-analysis, for diseases of the circulatory system (DCS). These approaches allow us to maximize the set of studies eligible for inclusion in meta-analysis. However, while these methods successfully address issues arising from heterogeneous reporting, use of such approaches can introduce uncertainty in the analysis. This presentation will discuss how improved reporting in published epidemiology studies can decrease such uncertainty and enhance the utility of meta-analyses across studies. Disclaimer: The views expressed are those of the authors and do not necessarily represent the views or policies of the US EPA.

O-SY-114 Estimation of the exposure response relation by combining epidemiological, human biomarker and animal data in a Bayesian meta-regression model

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INTRODUCTION: The importance of integrating various datatypes such as human disease, biomonitoring and animal data into the risk assessment process of chemicals has been emphasized in several risk assessment guideline. So far attempts have been mainly qualitative.

MATERIAL AND METHODS: We developed a Bayesian data augmentation approach and tested this on the evidence domain of benzene and acute myeloid leukemia. The benefit of our approach is that it facilitates the use of non-linear regression models and therefore provided more flexibility in assessing the shape of the benzene induced ERC of AML.

RESULTS: Combining epidemiological, animal and human biomonitoring data in a Bayesian meta-regression model resulted in more precise risk estimates in comparison to using only evidence from human benzene-AML studies.

DISCUSSION: With the current analyses we demonstrated that in the case of deriving the benzene and AML ERC, quantitatively combining animal- and biomarker studies with epidemiological studies was feasible and worthwhile, though came at the cost of making strong assumptions that in the end may hamper the interpretation of the derived ERC.

SYMPOSIUM 24: Chemical exposures and children's health in the United States: results from the NIH Environmental influences on Child Health Outcomes (ECHO) Program

O-SY-115 Solution-oriented research for chemical exposures and children's health: the ECHO Program

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BACKGROUND: The National Institutes of Health's Environmental Influences on Child Health Outcomes (ECHO) Program launched in 2016 with the goal to advance understanding of environmental influences on childhood disease. With rich chemical bioassay data for hundreds of chemicals, ECHO is uniquely suited to address gaps in exposure assessment and risk characterization of chemical exposures during pregnancy and early life.

METHODS: We overview ECHO data related to 1) chemical exposures, including available information from bioassays, place-based measures, and questionnaires; and 2) children's health outcomes, including ECHO's focus areas of pre-, peri-, and postnatal; respiratory; obesity; neurodevelopment; and positive health.

RESULTS: ECHO consists of more than 50,000 mother-child pairs from 69 cohorts with diverse geography and demographic characteristics. ECHO cohorts have measured a vast array of chemicals in pregnancy samples, including phthalates, environmental phenols, organophosphate ester flame retardants, per- and polyfluoroalkyl substances, and metals/trace elements. Leveraging large sample sizes, diverse cohorts, and rich data, ECHO investigators are conducting innovative epidemiologic studies to address key gaps in children's environmental health research. Importantly, the ECHO data platform will be made publicly available to the broader research community to facilitate high impact environmental epidemiology research. ECHO's rich data can be used to address multi-faceted problems such as co-pollutant mixtures; interactions with social, physical, and behavioral stressors; gene-environment interactions; health disparities; effects of cumulative exposures during early life; and periods of heightened susceptibility.

CONCLUSION: ECHO, the largest ever study of children's health in the United States, is an unprecedented data resource for addressing urgent environmental health questions to improve child health in the US and around the world.

O-SY-116 Organophosphate ester flame retardant exposure and perinatal outcomes

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BACKGROUND AND AIMS: Following a phase out of PBDE flame retardants in the mid-2000s due to concerns about toxicity, exposure to organophosphate ester (OPFRs) flame retardants increased, leading to increasing concerns regarding the toxicity of OPFRs. We hypothesize that prenatal exposure to OPFRs adversely affects outcomes at birth. Our overarching hypothesis is that prenatal exposure to OPFRs flame retardant chemicals adversely affects outcomes at birth. We propose to quantify prenatal exposure to a suite of flame retardants utilizing maternal urine collected during pregnancy to address our specific aims: 1) examine exposure trends over calendar time, and 2) investigate associations with perinatal outcomes, specifically low birth weight, preterm birth, and small for gestational age.

METHODS: We quantify prenatal exposure utilizing a single maternal urine collected during pregnancy, quantifying 9 OPFRs: Dipropyl phosphate (DPRP), Dibutyl phosphate + Di-isobutyl phosphate (DBUP_DIBP), bis(butoxyethyl) phosphate (BBOEP), bis(2-ethylhexyl) phosphate (BEHP), Bis(2-chlorethyl) phosphate (BCETP), Bis(1-chloro-2-propyl) phosphate (BCPP), Bis(1,3-dichloro-2-propyl) phosphate (BDCPP), Diphenyl phosphate (DPHP), and bis(2-methylphenyl) phosphate (BMPP). The study sample includes over 7000 pregnancies from 19 ECHO cohorts over 9 states. Outcomes include gestational age (continuous and categorized to consider preterm birth), birth weight (continuous and categorized to consider low birth weight), birthweight for gestational age (continuous and categorized to consider small for gestational age). Key confounders expected to be associated with both exposures and outcomes based on prior literature include cohort, maternal age, socioeconomic status (measured by education, marital status, income, or related variables), race/ethnicity, BMI, and year of birth.

RESULTS: The following compounds were detected in over 85% of the samples: BDCPP, DBUP_DIBP, and DPHP, while BBOEP, BCETP, and BCPP were detected in over 50% of samples. DPHP had the highest geometric mean concentration of 1.0 ng/mL, followed by BDCPP (0.86 ng/mL). Analysis of associations between exposures and outcomes is underway.

O-SY-117 Prenatal exposures to bisphenols and phthalates, gestational length and birth weight in the US: a national longitudinal study

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Phthalates are synthetic chemicals used in personal care products, cosmetics and food packaging. Because they disrupt sex hormones and promote oxidant stress, they have the potential to disrupt fetal growth. Multiple longitudinal studies suggest consistent relationships of prenatal phthalate exposures with decreased gestation, but they have typically measured 1–2 spot samples during pregnancy, which introduces exposure imprecision and limits insight into effects that depend on the stage of fetal development. We therefore leveraged the NIH Environmental Influences on Child Health Outcomes (ECHO) Program to study the effects of prenatal phthalate exposure on gestational length and birth weight.

O-SY-118 Exposures to environmental phenols and asthma risk

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BACKGROUND: Prenatal exposure to bisphenol (BP) A has been associated with asthma. While the mechanisms underlying these associations are poorly understood, altered endocrine disruption, upregulated allergic immune response, altered response to oxidative stress, and mitochondrial dysfunction have been implicated in the adverse respiratory effects. As a result of these associations, the use of BPA has been banned in certain materials (i.e. baby bottles), although exposure remains prevalent. In many cases, BPA has been replaced with structurally similar chemicals, including BPF and BPS, despite the uncertain safety of these compounds.

METHODS: We assessed whether prenatal exposure to BPA and analogues BPF and BPS among mothers participating in the Environmental Influences on Child Health Outcomes (ECHO) study was associated with respiratory and allergic outcomes among their offspring. Exposure measures (adjusted for urinary dilution using the Boeniger method), outcomes, and covariates (including sex, race, child BMI, mode of delivery, maternal smoking status, income, education, parental asthma history, sibling and pet ownership) were harmonized across ECHO cohorts, and asthma was assessed in children ages 5-9 years. Multivariable logistic regression was applied to estimate associations between exposure and outcome.
Results/

CONCLUSIONS: In the ECHO consortium, we evaluated 830,645, and 771 mother-child pairs for analysis of associations between BPA, BPF, and BPS, and asthma. Preliminary results did not suggest associations between prenatal BPA, BPF, or BPS with asthma, but child BMI and parental history of asthma showed significant associations with child asthma. Ongoing analyses will examine: 1) the impact of additional harmonized covariates including season, 2) variation across cohorts in the relationship between prenatal phenol exposure and asthma diagnosis, and 3) associations between BPA, BPF, and BPS on additional outcomes such as rhinitis, wheeze phenotypes, asthma phenotypes, and atopic dermatitis.

O-SY-119 Associations of gestational perfluoroalkyl substances exposure with early childhood BMI Z-scores and risk of overweight/obesity: results from the ECHO cohorts

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BACKGROUND AND AIM: Gestational per- and polyfluoroalkyl substances (PFAS) exposure may be associated with adiposity and increased risk of obesity among children and adolescents. However, results from prospective cohort studies evaluating associations between gestational PFAS and child adiposity are inconsistent. We estimated the associations of PFAS concentrations in pregnancy with child BMI z-scores and risk of overweight/obesity.

METHODS: We used data from 1,391 mother-child pairs that enrolled in eight Environmental Influences on Child Health Outcomes (ECHO) cohort studies. We quantified concentrations of seven PFAS in maternal plasma or serum in pregnancy. We measured child weight and height between ages 2-5 years and calculated age- and sex-specific body mass index (BMI) z-scores. We estimated associations of individual PFAS and their mixture with repeated child BMI z-scores and risk of overweight/obesity using linear mixed models, modified Poisson regression models, and two Bayesian approaches for mixtures. We explored whether child sex modified these associations.

RESULTS: Overall, gestational PFAS were associated with slightly higher BMI z-scores and risk of overweight/obesity. for instance, adjusting for covariates, each doubling in perfluorohexane sulfonic acid concentrations was associated with higher BMI z-scores at age 2-5 years (β=0.06, 95%CI: 0.01, 0.11). Each doubling in perfluroundecanoic acid (RR=1.10, 95%CI: 1.04, 1.16) and N-methyl perfluorooctane sulfonamido acetic acid (RR=1.06, 95%CI: 1.00, 1.10) were associated with increased risk of overweight/obesity, with some evidence of a monotonic dose-response relation. We found no mixture effect of PFAS on child BMI z-scores or the risk of being overweight/obese. These associations did not differ by child sex.

CONCLUSIONS: In eight US-based prospective cohorts, higher gestational concentrations of PFAS were associated with subtly higher childhood BMI z-score and risk of overweight or obesity. Future ECHO studies should evaluate the associations between PFAS concentrations in pregnancy and related cardiometabolic health outcomes in children.

KEYWORDS: PFAS; pregnancy; BMI; ECHO

O-SY-120 Prenatal exposure to per- and polyfluoroalkyl substances and childhood autism-related outcomes

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BACKGROUND AND AIM: Epidemiological evidence linking prenatal exposure to per- and polyfluoroalkyl substances (PFAS) with altered neurodevelopment is inconclusive, and few large studies have focused on autism-related outcomes. This study investigates whether blood concentrations of PFAS in pregnancy are associated with child autism-related outcomes.

METHODS: Ten cohorts from the National Institutes of Health (NIH)-funded Environmental influences on Child Health Outcomes (ECHO) Program were included (n=1318). Fourteen PFAS analytes were measured in maternal serum or plasma collected during pregnancy. We assessed quantitative autism-related traits in children aged 2.9-18.0 years via parent report on the Social Responsiveness Scale (SRS). In multivariable linear models, we examined relationships of each PFAS with SRS scores. We further considered PFAS as a complex mixture using a Bayesian shared mean model and Bayesian Weighted Sums (BWS). We also examined modification of these relationships by child sex.

RESULTS: Higher blood concentrations of perfluorononanoic acid (PFNA) (adj-β [95% CI]=3.6 [-0.5, 7.8]) and perfluorooctane sulfonate (PFOS) (adj-β [95% CI]=3.4 [-0.8, 7.6]) were associated with higher total raw SRS scores. Adjustments for co-pollutants in the Bayesian shared mean model strengthened the point estimate for PFOS (adj-β [95% Highest Posterior Density [95% HPD]]=5.8 [-0.5, 12.3]. The BWS summed mixture, which included PFAS detected in >98% of participants, was associated with a small increase in total raw SRS scores (adj-β [95% HPD]=2.3 [-2.7, 7.3]). Sex-stratified estimates were imprecise but suggested that some PFAS (e.g., NMFOSAA, PFDA, and PFOS) may be associated with higher autism-related traits in girls only.

CONCLUSIONS: We found limited evidence that prenatal PFAS blood concentrations are associated with autism-related outcomes in children. Future work should continue to examine the relationship between exposures to both legacy and emerging PFAS and additional dimensional, quantitative measures of child neurodevelopment and neurobehavior.

KEYWORDS: PFAS; neurodevelopment; prenatal exposure

SYMPOSIUM 25: Global perspectives on harmonizing chemical risk assessments: current status and future needs

O-SY-121 Towards 'one substance-one assessment': an analysis of European chemical registration and environmental risk assessment frameworks

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BACKGROUND AND AIM: The registration and risk assessment of chemicals on the European market is currently fragmented across different legal frameworks, dependent on the chemical's use. A 'one-substance one-assessment' (OS-OA) approach has been proposed in order to better protect human and environmental health, and increase harmonisation and consistency across these different legal frameworks. We reviewed the five main European chemical registration frameworks and their risk assessment procedures for the freshwater environment, covering 1) medicines for human use, 2) veterinary medicines, 3) pesticides, 4) biocides and 5) industrial chemicals in order to provide an understanding of the differences between these chemical legislations and analyse how a shift towards an OS-OA approach might be realised.

RESULTS: Overall, the function of the current frameworks is similar, but important differences exist between the frameworks' environmental protection goals and risk assessment strategies. These differences result in inconsistent assessment outcomes for similar chemicals. Chemicals are also registered under multiple frameworks due to their multiple uses, and chemicals that are not approved under one framework are in some instances allowed on the market under other frameworks. In contrast, an OS-OA will require a uniform hazard assessment between all different frameworks. In addition, we show that industrial chemicals are the least hazardous for the freshwater environment, whilst biocides seem the most toxic following current regulatory assessment schemes. Finally, in order to facilitate a successful move towards an OS-OA approach we recommend a) harmonisation of protection goals and risk assessment strategies, b) that emission, use and production data should be made publicly available and that data sharing becomes a priority, and c) an alignment of the criteria used to classify problematic substances.

KEYWORDS: EU chemical legislation, Regulatory risk assessment, Water pollution, Environmental risk assessment

O-SY-122 Environmental health assessment in the United States

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In the United States, chemical evaluations and assessments are conducted by several federal agencies responding to distinct statutory requirements and focusing on different exposure scenarios. This presentation will highlight a novel infographic depicting more than 30 different evaluation and assessment processes conducted by federal agencies for chemicals found in the environment, workplace, consumer products, hazardous waste sites, food, and/or cosmetics. This infographic illustrates the opportunity and need for further intra- and interagency collaboration and coordination – including a particular focus on aggregate risk assessment, given that the population regularly experiences exposures from multiple sources crossing agency domains.

O-SY-123 Advancing coordination of systematic review

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Systematic review is resource- and time-intensive, yet it is an essential part of the chemical assessment process. Alignment of systematic review (SR) approaches can allow for sharing of intermediate products (e.g., systematic evidence map (SEM)), which has the potential to minimize duplication and increase efficiency and collaboration between and within agencies. This presentation will provide updates on efforts to improve coordination of SR, including 1) collaboration across EPA; 2) development of an SEM template; 3) software applications to facilitate date re-use; and 4) unified ontologies.

O-SY-124 Evaluating chemical hazard on a global scale

Tracey Woodruff

Approaches to address the growing burden of chemical related diseases globally has not kept pace with this increasing human health threat. Policy and regulatory structures for addressing chemical exposures vary globally, but all incorporate elements of scientific evidence collection and evaluation. More transparent, consistent methods for hazard identification including systematic reviews have been implemented and adopted by various countries and global agencies. This talk will discuss opportunities to standardize and improve hazard identification that can be shared between high resource and low resource countries. More consistent approaches that incorporate contemporary scientific principles for robust data evaluation will improve the basis for health-related decision making.

ORAL PRESENTATIONS SESSIONS

Monday, September 19

ORAL PRESENTATIONS SESSION 01: Air pollution, diabetes and cardiometabolic outcomes

O-OP-001 Long-term air pollution exposure and diabetes risk in American older adults: a national cohort study

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BACKGROUND AND AIM: Type 2 diabetes is a major public health concern. Studies show that both genetics and environmental exposures play a significant role in developing the disease. We assessed the association between air pollution and first documented diabetes occurrence in a national U.S. cohort of older adults to estimate diabetes risk.

METHODS: We included all Medicare enrollees 65 years and older in the fee-for-service program, part A and part B, in the contiguous United States (2000-2016). Participants were followed annually until the first recorded diabetes diagnosis, end of enrollment, or death (264,869,458 person-years). We obtained annual estimates of fine particulate matter (PM2.5), nitrogen dioxide (NO2), and warm-months ozone (O3) exposures from highly spatiotemporally resolved prediction models. We assessed the simultaneous effects of the pollutants on diabetes risk using survival analyses. We repeated the models in cohorts restricted to ZIP codes with air pollution levels not exceeding the national ambient air quality standards (NAAQS) during the study period.

RESULTS: We identified 10,024,879 diabetes cases of 41,780,637 people (3.8% of person-years). The hazard ratio (HR) for first diabetes occurrence was 1.074 (95% CI 1.058; 1.089) for 5 µg/m3 increase in PM2.5, 1.055 (95% CI 1.050; 1.060) for 5 ppb increase in NO2, and 0.999 (95% CI 0.993; 1.004) for 5 ppb increase in O3. Both for NO2 and PM2.5 there was evidence of non-linear exposure-response curves with stronger associations at lower levels (NO2 ≤ 36 ppb, PM2.5 ≤ 8.2 µg/m3). Furthermore, associations remained in the restricted low-level cohorts. The O3-diabetes exposure-response relationship differed greatly between models and require further investigation.

CONCLUSIONS: Exposures to PM2.5 and NO2 are associated with increased diabetes risk, even when restricting the exposure to levels below the NAAQS set by the U.S. EPA.

KEYWORDS: Air pollution; diabetes; PM2.5, NO2, O3

O-OP-002 Air pollution exposure and glucose and lipids levels among the World Trade Center Health Program General Responder cohort

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BACKGROUND AND AIM: Several studies found associations between fine particulate matter (PM2.5) and glucose and lipids, but evidence of the effects of extreme air-pollution events is scarce. Furthermore, studies investigating the cardiometabolic risk associated with World Trade Center (WTC) related exposures are mixed. We aimed to assess the simultaneous association of WTC-related exposure and subsequent PM2.5 exposure and blood glucose and total cholesterol levels among responders who participated in the clean-up, rescue, and recovery mission after the WTC disaster.

METHODS: This retrospective cohort study includes 22,447 members of the WTC Health Program (2004-2019). WTC-exposure was derived from a questionnaire applied upon recruitment to the cohort. Daily mean PM2.5 levels were derived from a satellite-based model. We assessed the simultaneous effects of WTC-related and PM2.5 exposures on glucose and total cholesterol (mg/dL) levels obtained during each cohort monitoring visit.

RESULTS: We included 96,155 cholesterol and 82,015 glucose blood test results. We observed a 0.53% (95% CI 0.16%;0.9%) increase in glucose and a 0.82% (95% CI 0.46%;1.18%) increase in cholesterol levels associated with an interquartile range increase in PM2.5 averaged six months before the test. Comparing to the lowest WTC-exposure, an intermediate exposure was associated with a 0.51% (95% CI 0.14%;0.87%) increase in cholesterol, and the highest exposure was associated with a 0.63% (95% CI 0.16%;1.1%) increase in glucose levels. Most associations were larger among people with diabetes. PM2.5-related cholesterol increases were largest among individuals with the highest WTC-exposure. PM2.5-related glucose increases among the lowest and highest WTC-exposure, were equally smaller than the effect observed among the intermediate WTC-exposure.

CONCLUSIONS: We found that WTC-related exposure and subsequent PM2.5 exposure were independently associated with increases in glucose and cholesterol levels. Associations were more substantial among people with Diabetes. Our findings suggest possible interactions between the two exposures, which requires further research.

O-OP-003 Longitudinal associations between metabolites and long-term exposure to ambient air pollution: results from the KORA cohort study

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BACKGROUND AND AIM: Long-term exposure to air pollution is associated with a vast number of adverse health outcomes, while the underlying mechanisms remain unclear. Therefore, this study aimed to investigate changes in serum metabolites associated with long-term exposure to air pollution in a longitudinal study design.

METHODS: We used data from the German population-based Cooperative Health Research in the Region of Augsburg (KORA) S4 survey (1999-2001) and two follow-up examinations (F4: 2006-08 and FF4: 2013-14). Mass-spectrometry-based targeted metabolomics was used to quantify metabolites among serum samples. Only participants with repeated metabolites measurements were included in current analysis. Land-use regression models were used to estimate annual average concentrations of ultrafine particles, particles with a diameter < 10 µm, coarse particles (PMcoarse), fine particles, PM2.5 absorbance (a proxy of elemental carbon related to traffic exhaust, PM2.5abs), nitrogen oxides (NO2, NOx), and ozone at individuals' residences. We applied covariate-adjusted linear mixed-effects regression models to examine associations between long-term exposure to air pollution and metabolites.

RESULTS: Among 9,620 observations from 4,261 KORA participants, we included 5,772 (60.0%) observations from 2,583 (60.6%) participants in this analysis. Out of 108 metabolites that passed stringent quality control among these study waves, we identified nine significant negative associations between phosphatidylcholines (PCs) and PM2.5abs, PMcoarse, and NO2, at a Benjamini-Hochberg false discovery rate (FDR) corrected p-value < 0.05. The strongest association was seen for an increase of 0.27 µg/m3 (interquartile range) in PM2.5abs and decreased phosphatidylcholine acyl-alkyl C36:3 (PC ae C36:3) concentrations [percent change in the geometric mean: -2.5% (95% confidence interval: -3.6%, -1.5%)].

CONCLUSIONS: Our study suggested that long-term exposure to air pollution is associated with metabolic alterations, particularly in PCs with unsaturated long-chain fatty acids. These findings might provide new insights into potential mechanisms for air pollution-related adverse health outcomes.

KEYWORDS: long-term air pollution, targeted metabolomics, phosphatidylcholine

O-OP-004 Exposure to air pollution, road noise and surrounding green space and risk for type 2 diabetes: a multi-exposure study covering Denmark

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BACKGROUND AND AIM: Air pollution, road noise and lack of greenness coexist in urban environments and have all been associated with type 2 diabetes (T2D). We aimed to identify how air pollutants, road noise and greenness were associated with T2D risk in a multi-exposure perspective.

METHODS: We estimated 5-year time-weighted exposure to PM2.5, ultrafine particles (UFP), elemental carbon (EC), NO2 and road traffic noise for all persons living in Denmark in 2005–2017 (HERMES study). for each air pollutant, we estimated the total contribution together with the traffic and non-traffic contributions. We estimated road noise at the most and least exposed façade and address-specific greenness (150m and 1000m radius). In total, 1.9 million persons aged >50 years were included, and 128,358 developed T2D during follow-up. Using Cox proportional hazards models, we conducted single-, two- and multi-pollutant analyses, with adjustment for individual and area-level sociodemographic co-variates.

RESULTS: In single-pollutant models, all air pollutants and road noise were associated with increased risk and green space with reduced risk of T2D. In two-pollutant models, HRs for NO2 total and UFP total were robust to further air pollution adjustment, besides when mutually adjusted, where HR for UFP total was markedly reduced. for air pollution originating from traffic, only UFP traffic was robust to adjustment for the other air pollutants. In models with mutual air pollution-noise adjustment, both air pollution and road noise were associated with higher T2D risk. HRs for green space remained virtually unchanged in all two-pollutant models. In a multi-pollutant analysis including both air pollution, noise and green space, HRs of all exposures but PM2.5 total and EC total remained associated with T2D.

CONCLUSIONS: Air pollution, road noise and green space were independently associated with risk for T2D in the Danish population.

KEYWORDS: Air pollution, road noise, greenness, type 2 diabetes, multi-pollutant

O-OP-005 Air pollution, metabolomic response, and bone mineral density among Women's Health Initiative participants

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BACKGROUND AND AIM: Ambient air pollution has been associated with bone damage. However, no studies have evaluated the metabolomic changes linked to air pollutants and their potential influence on bone damage in postmenopausal women.

METHODS: We analyzed data available among Woman's Health Initiative (WHI) participants. We used log-normal, ordinary kriging to estimate daily mean concentrations of PM10 (µg/m3) and NOx, NO2, and SO2 (ppm) at their geocoded addresses. We averaged the means over 1-, 3-, and 5-year periods before metabolomic assessments. We measured whole-body, total hip, femoral neck, and spine bone mineral density (BMD) via dual-energy X-ray absorptiometry. We processed 2,129 plasma samples using liquid chromatography-tandem mass spectrometry (LC-MS) to estimate the concentration of approximately 500 metabolites. We used multivariable linear models adjusted for age, body mass index, ethnicity, education, and coronary heart disease to identify metabolome-wide significant cross-sectional associations between air pollutants, metabolites, and BMD at an FDR-corrected threshold of 0.05. We then used a hypergeometric enrichment test hosted on Metaboanalyst to conduct pathway analysis with the KEGG metabolic map as reference.

RESULTS: The mean (standard deviation) age of participants was 67.0 (7.1) years. Air pollutants were associated with several metabolite concentrations. for example, 1-year mean NOx exposure was associated with 104 metabolites after adjusting for multiple comparisons, including homoarginine, sphingosine-1-phosphate, uridine diphosphate glucose (UDP), UDP-galactose, alpha-glycerophosphate, kynurenine, cytidine monophosphate, malonylcarnitine, docosatrienoic acid, carboxybuprofen, and others. These NOx-associated metabolites enriched the arachidonic acid, purine, glycerophospholipid, and arginine metabolic pathways. Likewise, 17 metabolites were significantly associated with BMD, particularly total hip and whole body. Homoarginine was associated with both NOx and BMD.

CONCLUSIONS: This initial study of air pollutant-associated metabolites and bone mineral density in the Women's Health Initiative highlights potential metabolomic mechanisms by which air pollution may negatively affect bone health among postmenopausal women.

KEYWORDS: Air pollution, Metabolomics, BMD, Postmenopausal, Women.

O-OP-006 Exposure to household and outdoor air pollution and fasting plasma glucose as a marker of diabetes risk in Chinese adults

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BACKGROUND AND AIM: Household air pollution (HAP) from solid fuel stoves is a widespread environmental exposure. Exposure to outdoor air pollution can increase risk of diabetes but studies of HAP and diabetes are limited.

METHODS: We modelled the relation of personal exposure to two HAP components – fine particulate matter (P2.5) and black carbon (BC), and stationary measures of outdoor PM2.5, with fasting plasma glucose (FPG) as a marker of diabetes risk in a cross-sectional study of 663 adults (40-79 years) in three provinces of China. We applied linear mixed regression models with a village-level random intercept to assess associations between pollutants and FPG levels in the same season as blood collection (winter) and for annual weighted mean exposure estimated across two seasons, adjusted for covariates.

RESULTS: We observed higher FPG (mmol/L) with winter outdoor PM2.5 (2.4%, 95% CI 0.2 to 4.5% per 100µg/m3 increase), driven by an increase in the southern non-heating province of Guangxi (10.5%, 95% CI -2.6% to 23.6% per 100µg/m3 increase). We observed higher FPG in association with winter and annual outdoor PM2.5 among participants with no hypertension and among those with BMI below the median (<25.1kg/m2). We found no association with winter or annual personal PM2.5 and BC exposures, however in sub-group analyses excluding those taking diabetes treatment, we found higher FPG levels with personal winter BC exposure (0.8%, 95% CI -0.2% to 1.7% per 1µg/m3 increase), an association that was stronger among participants with a BMI below the median (1.9%, 95% CI 0.7% to 3.1% per 1µg/m3 increase).

CONCLUSIONS: We found some evidence of detrimental associations between air pollutants and FPG levels. Longitudinal investigations of HAP exposure and markers of diabetes risk are needed in settings where solid fuels are an important energy source for cooking and heating.

KEYWORDS: air pollution, diabetes

ORAL PRESENTATIONS SESSION 02: Reproductive outcomes and various environmental exposures (1)

O-OP-007 Heavy metals and diminished ovarian reserve: single-exposure and mixture analyses amongst women consulting in French fertility centres

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BACKGROUND AND AIM: Diminished ovarian reserve (DOR) is one of the most frequent pathology diagnosed in women consulting for infertility. Animal studies have reported impacts of some heavy metals on the ovarian function but research on the ovarian reserve in humans is limited.

METHODS: We included 139 cases and 153 controls between 2016-2020. The participants were aged 18-40 and consulted for couple infertility in one of four fertility centres in western France. Cases of DOR were defined as women with an antral follicle count < 7 and/or anti-müllerian hormone (AMH) levels ≤ 1.1 ng/ml. Controls were frequency matched on age and centre and were women with normal ovarian reserve evaluations, no malformations, and regular menstrual cycles. Four heavy metals (lead, mercury, cadmium and chromium) were measured in whole blood at inclusion. Single-exposure associations were examined with multivariable logistic regressions adjusted on potential confounders. Mixture effects were investigated with quantile g-computation and bayesian kernel machine regression (BKMR).

RESULTS: All metals were detected in over 85% of control samples. We observed non-significant increased risks of DOR for chromium (OR = 1.24 [0.65 - 2.39] for the second tercile of exposure and OR = 1.77 [0.84 - 3.70] for the tercile) and cadmium (OR = 1.89 [0.98 - 3.67] for the second tercile of exposure and OR = 1.18 [0.55 - 2.52] for the tercile). Quantile g-computation and BKMR both yielded a non-significant increased risk of DOR for the mixture of metals, with no evidence of interaction.

CONCLUSIONS: We detected weak signals that some heavy metals could be associated with DOR. These findings should be replicated in other studies.

KEYWORDS: Reproductive outcomes, Female fertility, Heavy metals, Chemical exposures, Mixtures, Environmental epidemiology.

O-OP-008 Association of solar and geomagnetic activity with fetal growth

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BACKGROUND AND AIM: Solar and geomagnetic activity have been previously shown to suppress melatonin, which is an important hormone for fetal development. We explored whether solar and geomagnetic activity were associated with fetal growth.

METHODS: We included singleton births with routine ultrasounds at an academic medical center in Eastern Massachusetts from 2011 through 2016. Sunspot number (SSN), interplanetary magnetic field (IMF), and Kp index were obtained from the NASA Goddard Space Flight Center. Three exposure windows were considered, including the first 16 weeks of pregnancy, one month prior to fetal growth measurement, and conception until fetal growth measurement (cumulative). Ultrasound scans from which we extracted biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference measurements were categorized as anatomic (<24 weeks' gestation) or growth scans (≥24 weeks' gestation). Ultrasound parameters and birth weight were standardized, and linear mixed models adjusted for seasonality, long-term trends, meteorological factors, and maternal characteristics were fitted.

RESULTS: Among 9,428 pregnancies, prenatal exposure was negatively associated with ultrasound parameters among growth scans. Associations varied by exposure window, solar metric, and fetal growth parameter. Cumulative exposure to solar and geomagnetic activity was important across exposure metrics, where an interquartile range (IQR) increase in SSN was associated with a -0.20 (95% CI: -0.30, -0.11), -0.28 (95% CI: -0.39, -0.17), and -0.16 (95% CI: -0.26, -0.06) difference in average BDP, HC, and FL z-scores, respectively. Cumulative IMF and Kp index were also associated with reduced average HC, -0.23 (95% CI: -0.36, -0.10) and -0.14 (95% CI: -0.24, -0.03) z-score difference per IQR increase, respectively.

CONCLUSIONS: Solar and geomagnetic activity were associated with reduced fetal growth. Future studies are needed to better understand the impact of these natural phenomena on clinical endpoints.

KEYWORDS: fetal growth, solar activity, pregnancy

O-OP-009 A prospective study of cadmium concentrations and uterine fibroid incidence

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BACKGROUND AND AIM: Although uterine fibroids are common, etiology of these smooth muscle tumors remains unclear. Mounting data suggest genetic mutations are an early event in fibroid development, with hormonal signaling promoting tumor growth. Cadmium exhibits mutagenic and hormonal properties, yet prior human studies of cadmium and fibroids have yielded discrepant results, and none were prospective investigations.

METHODS: The Study of Environment, Lifestyle & Fibroids is a cohort study of 1,693 Black women ages 23-35 years, based in Detroit, Michigan. Participants underwent transvaginal ultrasound at baseline and every 20 months for 5 years to detect fibroids ≥0.5 cm in diameter. Among 1,123 fibroid-free participants at baseline, we quantified baseline whole blood and creatinine-corrected urinary cadmium concentrations in 1,027 and 1,119 participants, respectively. We conducted Cox regression to estimate adjusted hazard ratios (aHRs), and 95% CIs for the association between cadmium and fibroid incidence, adjusting for urinary creatinine and time-varying factors of parity, years since last birth, years since last depot medroxyprogesterone acetate use, body mass index, smoking, and education.

RESULTS: Urinary cadmium was not associated with fibroid incidence. However, we observed elevated incidence estimates with blood cadmium (quartile 3 vs. 1: aHR 1.49, 95% CI: 1.07,2.08; quartile 4 vs. 1: 1.17, 95% CI: 0.75,1.84). Considering the short half-life of cadmium in blood (3 months), we repeated the analyses restricting follow-up to 20 months and observed a stronger association (quartile 3 vs. 1: aHR 1.79, 95% CI: 1.03,3.10; quartile 4 vs. 1: aHR 1.42, 95% CI: 0.67,2.99).

CONCLUSIONS: We found suggestive evidence of an association between blood cadmium concentrations and fibroid incidence. While urinary cadmium represents long-term exposure over prior decades, urinary excretion may come directly from kidney storage rather than blood circulation, which is the component available to the uterus. Future analyses will examine blood cadmium and fibroid growth.

O-OP-010 Associations between phenols and phthalates and placental weight in a mother-child cohort with improved exposure assessment

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BACKGROUND AND AIM: The placenta plays a key role in assuring a normal foetal development and growth. Few epidemiological studies have investigated the effects of phenols and phthalates on placental function. We aimed to explore whether maternal exposure to phenols and phthalates during the second and third pregnancy trimesters are associated with changes in placental weight at birth and placental-to-birth weight ratio (PFR).

METHODS: We relied on a subsample of 357 women from the French SEPAGES cohort with placental and birth weights assessed, and for whom 8 phenols (4 parabens, 2 bisphenols, triclosan and benzophenone-3), 13 phthalate metabolites and 2 non-phthalate plasticizer metabolites were measured in within-subject pools of repeated urine samples collected at second and third pregnancy trimesters (median= 21 samples/trimester). Adjusted linear regressions were used to evaluate the associations between each compound and placental weight or PFR.

RESULTS: Each ln-unit increase in urinary monobenzyl phthalate (MBzP) concentrations at the second and third trimesters was associated with a mean placental weight decrease of 19.67 g (95%CI: -37.94; -1.4) and 16.71 g (95%CI: -33.08; -0.33), respectively. A decrease in PFR was also observed with MBzP exposure at the second (β: -0.51; 95%CI: -0.99; -0.04) and third trimester (β: -0.46; 95%CI: -0.88; -0.03). Children born to mothers with detected/quantified bisphenol S (BPS) in the second trimester showed a significantly lower PFR compared to mothers with undetected BPS (β: -0.83, 95%CI: -1.57; -0.09). No associations were observed with the remaining compounds.

CONCLUSIONS: This is the first study exploring the effect of BPS maternal exposure on placental function in humans. Our MBzP results are consistent with a previous study that found a similar negative association on placental function in girls, whereas three other studies relying on spot urine samples reported null associations.

KEYWORDS: placental weight, phenols, phthalates, pfr, prenatal exposure

O-OP-011 Exposure to perfluoroalkyl substances at preconception in association with fertility outcomes in women from Singapore

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BACKGROUND AND AIM: Exposure to perfluoroalkyl substances (PFAS) may affect fertility, but human studies are scarce. We assessed associations between PFAS concentrations and probability of pregnancy and live birth in women in Singapore.

METHODS: In a case-control study nested within the Singapore Preconception Study of Long-Term Maternal and Child Outcomes, we measured PFAS in preconception serum from 382 women of reproductive age (328 who became pregnant and 54 who failed to conceive or miscarried). We used logistic and weighted quantile sum (WQS) regression respectively to assess the associations between concentrations of seven individual PFAS and the PFAS mixture with the odds of pregnancy or live birth. We calculated time-to-pregnancy based on the number of menstrual cycles over 12 months of follow up and used Cox regression to estimate fecundability ratios (FR). We used inverse probability weighting to account for the nested case-control design. All models were adjusted for batch, age, ethnicity, education, household income, and parity.

RESULTS: Higher PFAS mixture exposure was associated with reduced odds of pregnancy (WQS: OR [95% CI] per PFAS quartile increase=0.67 [0.44, 1.02]) and live birth (0.71 [0.48, 1.07]), with PFOA and PFOS being the major contributors to the mixture associations. In individual PFAS analyses, the strongest associations were observed for PFOA (OR [95% CI]=0.58 [0.35, 0.96] for pregnancy and 0.62 [0.39, 1.00] for live birth) compared to other PFAS. Higher concentrations of PFOA (FR [95% CI]=0.87 [0.75, 1.02]), PFOS (0.84 [0.68, 1.03]), and PFHpA (0.76 [0.59, 0.98]) were associated with lower fecundability. Associations for PFHxS, PFDA, and PFHpS were in the same direction but more attenuated. There was no association between PFNA and the fertility outcomes.

CONCLUSIONS: Higher PFAS exposures may decrease fertility in women from Singapore. These findings need further investigation in larger populations.

KEYWORDS: Perfluoroalkyl substances; Endocrine disrupting chemicals; Fertility; Pregnancy outcomes.

O-OP-012 Water fluoridation and birth outcomes in California

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BACKGROUND AND AIM: Evidence suggests fluoride exposure may affect neurodevelopment among children. A portion of this effect may be operating via adverse birth outcomes, but there is a lack of research on the relationship between water fluoridation and pregnancy outcomes.

METHODS: We linked California birth records from 2010-2018 to annual average fluoride levels by community water system. Fluoride levels were collected from consumer confidence reports. Births were geocoded to the address at delivery and the fluoride level in the year of pregnancy was determined, using a weighted average if the pregnancy spanned multiple years. We estimated the effects of a hypothetical intervention reducing water fluoride levels to 0.7 ppm and 0.5 ppm on birthweight and gestational age using G-computation. We used a linear regression model with a natural cubic spline to allow for non-linearity in the effects of fluoride. Individual covariates included maternal age, race/ethnicity, insurance type, educational attainment, and the month and year of conception. Area-level covariates included water system size, county-level unemployment, income inequality, temperature and urbanicity. Inference was calculated using a clustered bootstrap with Wald-type confidence intervals.

RESULTS: There was no estimated effect of the hypothetical intervention to reduce fluoride levels to 0.7 ppm on birthweight (-1.6 g, 95% CI -4.1, 0.8). We did observe a negative association of the hypothetical intervention to reduce fluoride level to 0.5 ppm (-7.6 g, 95% CI -12.6, -2.6). We also observed no effect for either the 0.7 or 0.5 ppm intervention on gestational age (-0.007 weeks, 95% CI -0.017, 0.003 and -0.023 weeks, 95% CI -0.050, 0.003, respectively).

CONCLUSIONS: We found a negative association of a hypothetical intervention of reducing fluoride levels to 0.5 ppm on birthweight, but no association for reducing fluoride levels to 0.7 ppm. We did not observe associations for either intervention with gestational age.

ORAL PRESENTATIONS SESSION 03: Noise exposure and health

O-OP-013 Associations between aircraft noise exposure and adiposity in the U.S.-based prospective Nurses' Health Studies

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BACKGROUND AND AIM: Aircraft noise exposure is increasingly linked to cardiovascular disease risk. But intermediate pathways such as adiposity, which is biologically influenced by stress and sleep disruption, lack attention. This study investigates associations between aircraft noise exposure and general obesity in two prospective Nurses' Health Studies (NHS I and II).

METHODS: Aircraft day-night average noise levels (DNL) were estimated at geocoded participant residential addresses from noise contours modeled using the Aviation Environmental Design Tool for 90 U.S. airports from 1995-2015 in 5-year intervals. Biennial surveys from 1994-2017 provided information on body mass index (BMI) and potential confounding factors. Categorical BMI (18.5-24 (reference), 25-29, >=30 kg/m2) was modeled against multiple cut-points of aircraft noise exposure (45, 55, and 65 A-weighted decibels: dB(A)) using repeated multinomial logistic regression and generalized estimating equations to evaluate the odds of an increased BMI category from elevated aircraft noise exposure (dichotomous or ordinal). Multivariable models adjusted for age, race, socioeconomic status (SES), region, menopausal status, hormone replacement therapy, parity, diet, physical activity, smoking status, alcohol use, and neighborhood SES.

RESULTS: at baseline, the 78,154 pooled female participants averaged 50.2 years old. of these participants, 83.0%, 14.7%, 2.2% and 0.1% were exposed to <45 (reference), 45-54, 55-64, and >=65 dB(A) of aircraft noise, respectively. While all multivariable models indicated increased odds of reporting BMIs 25-29 or >=30 kg/m2 for each aircraft noise exposure cut-point, the largest increased odds were at the 55 dB(A) threshold (16.6% [95% CI: 6.8%, 27.3%]; 16.0% [95% CI: 4.0%, 29.4%], respectively). Increasing ordinal exposure was associated (ptrend<0.001) with each respective BMI group above 25 kg/m2.

CONCLUSIONS: In the NHS cohorts, higher aircraft noise exposure groups were associated with higher BMI categories. The relationship was independent of multiple factors influencing BMI over time, suggesting the importance of an adiposity pathway for noise-health effects.

O-OP-014 Long-term exposure to source-specific transportation noise and diabetes mellitus mortality: a national cohort study

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BACKGROUND AND AIM: Long-term exposure to transportation noise is related to cardio-metabolic diseases. Identified as an important health outcome in the 2018 WHO environmental noise guideline systematic reviews, the body of evidence supporting an association between noise and diabetes mellitus incidence is growing. This study aimed to evaluate the association between road traffic, railway and aircraft noise exposure and diabetes mortality.

METHODS: Over 4.1 million adults in the Swiss National Cohort were followed from 2001-2015. Accounting for residential history, source-specific noise calculations were performed for residential locations. During follow-up over 73000 deaths identified diabetes mellitus on death certificates as the primary cause (~20%), or as a concomitant, consecutive or initial disease. Multipollutant, time-varying Cox regression with age as timescale was applied to evaluate the risk of mortality (hazard ratios, HR and 95% confidence intervals). Models included each noise source (road traffic, railway and aircraft Lden), and were incrementally adjusted for individual and area-level covariates and air pollution. HRs stratified by sex and age were also derived.

RESULTS: HR in the adjusted model (including PM2.5) were 1.061 (1.051-1.071), 1.022 (1.015-1.030) and 1.004 (0.991-1.018) per 10dB Lden road traffic, railway and aircraft noise, respectively. Substituting PM2.5 with NO2 did not change the associations with noise. The relative risk of mortality was higher in males compared to females (1.076 [1.062-1.090] vs. 1.045 [1.031-1.059] per 10dB road traffic noise), and higher in younger compared to older adults.

CONCLUSIONS: Though cautious interpretation is warranted due to the lack of adjustment for important lifestyle factors, this study provides new evidence that death with diabetes mellitus may be associated with road traffic and railway noise exposure. Given similar findings in incidence studies, the increasing diabetes prevalence and the large disease burden, further research on this association is of great public health interest.

KEYWORDS: metabolic disease; noise; transport

O-OP-015 Impact of road traffic noise on annoyance and preventable mortality in European cities: a health impact assessment

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BACKGROUND AND AIM: Road traffic noise is one of the main environmental risks to health and wellbeing. We aimed to provide an in-depth assessment of available road traffic noise data and to estimate population exposure and health impacts for cities in Europe.

METHODS: We analyzed 724 cities and 25 greater cities in 25 European countries. We retrieved strategic noise maps delivered under the Environmental Noise Directive (END) or available from local sources. We employed the 24h day-evening-night noise level indicator (Lden) and estimated the health impacts of compliance with the World Health Organization (WHO) recommendation for road traffic noise (53 dB Lden) for adults aged 20 and over (n=123,966,346). Two primary health outcomes were assessed: high noise annoyance and Ischemic Heart Disease (IHD), using mortality from IHD causes as indicator.

RESULTS: Strategic noise map data varied in formats, noise ranges and levels of exposure categorization. The majority of noise maps (83.2%) were considered of moderate or low quality. Almost 60 million adults were exposed to road traffic noise levels above 55 dB Lden, equating to a median of 42% of the adult population. Approximately 11 million adults were highly annoyed by road traffic noise and 3608 deaths from IHD (95% CI: 843-6266) could be prevented annually.

CONCLUSIONS: A considerable number of adults are exposed to road traffic noise levels harmful for health. Efforts to standardize the strategic noise maps and to increase data availability at the city level are needed. These would allow for a more accurate and comprehensive assessment of the health impacts and further help local governments to address the adverse health effects of road traffic noise.

KEYWORDS: health impact assessment; road traffic noise; preventable mortality; ischaemic heart disease; annoyance; European cities.

O-OP-016 Transportation noise exposure, insulin resistance and diabetes: what is the role of sleep?

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BACKGROUND AND AIM: Adverse health effects of noise, especially on cardiovascular health, are well identified; however, the mechanisms and sleep patterns underlying such effects remain unclear. The aim of this study is to understand whether exposure to road noise is associated with insulin resistance and diabetes and quantify the contribution of sleep in these associations.

METHODS: Among the Community of Mine Study, in San Diego County, insulin resistance and type 2 diabetes were assessed. Exposure to road noise was calculated based on the participant's census tract of residence and categorized according to WHO guidelines (>53dBA). Sleep was characterized by 3 variables: alertness, efficiency, and duration (from actigraphy). Associations of noise with insulin resistance or diabetes were quantified using generalized estimating equation models adjusted for sex, age, race/ethnicity, income and NO2. We conducted causal mediation analyses using Inverse Odds Ratio Weighting method, considering multiple sleep mediators. All analyses were stratified by neighborhood poverty levels coupled with heterogeneity tests (Cochran Q test).

RESULTS: Among 573 participants (mean age 58.7 years), individuals living in poorer neighborhoods were more vulnerable to the effect of noise on insulin resistance (p-Cochran=0.09) and diabetes (p-Cochran=0.03). An exposure to road noise equal to or greater than 53dBA was associated with higher level of insulin resistance (β, 95% Confidence Interval [CI]: 0.19, 0.01-0.37) and increased risk of diabetes (Odds Ratio [OR], 95%CI:3.05, 1.26-7.42), only for participants living in poorer neighborhoods. Among these participants, when decomposing the noise-diabetes association, we observed a Natural Indirect Effect (NIE) of 1.01 (95%CI:0.65-1.45) for sleep alertness, 1.00 (95%CI:0.62-1.52) for sleep efficiency and 1.00 (95%CI:0.63-1.42) for sleep duration. Similar findings were observed with insulin resistance.

CONCLUSIONS: In this population, neighborhood income is an important effect modifier for the associations between noise and insulin resistance or diabetes. Sleep does not seem to contribute to these associations.

O-OP-017 Associations between residential exposure to aircraft noise, cardiovascular disease, and all-cause mortality in the Nurses' Health Studies

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BACKGROUND AND AIM: Aircraft noise is hypothesized to increase cardiovascular disease (CVD) risk and mortality through multiple pathways; however, there is limited evidence. We aim to examine associations between aircraft noise, CVD, and all-cause mortality in the prospective US-based Nurses' Health Studies (NHS/NHSII).

METHODS: Between 1994 and 2014, we followed 109,432 participants from NHS and 114,746 from NHSII free of CVD at baseline. Aircraft noise was estimated for 90 US airports in 5-year intervals and linked to geocoded residential addresses. Time-varying Cox proportional hazards models were used to assess relationships between dichotomized (< vs. ≥45 dB(A)) day-night average sound level (DNL) and each outcome, adjusting for race/ethnicity, spouse's education, region, fine particulate matter (PM2.5), neighborhood socioeconomic status (nSES), population density, lifestyle factors, menopausal status, and family history of CVD. We assessed effect modification by duration at current residence, nSES, PM2.5, and population density.

RESULTS: Over 20 years of follow-up, there were 8,730 CVD cases and 28,312 deaths in NHS as well as 1,482 CVD cases and 2,471 deaths in NHSII. Approximately 7% of participants were exposed to DNL ≥45 dB(A). In CVD models, we observed adjusted hazard ratios (aHRs) of 0.95 (95% CI: 0.88, 1.04) in NHS and 0.99 (95% CI: 0.81, 1.21) in NHSII comparing exposed and unexposed participants. Similarly, for all-cause mortality, we observed aHRs of 0.99 (95% CI: 0.94, 1.03) and 1.00 (95% CI: 0.86, 1.16) in NHS and NHSII, respectively. We only observed evidence of effect modification by nSES on noise and all-cause mortality in NHS, with greater adverse effects of noise among those living in areas of higher nSES.

CONCLUSIONS: We did not find associations between noise and CVD or all-cause mortality overall. Unexpectedly, we found associations between aviation noise and all-cause mortality among those living in more affluent areas.

KEYWORDS: aircraft, noise, CVD

O-OP-018 A nationwide cohort study on transportation noise and tinnitus: expanding current knowledge on the adverse health effects of noise pollution

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BACKGROUND AND AIM: Transportation noise is a major contributor to the environmental burden of disease worldwide and has been consistently linked to several non-auditory health outcomes. However, there is a clear lack of studies investigating transportation noise and auditory outcomes, such as tinnitus, even though these are considered critical outcomes for the development of public health guidelines. We aimed to investigate the association between transportation noise exposure and incident tinnitus in a nationwide cohort from Denmark.

METHODS: Our study population included all adults ≥ 30 years old living in Denmark between 2000 and 2017. Road traffic and railway noise were modelled at the most and least exposed façades of all Danish addresses for the period 1990-2017, enabling us to calculate 10-year time weighted mean noise exposure for all cohort members. We used data from health and administrative national registers to retrieve individual-level information on tinnitus diagnosis, address history and socioeconomic factors. Analyses were based on Cox Proportional Hazard models, with adjustment for potential individual and area-level confounders, and air pollution.

RESULTS: We identified 40,692 cases of tinnitus. Ten-year mean residential exposure to road traffic noise (per 10 dB) at the most and least exposed façades were positively associated with tinnitus, with respective hazard ratios of 1.018 [95% CI 1.005 – 1.032] and 1.056 [95% CI 1.037 – 1.075]. Associations between road noise at the least exposed façade and tinnitus followed a linear and positive exposure-response relationship throughout the entire exposure range. No associations were found between railway noise and risk of tinnitus.

CONCLUSIONS: We found road traffic noise to be associated with a higher risk of tinnitus, thus suggesting transportation noise may also affect the auditory system.

KEYWORDS: Transportation noise; road traffic; railway; tinnitus; auditory outcomes

ORAL PRESENTATIONS SESSION 04: Environment and health in low and medium income countries (1)

O-OP-019 Characterization of urban built and natural environments with high-resolution satellite images and unsupervised deep learning

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BACKGROUND AND AIM: Cities in the developing world are expanding rapidly and undergoing changes to their roads, housing and other buildings, vegetation, and land use characteristics. Timely data are needed to ensure that urban change enhance health, wellbeing and sustainability.

METHODS: We characterise, as mutually exclusive clusters, the complex, multidimensional, built and natural environments in cities with high-resolution satellite images and unsupervised deep clustering. We apply our approach to Accra, Ghana, one of the fastest growing cities in the developing world, and contextualise the resultant clusters with demographic and environmental data that were not used for clustering.

RESULTS: We show that image-based clusters captured distinct features of the urban built environment (building count, size, density, and orientation; length and arrangement of roads), vegetation, water, and population, either as a unique defining characteristic (e.g., bodies of water or dense vegetation) or in combination (e.g., buildings surrounded by vegetation or sparsely populated areas intermixed with roads). Clusters that were based on single defining characteristics were robust to the spatial scale of analysis and choice of cluster number, whereas those based on a combination of defining characteristics changed based on scale and number of clusters.

CONCLUSIONS: The results demonstrate that satellite data and unsupervised deep learning provide a cost-effective interpretable and scalable approach for real-time tracking of sustainable urban development, especially where traditional environmental and demographic data are limited and not frequently updated. Our approach has multiple urban environmental applications, such as providing ground data for tracking and measuring urban health, air- and noise pollution, urban connectivity and road traffic, as well as city growth in cities across Africa and beyond.

KEYWORDS: Big data, satellite imagery, deep learning, built environment; urban growth, unsupervised machine learning

O-OP-020 Diarrhea in children under 5 years and extreme precipitation in Nigeria

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BACKGROUND AND AIM: Extreme precipitation events are expected to increase in frequency and intensity due to climate change. Understanding the potential links between extreme weather events and infectious disease in Nigeria is important to reduce the future burden disease, particularly for the vulnerable population. We examined the association between extreme precipitation and diarrhea in children younger than 5 years in Nigeria.

METHODS: We obtained the survey data collected in 2018 from Demographic and Health Survey (DHS) survey for Nigeria with GPS coordinated of each household cluster. We used these data with monthly high-resolution precipitation data from Climate Hazard group InfraRed Precipitation with Station data (CHIRPS) for year 2005-2020. Extreme precipitation was defined when the rainfall in the month of DHS survey (30 days prior to the survey) higher than 90th percentile of the entire data. We used multivariable logistic regression in examining the diarrhea and extreme precipitation association, after adjusting for the covariates of temperature and sanitation variables. Stratified analysis by different climate zones was subsequently performed.

RESULTS: Among the 33,924 children under 5 years of age included in the survey (in 2018), approximately 12% reported having diarrhea within the 2 weeks prior to the survey. Extreme precipitation was associated with under-5 diarrhea in Nigeria [Odds Ratio (OR) = 1.30 (95% Confidence Interval (CI): 1.17-1.44)]. We found that improved water drinking source, toilet facilities, and living in urban area reduced the risk of under-5 diarrhea. Stratified analysis revealed a variation in the extreme precipitation and under-5 diarrhea association across the country.

CONCLUSIONS: Our findings show that extreme precipitation can affect the risk of diarrhea in young children in Nigeria. The health burden of climate-sensitive disease such diarrhea can be protected by encouraging to access safe water drinking and sanitation infrastructure.

KEYWORDS: Diarrhea, children, extreme precipitation

O-OP-021 The protective effect of green space on heat-related respiratory hospitalization among children under five years of age in Hanoi, Vietnam

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BACKGROUND AND AIM: Combined effects of global warming and rapid urbanization replaces green spaces with urban facilities. Children in urban areas are at a higher risk of heat-related adverse health effects. Our study aimed to examine the protective effect of urban green space on heat-related respiratory hospitalization among children under five years of age in Hanoi, the capital city of Vietnam.

METHODS: We estimated district-specific meteorological conditions from 2010 to 2014 by using a dynamic downscaling approach with a fine-resolution numerical climate model. The green space in each district was calculated using satellite data. The attributable fraction of heat-related respiratory hospitalization was estimated using a two-stage model, including a distributed lag non-linear model (DLNM) coupled with multivariate meta-analysis. The association between heat-related respiratory hospitalization and green spaces at the district level was explored using a linear regression model.

RESULTS: The central districts were more crowded and hotter, with less green spaces than the outer districts. at temperatures > 34oC (extreme heat threshold), the hospitalizations in the central districts increased significantly; however, in the outer districts, the hospitalization rate was insignificant. On average, extreme heat attributed 0.33% to citywide hospitalization, 0.35% in the center, and 0.32% in the outer region. Every 1% increase in the greenspace fraction will reduce heat-related respiratory hospitalization risk by 3.8%.

CONCLUSIONS: Heat significantly increased the risk of respiratory hospitalization among children under five years in Hanoi, Vietnam. These findings are valuable for authorities to consider strategies to protect children's health against the effects of heat, including increasing greenspace.

KEYWORDS: Greenspace, the heat-related hospitalisation, children under five years old, Vietnam

O-OP-022 Pesticide exposure assessment in farmers from Malaysia, Uganda, and the UK: an analysis of urinary biomarker concentrations

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BACKGROUND AND AIM: More robust exposure data are needed for epidemiological studies of pesticide exposure, particularly in low and middle income countries. The aim of our study was to examine pesticide exposure in farmers based on urinary biomarkers.

METHODS: We used data from three cohorts of pesticide applicators in Malaysia, Uganda, and the UK. Participants completed questionnaires and provided same day urine samples for pre- and post-direct handling and spraying of pesticides. We analysed urinary biomarkers based on the reported use of active ingredients, including 3PBA (pyrethroids), DCVA (cypermethrin/cyfluthrin), ETU (mancozeb), TCPyr (chlorpyrifos), and Glyph (glyphosate). We report biomarker results where post-activity concentrations were less than the limit of quantification (LoQ) in <50% of samples.

RESULTS: There were 81, 84, and 106 participants from the Malaysia, Uganda, and UK cohorts, respectively, who provided a total of 758 urine samples. Several biomarkers included post-activity urine concentrations with ≥50% of samples above the LoQ in multiple studies, including 3PBA (16/32 [50%] in the UK to 67/73 [92%] in Malaysia), Glyph (100/192 [52%] in Uganda to 86/106 [81%] in the UK), and TCPyr (23/32 [72%] in the UK to 62/62 [100%] in Malaysia). of these same three biomarkers, median post-activity concentrations (in nmol/L) in Uganda and Malaysia were greatest for TCPyr: 2.66 (Interquartile Range [IQR]: 1.00-5.99) and 6.38 (IQR: 0.76-28.8), respectively. However, in the UK, median concentrations were highest for Glyph: 1.25 (IQR: 0.61-2.26).

CONCLUSIONS: Preliminary findings suggest distinct exposure patterns and pesticide use in Malaysia, Uganda, and the UK based on objective indicators. We will continue our analysis using linear mixed effects regression with multiple imputation to assess the importance of different exposure modifying factors for a suite of urinary biomarkers.

KEYWORDS: Active ingredients; Occupational epidemiology; Validation study

O-OP-023 Occupational heat stress induced renal health impacts – A field study on outdoor workers in Southern India

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BACKGROUND AND AIM: Temperature increases have been linked to large increases in heat-related illnesses as a result of global climate change. Heat stress, strenuous labour, and dehydration are all known to be major risk factors for kidney disease in workers who toil in heat. The goal of this study was to fill in the gaps in data on heat stress impacts on renal health among outdoor workers in India.

METHODS: During the summer and winter seasons of 2018-2019, three unorganised outdoor sectors were surveyed. The ACGIH standards and TLV-WBGT°C were used to establish job-specific workloads. Tympanic temperatures (Ttemp), Sweat Rates (SwR), Serum creatinine, and urine dipstick were all measured in ~550 workers, and heat-strain symptoms were assessed using questionnaires. The estimated Glomerular Filtration Rate (eGFR) was calculated using the CKD-EPI formula.

RESULTS: The mean WBGT temperature in summer and winter was 30.1±2.4°C and 27.0±2.5°C, respectively. While 86% of workers did heavy work, the remaining 14% had moderate job profiles. 65.3% of workers (N =364) were exposed to excessive heat, and they reported 2.8-times the number of heat-related illnesses/symptoms. Heat-exposed workers showed cross-shift increases in Ttemp > 1°C (17%), USG (36%), and SwR (30%). Even after controlling for confounders such as age, gender, and behavioural aspects, 36% of the workers had eGFRs < 90 mL/min/1.73m2 (AOR: 2.7; 95%CI: 1.8-4.2) and 8% of the workers had eGFRs < 60 mL/min/1.73m2 (AOR: 2.6; 95% CI: 1.2-6.2) that were significantly associated with heat exposure.

CONCLUSIONS: Excessive heat exposure, physical activity, dehydration, and reduced kidney function among outdoor workers warrant further in-depth investigation to develop workplace interventions and implementation of protective labour legislation and welfare measures for these workers.

KEYWORDS: Occupational heat stress, WBGT, heat strain, outdoor workers, reduced kidney function.

ORAL PRESENTATIONS SESSION 05: Challenges in health studies of chemicals: from methods to policy

O-OP-024 The relative importance of faecal and urinary excretion of PFAS and implications for epidemiological studies

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BACKGROUND AND AIM: Some per- and polyfluoroalkyl substances (PFAS) are persistent with long half-lives. Elimination rates and half-lives for PFAS have been described in animal and human studies, but there is little data on the importance of different routes of excretion, and many reviews have assumed that the renal route is primary.
The aim is therefore to address the magnitude of faecal vs renal excretion for PFAS in a population highly exposed to PFAS.

METHODS: Municipal drinking water contaminated with PFAS was distributed to many households in Ronneby, Sweden. The source was firefighting foam used nearby since the mid-1980s. Clean water was provided from December, 2013. Faeces and urine samples have been collected from over 200 participants in the serum biomonitoring programme with parallel measurements of multiple PFAS, including: perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS), linear perfluorooctane sulfonate (L-PFOS) and branched PFOS.
This study will estimate the distribution of individual excretion rates by the two routes in this population based on concurrent measured PFAS in serum, blood, and faeces. Preliminary data presented here are for 51 subjects with repeated blood measurements between 2014 and 2018, in a half-life study.

RESULTS: for PFOA median concentrations were 10 ng/ml in serum, 0.02 ng/ml in urine and 0.6 ng/g dry weight in faeces, corresponding to estimated elimination rates of 28 and 17 ng/day via urine and faeces respectively. Faecal elimination was generally less than urinary, median ratio 0.45. Equivalent median faecal/urinary daily elimination ratios were 0.18 for PFHxS and 3.65 for PFOS.

CONCLUSIONS: Faecal elimination is important and for some PFAS, eg L-PFOS, far outweighs renal elimination. This has implications for epidemiological studies using serum concentration, as measured levels are sensitive to gut excretion rates, and variation in this rate has the potential to confound associations with some outcomes studied.

KEYWORDS: PFAS, Biomonitoring

O-OP-025 Associations between perfluoroalkyl substances and lipid profile in a highly exposed adult community in the Veneto Region: a comparison of mixture-based statistical approaches

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BACKGROUND AND AIM: Residents of a large area in the Veneto Region were exposed to drinking water contaminated by perfluoroalkyl substances (PFAS) for decades. Combined exposures to multiple PFAS has been poorly investigated for serum lipid profile and highly exposed populations. We will compare results across statistical methods specifically developed to examine the association between mixtures of chemicals and their effects, in order to identify the impact of PFAS mixture on lipid parameters.

METHODS: Cross-sectional data from the Regional health surveillance program (34,633 individuals aged 20-64 years) were used to assess the association between the mixture of four serum PFAS namely, PFOA, PFOS, PFNA, PFHxS and total cholesterol (TC), high-density-lipoprotein cholesterol (HDL-C) and low-density-lipoprotein cholesterol (LDL-C). Given that no statistical mixture method is considered the gold standard, both Weighted Quantile Sum (WQS) regression, Quantile-based G-computation (Q-Gcomp) and Bayesian Kernel Machine Regression (BKMR) were selected based on their ability to handle highly correlated chemicals.

RESULTS: Each quartile increased in the WQS index was associated with an increase in the levels of TC (β:4.09, 95%CI:3.47-4.71), HDL-C (β:1.13, 95%CI:0.92-1.33), and LDL-C (β:3.14, 95%CI:2.65-3.63). Q-Gcomp estimated that a quartile increase in the PFAS mixture was associated with increased TC, HDL-C and LDL-C (ψ:4.04, 95%CI:3.5-4.58; ψ:1.07, 95%CI:20.87-1.27; ψ:2.71, 95%CI:2.23-3.19). In the BKMR analysis, the effect of PFAS mixture on serum lipids increased significantly when their concentrations were at their 75th percentiles or above compared to those at their median. All the three methods revealed a major contribution of PFOS and PFNA, although the main exposure was due to PFOA.

CONCLUSIONS: The PFAS mixture was positively associated with lipid parameters, regardless of the applied method. Very similar results obtained from the three methods may be attributed to the linear positive association with the outcomes and no interaction between each PFAS

KEYWORDS: combined exposure; mixture; PFAS; lipid.

O-OP-026 The Devil they knew: chemical documents analysis of industry influence on PFAS Science

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are widely-used persistent and bio-accumulative chemicals of global health concern. PFAS have been produced since the 1940s, but their toxicity wasn't publicly established until late 1990s. We use established methods to evaluate the role of the chemical industry in delaying public information on PFAS toxicity using previously undisclosed industry documents.

METHODS: We reviewed a collection of previously secret industry documents archived at the UCSF Chemical Industry Documents Library. We analyzed PFAS industry documents using well-established document analysis methods, identifying themes through deductive or inductive reasoning and grouping them. Our deductive codes were adapted from White and Bero, evaluating six strategies (Manipulating the research question; funding and publishing research supporting industry interests; suppressing unfavorable research; distorting public discourse about research; changing or setting scientific standards to serve corporate interests; and disseminating favorable research directly to decision makers and the public, bypassing normal channels of scientific discourse) six industries. We also conducted a literature review to establish when scientific information on the health effects of PFAS became public.

RESULTS: We found companies knew PFAS was "highly toxic when inhaled and moderately toxic when ingested" by 1970, forty years before the public health community. The industry used several strategies common to tobacco, pharmaceutical and other industries to influence science and regulation – notably, suppressing unfavorable research and distorting public discourse. We did not find evidence in this archive of funding favorable research or targeted dissemination of those results.

CONCLUSIONS: Lack of transparency in industry-driven research on industrial chemicals has significant legal, political and public health consequences. Illuminating industry strategies to suppress scientific research findings or early warnings about the hazards of industrial chemicals help guides future prevention.

KEYWORDS: PFAS, chemical policy, environmental health, commercial determinants, industry documents, research ethics

O-OP-027 Associations between organochlorine pesticide mixtures and sex steroid hormones modified by age, gender and body mass index in the US 2011-2016: a quantile-based g-computation approach

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BACKGROUND AND AIM: Toxicological studies have shown adverse effects of organochlorine pesticides on reproductive function in animals; however, human studies are limited and mostly on a single pesticide. This study, therefore, examined the combined effects of lipid-adjusted serum concentrations of organochlorine pesticides and sex hormones in the US and to what extent these associations vary by age, gender, and body mass index (BMI).

METHODS: We have used six years of repeated cross-sectional data that consist of three consecutive National Health and Nutrition Examination Survey (NHANES) cycles from 2011 to 2016. Serum concentrations of seven organochlorine pesticides (β-hexachlorocyclohexane, hexachlorobenzene, oxychlordane, p,p'-dichlorodiphenyltrichloroethene, p,p'-dichlorodiphenyltrichlorethane, trans-Nonachlor, and Mirex) were used as mixtures. The sex hormones considered were testosterone in nmol/L (n=798), estradiol in pmol/L (n=528 in), sex hormone-binding globulin -SHBG in nmol/L (n=497), and testosterone/estradiol in pg/mL (n=528). Quantile-based g-computation method was used for mixture effects, adjusting for potential confounders, and survey design.

RESULTS: Results showed that lipid-adjusted pesticide mixtures had an inverse association with testosterone (β=-1.02, 95% CI: -1.81, -0.23; p= 0.012), estradiol (β= -663.16, 95% CI: -1232.09, -94.23, p= 0.022), SHBG (β= -14.62, 95% CI: -32.00, 2.77, p=0.100) and testosterone/estradiol (β= -3.06, 95% CI: -17.41, 11.29, p= 0.676). These associations were modified by gender with higher precisions for testosterone (Male: -1.90, 95% CI: -3.46, -0.35, pint= 0.003; Female: -0.79, 95% CI: -1.60, 0.02, p= 0.003). Moreover, age and BMI also significantly modified the effects of pesticide mixtures on sex hormones with higher precision in testosterone and estradiol.

CONCLUSIONS: Our study suggests that pesticide mixture is inversely associated with sex hormones in the US population aged 12-80 years old, and these associations are modified by age, gender, and BMI. Intervention should be focused on reducing pesticide mixture exposures focusing on vulnerable communities.

KEYWORDS: Pesticides; Mixture; Testosterone; Hormones; Quantile g-computation

O-OP-028 Prenatal endocrine disrupting chemical exposure and child IQ: accounting for uncertainty in pattern identification in a two-stage health analysis

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BACKGROUND AND AIM: A growing body of evidence links prenatal endocrine disrupting chemicals (EDCs) with adverse neurodevelopment in children, and previous research has analyzed the impact of environmental mixtures of EDC classes on health outcomes. Here, we investigate the relationship between EDC exposure patterns in pregnant women and their children's neurodevelopment.

METHODS: We measured exposure to 17 phenols and phthalates in 343 pregnant women in a mother-child cohort and full-scale IQ in children at seven years of age. We designed a two-stage Bayesian hierarchical model to estimate health effects of environmental exposure patterns while incorporating the uncertainty of pattern identification. In the first stage, we identified EDC exposure patterns using Bayesian non-parametric non-negative matrix factorization (BN²MF). In the second stage, we included individual pattern scores and their distributions as exposures of interest in a linear regression model, with child IQ as the outcome, adjusting for potential confounders. We present sex-specific results.

RESULTS: BN²MF identified two underlying patterns of exposure. One pattern expressed exposure to phthalates and bisphenol A (BPA). One standard deviation increase in this pattern was associated with a decrease of 3.2 IQ points (95% credible interval: -6.4, -0.2), on average, in female children but not in males (-0.6 IQ points, 95% CrI: -2.7, 1.5). The second pattern represented exposure to phenols and di-ethyl phthalate. We found no associations between this pattern and child neurodevelopment.

CONCLUSIONS: The two BN²MF-identified patterns of EDC exposure in pregnant mothers corresponded with diet and personal care product use as potentially separate sources or behaviors leading to exposure. Phthalates and BPA found in food packaging and can linings formed a pattern of EDC exposure associated with decreases in full-scale IQ in female children. Results may be used to inform interventions designed to target modifiable behavior or regulations to act on dietary exposure sources.

O-OP-029 Data quality evaluation criteria for systematic review of epidemiology studies under the Toxic Substances Control Act (TSCA): refinement through practical application in risk evaluation

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BACKGROUND AND AIM: The 2016 Frank R. Lautenberg Chemical Safety for the 21st Century Act and the 2017 Procedures for Chemical Risk Evaluation under the Amended Toxic Substances Control Act (TSCA) require the U.S. Environmental Protection Agency (EPA) to conduct risk evaluations using the best available science and weight of the scientific evidence. Therefore, EPA has developed systematic review methods including data quality evaluation criteria to evaluate scientific studies in specific disciplines including epidemiology. EPA has aimed to refine these criteria for practical application in risk evaluation of high-priority chemicals under TSCA.

METHODS: EPA considered the pros and cons of multiple existing systematic review frameworks and guidance documents and drew upon these methodologies to develop data quality evaluation domains, metrics, and criteria for the systematic review of epidemiology studies under TSCA. EPA refined these domains, metrics, and criteria through practical application to add specificity to increase consistency among evaluators and to harmonize with the evaluation of animal toxicology studies under TSCA.

RESULTS: EPA adopted aspects of methods including the National Toxicology Program (NTP) Office of Health Assessment and Translation (OHAT) and EPA's Integrated Risk Information System (IRIS) methods, but also aimed to be consistent with other disciplines and to address TSCA scientific standards.

CONCLUSIONS: EPA has further refined data quality evaluation criteria for systematic review of epidemiology studies under TSCA in response to comments from peer reviewers, the public, the National Academies, and the TSCA Science Advisory Committee on Chemicals (SACC). Systematic review of epidemiology studies is a critical component of protecting human health under TSCA.
DISCLAIMER: The views expressed in this presentation are solely those of the authors and do not represent the policies of EPA. Mention of trade names or commercial products should not be interpreted as an endorsement by EPA.

KEYWORDS: Systematic Review, Data Quality Evaluation

ORAL PRESENTATIONS SESSION 06: Environment and aging

O-OP-030 Associations of source-specific PM2.5 and incident disability in older U.S. adults: the Health Retirement Study

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BACKGROUND AND AIM: Late-life disability is a common endpoint of the chronic health conditions that affect people as they age. Although fine particulate matter (PM2.5) is associated with chronic conditions that contribute to disability, associations with disability itself are understudied, and the most toxic emission sources have yet to be identified. We evaluated the association between long-term exposure to PM2.5 from specific emission sources and disability.

METHODS: We used biennial survey data between 2006 and 2016 on Activities of Daily Living (ADL) from participants >65 years of the Health and Retirement Study. Using a spatiotemporal prediction model, we estimated 10-year PM2.5 concentrations at participants' residences and multiplied these values by spatially-resolved fractions of PM2.5 from sources including agriculture, energy production, industry, transportation, fires, and windblown dust, derived from a chemical transport model. We used Cox models to estimate the risk of incident ADL disability per 1-μg/m³ source-specific PM2.5, adjusting for individual- and area-level confounders, time, geography, and sampling weights.

RESULTS: Among 11,782 adults (72±6.8 years), 37% reported a new disability during follow-up. Overall, both total PM2.5 and source-specific PM2.5 were associated with increased incident of ADL disability. A 1-μg/m³ increment in total PM2.5 corresponded to a 2% (95% CI: 1.00, 1.04) greater hazard of ADL. In single-sector models, PM2.5 from each source was also positively associated with incident ADL. After adjusting for PM2.5 from other sources, associations with agriculture, non-road and road transportation, non-coal energy production, and windblown dust PM2.5 remained, whereas no associations were observed for the other sources.

CONCLUSIONS: We found evidence that higher levels of PM2.5 from some but not all sources were associated with increased risk of disability, suggesting that selective interventions could be effective at improving health and function in late-life.

KEYWORDS: Air Pollution, emission sources, Activities of Daily Living, PM2.5

O-OP-031 Investigation on associations between long-term air pollution exposure and osteoporotic fracture using nationwide cohort study data in South Korea

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BACKGROUND AND AIM: Bone health is a major concern for aging populations globally. Human and animal studies have suggested biological mechanisms for osteoporosis and bone density associated with air pollution, but less is known about the impacts of air pollution on osteoporotic fracture. We examined the associations between long-term air pollution exposure and risk of osteoporotic fracture in adults in seven large Korean cities.

METHODS: We used Cox proportional hazard models to estimate hazard rations (HRs) of time-varying moving window of past exposures of particulate matter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), and ozone (O_3) for osteoporotic fracture in Korean adults (age ≥50 years) in the National Health Insurance Service-National Sample Cohort data, followed 2002 to 2015. HRs were calculated for an interquartile range (IQR) increase of 3-year moving average concentration of each pollutant. Data of 56,467 participants over 535,481 person-years of follow-up were used. The model adjusted for individual-level confounders (comorbidity, prescription for osteoporosis, age, sex, body mass index, health behaviors, income).

RESULTS: Linear and positive exposure-response associations were found for SO_2, while PM_{10} and NO_2 showed nonlinear associations. SO_2 was associated with osteoporosis-related fracture with marginal significance (HR for an IQR [2 ppb] increase = 1.04, 95% CI: 1.00–1.09). The SO_2 HR estimates were robust in analyses applying various moving windows of exposure (from one to three years of past exposure) and two-pollutant models. The O_3 HR estimate was positive but not significant (HR for 0.007 ppm increase = 1.01, 95% CI: 0.97–1.06). PM_{10}, CO, and NO_2 did not show associations. Vulnerable groups by sex, age, exercise, and income varied across air pollutants and there was no evidence of effect modifications.

CONCLUSIONS: Long-term exposure to SO_2 was associated with increased osteoporotic fracture risks in Korean adults.

KEYWORDS: Air pollution, bone fracture, cohort studies, osteoporosis.

O-OP-032 Shortened leucocyte telomere length is associated with increased daily air temperature: KORA F3 and KORA F4

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BACKGROUND AND AIM: Climate change endangers human health and well-being in numerous ways. Increased air temperature is associated with increased age-related morbidity and mortality, but the mechanisms are not yet fully understood. We aimed to assess the short-term effects of air temperature on leucocyte telomere length, a clinical gauge for age-related disease risk, among an adult population.

METHODS: This population-based study involved 5,864 participants from the KORA F3 (2004-2005) and F4 (2006-2008) cohort studies, conducted in Augsburg, Germany. Leucocyte telomere length was assessed by a quantitative PCR-based method. We estimated air temperature at each participant's residential address by a highly resolved spatio-temporal model using satellite, meteorological and land-use data. We conducted cohort-specific generalized additive models to explore the short-term effects of air temperature on leucocyte telomere length at lags 0-1, 2-6, 0-6, and 0-13 days separately and pooled the estimates by fixed-effects meta-analysis. We investigated potential effect modification by including interaction terms for individual characteristics, season and ozone.

RESULTS: A 1°C increase in daily air temperature was associated with decreased leucocyte telomere lengths at lags 0-1, 2-6, 0-6 and 0-13 days [%changes (95% confidence interval): -0.28 (-0.42; -0.13), -0.28 (-0.45; -0.11), -0.42 (-0.62; -0.22), and -0.72 (-0.99; -0.46), respectively]. Only participants examined in the cold season showed a stronger effect of air temperature on leucocyte telomere length at lags 0-1 days, compared to participants examined in the warm season. There was no indication for other effect modification.

CONCLUSIONS: This meta-analysis of two cohort studies showed that increased daily air temperature was associated with shortened leucocyte telomere length. Our findings add to the burgeoning evidence of how increases in air temperature can adversely impact human health. This abstract does not necessarily represent the policies of the US EPA.

KEYWORDS: short-term effects, air temperature, telomere length

O-OP-033 Ambient exposure and fetal black carbon load in association with telomere length in cord blood

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BACKGROUND AND AIM: Ambient particulate matter (PM) is an important factor that is associated with telomere length (TL) at birth. A recent study has shown that translocation of black carbon (BC), one of the most toxic components of PM, towards the fetus is possible, but it is not yet linked to biological outcomes. In this study, we investigated whether 1) ambient BC is associated with cord blood TL, 2) fetal BC load relates to ambient BC exposure and 3) fetal BC load is related to newborn TL.

METHODS: In 247 mother-newborn pairs from the ENVIRONAGE (Environmental Influence On Early Ageing) study, which is a population-based birth cohort study located in Limburg, Belgium, maternal residential exposure to BC during pregnancy was estimated using a spatial-temporal interpolation model. BC particles were detected in cord blood by the generation of white-light under femtosecond pulsed laser illumination. Cord blood TL was measured using qPCR. We applied Pearson correlations and distributed lag models to associate BC exposure with cord blood TL.

RESULTS: An IQR increment (0.85 µg/m3) in ambient BC was associated with a -12% (95% CI: −21% to −2.8%) decrease and a 20% (95% CI: 7.6% to 34%) increase in cord blood TL during the second and third trimester of pregnancy respectively. Secondly, fetal BC load showed the highest correlation with ambient BC during trimester 3 ($r=0.28$, $p<0.0001$). Thirdly, fetal BC load was positively correlated with TL in cord blood ($r=0.15$, $p=0.023$).

CONCLUSIONS: Our findings show that mothers with a higher exposure to ambient BC had more BC particles in cord blood. The positive correlation between both ambient and fetal BC exposure during trimester 3 and cord blood TL may suggest the possibility of an acute protective response, but additional studies are needed to investigate the underlying mechanisms.

KEYWORDS: Telomere Length, Particulate Matter, Black Carbon, Ageing

O-OP-034 Role of sleep quality in the acceleration of biological aging and its potential for preventive interaction on air pollution insults: findings from the UK Biobank cohort

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BACKGROUND AND AIM: Sleep has been associated with aging and relevant health outcomes, but the causal relationship remains inconclusive. Additionally, air pollution is a critical environmental exposure that could advance aging and affect sleep quality, but no studies yet evaluated whether the sleep quality could modify the adverse effects of air pollution on biological aging or vice versa.

METHODS: We investigated the associations of sleep behaviors with biological ages (BAs) among 363,886 middle and elderly adults from UK Biobank. A sleep index (0[worst]-6[best]) was retrieved from six sleep behaviors: snoring, chronotype, daytime sleepiness, sleep duration, insomnia, and difficulties in getting up. Two BAs, the KDM-biological age and PhenoAge, were estimated using clinical traits, and their residual discrepancies with chronological age were defined as age accelerations (AAs). Annual averaged ambient levels of PM2.5, PMcoarse, PM10, NO2, and NOx of the participants were estimated using Land Use Regression model.

RESULTS: We first observed negative associations between the sleep index and the two AAs, and demonstrated that the change of AAs could be the consequence of sleep quality using Mendelian randomization with genetic risk scores of sleep index and BAs. Particularly, a one-unit increase in sleep index was associated with 0.104- and 0.119-year decreases in KDM-biological age acceleration and PhenoAge acceleration, respectively. We further observed significant independent and joint effects of sleep and air pollution (PM2.5 and NO2) on AAs. Sleep quality also showed a modifying effect on the associations of PM2.5/NO2 with accelerated AAs. for instance, an interquartile range increase in PM2.5 level was associated with 0.009-, 0.044-, and 0.074-year increase in PhenoAge acceleration among people with high (5-6), medium (3-4), and low (0-2) sleep index, respectively.

CONCLUSIONS: Our findings elucidate that better sleep quality could lessen accelerated biological aging resulting from air pollution.

KEYWORDS: aging; biological age; air pollution; PM2.5; sleep

O-SY-127 Association of environmental chemical exposure during pregnancy with subsequent breast cancer risk

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BACKGROUND AND AIM: Breast cancer became the most common cancer globally as of 2021, accounting for 12% of all new annual cancer cases worldwide, according to the World Health Organization. Despite epidemiologic studies establishing a number of risk factors for breast cancer, additional research is needed to elucidate environmental exposures that increase breast cancer risk. In this study, we used highly informative, existing pregnancy cohort biospecimens with an untargeted high-resolution mass spectrometry (HRMS) approach to discover possible environmental chemical exposures associated with subsequent breast cancer occurrence.

METHODS: Archived pregnancy samples, collected between 1959-1967, from the Child Health and Development Studies in California, one of the largest prospective pregnancy cohorts, were analyzed and searched against the Toxic Exposome Database (T3DB). The samples included 2nd (T2) and 3rd (T3) trimester archival samples of 182 women who subsequently developed breast cancer, compared to T2 and T3 samples from 384 women who did not develop breast cancer. Metabolites and environmental chemicals extracted from 50 µL aliquots of thawed pregnancy serum (n=1,148) were analyzed by HRMS with liquid chromatography followed by advanced data extraction, annotation and pathway enrichment analysis.

RESULTS: A large number of mass spectral features differed between cases and controls at $p<0.05$. Annotation of the discriminatory metabolites with T3DB showed increased abundance of accurate mass matches (within 5 ppm) to methylmercury and the organophosphate insecticide, tebupirimfos, in both T2 and T3 breast cancer cases compared to controls ($P<0.05$). Additional verification of chemical identities is ongoing. Available literature is mixed for mercury association with breast cancer; however, methylmercury has been found to stimulate proliferation of breast cancer cells in culture.

CONCLUSIONS: In addition to a significant metabolic disruption, exposure to methylmercury or/and organophosphate insecticide during pregnancy is associated with subsequent breast cancer risk.

KEYWORDS: Breast cancer, environmental chemical exposure, metabolic disruption, high-resolution metabolomics, pregnancy.

ORAL PRESENTATIONS SESSION 07: Exposure assessment for chemicals and PFAs

O-OP-035 Exposure assessment of per- and polyfluoroalkyl substances (PFAS) and disinfection by-products (DBPs) in drinking water during pregnancy

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BACKGROUND AND AIM: Prenatal exposure to per- and polyfluoroalkyl substances (PFAS) and disinfection by-products (DBPs) have been linked to multiple adverse birth outcomes in epidemiological studies. The aim of this study was to comprehensively assess exposure to these chemicals in drinking water during pregnancy in the Barcelona Life Study Cohort (BiSC).

METHODS: A total of 1086 pregnant women living in the Barcelona Metropolitan area were recruited at the first trimester of pregnancy and followed by surveys until delivery (2018-2021). Water ingestion habits were ascertained at the first and third trimesters through questionnaires. Tap water samples were collected in a subset (N=105) during the 3rd trimester to analyze 35 PFAS. Routinely monitored DBPs (trihalomethanes, THMs) were obtained from the local public health authority for the pregnancy period (N=183). PFAS and DBPs concentrations were modelled based on geolocation and temporal variation to predict concentrations in the residential water supply of each participant from conception until delivery.

RESULTS: 5/35 PFAS were detected, namely perfluoropentanoic acid (PFPeA), perfluorohexanoic acid (PFHxA), perfluoroheptanoic acid (PFHpA), perfluorobutane sulfonic acid, (PFBS), and perfluorooctane sulfonic acid (PFOS), at median (Interquartile range; IQR) concentrations (ng/L), respectively, of 5.7(4.3-8.3), 12.0(10.5-12.0), 3.4(2.5-4.7), 8.3(7.2-10.5), and 13.0(11.8-14.0). Median (IQR) concentrations (µg/L) of THMs were 18.6(7.3-27.6) for chloroform, 9.4(5.6-12.4) for dibromochloromethane, 6.4(2.9-10.3) for bromodichloromethane, and 26.1(16.2-36.0) for bromoform. Drinking water consumed at home was bottled (64.8%), filtered (22.9%), and tap water (12.3%). Water used for cooking was from tap (78.4%), filtered (15.7%), and bottled water (0.6%). Individual exposure estimates by trimester and for the whole pregnancy will be calculated using residential levels multiplied by amount and type of water consumed.

CONCLUSIONS: The study population is exposed to relatively low concentrations of PFAS in drinking water, and THMs have a significant component of brominated species.

KEYWORDS: drinking water; PFAS; disinfection byproducts; exposure assessment.

O-OP-036 An assessment of health risks posed by consumption of pesticide residues in fruits and vegetables among residents in the Kampala Metropolitan Area in Uganda

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BACKGROUND AND AIM: Pesticide use for fruits and vegetable production in Uganda may result in presence of residues on produce which may pose health risks to consumers. This research aimed at conducting a health risk assessment of presence of pesticide residues in fruits and vegetables in Kampala Metropolitan Area, Uganda.

METHODS: Pesticides were measured in 160 fruits and vegetables samples were analysed using liquid chromatography-tandem mass spectrometry. Fruit and vegetable consumption information was collected from 2,177 people. Pesticide concentrations were compared with European Union maximum residual limits (MRLs). Mean values of pesticide concentrations; and fruits and vegetables intake and body weight were used to calculate the estimated daily intake (EDI) of pesticide residues. EDI values were compared with acceptable daily intakes (ADI) to calculate the hazard quotient by age group, and stage of consumption along the chain.

RESULTS: Concentrations of fonofos, fenitrothion and fenhexamid were above the European Union MRLs in some samples. Hazard quotients based on dietary ingestion scenarios for eighteen pesticides, including dichlorvos (444) alanycarb (314), fonofos (68), fenitrothion (62), dioxacarb (55) and benfuracarb (24) and others, were above 1, indicating the possibility of chronic health risk to consumers. Chronic health risk decreased with age but was stable for stage at which consumption happens along the food chain. The number of pesticides with EDI greater than the ADI decreased with increase in age; with 18, 13, 9, 11, 8, 9, and 9 pesticides for age groups <5, 5-12, 13-19, 20-25, 36-49 and ≥50 respectively.

CONCLUSIONS: Chronic dietary pesticide exposures to Ugandans are likely common, and for some pesticides results in exposure exceeding health-based benchmarks. Risks were highest for younger participants. There is urgent need to increase monitoring and regulation of pesticides in fruits and vegetables in order to protect consumers, especially children who are more vulnerable to adverse health effects.

O-OP-037 Incorporating land use and wind direction in assessment of residential exposure to agricultural herbicides

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ORAL PRESENTATIONS SESSION 07: Exposure assessment for chemicals and PFAs, MC3.3 Hall, September 19, 022, 1:15 PM - 2:45 PM

BACKGROUND AND AIM: Few studies have incorporated land use or wind direction in agricultural pesticide exposure metrics. Using the California Pesticide Use Reporting (PUR) database, we evaluated agricultural herbicide applications and herbicide concentrations in carpet dust before and after accounting for land use and wind direction.

METHODS: We measured concentrations (ng/g) of 2,4-dichlorophenoxyacetic acid (2,4-D), trifluralin, simazine, and glyphosate (µg/g) in carpet dust samples from 598 California homes. We determined PUR use (reported at ~1 mile²) within 0.5-, 1-, 2-, and 4-km radial buffers around homes and calculated density of use (kg/km²) 30-, 60-, 180-, and 365-days before sampling. for land use metrics, we apportioned herbicide applications to the land area of crop fields within the buffers. for wind metrics, we weighted applications by the proportion of days between application and dust collection that the home was 90° downwind of the application. We modeled natural-log transformed dust concentrations using Tobit regression adjusting for season/year, occupation, and home/garden uses.

RESULTS: Detections were 60% for trifluralin and >90% for 2,4-D, simazine, and glyphosate. for each herbicide, we found similar increases in dust concentrations with increasing densities for all time periods and buffers and comparing the PUR metric to the land use and wind metrics. The highest tertiles of glyphosate use (365-days) were associated with ~2-fold higher dust concentrations compared to homes without applications within 0.5km (PUR-365-day eβ=2.02, 95%CI=1.34-3.04; land use: eβ=1.51, 95%CI=0.95-2.39; wind: eβ=2.25, 95%CI=1.50-3.37) and 4km (eβ=2.09, 95%CI=1.53-2.85; land use: eβ=2.20, 95%CI=1.60-3.05; wind: eβ=1.94, 95%CI=1.43-2.65). Compared to homes without applications, the highest tertiles of 2,4-D, simazine, and trifluralin applications within 4km (365-days) were associated with 2-, 3.5-, and 6.8-fold higher concentrations, respectively; the magnitude for each was similar across all metrics.

CONCLUSIONS: Agricultural herbicide use was an important determinant of indoor contamination up to 4km from homes.

KEYWORDS: Pesticides; Agriculture, GIS, Exposure assessment

O-OP-038 Pilot study of consumer product chemicals measured using silicone wristband monitors

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BACKGROUND AND AIM: The assessment of human exposure to chemical constituents of personal and household care products is an enormous challenge. It is hindered by the vast array of products, considerable variability in formulations, and ubiquitous use. The U.S. Environmental Protection Agency's Office of Research and Development partnered with the National Institute of Environmental Health Sciences to evaluate effective exposure assessment strategies, with an emphasis on novel and non-traditional methods.

METHODS: The consumer product use of nine female, nonsmoking participants was monitored over a 10-day period. Biological and environmental samples were collected, including silicone wristbands used as personal monitors. A suite of chemicals, including many commonly associated with consumer products, was measured via a contract with Oregon State University (OSU). Wristbands were extracted using thermal and liquid methods, and a wide range of analytes were measured using GC/MS, including 1400 chemicals using OSU's multiple analyte quantitative screening method.

RESULTS: Only about 60 compounds out of more than 1400 were detected using the quantitative screening method. However, among the compounds with at least one detected measurement were phthalates, personal care product ingredients, and flame retardants, which were detected at frequencies of 52%, 41%, and 32%, respectively.

CONCLUSIONS: Wristband samplers hold considerable promise as a personal and low-burden sampling method that identifies a broad swath of chemicals to which we are exposed. However, to realize this potential, careful consideration needs to be given to sampling duration. Despite far fewer compounds being detected using silicone wristband samplers over a ten-day period than expected, several compounds associated with personal care products were measured with relatively high detection frequencies. Moreover, as several of these compounds are not typically measured in exposure studies, these results are expected to inform future studies of exposure to chemical constituents of consumer products. This abstract does not reflect EPA policy.

O-OP-039 A healthy and diverse diet and the association with perfluoroalkyl acids (PFAA) concentrations in Swedish adolescents

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BACKGROUND AND AIM: Food is a major exposure source of perfluoroalkyl acids (PFAA) for adult populations, yet said relationship has rarely been studied in adolescent populations. Considering the role of a healthy diet as a major positive influence on health and consequent development, we studied the association between legacy PFAA concentrations in serum and a healthy eating index (SHEIA15) and diet diversity score (RADDS) amongst Swedish adolescents.

METHODS: Serum samples of adolescents (age 10-21, n=1098), from the nationally representative dietary survey Riksmaten Adolescents 2016-17 (RMA), were analysed by liquid chromatography tandem-mass spectrometry. Consumption of individual food groups and composited dishes were captured using both food frequency questionnaires and dietary registrations. The associations were analysed by fitting the cumulative probability model using ordinal regression.

RESULTS: Median concentrations of <1 ng/g serum were observed for perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), perfluoroundecanoic acid (PFUnDA), linear (lin) perfluorohexanesulfonic acid (PFHxS) and branched (br) perfluorooctanoic acid (PFOS), and ranging between 1-2 ng/g serum for lin-perfluorooctanoic acid (PFOA) and lin-PFOS (n=1098). Those adhering to a healthier, as well as a more diverse diet as suggested by SHEIA15 and RADDS, had significantly higher serum PFNA, PFDA, PFUnDA and lin-PFOS concentrations. Given the correlation between SHEIA15/RADDS and habitual consumption of fish and seafood, as well as the positive association between fish consumption and serum PFNA, PFDA, PFUnDA and lin-PFOS, seafood consumption was likely a major driver behind the observed associations. The lack of association for br-PFOS and both SHEIA15/RADDS suggest isomeric differences in PFOS exposure sources.

CONCLUSIONS: We conclude that more research is needed for understanding the relationship between healthy eating and the corresponding health implications from a PFAA exposure perspective.

KEYWORDS: Human biomonitoring, dietary index, fish, healthy diet, PFAS

O-OP-040 Cumulative risk assessment and exposure characteristics of parabens in the general Taiwanese using multiple hazard indices approaches

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BACKGROUND AND AIM: Parabens, a group of endocrine disrupting chemicals (EDCs), are well known preservatives in personal care products (PCPs). However, studies on parabens exposure and their cumulative effects in Asian population are limited. This study aimed to identify the exposure characteristics, like PCPs, and estimate the cumulative risk of four parabens in the general Taiwanese.

METHODS: We used urine samples, included 271 adults (18–97 yrs old) and 95 minors (7–17 yrs old), from Taiwan Environmental Survey for Toxicants 2013, and analyzed for four urinary parabens including methyl (MeP)-, ethyl (EtP)-, propyl (PrP)-, and butylparaben (BuP) by using UPLC-MS/MS. The health-based guidance value (HBGV) and the antiandrogenic-based of parabens were used to calculate the hazard index (HI) for cumulative risk.

RESULTS: MeP and PrP were most abundant compounds and startlingly higher than those in other countries. Adults had a higher geometric mean level of four parabens than minors (adults: MeP, 381.7; PrP, 108.6; EtP, 39.6 and BuP 6.3 ng/mL; minors: MeP, 65.7; PrP, 7.9, EtP, 2.6 and BuP 2.2 ng/mL). Participants who used a higher number of personal care products had a significantly higher risk with higher concentrations of PrP (above 75th %tile) [adjusted odds ratio (aOR): 1.78, 95% CI: 1.01–3.15] and BuP [aOR: 1.80, 95% CI: 1.04–3.11]. The median and 95th %tile HI (the sum of the HQs of each paraben) was as 1.10 and 4.39-fold higher than acceptable cumulative threshold (HI <1) and PrP accounted for 90% of the HI.

CONCLUSIONS: Our results indicate omnipresent exposure to parabens among the Taiwanese, which might cause certain level of concerns. These significant increasing trends of HI with age dependence were observed, which mainly driven by PPCPS used. Routine survey of parabens in PPCPs and continued biomonitoring needs to be urgently addressed.

KEYWORDS: personal care products; hazard index; cumulative risk assessment

ORAL PRESENTATIONS SESSION 08: Child health and exposure to phthalates

O-OP-041 Mixtures of phthalates and phthalate replacements in relation to size-for-gestational age in the LIFECODES Fetal Growth Study

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BACKGROUND AND AIM: Phthalate exposure has been previously associated with reductions in fetal growth, including small-for-gestational age (SGA) births. Little is known about how phthalate replacements may be associated with adverse growth outcomes, including changes at both the small and large ends of the growth spectrum. Thus, we estimated joint associations between phthalates and their replacements with size-for-gestational age, including both SGA and large-for-gestational age (LGA) births.

METHODS: Using the LIFECODES Fetal Growth Study, a case-cohort of 249 SGA, 411 appropriate-for-gestational age (AGA), and 241 LGA births, we measured concentrations of metabolites for 13 phthalates and 4 phthalate replacements at three timepoints during pregnancy. We used quantile g-computation as a multipollutant approach to estimate the joint association between phthalates or phthalate replacements and the odds ratios (OR) (95% confidence intervals [CI]) of an SGA or LGA birth.

RESULTS: of the metabolites analyzed, 12 phthalate and 2 phthalate replacements were detected frequently (> 70% of participants). The highest correlations were observed within chemical classes. Phthalate replacement metabolites were negatively correlated with phthalate metabolites. A simultaneous one-quartile increase in the concentrations of all phthalate replacement metabolites was associated with higher odds of an SGA birth (OR: 1.33, 95% CI: 1.13, 1.57) and inverse, though null, associations were observed for phthalate metabolites (OR: 0.82, 95% CI: 0.64, 1.07). Associations with LGA births were generally inverse or null. Single-pollutant models were consistent with our mixtures results. for example, an interquartile range-increase in concentrations of the phthalate replacement metabolite mono-2-ethyl 5-carboxypentyl terephthalate (OR: 1.64, 95% CI: 1.25, 2.15) was associated with higher odds of an SGA birth.

CONCLUSIONS: Phthalate replacements were associated with higher odds of an SGA birth. Given the increasing prevalence of exposure to phthalate replacements, further research should continue to examine their health impacts.

KEYWORDS: phthalates, phthalate replacements, fetal growth, mixtures

O-OP-042 Associations of pregnancy and early childhood phthalate exposures with adolescent lipid levels and insulin resistance: The HOME Study

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BACKGROUND AND AIM: Early-life phthalate exposures may disrupt metabolism, but few prospective studies have assessed their association with cardiometabolic outcomes during adolescence. We investigated associations of pregnancy and childhood urinary phthalate biomarker concentrations with serum lipids and insulin resistance at age 12-years.

METHODS: We used data from 183 mother-adolescent pairs in a prospective cohort study that enrolled pregnant women in Cincinnati, OH from 2003-2006. We quantified nine phthalate metabolites in spot urine samples collected twice from mothers during pregnancy and up to seven times from children at ages 1-5, 8, and 12 years. at age 12 years, we assessed triglycerides, high-density (HDL) and low-density (LDL) lipoprotein cholesterol, insulin, and glucose from fasting serum samples and calculated homeostatic model assessment of insulin resistance. Using a multiple informant model, we estimated covariate-adjusted associations between phthalate concentrations at each time period and cardiometabolic biomarkers at age 12 years and assessed modification by child sex.

RESULTS: Overall, we observed weak or null associations of phthalate biomarker concentrations with lipid levels and insulin resistance. Urinary Monoethyl (MEP), Mono-n-butyl (MnBP), Mono-isobutyl (MiBP), and Monobenzyl (MBzP) biomarkers were generally associated with lower LDL at age 12 years. for example, a 10-fold increase in 4- and 12-year MEP was associated with -15.3 mg/dL (95% CI: -27.5, -3.13 mg/dL) and -11.8 mg/dL (-22.0, -1.51 mg/dL) lower levels of 12-year LDL, respectively. Inverse associations were generally stronger in females than males. for example, a 10-fold increase in 3-year MEP concentrations was associated with 12.0 mg/dL (95% CI: -7.11, 31.1 mg/dL) higher LDL levels in males and -30.4 mg/dL (95% CI: -50.9, -9.83 mg/dL) lower LDL levels in females.

CONCLUSIONS: Early-life phthalate concentrations may be associated with exposure period- and sex-dependent differences in LDL during early adolescence in this cohort.

KEYWORDS: Children’s health, metabolic disruptors, phthalates, insulin resistance, lipids

O-OP-043 Parental Exposure to Phthalates and Children's Behavior: Results from the PEACE Study

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BACKGROUND AND AIM: Emerging evidence suggests that preconception environmental exposures, including phthalates, affect offspring health. There are few studies examining associations of paternal and maternal preconception phthalate exposure with children's neurodevelopment, as most focus on maternal prenatal exposures. This study aims to explore this window of exposure.

METHODS: Since 2019, children whose parents attended a Boston fertility clinic were recruited in the Preconception Environmental exposure and Childhood health Effects (PEACE) study. for 12 phthalate metabolites, we calculated specific gravity-adjusted geometric-means in the preconception (mother and father) and prenatal periods (mother only). We used linear regression to estimate covariate-adjusted differences in Behavioral Assessment System for Children-3 (BASC-3) Externalizing, Internalizing, and Behavioral Symptom Index (BSI) scores per log e increase in specific gravity standardized urinary phthalate metabolite concentrations. Higher BASC-3 scores indicate more problematic behaviors.

RESULTS: As of March 2022, 112 children aged 6-11 years (mean: 9.7 years) and their 187 parents enrolled in the ongoing PEACE study. They all completed BASC-3 questionnaires and provided preconception and/or prenatal urines. Men and women provided a median of 1 preconception sample, and women provided a median of 2 prenatal samples. Higher maternal preconception MBP, MBzP and MiBP concentrations were associated with 2.3 (95% CI: 0.3, 4.3), 2.3 (95% CI: 0.7, 3.9) and 2.5 (95% CI: 0.8, 4.1) point increases in externalizing scores, respectively. Higher maternal preconception MBzP (β: 2.0; 95% CI: 0.51,3.4) and MiBP (β: 2.2; 95% CI: 0.6, 3.8) concentrations were also associated with higher BSI scores. Higher maternal urinary MBzP during pregnancy was associated with a 2.9 (95% CI: 1.2, 4.6) point increase in externalizing scores. Paternal preconception phthalate metabolites were not associated with BASC-3 scores.

DISCUSSION: Women's preconception and prenatal concentrations of some phthalates were associated with more problematic child behaviors. Paternal preconception concentrations of phthalate metabolites were not associated with children's behavior.

O-OP-044 Associations between bisphenols and onset of puberty: the Hokkaido Study

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BACKGROUND AND AIM: Bisphenols are class of chemicals with concern about endocrine disrupting properties. Associations between bisphenol levels with children's timing of puberty as well as reproductive and steroid hormone levels at pubertal age are not well known. The aim of this study is to assess bisphenol levels in urine and their association with puberty onset and reproductive hormones at pubertal age.

METHODS: The Hokkaido Study is an ongoing birth cohort. at age 9-11 children living in Sapporo area were asked to visit pediatrician for face-to-face health check-up, and blood and urine samples were collected. Seven bisphenols in urine were measured by GC/MSMS, 14 steroid hormones in plasma by LC/MSMS, and reproductive hormones by ELISA, respectively. Onset of puberty were determined according to LH levels, testosterone and estradiol levels, or menarche (girls only). Specific gravity corrected bisphenols with associations between onset of puberty, having menarche, and hormone levels were examined by logistic regression models, and linear regression models. Both bisphenols and hormones were log-natural transformed and adjusted for age and BMI after stratified by sex.

RESULTS: In this study, 230 boys and 197 girls were included. Median levels of BPA, BPS, and BPF were 514, 81.0, and 42.0 pg/mL, respectively, with their detection frequency >65%. None of bisphenols was associated with onset of puberty, nor menarche. Among boys, positive associations were found between BPA and androstenedione, BPS and corticosterone, whereas BPA and FSH, and BPS and inhibin B were inversely associated. Among girls, BPA was positively associated with 11-deoxycortisol and corticosterone.

CONCLUSIONS: Although a few significant associations suggest bisphenols' hormone-disrupting effects, bisphenols are unlikely to affect the phenotypic timing of secondary sexual onset. The results should be interpreted with caution, as the study has a cross-sectional design.

KEYWORDS: bisphenols, puberty, reproductive hormones, steroid hormones

O-OP-045 Effects of Prenatal Phthalate Exposure on Early Childhood Expressive Language Development Trajectories

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BACKGROUND AND AIM: Phthalates are common endocrine disruptors that can impair neurodevelopment. We investigated potential links between prenatal exposure to phthalates and child language development trajectories given prior inconsistent evidence across individual phthalates.

METHODS: We investigated fourteen urinary phthalate metabolites, measured in maternal urine during pregnancy, and child expressive language scores from the Mullen Scales of Early Learning (MSEL) at 6, 12, 24, and 36 months in 231 children from an enhanced autism-risk cohort (19% with autism): Early Autism Risk Longitudinal Investigation (EARLI), born 2009 - 2013 from California, Maryland, and Pennsylvania. We used multiple imputation to handle missingness in MSEL (~37%) and phthalates (~9%), and assigned children to six distinct expressive language trajectories after selecting the latent class growth analysis model with best goodness-of-fit measures. We estimated relative risk ratios (RRR) of being in different language trajectories ("high growth" as reference) associated with two-fold change in creatinine adjusted phthalates using multinomial logistic regression with Firth correction, adjusting for child sex, birth season, income, and maternal age, race, and education.

RESULTS: Some low molecular weight phthalates were associated with sub-optimal language trajectories, e.g. RRRs of 1.33 or higher for mono-2-hydroxy-iso-butyl phthalate, peaking at 1.51 (1.02, 2.24) for the delayed growth low trajectory. In contrast, some high molecular weight phthalates exhibited protective effects for delayed growth trajectories but adverse effects for plateau and tracking trajectories: e.g. mono-isononyl phthalate with RRR 0.72 (0.59, 0.89) with delayed growth low but 1.29 (1.08, 1.53) with the tracking low trajectory. Some phthalates exhibited null patterns.

CONCLUSIONS: Prenatal phthalate exposure may impact the trajectory of expressive language development in early childhood, with differences by individual phthalates, perhaps by molecular weight group. We observed adverse and protective influences of phthalates that may be influenced by small numbers in each trajectory class.

KEYWORDS: phthalates, language development, trajectory analysis

ORAL PRESENTATIONS SESSION 09: Climate change: Health Impact Assessment and intervention policies

O-OP-046 Extreme Heat Public Health Preparedness Planning and Response Activities in the Most Populous Jurisdictions in the United States: Survey

RESULTS: Jeremy Hess[1], Cat Hartwell[1], Juliette Randazza[1], Quinn Adams[2], Amruta Nori-Sarma[2], Keith Spangler[2], Yuantong Sun[2], Kate Weinberger[3], Gregory Wellenius[2], Nicole Errett[1]
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BACKGROUND AND AIM: Extreme heat causes more deaths each year than any other type of extreme weather in the U.S. Urban populations can experience heightened heat risk as a result of hazard amplification from the built environment and other factors. Climate change is increasing extreme heat exposure, prompting the need for adaptation measures at all levels of governance. Our study aimed to assess the level and type of heat preparedness and response activities occurring in U.S. jurisdictions with populations of 200,000.

METHODS: We developed and administered an online survey to public health and emergency management agencies in 99 jurisdictions representing municipalities and counties in the US with populations of at least 200,000 people. Survey questions explored heat adaptation activity implementation, including presence or absence of a written heat action plan (HAP), timing of HAP development and updates, critical HAP components, and facilitators and barriers surrounding heat activities.

RESULTS: 38.4% (38) jurisdictions responded to the survey. of those, 60.5% reported having a formal HAP. There was considerable variability in the prevalence of various prevention activities. Jurisdictions with HAPs reported higher engagement in several heat-related activities, including communications about extreme heat, surveillance of heat-related health conditions, and providing climate-controlled shelter for populations experiencing homelessness, compared to jurisdictions without HAPs. The most prevalent communication and outreach modalities were social media, news alert, and internet, which may be less likely to reach populations identified as the most vulnerable to extreme heat (low income, elderly, and people experiencing homelessness).

CONCLUSIONS: Jurisdictions with formal HAPs broadly reported more engagement in heat adaptation activities. Results indicate reliance on lower-cost outreach strategies that may not adequately reach some at-risk populations. Health departments and emergency agencies should consider establishing HAPs as temperatures rise.

KEYWORDS: Extreme heat, climate change, adaptation, public health preparedness

O-OP-047 A Novel Decision-Support Tool for Estimating Local Climate Change Health Risks: Current and Projected Heat-Related Risks in Washington State

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BACKGROUND AND AIM: Climate change presents a variety of health risks. These risks are location-specific and determined substantially by population vulnerability. There is a need to develop and validate risk assessment and management tools tailored to individual geographies and hazards. Therefore, the UW Center for Health and the Global Environment (CHanGE) has collaborated with local partners to create an interactive tool for estimating current and future health risk associated with climate-sensitive hazards. The approach is piloted using heat in Washington State (WA) which has emerged as an important priority following the unprecedented Pacific Northwest 2021 heat dome.

METHODS: Predicted census-tract heat-health risk (PHHR) is modeled using fuzzy logic. Heat vulnerability indicators were selected from published literature and constructed into a hierarchical model using fuzzy logic conversions and operators. Heat hazards are modeled for 1979-2020 and 2045-2055. Modeled PHHR in WA is compared against established WA environmental hazard indices using rank correlation analysis.

RESULTS: The CHanGE tool displays public-facing, interactive maps alongside associated fuzzy logic models enabling users to visualize distributions of PHHR for historic and projected hazards and determine local PHHR drivers. Historically, high PHHR tracts are concentrated in central WA. Given the predicted rise in temperature, PHHR increases statewide in our projections. Initial findings from a comparison against established hazard indices indicate the CHanGE tool outputs similar risk patterns across WA; however, hazard specific indicators may modify risk locally.

CONCLUSIONS: The CHanGE tool's ability to support transparent, flexible visualizations and allow users to interactively explore local drivers of PHHR fills a gap in climate risk assessment and decision-support. Future development will be focused on model validation and calibration against observed data, and expansion to other hazards and geographies. Recent updates and additions to the tool will also be presented.

KEYWORDS: Climate and Health, Fuzzy Logic, Risk Assessment, Decision-Support, Heat

O-OP-048 Inequalities in drought effects on non-external, circulatory, and respiratory mortality in the population of macro urban areas of Brazil

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BACKGROUND AND AIM: Drought poses a threat to the health, safety, and livelihood of many populations worldwide. The urban population of Brazil is especially vulnerable to drought exposure but the effect of this phenomenon on mortality risk across the population is unknown. Our objective was to assess the drought impact on non-external, circulatory, and respiratory mortality in the urban population of Brazil exploring the populations at potential risk.

METHODS: A two-stage time-series analysis was conducted in 13 macro urban areas of Brazil between 2000 and 2019. We applied quasi-Poisson regression models adjusted by temperature to assess the short-term association between drought (measured by the Standardized Precipitation Evapotranspiration Index) and weekly non-external, circulatory, and respiratory mortality in each location. Then, we fitted independent multivariate meta-analytical models for each cause of death to pool individual estimates and obtain overall risks. We also included stratified analysis by sex and age groups (0-9, 10-44, 45-64, 65-74, ≥75). Relative risks (RRs) and attributable fractions were calculated for different drought severity levels.

RESULTS: Overall, a positive but no significant association between drought exposure and mortality risk was found in the total population with RRs varying from 1.003 [95%CI: 0.999-1.007] to 1.010 [0.996-1.025] for non-external mortality associated with moderate and extreme drought, respectively; 1.002 [0.997-1.007] to 1.008 [0.991-1.026] for circulatory mortality; and 1.004 [0.995-1.013] to 1.013 [0.983-1.044] for respiratory mortality. However, a significant positive association was found in females for all causes of death analysed. According to age groups, we found strong effects in the elderly and children. Moreover, heterogeneity was observed between Brazilian locations.

CONCLUSIONS: Our findings suggest that drought affects the urban population of Brazil unequally, disproportionately affecting females, the elderly, and children. However, action measures should be designed ad hoc according to the specific characteristics of each region.

KEYWORDS: drought; mortality; Brazil, urban population; gender assessment

O-OP-049 The impact of climate change on agricultural labour productivity: implications for human mobility and poverty

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BACKGROUND AND AIM: Working in hot or cold environments causes discomfort, fatigue, and cognitive impairment, raising the risk for health complications. The present study developed a new model to estimate the impact of ambient conditions on labour productivity based on field data and applied this model to predict the welfare implications of climate change by estimating the labour productivity change between the years 2000 and 2040.

METHODS: In total, we monitored 1,260 hours of work performed by 194 (men=123; women=71) experienced and acclimatized agriculture workers from 10 nationalities. Time-motion analysis using video recordings was used to extract detailed information on each worker's activities during their work shift. Sine orthogonal distance regression was used to generate the labor loss functions for WBGT and air temperature. Using this model, we projected the welfare implications across the globe of climate change by estimating the labour productivity change between the years 2000 and 2040, using an extended unified general equilibrium framework combining labour mobility and trade interactions between locations.

RESULTS: Our findings reveal an inverted U-shaped relationship with the highest labour productivity observed at 15 °C WBGT or ambient temperature (R2 0.95-0.98). By applying this model to project global welfare implications, we found that the ongoing climate change is expected to impair agricultural labour productivity, promoting significant labour mobility and wealth redistribution across the globe. In contrast to cold regions, which are projected to have average gains up to 6.3%, regions located close to the equator, where poverty is widespread, will face average losses up to 1.2% in productivity and wealth.

CONCLUSIONS: Our projections show larger labour productivity losses in countries where poverty is widespread and the economy is heavily dependent on the agricultural sector. This creates concerns over whether the 1st Sustainable Development Goal involving eradication of poverty can be achieved by 2030.

ORAL PRESENTATIONS SESSION 10: Air pollution and neurobehavioural outcomes

O-OP-050 Lifetime Residential Air Pollution Exposure, Amygdala Volumes, and Emotional Function in Young Adults

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BACKGROUND AND AIM: Air pollution (AP) exposure at differing timepoints across life has been linked to adverse mental health conditions. However, the effects of lifetime exposure to AP on emotional behavior and related functional regions of the brain are not well understood. Therefore, we investigated the effect of lifetime AP exposure on emotional behaviors and associated amygdala volumes in young adults.

METHODS: We recruited 39 participants in a follow up to the Children's Health Study. We performed structural brain Magnetic Resonance Imaging (MRI) and assessed emotional behavior using the Achenbach System of Empirically Based Assessment Adult Self Report questionnaire. Lifetime exposure to particulate matter with aerodynamic diameter <2.5µm ($PM_{2.5}$) and <10µm (PM_{10}), ozone (O_3), and nitrogen dioxide (NO_2) were assessed using inverse distance square weighted interpolation from ambient monitoring data and the Di et al. (2019, 2020) and Requia et al. (2020) spatiotemporal models. We fit linear regression models to estimate the association between lifetime AP exposure (from birth to ~21 years at MRI scan) and emotional behaviors and amygdala volumes, adjusting for key covariates.

RESULTS: Participants were largely Hispanic (38%) and Non-Hispanic White (44%), with a mean (SD) age of 21.6 (0.9) years. We found a SD increase in $PM_{2.5}$,sptmp was associated with a 100.60 mm^3 (95% CI: 13.76 –187.45) increase in total amygdala volume after accounting for total cranial volume, which remained after adjustment for O_3,sptmp. Additionally, a SD increase in O_3,sptmp (β = 12.53, 95% CI: 5.31 -19.74; p =0.001), PM_{10} (β = 17.01, 9.67 –24.34; p <0.001), and $PM_{2.5}$ (β = 11.58, 4.20 –18.96; p =0.003) was significantly associated with greater total emotional problems.

CONCLUSIONS: Lifetime exposure to ambient air pollution is linked to both structural differences in the key emotional brain region of the amygdala as well as greater impairments in emotional functioning in early adulthood.

O-OP-051 Metals mixture is associated with cognitive function in older U.S. adults: the National Health and Nutrition Examination Survey (NHANES) 2011–2014

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BACKGROUND AND AIM: Non-essential metals (e.g., cadmium and lead) have adverse effects and essential metals (e.g., selenium) have protective effects on cognitive function. Mixture effects, including interactions and non-linear relationships, have rarely been evaluated. We examined the association of blood metal markers with cognitive function in older U.S. adults using mixture approaches.

METHODS: We examined 1825 participants aged ≥60 years who had complete data on blood metal, cognitive function tests, and covariates in the National Health and Nutrition Examination Survey 2011-2014. Lead, cadmium, total mercury, manganese, and selenium measured in whole blood were included. Four measures of cognitive function (Consortium to Establish a Registry for Alzheimer's Disease (CERAD) word learning, CERAD recall, animal fluency, digit symbol substitution test) were standardized and averaged to create a composite cognitive z-score. Bayesian kernel machine regression (BKMR) was the primary approach for assessing the overall mixture effects. Quantile g-computation was used to evaluate the robustness of the mixture effects. for both approaches, mixture effects were estimated of increasing octiles of lead, cadmium, mercury, and manganese concentrations and decreasing octiles of selenium concentrations.

RESULTS: In BKMR adjusted for covariates, the relationship between cadmium and cognitive z-score was a non-linearly decreasing curve, while selenium showed a non-linearly increasing curve [change in z-score per interquartile increase (95% CI): -0.03 (-0.06, 0.00) and 0.02 (-0.01, 0.05), respectively]. No significant interactions between the exposures were observed. In the mixture analysis, a quantile increase in lead, cadmium, mercury, and manganese and a quantile decrease in selenium simultaneously were associated with lower cognitive z-scores [change in z-score per interquartile change (95% CI): -0.06 (-0.11, -0.01)]. Similar mixture effects were observed in quantile g-computation.

CONCLUSIONS: Exposure to higher levels of cadmium and lower levels of selenium may be associated with lower cognitive function in older adults.

KEYWORDS: cadmium, selenium, cognitive decline, BKMR

O-OP-052 Early life metal exposure is associated with reduced fractional anisotropy in the corpus callosum in children

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BACKGROUND AND AIM: The corpus callosum (CC) is the largest white matter structure in the brain, connecting the left and right hemispheres into functional networks subserving cognition and behavior. Neuroimaging studies demonstrate rapid CC development during the first years of life. During these early-life critical windows, the CC is vulnerable to perturbation by neurotoxicants including heavy metals. Most environmental studies consider single neurotoxicant exposures at a single time point, potentially missing the effects of joint exposure across a developmental stage. Here, we investigated associations between early life metal mixture exposure and CC white matter microstructure integrity in children.

METHODS: In a preliminary analysis of 47 children (8-13 years; 22 females) enrolled in a neuroimaging substudy within the Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) study, we estimated weekly exposure (22nd-week gestation through 43rd week postnatal) to manganese (Mn), zinc (Zn), and lead (Pb) using laser ablation-inductively coupled plasma-mass spectrometry of teeth. We estimated CC white matter microstructure integrity using fractional anisotropy (FA) from diffusion tensor imaging (DTI) acquired in a 3T Siemens scanner. We used lagged weighted quantile sum (lWQS) regression to estimate the time-varying mixture effect on FA in the CC.

RESULTS: A higher metal mixture index in the 24th-43rd postnatal weeks was associated with decreased FA in the CC genu, body, and splenium (maximum β = -0.65 [95% CI -0.25, -1.07]), driven mainly by Zn and Pb.

CONCLUSIONS: The CC may demonstrate a postnatal critical window to metals, with higher exposure to Zn and Pb associated with reduced FA. These results may help understand the role of exposure timing in driving neurodevelopmental outcomes, pointing to future optimal and timely public health interventions.

O-OP-053 Prenatal/Early-Life Exposure to Polycyclic Aromatic Hydrocarbons (PAHs) and Adverse Neurodevelopment Outcomes in Children: A Systematic Review and Meta-Analysis

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BACKGROUND AND AIM: Research indicates prenatal/early-life exposure to PAHs may be associated with adverse neurodevelopment outcomes, but there are conflicting research results. A weight of evidence approach is needed.
OBJECTIVE: Summarize eligible evidence of prenatal/early-life PAH exposure on neurodevelopment outcomes in children.

METHODS: Using a priori search strategy, we conducted a systematic review (SR) to identify eligible peer-reviewed studies in English, in PubMed, Wed of Science, and Google Scholar. Eligible studies modeled or measured PAH exposure during pregnancy or at least six months prior to neurodevelopment assessment, with no limits on study time-period or geography. Two reviewers, working independently, followed PRISMA protocol. Risk of bias assessment followed Navigation Guide protocol. of 613 studies identified, 26 were included in final meta-analysis. Outcomes were grouped into either dichotomous (summary effect measure: odds ratio) or continuous outcomes (Cohen's d). We report the summary effect size of each outcome, 95%CI, and I2.

RESULTS: We found a statistically significant positive association in dichotomous outcomes between prenatal/early-life PAH exposure and anxiety/depression (OR: 1.36; 95%CI:1.10,1.68; p=0.005; npooled=4,989; I2=73.6%), and in neurodevelopment delay (1.07; 95%CI: 1.01, 1.14; p =0.028; npooled = 1,113; I2 = 30.2%). We found a marginal positive association with attention problems (OR: 1.81; 95%CI:0.96,3.43; p=0.068; npooled=2,997; I2=86.4%). In continuous outcomes, we found a statistically significant negative association in motor skills (Cohen's d: -0.371; 95%CI:-0.52,-0.22; p<0.001; npooled=1,372; I2=96.7%), and in adaptive behavior (-0.142, 95%CI:-0.25,-0.00; p=0.042; npooled = 1,128; I2=84.3%). We did not find an association in intelligence, language skills, social behavior, ADHD, or other behavior problems.

CONCLUSIONS: There is limited human evidence that prenatal/early-life PAH exposure adversely affects neurodevelopment. Between-study variance was low to high. However, limited human evidence of adverse neurodevelopment effects associated with prenatal/early-life exposure to common environmental pollutants is cause for concern.

ORAL PRESENTATIONS SESSION 11: Environmental exposures and emerging outcomes

O-OP-055 Associations between long-term air pollution and kidney diseases in the US Medicare population

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BACKGROUND AND AIM A few studies have reported that long-term exposure to air pollution is associated with an increase in the risk of incident chronic kidney disease (CKD); however, the generalizability of these results was limited due to the non-representative nature of the study populations. This study aimed to provide quantitative evidence on the risk of air pollution on the development of kidney diseases using a nationwide Medicare longitudinal cohort.

METHODS: Over 61 million US Medicare fee-for-service beneficiaries and 34,849 ZIP codes across the continental United States (2000-2016) with data collected from the Medicare Part A fee-for-service (FFS). As exposure variables, annual averages of traffic-related pollutants (fine particles (PM2.5) and nitrogen dioxide (NO2)) were assigned according to the ZIP code of residence of each beneficiary with the use of well-validated prediction models. We estimated the association between long-term exposure to air pollution and first admission with diagnosis codes related to the total kidney disease or CKD, separately, using a two-pollutant Cox-equivalent re-parameterized Poisson model.

RESULTS: The average annual concentrations of air pollution were 9.8 μg/m3 for PM2.5 and 18.9 ppb for NO2. The total number of first admissions related to total kidney disease and CKD were around 19.0 and 5.9 (2000-2016). for total kidney disease, hazard ratios (HRs) were 1.1076 (95% CI: 1.071 to 1.081) for 5 μg/m3 increase in PM2.5 and 1.040 (1.036 to 1.043) for 10 ppb increase in NO2. for CKD, HRs were 1.106 (1.097 to 1.115) for 5 μg/m3 increase in PM2.5 and 1.013 (1.008 to 1.019) for 10 ppb increase in NO2. These positive association between PM2.5 and kidney outcomes persisted at concentrations below national health-based air quality standards.

CONCLUSIONS:We found that annual air pollution levels are associated with development of kidney diseases in the Medicare population.

KEYWORDS: Kidney disease, Air pollution, Medicare

O-OP-056 Chronic Kidney Disease (CKD) and Exposure to Fine Particulate Matter and Ozone: A Cross-Sectional Study Utilizing North Carolina Electronic Healthcare Records

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BACKGROUND AND AIM: Chronic kidney disease (CKD) affects more than 38 million people in the United States, predominantly those over 65 years of age. While CKD etiology is complex, recent research suggests associations with certain environmental exposures. Additional studies are needed to understand the strength of associations. We examine estimated glomerular filtration rate (eGFR) using a random sample of North Carolina electronic healthcare records (EHRs) and potential relationships with $PM_{2.5}$ and O_3.

METHODS: Patient data came from a random sample of 7,065 EHRs within the EPA CARES resource, with recorded serum creatinine concentrations. Patients were seen at a University of North Carolina Healthcare System affiliated hospital or clinic from 2004-2017. We estimated eGFR using CKD-EPI equations. $PM_{2.5}$ data comes from a hybrid model using 1x1 km grids and O_3 data from CMAQ 12x12 km grids. Exposures were annual average $PM_{2.5}$ and O_3 based on the creatinine lab test date. We used multiple linear regression to estimate eGFR per IQR increase of $PM_{2.5}$ & O_3. We adjusted for patient sex, race, age, comorbidities, and 2010 census block group measures of sociodemographic and economic factors.

RESULTS: Patients averaged 55.3 (SD: 16.2) years of age, with 58.3% female. There were 1,001 patients (14.2%) diagnosed with CKD, identified by ICD-9 & 10 codes. Mean concentrations for the study period of $PM_{2.5}$ and O_3 were 9.92 (IQR: 1.61) $\mu g/m^3$ and 40.20 (IQR: 2.53) ppb respectively. eGFR decreased 8.45 mL/min/1.73m² (95% CI: 7.92, 8.98) per IQR increase of $PM_{2.5}$ and a more modest decrease of 0.66 mL/min/1.73m² (95% CI: -.08, 1.40) per IQR of O_3.

CONCLUSIONS: Annual average $PM_{2.5}$, and to a lesser extent O_3, were associated with lower (poorer) eGFR. Future work will examine the relationship between air pollution and onset of CKD and impaired renal function. This abstract does not reflect EPA policy.

O-OP-057 Combined effects of air pollution and neighborhood violence on epilepsy and seizures in children

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BACKGROUND AND AIM: Psychosocial stress and air pollution are being linked to multiple neurological disorders. However, research investigating their impact on epilepsy and seizures is scarce. We examined the combined effects of acute exposures to multiple pollutants and neighborhood violent crime (a critical urban psychosocial stressor) on epilepsy/seizure aggravation among children (0-4 years) in New York City.

METHODS: Using conditional logistic regression in a time-stratified, case-crossover design, we quantified percent excess risk of epilepsy/seizure event per 10-unit increase in daily exposures to PM2.5, NO2, SO2, and O3. Data on epilepsy/seizure cases (n = 28,385), presenting at NYC emergency departments, 2005 to 2011, was obtained from New York Statewide Planning and Research Cooperative System. for each case, residence-specific, year-round, daily average spatio-temporal pollution and temperature exposures were estimated using data from NYC Community Air Survey, and daily EPA pollution and NOAA weather data. Point-level NYPD crime data were aggregated to tract-level annual average rates. Separate models were fit for each pollutant for lag days 0 to 6, controlling for case-day effects of other pollutants, temperature, and humidity, after sensitivity-testing multiple co-pollutant adjustment strategies. Interactions with quintiles of crime rates were assessed.

RESULTS: Strongest main effects were observed for PM2.5 on lag day 1 [β = 2.93 (0.63, 5.28)], lag day 2 [β = 1.79 (-0.28, 3.90)], and lag day 3 [β = 2.47 (0.44, 4.54)]. NO2, SO2, and O3 effects were statistically non-significant. Violence modified PM2.5 effects in opposite-to-hypothesized direction; U-shaped exposure-response observed with violence quintiles 1 and 4 demonstrating the strongest associations across lag days 1-3.

CONCLUSIONS: Acute PM2.5 exposure may be associated with pediatric seizure risk. Greater apparent effects in the lowest and high violence communities need further investigation but could result, in part, from saturation effects in socio-environmental stressor synergism.

KEYWORDS: air pollution, stress, violence, epilepsy, seizure, children

O-SY-129 Metabolome-wide association study suggests antagonistic responses to cadmium and selenium in diseased human lungs

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BACKGROUND AND AIM: Cadmium (Cd) is a toxic environmental metal that binds selenium (Se) and contributes to many lung diseases. Humans have widespread exposures to Cd through diet and cigarette smoking, and studies in rodent models show that Se can protect against Cd toxicities. We performed metabolome-wide association study (MWAS) of Cd and Se in diseased and non-diseased human lungs to test for possible Cd-Se interactions.

METHODS: We analyzed tissue from 31 human lung explants, including 25 from patients with end-stage lung diseases, including idiopathic pulmonary fibrosis, cystic fibrosis, and chronic obstructive lung disease (COPD)/emphysema. We used ICP-MS (Inductively Coupled Plasma Mass Spectrometry) to measure Cd and Se, and liquid chromatography-high-resolution mass spectrometry (LC-HRMS) to conduct metabolomics analysis.

RESULTS: Metabolic pathway associations with Cd were similar to those previously observed in experimental models, including amino acid, lipid and energy-related pathways, many of which were also associated with Se. Two-way hierarchical cluster analysis (HCA) of metabolites associated with Cd revealed separation of individuals according to disease, with COPD/emphysema in the highest Cd cluster, and non-diseased individuals in the lowest Cd cluster. HCA of Se-associated metabolites revealed that COPD/emphysema also clustered by lower Se compared to others. More pathway associations occurred for the ratio of Cd:Se than either Cd or Se alone, suggesting an antagonistic relationship, and network analysis showed that most metabolites were associated with either Cd or Se. A relatively small number of polyunsaturated fatty acids and metabolites associated with inflammatory signaling had high Eigenvector centrality scores, suggesting a central mechanism of antagonistic interaction.

CONCLUSIONS: Overall, the data show that metabolic pathway responses in human lung vary with Cd:Se ratio in a pattern suggesting that Se is antagonistic to Cd toxicity.

KEYWORDS: Human lung disease, environmental metals, metabolic disruption, high-resolution metabolomics.

ORAL PRESENTATIONS SESSION 12: Health impact and risk assessment

O-OP-058 Cooling cities through urban green interventions: A health impact assessment in European cities

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BACKGROUND AND AIM: High ambient temperatures are associated with many health effects including premature mortality. Given the current warming trend due to climate change and the global built environment expansion, the intensification of urban heat islands (UHI) is expected, accompanied by adverse impacts on population health. Urban green interventions can reduce local temperatures. We aimed to estimate the mortality burden that could be attributed to the UHI and the mortality burden that would be prevented by increasing the urban tree cover (Tc) in 93 European cities.

METHODS: We conducted a quantitative health impact assessment (HIA) for the summer (June-August) of 2015 to estimate the impact of the UHI, on natural-cause mortality for adult residents in 93 European cities. In addition, we estimated the temperature reduction resulting by increasing the Tc to 30% for each city and estimated the number of deaths that could be potentially prevented as a result, with the aim of providing decision-makers with usable evidence to promote greener cities. We performed all analyses at a high-resolution grid-cell level (250m x 250m).
FINDINGS: The population-weighted-city-average daily UHI from June to August was 1.5°C (city range 0.5°C - 3.0°C). Overall, 7,053 (95% CI 5,961 - 8,135) premature deaths could be attributable to the UHI (ie, 4.6%, city range 0.2%-16.9% of summer mortality). Increasing the Tc up to 30% at 250m resolution resulted in an average city cooling of 0.4ºC (city range 0.0ºC-1.3ºC). We estimated that 2,597 (95% CI 2,451-2,728) premature deaths (ie, 1.9%, city range 0.0%-11.2% of summer mortality) could be prevented by increasing the average Tc in cities to 30%.
INTERPRETATION: Our results showed the impacts on mortality of the UHI and highlight the health benefits of green infrastructure to cool urban environments, while promoting more sustainable and climate-resilient cities.

KEYWORDS: urban heat island, urban green infrastructure, tree cover density, cooling, mortality, health impact assessment

O-OP-059 A quantitative burden of proof risk function to evaluate environmental risk factors in comparative risk assessments

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BACKGROUND AND AIM: Assessing strength and quantifying risk-outcome relationships is critical for public health prioritization, policy formulation, clinical guidance and to inform personal choices related to modifiable risk factors. While meta-analyses or meta-regressions are often used as an inputs, their use in decision making is often subjective. We introduce the quantitative burden of proof risk function in the context of the Global Burden of Disease comparative risk assessment framework.

METHODS: The burden of proof risk function combines meta-regression mean relationship between exposure and risk with unexplained between-study heterogeneity, adjusted for number of studies. We developed and applied a Bayesian meta regression framework to robustly estimate the mean and burden of proof risk function, allowing for non-linear relationships, and applied this to 197 behavioral, metabolic and environmental risk factor – outcome relationships. Relationships were summarized by a 'star-rating' where 1-star risks had a probability of no association after accounting for between-study heterogeneity, and 2, 3, 4, and 5-star risks indicated a 0-15%, >15-50%, >50-85% and >85% increase in risk, respectively, over the 15%-85% percentiles of exposures of included studies.

RESULTS: Environmental risk factors included in the Global Burden of Disease ranged from 4-star (e.g. sanitation-diarrheal disease) to 1-star (e.g. NO2 – asthma). Across all 197 included risk-outcome pairs, 4%, 7%, 25%, 42% and 23% were 5, 4, 3, 2, and 1-star, respectively. 81% of the 32 included environmental risk factor-pairs, were 2 or 3-star.

CONCLUSIONS: The burden of proof risk function is a cautious interpretation of evidence, incorporating both magnitude and uncertainty in relative risks. Higher risk scores indicate a larger effect and/or a lower probability of results driven by residual confounding or other bias. Risk-outcome pairs with low star ratings indicating substantial between-study heterogeneity may suggest a need for additional studies, especially where exposure and outcome prevalence are high.

O-OP-060 Methods for evaluating environmental health impacts at different stages of the policy process in cities

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BACKGROUND AND AIM: Evaluating the environmental health impacts of urban policies is critical for developing and implementing policies that lead to more healthy and equitable cities. This narrative review aims to (1) identify research questions commonly used when evaluating the health impacts of urban policies at different stages of the policy process, (2) describe commonly used methods, and (3) discuss challenges, opportunities, and future directions.

METHODS: We reviewed the scientific literature on methods to quantify the urban environmental health impacts of policies given research questions. We prioritized articles published in the last five years and included some relevant older papers to illustrate specific knowledge that complements the reviewed papers. Given the diversity of health impact evaluation studies, we separate our discussion by policy stage, following the policy process: diagnosis, design, pilot, implementation, operation, and dismantling.

RESULTS: In the diagnosis and design stages of the policy process, research questions aim to characterize environmental problems affecting human health and estimate the potential impacts of new policies. Simulation methods using existing exposure-response information to estimate health impacts predominate at these stages of the policy process. In subsequent stages, e.g., during implementation, research questions aim to understand the actual policy impacts. Simulation methods or observational methods, which rely on experimental data gathered in the study area to assess the effectiveness of the policy, are often applied at these stages.

CONCLUSIONS: The policy process consists of interdependent stages, from inception to end, but most reviewed studies focus on single stages, neglecting the continuity of the policy life cycle. Studies assessing the health impacts of policies using a multi-stage approach are lacking. Most studies investigate intended impacts of policies; focusing also on unintended impacts may provide a more comprehensive evaluation of policies.

KEYWORDS: Healthy cities, Urban policy, Environmental health, Impact evaluation, Policy process

O-OP-061 Cancer hazard Evaluations for Contemporary Needs: What's New at NIEHS

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BACKGROUND AND AIM: Primary prevention is an effective strategy for reducing the global cancer burden. To inform public health decisions and communicate hazards, the U.S. National Toxicology Program conducts cancer hazard evaluations for possible listing in the congressionally mandated Report on Carcinogens (RoC). The scientific community recognizes challenges with traditional cancer hazard evaluations that do not always address real-world experiences like exposure to complex mixtures that disproportionally affect certain racial and ethnic communities.
To increase the relevance and usefulness of our cancer hazard evaluations, we have enhanced our assessment methods and communication strategy.

METHODS: AND

RESULTS: We highlight advancements from recent and ongoing cancer hazard evaluations, encompassing the entire lifecycle of our review process – from substance selection to systematic review methods and hazard communication.
We have selected real-world exposures such as mixtures (e.g., wood smoke), non-traditional agents (e.g., light at night), complex exposure scenarios (e.g., night shift work), and chemical classes (e.g., polycyclic aromatic hydrocarbons) for review. Systematic review methodology improvements include (1) using evidence maps to inform the review approach, (2) implementing more structured approaches to identify and organize mechanistic data, (3) exploring read-across approaches to evaluate substances without human and animal cancer data, and (4) incorporating triangulation approaches for evidence integration. To improve hazard communication, we are contextualizing hazards (e.g., persistent night shift work), providing information on prevention (e.g., Helicobacter pylori), and presenting information in an interactive format. for example, our online platform allows the public to explore substance uses and specific human cancers associated with RoC listings. We are also exploring ways to emphasize and communicate environmental health disparities.

CONCLUSIONS: The RoC has a legacy of providing highly impactful information that significantly enables cancer prevention efforts. We are actively evolving our approaches to meet contemporary challenges.

KEYWORDS: Cancer Hazard Assessments, Policy, Systematic Review

ORAL PRESENTATIONS SESSION 13: Occupational exposures, mental health and other outcomes

O-OP-062 Consumption of Iron- and Protein-Rich Diets may Ameliorate the Effect of Metals-Induced Anemia among Informal Electronic Waste Recyclers in Ghana

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BACKGROUND AND AIM: Environmental exposure to metals may play a role in the pathogenesis of anemia, yet, nutrition may ameliorate adverse effects of these metals on hemoglobin (Hb) levels in humans. Although informal electronic waste (e-waste) recycling processes have recently drawn attention as an important source of pollution, there is almost no empirical evidence on the relationship between diet, metals exposure and anemia among e-waste recyclers. Therefore, we evaluated possible ameliorating effects of diet on metal-induced anemia, as measured by Hb levels of e-waste recyclers and a reference population in Ghana.

METHODS: Study employed a repeated-measures design to collect whole-blood samples from e-waste recyclers (n=142) and a reference population (n=65) between March 2017 and October 2018. Blood was analyzed for the following metals: Cd, Pb, Rb, Tb & Eu using the ICP-MS®. Dietary intake parameters; proteins, folate, carbohydrates, Fe, Ca, Mg, Se, Zn and Cu were assessed using a 48-hour-recall. Blood Hb levels were measured using the URIT-810® semi-automatic biochemistry analyzer. Ordinary least-square regression models were used to estimate joint effects of metals and nutrients on Hb levels.

RESULTS: at baseline, mean Hb was lower among recyclers (12.99±3.17g/dL) than the reference group (13.02±2.37g/dL). Blood Pb, Cd, Rb, Eu and Tb were associated with significant decreases in Hb levels of e-waste recyclers. Dietary intake of proteins and Fe was associated with concomitant increase in Hb levels of both groups as well as when analysis was restricted to recyclers. Despite the high exposure of e-waste recyclers to a myriad of metals, consumption of Fe-rich diets seemed to ameliorate anemia and improved Hb levels (β=0.229; 95% CI: 0.013, 0.445; p=0.04).

CONCLUSIONS: Consumption of Fe and protein-rich foods was associated with significant increases in Hb levels of e-waste recyclers, even when exposed to high levels of these metals.

KEYWORDS: e-waste, hemoglobin, anemia, metals, diet

O-OP-063 Gendered precarious employment trajectories and self-reported health outcomes: a retrospective study in France

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BACKGROUND AND AIM: As precarious employment has been prevalent since the mid-1970s in high-income countries, it emerged as a social determinant of health, with potentially different health consequences for men and women. In France, unemployment and temporary employment have been high since the early 2000s. Our objective was to investigate the gendered influence of precarious employment trajectories on health outcomes in the French context.

METHODS: We used a retrospective national survey (4445 men, 5371 women) to create patterns of employment trajectories by sex, using multiple correspondence analysis followed by hierarchical ascendant clustering. We considered five dimensions of precariousness: unemployment (%), inactivity (%), frequency of job changes, qualification trend, and versatility of duty. We then explored the associations between the trajectory patterns and four health outcomes (self-perceived health, chronic morbidity, activity limitations and depression) through multivariate logistic regression, taking the most continuous, stable, and skilled trajectories as the reference.

RESULTS: Five patterns of employment trajectories were observed in each sex, with some specificities. Highly precarious trajectories concentrated in one cluster in both men (19%) and women (10%) ; they were associated with worse self-perceived health (OR_men=1.34, 95%CI [1.00;1.80] ; OR_women=1.56, 95%CI [1.22;1.99]), and more activity limitations (OR_men=1.52, 95%CI [1.05;2.20] ; OR_women=1.40, 95%CI [1.05;1.88]) as compared to the stable pattern. In women, high precarity was also associated with depression (OR_women=1.37, 95%CI [1.09;1.73]), while those who experienced a sex-specific inactivity pattern (24% of women) or long-lasting low-skill pattern (22%) only reported worse self-perceived health. Men experiencing a sex-specific medium precarity pattern (15%) reported more chronic morbidity and activity limitations than in the stable trajectory.

CONCLUSIONS: Different patterns of employment trajectories were found in men and women. The precarious patterns were also associated with different adverse health outcomes depending on gender. Ongoing analysis will further address potential mediation through working conditions.

O-OP-064 Functional changes in neural mechanisms underlying post-traumatic stress disorder in World Trade Center responders

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INTRODUCTION: World Trade Center (WTC) responders have high prevalence (23%) of persistent, clinically significant WTC-related post-traumatic stress disorder (PTSD). Recent structural magnetic resonance imaging (MRI) studies demonstrate anatomical differences between WTC responders with and without PTSD. We used resting state functional (rs-fMRI) to investigate neural mechanisms underlying WTC-PTSD and identify changes in local brain areas associated with WTC exposure.

METHODS: Using graph theory analysis of rs-fMRI data, we calculated eigenvector centrality (EC) to measure connectivity in 111 brain areas in WTC responders with PTSD (WTC-PTSD, n = 45) and matched responders without PTSD (non-PTSD, n = 51). Permutation statistics quantified EC differences; partial least squares discriminant analysis (PLS-DA) modeled the divergence in EC values between groups. Associations between WTC-exposure duration (months on site) and EC in identified brain areas were examined using general linear model (GLM) regression, adjusting for medication usage and comorbid depression. Generalized weighted quantile sum (WQS) regression was used to examine associations between an index of PTSD symptoms and EC values.

RESULTS: PLS-DA analysis of EC values enabled effective discrimination (auc: 0.749 (0.651-0.847)) of WTC-PTSD from non-PTSD; EC in nine brain regions (right/left anterior inferior temporal gyrus, right superior parietal lobule, right anterior parahippocampal gyrus (PHG), right anterior/posterior temporal fusiform cortex, right caudate nucleus, left amygdala (AMG) and brainstem) differed significantly and contributed the most to differentiate functional neuro-profiles between groups. The association between exposure duration and EC differed significantly between WTC-PTSD and non-PTSD in PHG and AMG (p= 0.010, 0.005, respectively). Within WTC-PTSD, the index of PTSD symptoms was positively associated with EC values in PHG and brainstem.

CONCLUSIONS: Our results confirm hypotheses about key brain areas associated with PTSD and extend our understanding of neural mechanisms linking WTC exposure with PTSD. Better understanding of neural mechanisms leading to WTC-PTSD would help guide intervention and treatment.

O-OP-065 Occupational Risk Factors of Prenatal Depression in Pregnant Women in the New York City Metropolitan Area

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BACKGROUND AND AIM: Approximately 80% of women become pregnant at some point during their career in the United States. Prenatal depression (PD) has been associated with adverse health outcomes in pregnant women and their offspring, particularly in lower sociodemographic (SES) populations. We examined the occupational risk factors associated with PD in a population of lower SES pregnant workers in New York City.

METHODS: Analyses included 487 women aged ≥18 years visiting obstetrics and gynecology clinics during pregnancy or within 2 months of child delivery between March to September 2017, with employment status at the time or after January 2014, when the Pregnant Workers Fairness Act legislation was enforced in NYC. Detailed occupational and sociodemographic data were collected via in-person interviews. Women completed a 10-item Edinburgh Depression Scale (EDS); EDS score ≥13 was classified as probable PD. Scores for established subconstructs of EDS (anxiety, anhedonia, classical depression) were also calculated. Multivariable adjusted regressions were used to identify the occupational factors that predict higher scores of EDS and its subconstructs, adjusting for age, race/ethnicity, education, marital status, and manager status.

RESULTS: Majority of women were black and/or Hispanic (84%), reporting <$30,000 annual household income (64%). Unconventional work shifts (night/evening or rotating shiftwork) [adjusted odds ratio {aOR} (95% CI)=2.01(1.14-3.55)], higher perceived work stress [aOR=2.91(1.27-6.70)], and health, science, or technology-related industry [aOR=2.74 (1.07-7.03)] were independently associated with elevated EDS score. for EDS subconstructs, higher perceived stress level at job was significantly positively associated with all three subconstructs, while job duty of lifting/pulling heavy objects was significantly associated with classical depression subconstruct (all $p<0.05$).

CONCLUSIONS: As more women continue to work during pregnancy, workplace policies to decrease hours of unconventional work shifts or physically demanding duties may be particularly important for protecting pregnant women and their children's well-being.

KEYWORDS: pregnant worker, occupational factors, stress, depression

ORAL PRESENTATIONS SESSION 14: Respiratory disorders in children and adults

O-OP-066 Precipitation and lung health in children with asthma

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BACKGROUND AND AIM: The frequency of heavy precipitation events is increasing in the northeastern United States (US) due to climate change, with potential implications for lung health. Thunderstorms and tropical cyclones have been associated with asthma exacerbations, potentially due to bioaerosol formation. We aimed to assess if short-term exposure to precipitation is associated with lung function and eosinophilic airway inflammation in children with asthma.

METHODS: Study subjects were adolescents with a history of asthma in a longitudinal cohort study based in the northeastern US state of Massachusetts (n=252). The mean age was 13.2y (SD 0.92). Daily precipitation estimates were based on an 800m resolution climate dataset linked to geocoded participant addresses. We used linear regression models adjusted for sex, age, height, race/ethnicity, household tobacco use, maternal education, season, study visit date, $PM_{2.5}$ and O_3 pollution, to evaluate associations of 1-, 2-, 3-, and 7-day moving averages of precipitation with forced expiratory volume in one second (FEV_1), forced vital capacity (FVC) and the natural log of fractional exhaled nitric oxide (FeNO).

RESULTS: Median daily precipitation for the 7 days preceding study visit was 2.08mm (IQR: 3.90mm). Median FeNO was 23ppb (IQR: 38.3ppb). Higher levels of precipitation were associated with lower FEV_1 and FVC. The association was statistically significant for previous-day precipitation and FVC: each 2mm increase in prior-day precipitation was associated with a 16.7 ml lower FVC (95% CI -29.3,-4.10). The 3- and 7-day moving averages of daily precipitation were associated with higher FeNO. Each 2mm higher 7-day moving average for precipitation was associated with an 8.55% (95% CI 1.22, 16.40) higher FeNO.

CONCLUSIONS: Short-term exposure to precipitation was associated with lower FVC and higher FeNO in children with a history of asthma.

KEYWORDS: Lung function, fractional exhaled nitric oxide, climate change
Research supported by NIH, NIEHS (grants: UG3OD02328, P30-ES000002, R01HD023286).

O-OP-067 Air pollution, lung function and mortality: survival and mediation analyses in UK Biobank

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BACKGROUND AND AIM: Air pollution is associated with lung function, and both are associated with premature mortality and cardiovascular disease (CVD). We performed mediation analysis to estimate the proportion of the relationship between air pollution and mortality or incident CVD explained by the association between air pollution and forced expiratory volume in 1 second (FEV1).

METHODS: We used data from the UK Biobank cohort (aged 40-69 years at baseline 2006-2010) with 8-year follow-up to mortality (N=208,998) and incident CVD (N=199,577). Exposures to PM10, PM2.5, and NO2 were assessed by land-use regression modelling to estimate exposures at baseline. Lung function (Forced Vital Capacity (FVC), FEV1) was measured by spirometry and transformed to Global Lung Function Initiative z-scores. Adjusted Cox proportional hazards and causal proportional hazards mediation analysis models were fitted, stratified by smoking status.

RESULTS: Long-term exposures to PM2.5 and NO2 (but not PM10) were associated with incident CVD, with similar effect sizes between ever-smokers and never-smokers (Hazard Ratio (HR) per IQR in ever-smokers, PM2.5: 1.05 [95%CI: 1.01, 1.09]; NO2: 1.04 [95%CI 1.00, 1.09]). PM2.5 was associated with CVD mortality in ever-smokers only (HR per IQR: 1.15 [95%CI: 1.02, 1.30]. Positive but non-significant associations were found with all-cause mortality. FEV1 and FVC were associated with all-cause, CVD mortality and incident CVD. Point estimates for the mortality outcomes were larger in ever-smokers than never-smokers. Mediated proportions of the air pollution—all-cause mortality estimates driven by FEV1 were 18% [95%CI: 2%-33%] for PM2.5, and 27% [95%CI: 3%-51%] for NO2. The estimated mediated proportions for air pollution—incident CVD were 9% [95%CI: 4%-13%] for PM2.5 and 16% [95%CI: 6%-25%] for NO2.

CONCLUSIONS: Lower FEV1 may mediate the effect of PM2.5 and NO2 on mortality and incident CVD outcomes, with more pronounced effects for NO2 than for PM2.5.

KEYWORDS: air pollution; lung function; mortality; mediation analysis; cardiovascular;

O-OP-068 Effects of long-term exposure to particle components on inpatient asthma hospitalizations among children and adults in the U.S. using Bayesian kernel machine regression (BKMR)

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BACKGROUND AND AIM: Particulate matter has been documented to adversely affect asthma exacerbation. However, few studies have investigated the long-term exposure of particle components in conjunction with PM2.5 and ozone to assess their individual and additive effects.
AIM: We aim to utilize a Bayesian Kernel machine regression (BKMR) to assess the individual and join effects of air pollutants including 15 different particle components such as organic carbon (OC), elemental carbon (EC), copper (Cu), and zinc (Z), along with PM2.5 and ozone, on counts of inpatient asthma hospitalizations for children ages 0 to 18 and adults ages 19 to 64 years.

METHODS: Inpatient records were collected from the State Inpatient Databases which included hospitals from 12 U.S. states ranging in years from 2000 through 2016. We also included temperature from Daymet and variables from the U.S. census to control for socio-economic status. All variables were aggregated to the annual level.

RESULTS: We observed an increase of 0.44 (95%CI: 0.28,0.59), 1.24 (95%CI: 1.07,1.40), and 2.35 (95%CI: 2.17,2.52) in the number of children asthma inpatient hospitalizations each year at the 25th, 50th, and 75th percentiles of pollutant mixture, respectively. In adults, we observed an increase of 0.84 (95%CI: 0.63,1.04), 1.98 (95%CI: 1.78,2.19), and 3.27 (95%CI: 3.06,3.48) in the number of asthma inpatient hospitalizations each year at the 25th, 50th, and 75th percentiles of the pollutant mixture, respectively.

CONCLUSIONS: Our results indicate that long-term exposure to pollutant mixtures result in increased asthma hospitalizations in both children and adults, and daily measurements of particle components data is needed to assess short-term exposure.

KEYWORDS: Asthma, PM Components, PM2.5, Ozone, BKMR

O-OP-069 Short-term exposure to livestock farm emitted endotoxin and acute effects on lung function in non-farming residents

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BACKGROUND AND AIM: Livestock-related air pollution is known for long-term effects on respiratory health in non-farming residents. Previous research indicated endotoxin as a relevant component in farm emissions. Acute respiratory effects of livestock-related air pollution has been shown for NH3 and PM10, but have not yet been studied for endotoxin. We aimed to assess associations between lung function and short-term exposure to livestock emitted endotoxin in co-pollutant models with NH3 and PM10.

METHODS: Spirometry data was used of 2494 persons living in a livestock dense area in 2014/2015. Residential exposure to farm emitted endotoxin during the week prior to spirometry was predicted by dispersion modelling. The model was applied to geo-located individual barns within 10km of each home address using provincial farm data and local hourly meteorological conditions. Regional week-average measured concentrations of NH3 and PM10 were obtained by monitoring stations. Lung function parameters were expressed in %-predicted value based on GLI-2012. Exposure-response relations were analysed with linear regression modelling.

RESULTS: Week-average endotoxin exposure was negatively associated with FVC, independently from NH3 and PM10 exposure. A decline in FVC of 1.1% was estimated, corresponding to an increase of endotoxin exposure from 10th to 90th percentile. Stratified analyses showed a larger effect (3.2% decline) for participants with current asthma and/or COPD. for FEV1 a significant negative association with week-average endotoxin exposure was observed, which did not remain after co-pollutant adjustment. FEV1/FVC and MMEF, showed no significant associations with week-average endotoxin exposure.

CONCLUSIONS: Results indicated an adverse effect on lung function of short-term endotoxin exposure for non-farming residents. These effects related to short-term exposure to endotoxin seemed stronger than long-term exposure effects as assessed in previous research. Co-pollutant modelling indicated the probable relevance of microbial emissions from livestock farms for public health besides chemical exposures.

KEYWORDS: Agricultural air pollution, residential exposure, endotoxin, lung function

ORAL PRESENTATIONS SESSION 15: Long-term exposure to air pollution and health outcomes

O-OP-070 The impact of exposure measurement error on the estimated concentration-response relationship between long-term exposure to PM2.5 and mortality

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BACKGROUND AND AIM: Exposure measurement error is a central concern in air pollution epidemiology. As studies have been using ambient air pollution predictions as proxy exposure measures, the potential impact of exposure error on health effect estimates needs to be comprehensively assessed. We aim to generate wide-ranging scenarios to assess direction and magnitude of bias caused by exposure errors under plausible concentration-response relationships between annual exposure to fine particulate matter (PM2.5) and all-cause mortality.

METHODS: We use daily PM2.5 predictions at 1-km spatial resolution to estimate annual PM2.5 exposures and their uncertainties for ZIP Codes of residence across the contiguous US between 2000–2016. We consider scenarios in which we vary the error type (classical or Berkson) and the true concentration-response relationship between PM2.5 exposure and mortality (linear, quadratic, or soft-threshold–i.e., smooth approximation to "hard-threshold" model). In each scenario, we generate numbers of deaths using error-free exposures and confounders of concurrent air pollutants and neighborhood-level covariates, and perform epidemiological analyses using error-prone exposures under correct specification or misspecification of concentration-response relationship between PM2.5 exposure and mortality, adjusting for the confounders.

RESULTS: We simulate 1000 replicates of each of 162 scenarios investigated. In general, both classical and Berkson errors can bias the concentration-response curve towards the null. The biases remain small even when using three times the predicted uncertainty to generate errors, and are relatively larger at higher exposure levels.

CONCLUSIONS: Our findings suggest that the causal determination for long-term PM2.5 exposure and mortality is unlikely to be undermined when using high-resolution ambient predictions since estimated effect is generally smaller than the truth. The small magnitude of bias suggests that epidemiological findings are relatively robust against exposure error. The use of ambient predictions with finer spatial resolution will result in smaller bias.

KEYWORDS: ambient air pollution prediction, exposure measurement error, concentration-response model

O-OP-071 Long-term exposure to source-specific fine particles and mortality – a pooled analysis of 14 European cohorts within the ELAPSE project

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BACKGROUND AND AIM: Past studies on the health effects of long-term particle component exposure were mostly analyzed on a constituent basis and have resulted in inconsistent findings. We aimed to assess mortality risks associated with source-specific fine particles (PM2.5) in a pooled European cohort of 323,782 participants.

METHODS: We estimated source-specific PM2.5 exposures through a combination of principal component analysis (PCA) of elemental composition on collected samples, and Europe-wide land-use regression models. Exposure to 2010 annual average concentrations of source-specific PM2.5 was assessed at baseline residential addresses. We applied Cox proportional hazards models to estimate mortality hazard ratios (HRs) adjusting for a variety of covariates at individual- and area-level. Besides the single-source analysis, we also performed a multi-source analysis where all identified source-specific PM2.5 were included in the model simultaneously.

RESULTS: We identified five source-related PM2.5 principal components: traffic, residual fuel oil combustion, soil, biomass & agriculture, and industry. In single-source analysis, all identified sources were significantly positively associated with increased natural mortality risks. In multi-source analysis, associations with all sources attenuated, but remained statistically significant with traffic, oil, and biomass & agriculture. The highest association per interquartile increase was observed for the traffic-PM2.5 (HR 1.06; 95% CI: 1.04, 1.08 per 2.86-µg/m3 increase) across five identified sources. On a per 1-µg/m3 basis, the residual fuel oil-related PM2.5 had the strongest association (HR 1.13; 95% CI: 1.05, 1.22), which is about ten times higher than that for the generic PM2.5 mass, suggesting a larger impact per unit mass by fossil fuel combustion derived particulate matter. Source-specific associations with cause-specific mortality were in general consistent with findings for natural mortality.

CONCLUSIONS: Fine particles from multiple sources were associated with increased mortality risks.

KEYWORDS: Source apportionment; PM2.5; sources; mortality

O-OP-072 Health effects of long-term exposure to ultrafine particles around Schiphol airport

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BACKGROUND AND AIM: Studies have shown elevated concentrations of ultrafine particles (UFP) near airports. Little is known about the health effects of UFP, in particular from aviation (UFP-aviation). We evaluated the health effects of long-term exposure to UFP-aviation around Schiphol Airport, The Netherlands.

METHODS: We investigated a wide range of health outcomes, by linking modelled annual average residential concentrations of UFP-aviation to individual data from existing health registries and surveys. We conducted two longitudinal cohort studies, on mortality and incidence of medication use, and a cross-sectional study using survey data on self-reported health and lifestyle factors. The cohort studies included all residents of 31 municipalities in a 45x50 km area around Schiphol Airport (~1.3 million adults). Survey data was available for 90,880 adults. Effect estimates were adjusted for individual and neighborhood-level covariates and expressed per 3500 pts/cm3 (~p5-p95 increment across the three studies). We performed a number of sensitivity analyses to evaluate the robustness of the results, including adjustment for co-pollutants and noise. The combination of different databases and designs allowed us to evaluate consistency of the findings both within and across studies.

RESULTS: We found no clear or consistent associations between UFP-aviation and health outcomes related to general health, respiratory health, neurodegenerative disease, or mental health. for cardiovascular health, we found robust positive associations with incidence of medication use for heart disease [HR 1.03 (95%CI 1.00-1.05)] and mortality for arrhythmia [HR 1.08 (95%CI 0.98-1.02)], but not for incidence of medication use for hypertension or (total or other subclasses of) cardiovascular mortality. In the survey data, we found robust significant associations with prevalence of hypertension and self-reported heart attack and consistently elevated (non-significant) associations with self-reported stroke.

CONCLUSIONS: Exposure to UFP from aviation around Schiphol Airport was associated with cardiovascular health outcomes.

KEYWORDS: ultrafine particles, aviation, air pollution, mortality, morbidity

O-OP-073 Long-term Exposure to PM2.5 Components and Mortality among Medicare Beneficiaries

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BACKGROUND AND AIM: PM2.5 has been linked to numerous adverse health outcomes. However, PM2.5 is a mixture made of many components. Identifying which components are most toxic is important in identifying sources and implementing mitigation measures.

METHODS: We looked at mortality among Medicare participants 65 years of age or older from 2000 to 2018 in response to changes in annual mean levels of 15 PM2.5 components, namely: organic carbon, elemental carbon, nickel, lead, zinc, sulfate, potassium, vanadium, nitrate, silicon, copper, iron, ammonium, calcium, and bromine. Data on exposure was derived based on high-resolution, validated spatio-temporal models which were then aggregated to each beneficiary's residential ZIP code. We aggregated the number of deaths in each ZIP code and year and used the rate of deaths in each ZIP code per year as the outcome of interest. Covariates included demographic, temperature, socioeconomic status, and access-to-care variables. We used a weighted quantile sum approach with a quasi-Poisson distribution to analyze the joint effects of PM2.5 components on mortality. We also ran single-pollutant models for comparison. We further looked at the effects of the components when PM2.5 mass levels were at concentrations below 8 µg/m3, and effect modification by temperature, socioeconomic status, and race.

RESULTS: Each decile increase in the PM2.5 mixture was associated with a 1.4% (95% CI: 1.4%-1.5%) increase in the rate of mortality among Medicare participants. The components which contributed the greatest weight to the mixture were organic carbon, nickel, lead, and zinc. at PM2.5 mass concentrations below 8 µg/m3, the increase in the rate of mortality per decile increase in PM2.5 components was 1.5% (95% CI: 1.5%-1.6%).

CONCLUSIONS: Increases in the concentration of PM2.5 components were associated with an increased rate of mortality among Medicare beneficiaries.

KEYWORDS: Air Pollution; Particulate Matter; Particulate Matter Components; Mortality; Mixture Analysis

O-OP-074 Causal modeling of the effects of fine particulate matter and nitrogen dioxide on natural-cause mortality within the ELAPSE project

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BACKGROUND AND AIM: Within the ELAPSE project, we found associations between natural-cause mortality and long-term exposure to fine particulate matter (PM2.5) and nitrogen dioxide (NO2 at concentrations lower than current European limit values. The current aim was to characterize the health effects of these pollutants for selected cut-off values in a causal modelling framework.

METHODS: We analyzed data from the ELAPSE pooled cohort, consisting of eight well-characterized adult cohorts from six European countries (enrolled 1985–2005; follow-up 2011–15), and seven population-based administrative cohorts of adults from Belgium, Denmark, England, the Netherlands, Norway, Rome (Italy), and Switzerland (enrolled 2000–11; follow-up 2011–17). Annual mean PM2.5 and NO2 concentrations from Europe-wide land use regression models were assigned to baseline residential addresses. We applied Cox proportional hazards models using inverse probability weights (truncated to 1-99% of the distribution) for selected cut-off levels of the pollutants (PM2.5: 10, 12 and 15 μg/m³; NO2: 20 and 40 μg/m³) to obtain causal risk estimates of long-term PM2.5 and NO2 exposure on natural-cause mortality.

RESULTS: of 325,367 and 28,153,138 participants in the pooled and administrative cohorts, 47,131 and 3,593,741 participants deceased from natural causes, respectively. When increasing PM2.5 exposure from levels below to above 15 μg/m³, the HR for natural-cause mortality was increased for the pooled (HR 1.224; 95% CI 1.195–1.254) and the majority of administrative cohorts. for an increase of NO2 levels below to above 20 μg/m³, the HR was 1.068 (95% CI 1.045–1.092) for the pooled cohort and ranged from 0.987 (0.972–1.003) to 1.098 (1.076–1.120) for the administrative cohorts.

CONCLUSIONS: Causal modeling showed mostly consistent associations for changes in exposure to PM2.5 and NO2 with increases in natural-cause mortality in the pooled and the administrative cohorts.

KEYWORDS: Causal models, inverse probability weighting, particulate matter, nitrogen dioxide, mortality

O-OP-075 A nationwide study of air pollution on the NCD related morbidity in an unselected population

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BACKGROUND AND AIM: Very few studies of the effect of air pollution on national mortality exist. Even fewer studies have investigated the effect of air pollution on non-communicable disease (NCD) in the total population. Thus, this study aims to elucidate the burden of air pollution on the morbidity of the total unselected population.

METHODS: The study cohort consisted of all individuals age 50 years or older who were alive and resided in Denmark on their 50th birthday or 1st January 2004, whichever came later (entry date) (N=2,872,957).
All hospital contacts for cancer, type 2 diabetes, asthma, Chronic Obstructive Pulmonary Disease (COPD), Alzheimer's-, Parkinson's-, ischemic heart -, and cerebrovascular-disease, between 1st January 2004 and 31st December 2016 were identified. We defined all NCD incident onsets as the date of first contact.
For each case and 5 randomly selected controls, we modelled pollution ($PM_{2.5}$, PM10, SIA, NO_2, O_3, BC, $PPM_{2.5}$, Sea salt, and SOA) as personal average concentrations over the 20 years prior to the incident date.
We estimated IRRs with 95% CIs for a fixed increase in air pollution assuming a linear exposure response relationship, adjusted for age, gender, calendar time, and individual as well as area-level socio-economic status.

RESULTS: We found IRR (95% CI) per 5 µg/m³ increase in $PM_{2.5}$ and per 10 µg/m³ increase in NO_2 to be highest for asthma, Alzheimer's disease, type 2 diabetes, and COPD, table 1.

	IRR $PM_{2.5}$	IRR NO_2
Type 2 Diabetes	1.47 (1.41 - 1.52)	1.27 (1.24 - 1.30)
Alzheimer's Dis	1.76 (1.67 - 1.87)	1.30 (1.26 - 1.35)
Asthma	1.88 (1.76 - 2.01)	1.47 (1.42 - 1.53)
COPD	1.34 (1.30 - 1.39)	1.36 (1.33 - 1.39)

In conclusion we find key NCDs are associated to $PM_{2.5}$ and NO_2 even in a low exposure environment.

KEYWORDS: Air pollution, non-communicable diseases, Nationwide, Cohort.

ORAL PRESENTATIONS SESSION 16: Child health and exposure to PFAs

O-OP-076 Glyphosate in house dust and risk of childhood acute lymphoblastic leukemia in California

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BACKGROUND AND AIM: In prior analyses in the California Childhood Leukemia Study (CCLS), house dust concentrations of the herbicide dacthal were associated with acute lymphoblastic leukemia (ALL). Here, we estimated ALL risk with concentrations of glyphosate in homes.

METHODS: The CCLS is a population-based case-control study of childhood leukemia (<15 years) in 35 counties in the Central Valley/San Francisco Bay area. Among those <8-years (no move since diagnosis/reference date), we collected dust (2001-2007) from the room where the child spent the most time while awake and measured >40 pesticides. Three-to-eight years later, we collected a second sample from non-movers. We used Ultra-Performance Liquid Chromatography Tandem Mass Spectrometry to measure glyphosate (µg/g dust) for 181 ALL cases and 225 controls and for 45 cases/controls with a second dust sample. Odds ratios (ORs) and 95% confidence intervals (CI) were calculated for quartiles of the concentration (first sample) using unconditional logistic regression. We computed the intraclass correlation coefficient (ICC), the within-to-between home variance ratio, and bias in a true OR=2.0 based on one dust sample.

RESULTS: Glyphosate was frequently detected (cases: 98%; controls: 99%). Higher concentrations in homes were associated with occupational pesticide exposure among family members, nearby agricultural use, treatment for lawn weeds and bees/wasps, and season. Increasing concentrations in the homes were not associated with ALL risk (adjusted ORQ4vs.Q1=0.8 CI 0.4-1.4). We observed similar null associations for boys and girls, Hispanics and non-Hispanic whites, and among those who resided in their home since birth (76 cases/117 controls) or age two (130 cases/176 controls). The ICC was 0.32 and the variance ratio was 2.13, which would result in a biased OR=1.25 based on one sample.

CONCLUSIONS: Glyphosate concentrations in homes were not associated with risk of childhood ALL. Due to large within-home temporal variability in concentrations, a modest association cannot be ruled out.

O-OP-077 Cumulative exposure to per- and polyfluoroalkyl substances from pregnancy to age 12 years and bone health in early adolescence: the HOME Study

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substance (PFAS) concentrations during pregnancy and childhood have been inversely associated with childhood bone mineral density (BMD). Because bone remodeling is ongoing throughout childhood, cumulative PFAS exposure may be more strongly related to bone accrual than measures at a single time point. We estimated associations of cumulative exposure to PFAS and their mixture from pregnancy through early adolescence with BMD at age 12 years.

METHODS: We quantified concentrations of perfluorooctanoate (PFOA), perfluorononanoate, perfluorohexanesulfonate, and perfluorooctanesulfonate in maternal serum collected at 16 weeks gestation and child serum collected at ages 3, 8, and 12 years among 222 mother-child pairs in the HOME Study (Cincinnati, OH; enrollment 2003-2006). for each PFAS, we estimated cumulative exposure as the area under the curve (AUC) of each participant's serial PFAS concentrations. at age 12 years, we measured BMD at six skeletal sites and calculated height-, age-, sex-, and race-specific Z-scores. We estimated covariate-adjusted differences and 95% confidence intervals (CIs) in Z-scores per interquartile range (IQR) increase in the AUC of each PFAS using linear regression and the PFAS AUC mixture using quantile g-computation. We explored sex differences using sex-stratified models.

RESULTS: We observed associations of the PFOA AUC and the PFAS mixture AUC with lower BMD at the 1/3rd distal radius. Differences in 1/3rd distal radius BMD Z-scores per IQR AUC increase were -0.19 (95% CI: -0.39, 0.00) for PFOA and -0.20 (95% CI: -0.42, 0.01) for the PFAS mixture. Associations were stronger for males [e.g., PFOA: -0.31 (95% CI: -0.55, -0.06)] than females [-0.08 (95% CI: -0.36, 0.20)]. Patterns of association were similar but generally weaker and not statistically significant at other skeletal sites (β range: -0.05 to -0.15).

CONCLUSIONS: Cumulative exposure to PFOA and PFAS mixtures from gestation through early adolescence were inversely associated with BMD, particularly among males.

O-OP-078 Latent profiles of early life perfluoroalkyl substances exposure and body composition at age 12 years: The Health Outcomes and Measures of the Environment (HOME) Study

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BACKGROUND AND AIM: We used latent profile analysis (LPA) to identify subpopulations with distinct perfluoroalkyl substances (PFAS) exposure trajectories during early life, and assess their associations with body composition at age 12 years.

METHODS: Among 390 mother-child dyads enrolled in the HOME Study, we quantified serum concentrations of perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorohexane sulfonate (PFHxS), and perfluorooctanesulfonic acid (PFOS) at least once during pregnancy (mothers) or at ages 3, 8, and 12 years (children). We measured child's weight and height to calculate body mass index (BMI) and performed dual energy x-ray absorptiometry to measure fat mass index (FMI) and lean body mass index (LBMI) at age 12 years, and calculated age- and sex-standardized Z-scores for all measures. We performed an LPA of all log2-transformed PFAS measures, across all timepoints, using full information maximum likelihood to account for missing exposure data, and used likelihood ratio tests to assess model fit. We estimated adjusted associations (95% confidence intervals) for profile membership with body composition measures among 239 singletons with at least one outcome measure, and adjusted for parity, duration of breastfeeding (weeks), household income, and average maternal serum cotinine and blood lead concentrations during pregnancy.

RESULTS: A two-profile model fit best, with ~50% of the analytic sample in each profile. Relative to profile 1, geometric means of PFAS concentrations in profile 2 were higher at all timepoints, particularly at the 3-year visit. In adjusted analyses, membership in profile 2 was associated with a -0.49 (-0.94, -0.03) lower height Z-score, -0.46 (-0.89, -0.02) lower BMI Z-score, -0.22 (-0.58, 0.08) lower FMI Z-score, and -0.74 (-1.23, -0.24) lower LBMI Z-score.

CONCLUSIONS: Using LPA to model longitudinal PFAS biomarkers, we found evidence that higher PFAS exposure during early life affects adolescent stature and body composition.

KEYWORDS: BMD, child, LPA, PFAS

O-OP-079 Plasma concentrations of Per- and Polyfluoroalkyl Substances and alanine aminotransferase among Adolescents with and without NAFLD from the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Study

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BACKGROUND AND AIM: Ubiquitous exposure to per- and poly-fluoroalkyl substances (PFAS) may increase the risk of metabolic- and liver- related disorders, especially in children. In a cohort of adolescents with severe obesity, we investigated the association of plasma concentrations of PFAS and alanine aminotransferase (ALT), a predominantly hepatocellular, cytoplasmic enzyme that is a validated biomarker of liver damage.

METHODS: Adolescents undergoing bariatric surgery were enrolled in the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS, 2007-2012) study. Plasma measurements of six PFAS (PFHxS, PFHpS, PFOS, PFOA, PFNA, PFDA) were determined using liquid chromatography-mass spectrometry. for each PFAS, we generated linear models of PFAS and ALT controlling for covariates. We additionally evaluated the association of PFAS and ALT among those with histologically validated nonalcoholic fatty liver disease (NAFLD, including nonalcoholic fatty liver [NAFL] or nonalcoholic steatohepatitis [NASH]) and those without NAFLD.

RESULTS: of those enrolled, 129 individuals had available measures of plasma-PFAS and ALT measured preoperatively. NAFL (n=47) or NASH (n=27) was present in 74 (57.4%) of the 129 participants with severe obesity. Among all participants, positive associations were observed between plasma concentrations of PFOA and ALT (ß=4.0, 95% CI: 0.87, 7.1) measured prior to bariatric surgery. Among those with NAFLD, a significant association between PFOA and ALT was observed (ß=5.2, 95% CI:0.3, 10.2), which was not observed among those without NAFLD (ß=0.48, 95% CI: -2.6, 3.5). No associations were observed between ALT and other PFAS.

CONCLUSIONS: Higher plasma PFOA concentrations were found to be associated with higher concentrations of ALT in a cohort of adolescents with severe obesity, and among the subset with NAFLD in particular PFAS may be an important toxicant contributing to NAFLD progression.

KEYWORDS: PFAS; NAFLD, obesity, environmental exposures, pediatric epidemiology

O-OP-080 Metals, Perfluoroalkyl Substance, and Birth Outcomes in the New Hampshire Birth Cohort Study: Beyond Single-Class Mixture Approaches

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BACKGROUND AND AIM: Exposure to either metal or perfluoroalkyl substance (PFAS) mixtures during pregnancy has been associated with adverse birth outcomes. However, little is known about the potential joint effects of these two classes of chemicals. We aimed to investigate the joint, index-wise, and individual impacts of metals and PFAS exposures on birth outcomes in a prospective cohort study using both established and novel mixture modeling approaches.

METHODS: Study participants included 537 mother-child pairs from the New Hampshire Birth Cohort Study (NHBCS). Primary analyses included metals measured in maternal toenails collected six weeks postpartum, reflecting exposures during the prenatal period. PFAS were measured in maternal plasma collected during pregnancy. Birth weight (BW) and head circumference (HC) at birth were abstracted from medical records. Joint and individual associations between in utero metals and PFAS exposures and birth outcomes were evaluated using Bayesian Kernel Machine Regression (BKMR) and employing the recently developed Bayesian Multiple Index Models (BMIM) to additionally assess index-wise associations and interactions among the chemical classes (i.e. toxic metals, essential elements, and PFAS).

RESULTS: After controlling for potential confounders, the metals-PFAS mixture was associated with a larger HC at birth. This was driven by Mn (posterior inclusion probability [PIP]: 0.95). Similar associations were identified for the essential element group (including Mn) using BMIM (indexPIP: 0.95; posterior mean for Mn: 0.69; 95% credible interval: 0.00, 0.99). The positive relationship between Mn (essential element group) exposure and HC was stronger at higher levels of Hg (toxic metal group), consistently shown in both BKMR and BMIM. Prenatal co-exposure to metals and PFAS was not associated with BW.

CONCLUSIONS: Our findings highlight the importance of simultaneously investigating multiple chemical classes in environmental mixture studies.

KEYWORDS: Perfluoroalkyl substance (PFAS); Toxic metals; Essential elements; Prenatal exposures; Bayesian kernel machine regression (BKMR); Bayesian multiple index model (BMIM)

O-OP-081 Dietary folate intake modifies the relationship between per- and polyfluoroalkyl substances and immune markers among U.S. adolescents

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are considered immunotoxic. Previous research found that folate was negatively associated with PFAS exposure. This study aimed to examine if dietary folate intake modifies associations between PFAS concentrations and immune markers in U.S. adolescents.

METHODS: The study included adolescents (12-19 years) from the National Health and Nutrition Examination Survey cycles 2007-2016 with measured serum concentrations of four prevalent PFAS compounds and immune markers (antibodies to measles and rubella (N=322), total white blood cell (WBC) and neutrophil counts (N=1564)). Study population was divided into lower vs. upper folate groups by the median dietary folate equivalent intake, estimated as the average of two 24-hr dietary recalls. for each folate group, we used linear regressions and quantile g-computation (QGC) to estimate covariate-adjusted associations of individual PFAS and PFAS mixtures with immune markers.

RESULTS: We observed negative associations between several PFAS compounds and measles and rubella antibody levels only in the lower (i.e., below the median) folate group, but not in the upper folate group. for example, serum perfluorononanoic acid concentration was associated with decreased rubella antibody levels in the lower folate group (percent change: -10.97%, 95%CI: -18.03%, -3.29%), while not in the upper folate group (percent change: 1.76%, 95% CI: -20.14%, 30.09%). Consistently, some PFAS concentrations were associated with higher WBC and neutrophil counts, again only in the lower folate group (p for interactions ranged 0.01-0.21). QGC models showed consistent patterns of associations between PFAS mixtures and immune markers, among adolescents with lower folate intake.

CONCLUSIONS: Associations between some PFAS and PFAS mixtures and immune markers were found in adolescents whose folate intake was below the population median level. These findings may have important implications for using diet as a mitigating measure to reduce PFAS related deleterious immune effects.

KEYWORDS: PFAS, folate, immune, mitigation, U.S.

ORAL PRESENTATIONS SESSION 17: Reproductive outcomes and various environmental exposures (2)

O-OP-082 Fetal and infant death associated with short-term ozone exposure

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BACKGROUND AND AIM: Air pollution is linked to adverse pregnancy outcomes such as preterm births, but few studies evaluated its acute impact on fetal and infant mortality. We evaluated short-term impacts of warm-season ozone and cold-season fine particulate matter <2.5 microns (PM2.5) exposures on the risk of fetal death (>20 weeks) and infant mortality (live birth to one year).

METHODS: This time-stratified case-crossover analysis includes 1,880 singleton fetal deaths (2007-2011) and 3,229 singleton infant deaths (2007-2015) from the San Joaquin Valley (SJV), California. Daily ozone and PM2.5 were estimated by the SJV Air Pollution Control District and geospatially linked to maternal zip code at birth. Critical exposure windows of interest included the day of death (lag 0) up to 14 days before (lag 14). Conditional logistic regression models estimated the odds ratio (OR) and 95% confidence intervals (CI) for each 5 units increase in pollutant.

RESULTS: In warm season (May-October), a 5-ppb increase in ozone was associated with a 7% (95% CI: 2%-13%) increased risk of fetal death and 6% (95% CI: 2%-10%) increased risk of infant death within two weeks. The estimates were generally consistent from lag 0 to lag 14 for both mortality outcomes, with evidence of slightly stronger estimates for fetal death compared to infant death during certain lags. During lag 7, a 5-ppb increase in ozone was associated with a 9% increased risk in fetal death (95% CI: 5%-14%) and a 4% (95% CI: 1%-7%) increased risk in infant death. No associations were observed for cold-season PM2.5.

CONCLUSIONS: Ozone exposure is positively associated with short-term risk of fetal and infant mortality in the warm season. Given the ubiquitous nature of air pollution, these associations merit further investigation. Meanwhile, efforts to minimize exposures among pregnant women may be warranted.

KEYWORDS: pollution, infant mortality, fetal death, stillbirth, pregnancy, mortality, ozone

O-OP-084 Association of vitamin D and green space. Results from the GINIplus & LISA birth cohorts

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BACKGROUND AND AIM: While there is increased awareness and a growing body of evidence for beneficial health effects of green space surrounding the home, underlying mechanisms are not yet fully understood. Here, we investigate vitamin D as a potential pathway linking greenness and health, including cardiometabolic, respiratory and mental health.

METHODS: 25-hydroxyvitamin D (25(OH)D) was measured at ages 10 and 15 years in the German birth cohort studies GINIplus and LISA. Greenness was measured using the Landsat-derived Normalized Difference Vegetation Index (NDVI) in a 500m buffer surrounding the home. We applied linear and logistic regression models at both time points adjusted for month of examination, sex, study area, study, parental education and BMI (N_10Y=2504, N_15Y=2613). In additional analyses, physical activity, time spent outdoors, urbanicity, and vitamin D-related genes were investigated as potential effect modifiers.

RESULTS: A 2-standard-deviation (SD) increase in NDVI was significantly associated with increased 25(OH)D values at ages 10 and 15 years (β_10y=2.41nmol/l, p=<0.01; β_15y =2.03nmol/l, p=0.02. In stratified analyses, the association was strongly attenuated in participants spending more than 5h/day outside in summer (β_10y=-2.39nmol/l, p=0.165; β_15y =-1.07nmol/l, p=0.675), having a high physical activity level (β_10y=0.62nmol/l, p=0.637; β_15y =1.71nmol/l, p=0.296), taking supplements (β_10y=-2.05nmol/l, p=0.386; β_15y =0.10nmol/l, p=0.296), or examined during winter season (β_10y=0.86nmol/l, p=0.352; β_15y =0.07nmol/l, p=0.970). In a subset with genetic data, a significant gene-environment interaction of NDVI with CYP2R1, an upstream gene in 25(OH)D synthesis, was observed.

CONCLUSIONS: We observed robust associations between greenness measured by NDVI and 25(OH)D levels in children and adolescents independent of other confounders and additionally supported by the presence of a gene-environment interaction. Effects were stronger in those having lower vitamin D levels due to genetically reduced 25(OH)D synthesis or due to their covariate profile.

KEYWORDS: Vitamin D, Greenspace, Children, Epidemiology

O-OP-085 Exposure to ambient temperature extremes during peri-conception and fecundability

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BACKGROUND AND AIM: Ambient temperature extremes, particularly high heat, have been associated with adverse pregnancy outcomes; however, fecundity has been little examined. We assessed the relationship of exposure to ambient temperature extremes during the menstrual cycle with fecundability.

METHODS: A total of 1,228 women enrolled in the EAGeR trial at study sites in Salt Lake City, Denver, Buffalo, and Scranton, USA. Analyses evaluated exposure to ambient temperature, obtained from local weather monitors during the first two menstrual cycles of follow-up, and pregnancy, assessed at the end of each menstrual cycle using urinary hCG. Mean daily temperature and hours per day above and below set thresholds (≥20°C, ≥25°C, ≥30°C, and <0°C) were calculated during the follicular phase (menses through ovulation), luteal phase (ovulation through next menses), ovulation (-5 to 0 days before ovulation), and implantation (6 to 10 days post-ovulation). Cox proportional hazards models calculated the fecundability odds ratio (FOR). Models were stratified by warm (Apr. 1-Sep. 30) versus cold (Oct. 1-Mar. 31) season and adjusted for participant characteristics.

RESULTS: A total of 2,147 cycles were observed. During the warm season, a 2°C increase in temperature across the menstrual cycle was associated with a trend of lower fecundability, though estimates were imprecise. Each additional hour per day of temperatures ≥30°C during ovulation and implantation was associated with lower fecundability (FOR 0.86, 95% CI 0.73-1.00 and FOR 0.89, 95% CI 0.78-1.01, respectively). During the luteal phase, overnight (10pm-6am) temperatures ≥25°C were most strongly associated with lower fecundability as compared to daytime temperature extremes (FOR 0.52, 95% CI 0.28-0.98 for each additional hour per night ≥25°C). No clear associations were observed during the cold season.

CONCLUSIONS: Exposure to high temperatures ≥30°C during ovulation and implantation and overnight temperatures ≥25°C during the luteal phase may reduce chance of pregnancy.

KEYWORDS: Temperature, Pregnancy, Fecundability

O-OP-086 Admission to neonatal intensive care in relation to satellite-based estimates of NO2 and PM2.5 in the United States, 2018

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BACKGROUND AND AIM: Prior work noted an increased risk of admission to neonatal intensive care units (NICU) associated with acute exposure to air pollution in 12 clinical centers across the US, 2002-2008. We aimed to assess chronic exposure in relation to NICU admission.

METHODS: We obtained 2018 birth certificate data for the US, including all counties with populations greater than 100,000. County-level air pollution data were derived from OMI (NO2), a combination of the MISR, MODIS, and SeaWIFS instruments (PM2.5) and downscaled CMAQ model data were assembled for ozone. We conducted both single and multi-pollutant logistic models for season of birth (winter: December to February; spring: March to May; summer: June to August; and fall: September to November). Exposure was characterized in quartiles with the lowest as reference. The risk of NICU admission among singletons (n=3,644,722) in relation to air pollution exposure was assessed using logistic regression with generalized estimating equations (to account for correlated data within county) and adjusted for maternal age, race, education, body mass index and infant sex.

RESULTS: NICU admission (8.1% of births) was significantly increased in relation to NO2 during all seasons in both single and multi-pollutant models. Adjusted odds ratios (OR) ranged from 1.21 to 1.28 for the highest quartile of exposure in single-pollutant models and 1.13 to 1.27 in multi-pollutant models. The highest quartile of PM2.5 was significantly associated with increased NICU risk in winter (single-pollutant OR=1.27, multi-pollutant OR=1.13), spring (single-pollutant OR=1.14) and summer (single-pollutant OR= 1.12). The highest quartile of ozone was associated with increased risk in the single pollutant model for summer (OR= 1.15) and reduced risk in fall and winter; all multipollutant models for ozone were non-significant.

CONCLUSIONS: Consistent with our prior work, ambient air pollutants, particularly NO2 and PM2.5, are associated with increased risk of NICU admission.

O-OP-087 Traffic-related air pollution and pregnancy loss in Eastern Massachusetts, USA

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BACKGROUND AND AIM: Prior studies that have examined associations with pregnancy loss have mostly relied on losses identified by medical records (i.e., a subset of all losses). Analyzing live birth-identified conceptions (LBICs) —the difference between the total number of conceptions and those lost for a given time window— can tell us about associations with pregnancy loss (including those undetected). Using this approach, we estimate the association between prenatal nitrogen dioxide (NO2) —a traffic emissions tracer— and pregnancy loss in a Massachusetts-based cohort.

METHODS: We used data on 21,204 live births from pregnancies conceived in 2003-2015 and that had their prenatal care at Beth Israel Deaconess Medical Center (Boston, USA). We used a distributed lag model coupled with g-computation to estimate the additive association between weekly NO2 during pregnancy and LBICs adjusted for temperature and time trends.

RESULTS: The mean number of LBICs per conception week was 30 (standard deviation [SD]: 6.5). Weekly NO2 concentrations (mean: 23.3 parts per billion [ppb], SD: 6.5 ppb) were below the USEPA annual standards. Higher NO2 in gestational weeks 5-19 was associated with fewer LBICs, and the strongest association was in week 11. A 10-ppb higher NO2 exposure sustained throughout weeks 5-19 was associated with 6.0 (95% CI: 1.3, 11.3) fewer LBICs. That is, out of 30 LBICs per conception week, 6 would be lost if average NO2 was 10-ppb higher in weeks 5-19.

CONCLUSIONS: We show through the analysis of LBICs that higher prenatal NO2 was associated with pregnancy loss with the critical exposure window in weeks 5-19. The described approach can quantify the change in the number of pregnancy losses per conception week as it is simply the complement of the change in live births from that week's conceptions.

KEYWORDS: air pollution, traffic, nitrogen dioxide, pregnancy loss, distributed lag models

O-SY-131 Reproductive health diseases among South Korean workers: the propensity score matching approach

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BACKGROUND AND AIM: To explore the reproductive health problems that may arise from occupational exposure of productive workers' workplace hazard.

METHODS: A retrospective investigation was made on the Korean health and Nutrition Examination Survey(KNHANES) of the workers with occupational classification code from 2007 to 2015 for adults ages 20 and 49 years. First, we compared workers classified as workers who KNHANES Korean Standard Classification of Diseases (KCD) reclassification codes 211 to 233 (including diseases such as urogenital system and infertility) and 234 to 244 (including pregnancy, childbirth, and puerperium) with those who did not classify reproductive health diseases reclassification codes (211 to 233, 234 to 244). Then, the relationship between reproductive health diseases and heavy metal exposure according to gender was investigated using the propensity score matching method.

RESULTS: In consideration of age, gender, body mass index, and occupation, a 1:1 optimal matching method was used to match workers with genital and non-reproductive diseases. Before matching, there were 2,135 men and 3,838 women. After matching, 42 men and 382 women were reproductive health workers, and 42 men and 382 women were non-reproductive health workers. As a result of estimation by the PSM method, there was no significant difference in male reproductive health disease and exposure to lead, mercury, and cadmium, and there was no difference even after matching. There were significant differences in female reproductive health disease and lead and mercury exposure, but lead did not show a significant difference after matching. Also, there was no significant difference between reproductive disease and cadmium exposure before and after matching.

CONCLUSIONS: It was confirmed that exposure to mercury in female workers was sensitive to reproductive health diseases. Exposure to mercury in the workplace should be more cautious.

KEYWORDS: workers, reproductive health disease, Korean health and Nutrition Examination Survey

ORAL PRESENTATIONS SESSION 18: Advances in statistical methods

O-OP-088 Misclassification bias in the assessment of gene-by-environment interactions

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BACKGROUND AND AIM: Misclassification bias is a common concern in epidemiologic studies. While there is good understanding of misclassification influences on main effects, general results for understanding when misclassification bias may affect studies involving gene-environment interactions have not yet been developed. Here, we address this issue using the example of a case-control study in which cases over-report exposures (reduced specificity of exposure classification among cases).

METHODS: We derive equations to assess the influence of recall bias on the identification of gene-environment interactions. Then, we numerically illustrate these results through simulating a case-control study of 500 cases and 1000 controls while varying several input parameters: exposure E prevalence (π_E), strength of E main effect (OR_E), exposure specificity among cases (level of recall bias), and strength of the gene-environment interaction (OR_INT). The prevalence of the genetic factor G and disease among those with G and E=0 were simulated to be low (0.2 and 0.01, respectively). Each scenario was simulated 1000 times.

RESULTS: In the absence of a true gene-environment interaction, the estimate is unbiased despite even large recall bias of OR_E under the assumptions of gene-environment and gene-recall independence. Further, if a true gene-environment interaction exists, the observed gene-environment interaction will always be biased towards the null. If gene-environment dependence exists (assessable among controls), observed results place bounds on possible gene-environment interaction. In simulations, we show that the impact of recall bias was attenuated with higher π_E and stronger OR_E. for example, when π_E=0.6, OR_E=2, the true OR_INT=2.5, and specificity=0.6, the observed OR_INT=2.33 (low bias) and coverage was appropriate (0.93).

CONCLUSIONS: Gene-environment interactions can be identified even in the presence of misclassification bias under the assumptions of gene-environment and gene-recall independence. This can greatly aid environmental studies when exposure recall is questionable.

KEYWORDS: Misclassification bias; epidemiologic methods; gene-environment interaction; risk factors; simulations.

O-OP-089 mpower – An R package for power analysis of exposure mixture studies

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BACKGROUND AND AIM: Researchers need to estimate sample size and statistical power as part of good study planning. Closed-form power equations exist for simple hypothesis tests but not for more complex settings. Estimating power with Monte Carlo simulations is flexible and applicable to a large class of models. Out of a sufficiently large number of simulations, the proportion of times in which a hypothesis test is rejected can be used to estimate power. However, it is not straightforward to code a simulation for non-experienced programmers. To simplify this process, we present an R package for power analysis of studies involving mixtures, which can be easily modified for other complex data settings.

METHODS: This package runs power analysis given a data generative model and an inference model. It can estimate a data generative model that preserves dependence structures between variables given existing data (continuous, binary, or ordinal). If no data are available, it provides a framework for users to specify a valid sampling distribution. It interfaces with several existing and newly developed analysis strategies for assessing associations between exposures to mixtures and health outcomes. Users can generate power curves to assess the trade-offs between sample size, effect size, and power of a design. Advanced users can easily integrate customized data generative and inference models. It also implements parallelism.

RESULTS: We demonstrate the utility of the package through several examples using synthetic data and mixtures data from NHANES. Users with basic knowledge of R can conduct power analysis using Monte Carlo simulation in only a few lines of code.

CONCLUSIONS: We provide an R package that can simulate mixed-typed data with realistic dependence structures and allows researchers to easily conduct power analysis for a large class of models.

KEYWORDS: power analysis, R package, mixtures

O-OP-090 Mixtures, linear index models and log-transformation of exposure data

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BACKGROUND AND AIM: Chemical exposure data are often right-skewed. Many investigators log-transform exposure data, but the rationale is often unstated. Here we investigate the potential impact for mixtures epidemiology, focusing on models that create linear indices such as wqs, qgcomp and BMIM (Bayesian Multiple Index Model). Such models have a long history in toxicology/pharmacology, providing an important intersection with mixtures epidemiology. Does log-transformation of exposure affect fits of linear index models and judgments about additivity and interaction?

METHODS: We use simulated data and concepts from toxicology/pharmacology. Linear index models of the form f[index], where f[.] is the exposure-response function and index is a weighted sum of exposures with non-negative weights, are essentially equivalent to the relative potency model of toxicology/pharmacology (where dose-response curves differ only in potency), a classic additive model.

RESULTS: Log-transformation of right-skewed exposure data is not required for regression modeling of outcome data. While it may help with potential influential points, there are other methods for examining this problem. It does change the shape of the assumed dose-response curve, although this may not matter much for single exposures. But log-transformation of exposure data alters the shape of isoboles, the level sets (contours) of response functions. for f[.] modeled as a Hill function, it changes the shape of isoboles describing the linear index model (parallel, negatively sloped straight lines) to curved, indicating interaction and implying that a linear index model would no longer properly fit the data.

CONCLUSIONS: Log-transformation of exposure data may cause artifacts in the modeling of mixtures data using index models.

O-OP-091 Integrating biological knowledge in Kernel-based analyses of environmental mixtures and health

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A key goal of environmental health research is to assess the risk posed by mixtures of pollutants. As epidemiologic studies of mixtures can be expensive to conduct, it behooves researchers to incorporate prior knowledge about mixtures into their analyses. This work extends the Bayesian multiple index model (BMIM), which assumes the exposure-response function is a non-parametric function of a set of linear combinations of pollutants formed with a set of exposure-specific weights. The framework is attractive because it combines the flexibility of response-surface methods with the interpretability of linear index models. We propose three strategies to incorporate prior toxicological knowledge into construction of indices in a BMIM: (a) constraining index weights, (b) structuring index weights by exposure transformations, and (c) placing informative priors on the index weights. We propose a novel prior specification that combines spike-and-slab variable selection with informative Dirichlet distribution based on relative potency factors often derived from previous toxicological studies. In simulations we show that the proposed priors improve inferences when prior information is correct and can protect against misspecification suffered by naive toxicological models when prior information is incorrect. Moreover, different strategies may be mixed-and-matched for different indices to suit available information (or lack thereof). We demonstrate the proposed methods on an analysis of data from the National Health and Nutrition Examination Survey and incorporate prior information on relative chemical potencies obtained from toxic equivalency factors available in the literature.

O-OP-092 Identifying drivers of vulnerability to heat and cold in European cities: an inverse probability weighting approach

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BACKGROUND AND AIM: Vulnerability to non-optimal temperature widely varies geographically, depending on local climatic, environmental, topologic and socio-economic characteristics. All these characteristics are highly interdependent and disentangling each one's individual contribution to modify the risk is a complex task. We aim to assess individual effect modification of multiple characteristics on temperature-mortality associations using a novel inverse probability weighting (IPW) approach.

METHODS: Using city-level exposure-response functions from 191 cities in Europe, we estimated effect modification from 22 city-level characteristic using a mixed-effects meta-regression model. for each characteristic, we first estimated generalized propensity scores using a gradient boosting algorithm, and then performed the meta-regression with IPW to reduce confounding by other correlated factors. for both heat and cold, we quantified the effect modification as the relative risk (RR) ratio for an interquartile increase in the vulnerability factor.

RESULTS: for cold, significant RR increases were found associated with the distance to the coast, with a ratio of 1.131 (95%CI: 1.024-1.248) for coastal versus inland cities. Higher vulnerability to cold was also found in hotter cities, with a RR ratio of 1.054 (95%CI: 1.025-1.084) associated with average annual temperature. for heat, significant increases in vulnerability were found associated with total population (RR ratio of 1.023, 95%CI: 1.010-1.035) and population density (1.040, 95%CI: 1.027-1.052), as well as the average NO2 level (1.105, 95%CI: 1.066-1.146).

CONCLUSIONS: The application of a novel IPW methodology embedded in a two-stage design can contribute to identify independent roles of local characteristics in modifying mortality risks associated with non-optimal temperature. Results show that vulnerability to heat and cold varies depending on different factors, for instance climatological and geographical features, versus population density and pollution, respectively. These findings can contribute to a better understanding of temperature-related risks and in the design of adaptation policies.

KEYWORDS: Temperature; Mortality; Urban areas; Vulnerability; Propensity scores.

O-OP-093 Comparing effects of air pollution on mortality within the ELAPSE project under standard and causal approaches

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BACKGROUND AND AIM: The association between long-term exposure to air pollution and mortality is well established using regression-based statistical approaches for covariate adjustment, however there is a limited number of observational studies using causal models.

METHODS: We analyzed data from the ELAPSE pooled cohort, consisting of eight adult cohorts from six European countries (enrolled 1985–2005; follow-up 2011–15), and one administrative cohort of adults in Rome (Italy) (enrolled 2001; follow-up 2015). Annual mean exposures to particulate matter < 2.5 µm (PM2.5) and nitrogen dioxide (NO2) were assigned to baseline residential addresses from Europe-wide land-use regression models. for each pollutant per cohort, we estimated generalized propensity scores (GPS), i.e., the conditional density of air pollution mean exposures given pre-exposure individual and area-level covariates. We subsequently fit Cox proportional hazard regression either by standard covariate adjustment or GPS adjustment via inverse-probability weighting (IPW), regression or matching.

RESULTS: of 325,367 and 1,263,712 participants in the pooled and Rome cohorts, 47,131 and 235,543 deceased from natural causes. When using standard regression-based Cox models, 5 and 10 µg/m3 increments in PM2.5 and NO2 were associated with hazard ratios (HRs) of 1.131 (95%CI: 1.107, 1.156) and 1.085 (95%CI: 1.069, 1.101) in the pooled cohort, and 1.066 (95%CI: 1.037-1.095) and 1.028 (95%CI: 1.019-1.036) in the Rome cohort, respectively. When we accounted for GPS via IPW or adjustment for GPS ventiles, results were comparable: for example, PM2.5 and NO2 HRs in the Rome cohort were 1.052 (95%CI: 1.017, 1.087) and 1.023 (95%CI: 1.012, 1.034) in models accounting for GPS via IPW. When we adjusted for GPS by matching, results were sensitive to hyper-parameter specifying pseudo-populations.

CONCLUSIONS: Long-term exposure to air pollution was associated with natural-cause mortality in both standard and causal models. Heterogeneous estimates across methods require further investigation.

KEYWORDS: Causal models, particulate matter, nitrogen dioxide, generalized propensity score.

ORAL PRESENTATIONS SESSION 19: Environmental equity: environmental inequalities and health implications (1)

O-OP-094 Nationwide geospatial analysis of county-level racial/ethnic composition and public drinking water arsenic and uranium

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BACKGROUND AND AIM: There is no safe level of exposure to inorganic arsenic or uranium. Both metals are frequently detected in community water systems (CWSs), which serve 90% of the US population. Sociodemographic and regional inequalities in CWS arsenic and uranium have been identified at the CWS level, but nationwide studies of disparities by racial/ethnic composition are critically needed. We conducted the first nationwide geospatial assessment of the county-level association between racial/ethnic composition and CWS arsenic and uranium concentrations(2000-2011) for 2,631 conterminous counties.

METHODS: First, we assessed spatial autocorrelation via Moran's I and identified Local Indicators of Spatial Association(LISA) clusters. Then, we estimated the geometric mean ratio(GMR) of county-level CWS metal concentrations per 10% higher proportion of each racial/ethnic group via spatial lag regression, adjusting for population density, percentage of public water sourced from groundwater, household income, and education. We evaluated spatial non-stationarity in the strength and direction of the association via geographically weighted regression.

RESULTS: In fully adjusted nationwide models, for a 10% higher county proportion of Hispanic/Latino and American Indian/Alaskan Native residents, the geometric mean (95% CI) of CWSs metal concentration was higher by 6% (4, 8) and 7% (3, 11) respectively for arsenic, and by 17% (13, 22) and 2% (-4, 8), respectively, for uranium. Nationwide associations were inverse for non-Hispanic White and non-Hispanic Black residents, although geographically weighted regression identified a positive relationship between a higher proportion of non-Hispanic Black residents and CWS metals in the Midwestern and Southwestern US.

CONCLUSIONS: Racial/ethnic composition is associated with public drinking water metal concentrations, adding to a growing body of literature characterizing nationwide environmental and racial injustices in US public drinking water contaminants. Findings from this study can advance environmental justice initiatives by informing infrastructure investment and regulatory action to protect communities disproportionately exposed to major environmental contaminants.

KEYWORDS: arsenic, uranium, drinking water, racism, environmental justice.

O-OP-095 Addressing U.S. racial-ethnic inequality in air pollution exposure

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BACKGROUND AND AIM: Air pollution levels in the US have decreased dramatically over the past decades, yet national racial-ethnic exposure disparities persist. It is unknown, however, how to systematically eliminate these disparities and even whether that outcome is possible.
AIM: To investigate three potential approaches to reducing or eliminating national exposure inequalities: (1) location-specific emission reductions (hereafter, "location"), (2) sector-specific emission reductions ("sector"; analogous to BACT-type approaches), and (3) requiring regions to meet a concentration standard ("NAAQS-like"). "Sector" and "NAAQS-like" approaches mirror aspects of current regulations; "location" would be a new regulatory approach.

METHODS: We use the InMAP (Intervention Model for Air Pollution) source-receptor matrix (ISRM) to estimate long-term average fine particulate matter (PM2.5) concentrations across the contiguous US caused by anthropogenic emissions. We employ the 2014 US EPA National Emission Inventory, grouped into 14 source sector and spatially allocated to 52,411 ISRM grid-cells. Emissions reductions for "location" and "sector" are an optimization to maximally reduce racial-ethnic disparities; "NAAQS-like" simulates successive, proportional emission-reductions in each region violating the hypothetical NAAQS.

RESULTS: The base level (no emission reduction) PM2.5 concentration disparity is 1.4 μg/m³ (20%) greater-than-average exposure for non-Hispanic Black people. Our results show that national inequalities in exposure can be eliminated with minor emission-reductions (optimal: ~1% of total emissions) if they target specific locations. In contrast, eliminating exposure inequality using existing regulatory strategies would require eliminating essentially all emissions (if targeting specific economic sectors) or is not possible (if requiring urban regions to meet concentration standards).

CONCLUSIONS: Our findings suggest that incorporating location-specific emissions reductions into the US air quality regulatory framework is crucial to eliminating long-standing national exposure disparities by race-ethnicity.

KEYWORDS: air pollution, environmental justice, fine particulate matter, air quality regulatory

O-OP-096 Socioeconomic disparities in aerosol pollutant exposure may be amplified by ultrafine particles despite declining PM2.5

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BACKGROUND AND AIM: No study has investigated the spatiotemporal race-ethnicity and income disparities in ultrafine particles (UFP; ≤0.1μm) exposure, which is increasingly identified as a key subcomponent of $PM_{2.5}$-related health effects. This study aims to establish the importance of distinguishing UFP from $PM_{2.5}$ and quantify their race-ethnicity and income disparities in New York State (NYS).

METHODS: Exposure disparities among seven race-ethnicity groups (Hispanics of any race, non-Hispanic Asian, Black, Native, Pacific& White alone, and Other/Mixed) and by household income across spatial scales (state, county, county subdivision, NCHS urban levels) during the period 2013–2020 for UFP and $PM_{2.5}$, were quantified using Census data. A global three-dimensional chemical transport model with state-of-the-science aerosol microphysical processes were used to estimate UFP/$PM_{2.5}$ that have been validated extensively with observations.

RESULTS: The average New Yorker was exposed to 5171#·cm^{-3} UFP and 8.2μg·m^{-3} $PM_{2.5}$ in 2013–2020. Minority race-ethnicity groups were invariably exposed to greater daily aerosol pollution in NYS (+51–104% UFP & +1.9–32% $PM_{2.5}$). Race-ethnicity exposure disparities for $PM_{2.5}$ exposure have declined over time; by −6% from 2013–2017 and plateauing thereafter despite increasing $PM_{2.5}$. Crucially and in contrast, these disparities have persisted (+10%) for UFP exposure and even widened in periods of declining UFP. Economic status (median household income) by itself does not reveal significant exposure disparities. However, in tandem with race-ethnicity it uncovers these disparities as disproportionately magnified for socioeconomically disadvantaged subgroups.

CONCLUSIONS: $PM_{2.5}$ decline was associated with decline in race-ethnicity exposure disparities. which continued despite a post-2018 reversal in $PM_{2.5}$ trends. However, race-ethnicity UFP exposure disparities were much larger, more disproportionate, and increased or remained constant across various income strata and levels of urbanicity. The need to distinguish ultrafine (UFP) from fine ($PM_{2.5}$) aerosols is established through microphysical, geostatistical, and exposure assessment perspectives.

KEYWORDS: air pollution, ultrafine particles, particulate matter, environmental justice, socioeconomic status

O-OP-097 The Role of Exposure to Per- and Polyfluoroalkyl Substances in Racial/Ethnic Disparities in Hypertension: Results from the Study of Women's Health Across the Nation

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BACKGROUND AND AIM: Racial/ethnic disparities in hypertension are a pressing public health problem. Most studies have focused on the role of socio-demographic and lifestyle factors. Little is known about the potential mediating role of per- and polyfluoroalkyl substances (PFAS), a pervasive environmental contaminant. We examined the extent to which racial/ethnic disparities in incident hypertension are explained by racial/ethnic differences in serum PFAS concentrations.

METHODS: We included 1,058 hypertension-free midlife women with serum PFAS concentrations in 1999-2000 from the multi-racial/ethnic Study of Women's Health Across the Nation with approximately annual follow-up visits through 2017. Causal mediation analysis was conducted using accelerated failure time models. Quantile-based g-computation was used to evaluate the joint effects of PFAS mixtures.

RESULTS: Black participants had higher risks of developing hypertension (relative survival: 0.58, 95% CI: 0.45-0.76) compared with White participants, which suggests racial/ethnic disparities in the timing of hypertension onset. The percent of this difference in timing that was mediated by PFAS was 8.2% (95% CI: 0.7-15.3) for perfluorooctane sulfonate (PFOS), 6.9% (95% CI: 0.2-13.8) for 2-(N-ethyl-perfluorooctane sulfonamido) acetate (EtFOSAA), 12.7% (95% CI: 1.4-22.6) for 2-(N-methyl-perfluorooctane sulfonamido) acetate (MeFOSAA), and 19.1% (95% CI: 4.2, 29.0 for PFAS mixtures). Significant differences in time to hypertension were not observed when comparing Japanese or Chinese to White participants. The percentage of the disparities in hypertension between Black versus White women that could have been eliminated if everyone's PFAS concentrations were dropped to the 10th percentile observed in this population was 10.2% (95% CI: 0.9-18.6) for PFOS, 7.5% (95% CI: 0.2-14.9) for EtFOSAA, and 17.5% (95% CI: 2.1-29.8) for MeFOSAA).

CONCLUSIONS: These findings suggest differences in PFAS exposure may be an unrecognized modifiable risk factor that partially accounts for racial/ethnic disparities in the timing of hypertension onset among midlife women.

KEYWORDS: Racial/ethnic disparities, hypertension, midlife women, mediation analysis, environmental justice

O-OP-098 Racial/ethnic disparities in phthalate metabolite mixtures and risk of preterm birth: A pooled study of 16 US cohorts

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BACKGROUND AND AIM: Environmental phthalate exposure is ubiquitous in pregnancy and may be a risk factor for preterm delivery. In the United States (US), large racial/ethnic disparities in phthalate exposure may be an important contributor to the racial/ethnic disparities in preterm birth. Utilizing the largest study of phthalates and preterm birth to date, we 1) investigated racial/ethnic disparities in phthalate exposure and 2) estimated how racial/ethnic disparities in preterm birth might improve by equitably reducing phthalate exposure.

METHODS: We pooled individual-level data from 16 US cohorts (N=6,045) on 9 prenatal urinary phthalate metabolites. We categorized participant race/ethnicity as non-Hispanic white (43%), non-Hispanic Black (13%), Hispanic/Latina (38%), or Other (5%; based on sparsity of sub-categories). We investigated confounder-adjusted differences in urinary phthalate metabolite concentrations by maternal race/ethnicity. We used g-computation to estimate changes in preterm birth by race/ethnicity after simultaneous, racial/ethnic-specific reductions in the concentration of all 9 phthalate metabolites. Our hypothetical intervention eliminated racial/ethnic disparities in the distributions of metabolite concentrations.

RESULTS: for 8 of the 9 phthalate metabolites, concentrations were highest among non-Hispanic Black participants and lowest among non-Hispanic whites. Covariate-adjusted differences in metabolite concentrations were most pronounced for monoethyl phthalate and mono-isobutyl phthalate, which were 143% (95% confidence interval [95CI]: 114%, 175%) and 80% (95CI: 66%, 95%) higher among non-Hispanic Black compared to non-Hispanic white participants, respectively. The hypothetical intervention to simultaneously reduce concentrations of metabolites by race/ethnicity, principally among non-white racial/ethnic groups, showed significant reductions in preterm birth. for non-Hispanic Black participants, the pre- and post-intervention probability of preterm birth was 117 (95CI: 94, 141) and 88 (95CI: 61, 118) preterm per 1,000 live births, respectively, representing a relative reduction of 25% (95CI: 16%, 35%).

CONCLUSIONS: Considerable differences in exposure to phthalates could play an important role in the racial/ethnic disparities in preterm birth within the US.

O-OP-099 Exposure to lead, cadmium, mercury and arsenic among Asian children and adolescents in the United States: NHANES 2015-2018

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BACKGROUND AND AIM: Toxic metals adversely influence child development at low concentrations. Higher concentrations of heavy metals were reported among Asians compared to other racial/ethnic groups in earlier NHANES cycles (2011–2014). We examined whether Asian children/adolescents had higher concentrations of several metals compared to other racial/ethnic groups in recent NHANES cycles, as well as potential mediation by fish/shellfish consumption.

METHODS: Data from 5,293 participants (1-19 years) of NHANES cycles 2015–2018 were included with blood measurement of lead (Pb), cadmium (Cd), mercury (Hg) and methylmercury (MeHg), and urinary arsenic (As), monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA). Survey-weighted linear models were assessed for differences in log-transformed metals concentrations between Asians and non-Asians and potential effect measure modification by SES factors. A model-based mediation analysis was conducted to assess the average causal mediation effect of recent fish/shellfish consumption.

RESULTS: Asian children/adolescents had higher blood/urine concentrations of Pb, Cd, Hg, MeHg, As, MMA and DMA, respectively, compared to non-Asians or whites, adjusting for age, sex, BMI-Z score, birthplace, parental education level, family income level and survey cycle. Interactions were estimated between being Asian with parental education with more pronounced associations between lower parental education and higher concentrations of blood Pb, Cd, Hg and MeHg. We estimated mediating effects of recent fish and shellfish consumption for Hg and MeHg exposure in Asians relative to non-Asians; proportions of the total differences mediated were 11% by fish and 7% by shellfish and more pronounced comparing Asians to whites only.

CONCLUSIONS: Asian children and adolescents have higher exposure to several heavy metals and their parent's education may play a more critical role than among non-Asians. Dietary consumption of fish and shellfish may explain some of the elevated exposure. Preventions efforts should be targeted to these potentially higher risk families.

KEYWORDS: NHANES, heavy metals, Asian, children, adolescents, SES, seafood, mediation

ORAL PRESENTATIONS SESSION 20: Exposure assessment, measurement error, uncertainty and correction methods

O-OP-100 Exposure assessment of acetaminophen use in pregnancy: a study comparing self-reported intake with maternal and newborn biomarker measures

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BACKGROUND AND AIM: Acetaminophen (APAP) is the most commonly used medication during pregnancy. Increasingly, studies have reported potential adverse associations between maternal prenatal use of APAP and offspring asthma, adverse reproductive outcomes, and neurodevelopmental disorders. However, most studies have relied on self-reported maternal exposure which has the potential for exposure misclassifications. We conducted this study to compare maternal self-reported APAP intake and three acetaminophen metabolites measured in urine collected during pregnancy and umbilical cord serum samples.

METHODS: We used maternal interview data and biospecimens from the Nutrition in Pregnancy cohort of 2291 pregnant women recruited from Connecticut and Western Massachusetts during 1996-2000. We selected three exposure groups including 10 mothers who reported frequent intake (14 days+) of APAP in the first 3 months of pregnancy, 10 who reported frequent intake in the last 3 months of pregnancy, and 10 who reported never using APAP in these two periods from the cohort. We analyzed three APAP metabolites (parent compound, acetaminophen glucuronide, and 3-(N-acetyl-l-cystein-S-yl)-acetaminophen) levels in the maternal urine (avg. 24 gestational weeks) and the umbilical cord serum samples.

RESULTS: The parent APAP compound and 3-(N-acetyl-l-cystein-S-yl)-acetaminophen) were detected in all urine and serum samples analyzed (100%), while acetaminophen glucuronide was less detectable in the cord serum (40% vs. 100% in urine). APAP metabolites in maternal urine and cord serum were correlated (r=0.43-0.70) within mother-child pairs. All three urinary and cord serum APAP metabolite levels were more strongly correlated with the reported number of days of APAP intake in late pregnancy (r=0.57-0.73; p-values <0.03, rank tests), and less with early pregnancy intake (r=0.18-0.34; p-values 0.21-0.60, rank tests).

CONCLUSIONS: Our findings suggest detailed intake data collected in maternal interviews is an efficient and valid measure to indicate exposure to APAP in pregnancy, while biomarker measures can be used to represent a specific exposure period of interest.

O-OP-101 Development of spatiotemporal high-resolution temperature data for São Paulo, Brazil; a valuable resource for epidemiologists

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BACKGROUND AND AIM: Most studies investigating the temperature-mortality association in cities rely on temperature recordings from few meteorological stations or models at coarse spatial resolution, implicitly assuming an homogenous spatial distribution across. Evidence from urban heat island studies, remote sensing data, and atmospheric and physical sciences suggest this assumption does not hold. Overlooking the spatial variability of temperature exposure in cities may lead to biased epidemiological findings and limit our ability to identify areas of high risk. Herein, we aim to develop an open-access dataset of daily ambient temperature at 500 meters resolution for the municipality of São Paulo (2015-2020).

METHODS: We obtained daily mean temperature data from 60 ground stations within the city and used spatiotemporal regression kriging to predict temperature at unmeasured locations. This technique uses multiple linear regression to model the spatiotemporal trend in temperature, and spatiotemporal kriging to model the regression residuals spatiotemporal autocorrelation. for the multilinear regression, we used several earth observation products including data relating to topography, the built environment and atmospheric processes, as explanatory covariates. The regression residuals were modelled by fitting a sum-metric spatiotemporal variogram model. We validated the model using a leave-one-out and 5-fold cross-validation.

RESULTS: of the 60 monitoring stations, 36 had data >75% valid data. Temperature records showed some spatial heterogeneity (interstation standard deviation: 1.4° C), supporting the need for spatially resolved temperature data. of all covariates used in the multilinear regression model, remotely sensed land surface temperature was the best predictor. Any residual variability was modelled through spatiotemporal kriging. Validation using R2 and root-mean-square-error indicators is ongoing.

CONCLUSIONS: This dataset provides epidemiologists with a unique opportunity to investigate exposure to daily mean temperature in São Paulo at high spatio-temporal resolution, and to identify areas of high risk for certain health outcomes, e.g., mortality, over time and space.

O-OP-102 Comparison of weather station and climate reanalysis data for modelling temperature-related mortality

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BACKGROUND AND AIM: Epidemiological analyses of health risks associated with non-optimal temperature are traditionally based on ground observations from weather stations. Though generally considered representative of the actual ambient conditions and individual's exposure, their broader application in environmental epidemiology is often constrained by inhomogeneous records and the sparse density of meteorological stations. Climate reanalysis represents an alternative option that provide complete spatio-temporal exposure coverage, and yet are to be systematically explored for their suitability in assessing temperature-related health risks at a global scale.
AIM: The aim of the study is to provide the first comprehensive analysis over multiple regions to assess the suitability of the most recent generation of reanalysis datasets for health impact assessments and evaluate their comparative performance against traditional station-based data.

METHODS: We applied the well-established time-series analyses with quasi-Poisson regression (with distributed lag non-linear models and multivariate meta-regression) to model the location specific temperature-mortality associations, across 612 cities within 39 countries over the period 1985–2019, covering a wide range of climates and including low- and middle-income countries. Briefly, we first systematically compared the correlation between daily temperature series derived from ground station observations and ERA5-Land/ERA5 reanalysis, then we evaluated differences in estimated exposure-response functions of temperature-mortality relationships, and finally we compared their performance using fit statistics.

RESULTS: Our findings show that reanalysis temperature from the last ERA5 products generally compare well to station observations, with similar non-optimal temperature-related risk estimates. However, the analysis offers some indication of lower performance in tropical regions, with a likely underestimation of heat-related excess mortality.

CONCLUSIONS: Reanalysis data represent a valid alternative source of exposure variables in epidemiological analyses of temperature-related risk. The consistent spatio-temporal coverage also makes it attractive for quantifying population attributable fractions, an indicator important for health planners and policy makers.

KEYWORDS: mortality, temperature, reanalysis, ERA5-Land, distributed lag models.

O-OP-103 Measurement Error Correction for Ambient PM2.5 Exposure Using Stratified Regression Calibration: Effects on All-Cause Mortality

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BACKGROUND AND AIM: We define measurement error as the difference between actual and predicted PM2.5 concentrations near subjects' home. Previous studies on the impact of measurement error for PM2.5 were mostly simulation studies or used single regression calibration model to correct for measurement error. However, the relationship between actual and error-prone
PM2.5 concentration may vary by time and region. Here we aim to correct the measurement error of PM2.5 predictions using stratified regression calibration and investigate how the measurement error biases the association between PM2.5 and mortality.

METHODS: The "gold-standard" measurements of PM2.5 were daily monitoring data from 2,156 sites across the United States between 2000-2016. The error-prone measure was PM2.5 estimated by ensemble machine learning models. PM2.5 data was stratified by seasons, elevation and census divisions. We regressed daily monitoring PM2.5 on modeled PM2.5 from the same location and time using model below by strata.
E(PM2.5monitoring)= β0j+ β1j PM2.5modeled+εj
Calibrated PM2.5 was calculated with stratum-specific calibration parameters β0j and β1j for each ZIP code and season and aggregated to annual level. Association between calibrated and error-prone annual PM2.5 and all-cause mortality were estimated using mortality data from Medicare beneficiaries with Quasi-Poisson regression models adjusting for demographics, socioeconomic status, access to healthcare, population density and meteorologic factors.

RESULTS: Across 72 strata, the median of β0 and β1 were 0.40 (25% 0.06, 75% 0.95) and 0.93 (25% 0.83, 75% 0.98). From calibrated and error-prone PM2.5 data, we estimated that each 10μg/m3 increase in PM2.5 was associated with 12.2% (95%CI 11.9-12.4) and 11.6% (95%CI 11.4-11.9) increase in the probability of death among Medicare beneficiaries, conditional on confounders.

CONCLUSIONS: Regression calibration parameters of PM2.5 varied by season and region. Using error-prone measure of PM2.5 underestimated the association between PM2.5 and all-cause mortality. Modern exposure models produce relatively small bias.

KEYWORDS: PM2.5; measurement error

O-OP-104 Addressing Geographic Uncertainty: Greenness and Depression Incidence in a Prospective Cohort Study of US Women

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BACKGROUND AND AIM: Geographic uncertainty, including uncertainty in the selection of a spatial scale for exposure, may bias health effect estimates. for example, studies showed protective associations of residential greenspace exposure with depression, but there is no standardized approach for selecting the appropriate buffer sizes to examine this association. By applying a novel statistical approach, we aimed to empirically identify buffer sizes and simultaneously report effect estimates in a longitudinal analysis of greenness and depression.

METHODS: We followed Nurses' Health Study cohort participants who were free of depressive symptoms at baseline (2000) and who reported doctor-diagnosed depression, antidepressant use, and important depression risk factors on biennial questionnaires from 2000 to 2016 (n = 41,945). We used high-resolution (30m x 30m) Landsat data to assess annual average greenness in multiple buffer sizes around participants' residential addresses: 90m, 150m, 270m, 510m, 750m, 990m, 1230m, 1500m, and 2100m. We used penalized Cox regression to estimate regression coefficients to identify buffers within which greenness was associated with risk of depression. Specifically, we modeled NVDI effects as a function of buffer size using B-splines, while adopting a group bridge penalty to identify relevant buffers, with an additional penalty to smooth the effect estimate curves.

RESULTS: Over 449,139 person-years follow-up, 5,454 incident cases occurred. Greenness was protectively associated with incident depression after adjusting for confounders. Our penalized approach identified greenness within the buffer distance of 150m around the residential address as the most relevant for depression incidence, with a 2% decrease in depression risk for each 0.1 increase in NDVI (95% CI 0.3%, 3.6%) within the 150m empirically identified buffer area.

CONCLUSIONS: To account for geographic uncertainty in assessing the impact of greenness on incident depression, we applied a novel statistical approach to identify that NDVI exposure within 150m was associated with lower risk of depression.

O-OP-105 Geomagnetic Disturbances Reduce Heart Rate Variability in the Normative Aging Study

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Solar and geomagnetic activity have been linked to increased cardiovascular (CVD) events. We hypothesize that heart rate variability (HRV) may be the biological mechanism between increased CVD risk and intense geomagnetic disturbances (GMD). To evaluate the impact of intense GMD on HRV in 618 male participants enrolled in the Normative Aging Study (Greater Boston Area), we performed repeated-measures using mixed-effects regression models. We evaluated two HRV outcomes: the square root of the mean squared differences of successive normal-to-normal intervals (r-MSSD) and the standard deviation of normal-to-normal heartbeat intervals (SDNN). We used data on global planetary K-Index (Kp) from middle latitudes as a GMD parameter from the NOAA. We found a near immediate effect of higher Kp on reduced HRV for exposures from 6 to 24 hours prior to electrocardiogram recording. A 75th percentile increase in 15-hour Kp prior the examination was associated with a -1.5% change in r-MSSD (95% CI: -2.3%, -0.6%, p-value = 0.0008) and a -0.8% change in SDNN (95% CI: -1.3%, -0.2%, p-value = 0.007). The associations remained similar after adjusting the models for air pollution, over the exposure window prior to the event. This is the first study to demonstrate the potential adverse effects of intense GMD on reduced heart rate variability in a large epidemiologic cohort over an extended period, which may have important clinical implications.

ORAL PRESENTATIONS SESSION 21: Air pollution and cancer

O-OP-106 Long term exposure to air pollution and kidney parenchyma cancer – Effects of Low-level Air Pollution: a Study in Europe (ELAPSE)

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BACKGROUND AND AIM: Particulate matter (PM) is classified as a group 1 human carcinogen. Previous experimental studies suggest that particles in diesel exhaust induce oxidative stress, inflammation and DNA damage in kidney cells, but the evidence from population studies linking air pollution to kidney cancer is limited.

METHODS: We included six cohorts from the "Effects of low level air pollution: A study in Europe" (ELAPSE) collaboration. We developed hybrid models combining monitoring and land use data, satellite observations, and dispersion model estimates for nitrogen dioxide (NO2), fine PM (PM2.5), black carbon (BC), warm season ozone (O3), and eight elemental components of PM2.5 (copper, iron, potassium, nickel, sulfur, silicon, vanadium, and zinc) to assign exposure to participants' residential addresses. We defined kidney parenchyma cancer according to the International Classification of Diseases 10th and 9th Revision codes C64 and 189.0. We applied Cox proportional hazard models adjusting for potential confounders at the individual and area-level.

RESULTS: A total of 302,493 persons were included in the analyses. During a total of 5,497,514 person-years of follow-up (mean 18.2 years), 847 incident cases of kidney parenchyma cancer occurred. Median (5–95%) exposure levels of NO2, PM2.5, BC and O3 were 24.1 µg/m3 (12.8–39.2), 15.3 µg/m3 (8.6–19.2), 1.6 10-5/m (0.7–2.1), and 87.0 µg/m3 (70.3–97.4), respectively. The results of the fully adjusted linear analyses showed a hazard ratio (95% confidence interval) of 1.03 (0.92, 1.15) per 10 µg/m³ NO2, 1.04 (0.88, 1.21) per 5 µg/m³ PM2.5, 0.99 (0.89, 1.11) per 0.5 10−5m−1 BC, and 0.88 (0.76, 1.02) per 10 µg/m³ O3. The analyses did not show associations between any of the elemental components of PM2.5 and cancer of the kidney parenchyma.

CONCLUSIONS: We did not observe evidence of an association between long-term ambient air pollution exposure and incidence of kidney parenchyma cancer.

O-OP-108 Impacts of long-term PM2.5 exposure on Endocrine related cancer patients in South Korea

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BACKGROUND AND AIM: In previous studies, endocrine tumors reported to be associated with endocrine disrupting chemicals (hereafter, EDCs). Among EDCs, air pollution is a carcinogen classified as an environmental factor. We investigated the relationship between air pollution and endocrine tumors.

METHODS: National health insurance recipients are subject to regular national health checkups. We linked this information with the data of the occurrence of the first cancer from the national cancer registration project. Those who were diagnosed with cancer (breast cancer (C50), prostate cancer (C61), and thyroid cancer (C73)) were selected from the health checkup subjects between 2007 and 2010.
The Extreme Boosting model was trained on a dataset gained from both satellite and observational data collected from 2015 to 2020 in South Korea. The model was used to predict monthly average PM2.5 values for each 1km grid nationwide for the period from 2007 to 2020. Grid values within a city district were averaged to obtain a monthly average PM2.5 value for all nationwide 229 city districts. We employed Cox's proportional hazards models with age, sex (only thyroid cancer patients), Body Mass Index (BMI), smoking status, blood pressure, waist circumference and total cholesterol as covariates. Follow-up started at 2007 following entry into the cohort, and the end date of the study was 31th Oct. 2021. Annual mean ambient PM2.5 of the patients' residential address was used as time-varying exposures.

RESULTS: In the time-varying cox model, the hazard ratio (HR) of mortality was 1.042 (95%CI: 1.031-1.052), 1.031 (95%CI: 1.022-1.039) and 1.029 (95%CI: 1.016-1.042) for breast cancer, prostate cancer patients and thyroid cancer patients, respectively.

CONCLUSIONS: We observed that an increase in PM2.5 concentrations increased the risk of mortality in patients diagnosed with breast cancer, prostate cancer, and thyroid cancer, respectively.

KEYWORDS: Endocrine-related cancer, cohort study, fine particle matter, Extreme Boosting model

O-OP-109 Exposure to Wildfires and Cancer Incidence in Canada: A Population-Based Cohort Study

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BACKGROUND AND AIM: Wildfires emit many carcinogenic pollutants that contaminate air, water, terrestrial and indoor environments. However, little is currently known about the relationship between exposure to wildfires and cancer risk. The aim of this study was to investigate the associations between residential exposure to wildfires and the incidence of several cancer outcomes in a national, population-based cohort in Canada

METHODS: We conducted a cohort study of over two million Canadians followed for cancer incidence over 20 years (approximately 34 million person-years). Exposures to wildfires were assigned based on area burned within a 20 or 50 km radius of residential locations and updated for annual residential mobility. Multivariable Cox proportional hazards models were used to estimate associations between exposure to wildfires and specific cancers associated with carcinogenic compounds released by wildfires including lung and brain cancer, non-Hodgkin lymphoma, multiple myeloma, and leukemia, adjusted for many personal and neighbourhood-level covariates.

RESULTS: Wildfire exposure was consistently associated with slightly increased incidence of lung cancer and brain tumors. for example, cohort members experiencing a wildfire within 50 km of residential locations in the past ten years had a 4.9% (adjusted HR= 1.049, 95% CI: 1.028-1.071) relatively higher incidence of lung cancer than unexposed populations, and a 10% (adjusted HR= 1.100, 95% CI: 1.026-1.179) relatively higher incidence of brain tumors. Similar associations were observed for the 20 km buffer size. Wildfires were not associated with hematologic cancers in this study, and concentration-response trends were not readily apparent when area burned was modelled as a continuous variable.

CONCLUSIONS: Long-term exposure to wildfires may increase the risk of lung cancer and brain tumors. Further work is needed to develop long-term estimates of wildfire exposures that capture the complex mixture of environmental pollutants released during these events.

KEYWORDS: wildfires, cancer

O-OP-110 Exposure to indoor wood-burning stoves and fireplaces and risk of lung cancer among Sister Study participants

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BACKGROUND AND AIM: Epidemiological evidence from case-control studies has identified exposure to household combustion of biomass fuel (primarily wood) as a probable lung carcinogen. However, few studies have been conducted in the United States, where indoor wood-burning and usage patterns differ. We examined the association of exposure to indoor wood smoke from fireplaces and stoves with incident lung cancer in U.S. women.

METHODS: 50,399 women were studied in the U.S.-based prospective Sister Study cohort (recruited 2003-2009) who answered baseline exposure information and did not have lung cancer before enrollment. at baseline, women reported their frequency of use of wood-burning stoves and/or fireplaces in their longest-lived adult residence. Cox regression was used to estimate adjusted hazard ratios (HRadj) and 95% confidence intervals (CI) for the association between indoor wood-burning fireplace/stove use and incident lung cancer.

RESULTS: During an average of 11.3 years of follow-up, 520 lung cancer cases were diagnosed. Overall, 62.2% of the study population reported the presence of an indoor wood-burning fireplace/stove at their longest-lived adult residence. Compared to those without a wood-burning fireplace/stove, an elevated risk of lung cancer was observed in women who used their wood-burning fireplace/stove ≥30 days/year (HRadj = 1.20; 95% CI = 0.94, 1.52; p-for-trend=0.09). Associations were more pronounced in never smokers, with elevated HRs observed in women reporting use both 1-29 days/year (HRadj = 1.87; 95% CI = 1.07, 3.28) and ≥30 days/year (HRadj = 1.69; 95% CI = 0.92, 3.11). Findings were stronger among women who were younger, had less educational attainment and lived in urban settings.

CONCLUSIONS: Our prospective analysis of a cohort of U.S. women found that frequent use of wood-burning indoor fireplaces/stoves was associated with incident lung cancer, consistent with earlier findings.

KEYWORDS: Wood Smoke; Lung Cancer; Women; Respiratory Diseases

O-OP-111 Influence of neighborhood social and natural environment on prostatic tumor histology in a US-based cohort of male health professionals

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BACKGROUND AND AIM: Neighborhood social and physical environments may contribute to prostate cancer (CaP), but biological mechanisms remain unclear. We examined associations between neighborhood factors and inflammation-related prostatic histology.

METHODS: Men diagnosed with CaP from 1986-2009 in the Health Professionals Follow-up Study were included. Addresses, demographic, clinical, and lifestyle data were provided through biennial questionnaires. Decennial census data were used to estimate neighborhood socioeconomic status (nSES) based on a summary z-scaled measure of nine census tract-level measures of income, wealth, education, and racial composition. Segregation was estimated using census tract-level Index of Concentration at Extremes (ICE). Neighborhood greenness within 270 meters of the participants' address was estimated using seasonal averaged Landsat Normalized Difference Vegetation Index (NDVI). Slides containing surgical tissue underwent a standardized histopathologic review. Chronic inflammation was assessed based on increasing presence of mononuclear cells. Focal atrophy was assessed through Simple Atrophy (SA), Simple Atrophy with Cyst Formation (SACF), and Postatrophic Hyperplasia (PAH). Exposures were assessed at baseline and using updated cumulative averages. Adjusted odds ratios (aOR) for inflammation (nominal) and focal atrophy (binary) measures were estimated from covariate-adjusted logistic regression models, per interquartile range (IQR) increase in each exposure.

RESULTS: Among 967 CaP cases with ≥1 lesion, each IQR increase in baseline NDVI (aOR: 0.76, 95% CI: 0.59, 0.98), Income-ICE (aOR: 0.79, 95% CI: 0.61, 1.04) and Race/Income ICE (aOR: 0.79, 95% CI: 0.63, 0.99) was associated with lower PAH. An IQR increase in nSES was associated with lower SACF (aOR: 0.77, 95% CI: 0.60, 0.99). No associations were observed for chronic inflammation. Associations using cumulative updated average exposures were weaker for NDVI but similar for nSES and ICE.

CONCLUSIONS: Favorable neighborhood socioeconomic and natural environments were associated with lower PAH but not other prostatic lesions. Prostatic inflammation arising from environmental sources may result in distinct pathological signatures.

Tuesday, September 20

ORAL PRESENTATIONS SESSION 22: Health effects of short-term air pollution exposure

O-OP-112 Acute effects of ambient air pollution on asthma emergency department visits in 10 US states

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BACKGROUND AND AIM: Ambient air pollution is a major risk factor for increased asthma morbidity. However, previous short-term health effect studies in the US have been limited to a small number of cities or pollutants.
OBJECTIVES: This study examined acute age-specific effects of exposure to particulate matter (PM2.5, PM10), major PM2.5 components (elemental carbon [EC], organic carbon [OC], nitrate, sulfate), and gaseous pollutants (O3, NOx/NO2, SO2, CO) on emergency department (ED) visits for asthma during 2005-2014 in 10 US states (Arizona, California, Georgia, Maryland, Missouri, Nevada, New Jersey, New York, North Carolina, and Utah).

METHODS: We used quasi-Poisson log-linear time-series models with unconstrained distributed lags to estimate acute (8-day) effects of air pollution exposure on asthma ED visits at agency monitoring sites, controlling for meteorology, time, and influenza ED visits. We used a Bayesian hierarchical model to combine site-specific associations. We also conducted age-stratified analyses (aged 1-4, 5-17, 18-49, 50-64, and 65+).

RESULTS: We observed positive associations between 8-day exposure to particulate matter (e.g., PM2.5: rate ratio [RR] = 1.016, 95% confidence internal [CI] = [1.008, 1.025] per 6.21 μg/m³ increase), major PM2.5 components (e.g., EC: RR of 1.010 [1.002, 1.018] per 0.52 μg/m³), and gaseous pollutants (e.g., O3: RR of 1.048 [1.026, 1.070] per 0.02 ppm). Associations of traffic-related pollutants (NOx, CO, EC, and OC) were generally weaker for same day (lag 0) exposures than for exposures at longer lags before the ED visit; in contrast, PM and O3 showed strongest effects at lag day 0. Total and carbonaceous PM had more pronounced associations within younger age groups (aged 17 and below) than older age groups.

CONCLUSIONS: This study reports associations between short-term air pollution exposure and increased risks of asthma ED visits. We found that short-term particular matter exposure posed a higher risk on children and adolescents than on adults.

O-OP-113 Short-term ambient air pollution exposure and risk of atrial fibrillation in patients with intracardiac devices

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INTRODUCTION: Atrial fibrillation (AF) is the most common cardiac arrhythmia and is associated with substantial morbidity and mortality. Short term exposure to fine particulate matter (PM2.5) air pollution has been causally linked to higher risk of cardiovascular disease, but the association with atrial fibrillation (AF) is less clear.

METHODS: We conducted a time-stratified case-crossover study to estimate the association between short-term air pollution levels and risk of AF episodes. The episodes were identified among patients with paroxysmal AF and an intracardiac devices able to register and store AF episodes. We obtained air pollution and temperature data from fixed monitoring stations and used conditional logistic regression to quantify the association of fine particulate matter (PM2.5) and ozone (O3) with onset of AF episodes, adjusting for temperature and public holidays.

RESULTS: We analyzed 584 episodes of AF from 91 participants and observed increased risk of AF episodes with PM2.5 levels for the 48-72 hours lag (OR 1.05 CI [1.01,1.09] per IQR)] and 72-96 hour (OR 1.05 CI [1.00,1.10] per IQR). Our results were suggestive of an association between O3 levels and AF episodes during the warm season. We did not observe any statistically significant associations for PM10 nor NO2.

CONCLUSIONS: Short-term increases in PM2.5 in a low-pollution level environment were associated with increased risk of AF episodes in a population with intracardiac devices. Our findings add to the evidence of a potential triggering of AF by short term increases in air pollution levels, well below the new WHO air quality guidelines.

O-OP-114 Longitudinal assessment of the association between short-term air pollution exposure and symptoms of generalized anxiety disorder in Nurses' Health Study II

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BACKGROUND AND AIM: Emerging evidence has linked air pollution exposure to mental health outcomes, such as anxiety. However, most previous studies are cross-sectional and specific methods of defining anxiety have varied. We used a longitudinal framework to investigate the association between one-, three-, and 12-month average $PM_{2.5}$ and NO_2 exposure and clinically-relevant generalized anxiety disorder (GAD) in a prospective, U.S.-based cohort study.

METHODS: We included 79,838 participants who had outcome and exposure data. Anxiety was measured in 2013 and 2017 using Generalized Anxiety Disorder Assessment (GAD-7). GAD-7 scores for both time points were dichotomized at a clinically-relevant cutoff (GAD-7 ≥ 5), indicating at least mild symptoms. Time-varying $PM_{2.5}$ ($\mu g/m^3$) and NO_2 (ppb) at each residential address were assigned using spatiotemporal prediction models for one, three, and 12 months prior to questionnaire return. We used generalized estimating equations (GEE) to estimate odds ratios (OR) and 95% confidence intervals (95% CI), adjusting for known risk factors of anxiety and potential confounders. We assessed effect modification by neighborhood socioeconomic status (nSES) using stratified models.

RESULTS: In multivariable models, interquartile range increases in exposure to average one-month $PM_{2.5}$ (OR: 1.02, 95% CI: 1.00, 1.04), one-month NO_2 (OR: 1.02, 95% CI: 1.01, 1.04), three-month NO_2 (OR: 1.03, 95% CI: 1.01, 1.04), and 12-month NO_2 (OR: 1.03, 95% CI: 1.01, 1.05) were associated with small elevated risks of GAD. There was evidence of effect modification by nSES, with those living in lower nSES areas being more susceptible to effects of short-term air pollution. for example, the OR for one-month average NO_2 in the lowest quintile of nSES was 1.06, 95% CI: 1.02, 1.11.

CONCLUSIONS: In this cohort of women, we found that higher exposure to short-term air pollution was associated with increased risk of clinically-relevant anxiety symptoms, and that nSES could be an important effect modifier.

O-OP-115 Heterogeneity in acute $PM_{2.5}$ mortality: big data strategies in the Mexico City Metropolitan Area

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BACKGROUND AND AIM: Identification of subgroups at greater risk of mortality from $PM_{2.5}$ may inform targeted public health interventions. The case-crossover design is a powerful tool for studying acute $PM_{2.5}$ mortality associations in large registries where statistical interaction indicates differentially susceptible subgroups. We explore shrinkage with resampling to identify these groups in a big data context.

METHODS: We used a time-stratified case-crossover design to investigate the association between $PM_{2.5}$ with 1.5 million ICD-10 coded non-external 18+ years-old death records from the Mexico City Metropolitan Area, 2004–2019. Daily municipal-level exposures for $PM_{2.5}$ and temperature came from population-weighting 1km satellite-based model predictions, and were scaled to z-scores. We assessed whether the subgroup-specific association of $PM_{2.5}$ exposure (lag_{01}) with daily mortality varied from the overall association for $PM_{2.5}$ by including weighted effect coded interaction terms of lag_{01} $PM_{2.5}$ by cause-of-death:age-group:sex groupings (56 interaction terms), adjusting for temperature. We fit conditional logistic regression with shrinkage for regularization (ridge regression), and cross-validation to select the value of λ with the minimum mean square error. Finally, bootstrap resampling was used for coefficient confidence intervals (95%CI).

RESULTS: Overall, a 10μg/m³ higher lag_{01} $PM_{2.5}$ was associated with 1.46% higher mortality (95%CI: 1.30-1.77). Subgroups exhibited substantial variation (point estimates from 1.1% to 1.91%) with the strongest associations seen for: circulatory system in females ≥80 years-old (1.91%, 95%CI: 1.51%-2.92%); respiratory system in females ≥80 years-old (1.86%, 95%CI: 1.44%-3.30%); and respiratory system in females 65-79 years-old (1.83%, 95%CI: 1.56%-3.61%).
CONCLUSION: Regularization techniques and inclusion of multi-way interactions in big data analyses aid in systematically identifying specific subpopulations with enhanced response to $PM_{2.5}$ relative to the population-average association.

KEYWORDS: $PM_{2.5}$, penalized regression, case crossover, mortality, big data

O-OP-116 The effect of ambient air pollution and wildfire smoke on emergency department visits for persons experiencing homelessness in San Diego, California

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BACKGROUND AND AIM: Homelessness may increase vulnerability to the adverse health effects of air pollution. San Diego (SD) was the urban center with the fifth largest number of people experiencing homelessness in the United States. This study aims to determine the effect of wildfire-specific PM2.5 and PM2.5 from other sources on emergency department (ED) visits for individuals experiencing homelessness in SD.

METHODS: A unique dataset with granularity on socio-demographics of ED visits from 2012 to 2020 was utilized. A validated ensemble model combining machine learning algorithms and spatio-temporal imputation technique was applied to isolate daily wildfire-specific PM2.5. A weighted daily exposure was estimated based on point-in-time counts of people experiencing homelessness in SD. A time stratified case-crossover design was applied to study the association between wildfire-specific PM2.5 and PM2.5 from other sources and ED visits for respiratory diagnoses, adjusting for specific humidity, wind speed and maximum temperature.

RESULTS: While representing less than 0.3% of SD County, over 10% of the 33,446 ED patients admitted for respiratory disease to a single health system were experiencing homelessness at the time of admission. for housed patients, an effect was observed for every 10□g/m3 increase in non-wildfire PM2.5 [OR:1.14, 95%CI: 1.03,1.27] with weaker imprecise estimates for wildfire-PM2.5 [OR:1.02, 95%CI: 0.9,1.17]. In contrast, no strong evidence was found for non-wildfire PM2.5 on ED visits of people experiencing homelessness [OR:0.94, 95%CI: 0.69,1.29], while wildfire-specific PM2.5 had stronger albeit imprecise impacts [OR:1.22, 95%CI: 0.92,1.61].

CONCLUSIONS: As the intensity of wildfires rises, understanding risks for vulnerable populations such as those experiencing homelessness is critical in developing effective mitigation strategies. As the first epidemiological study to quantify effects of PM2.5 on this population, we hope to pave the way for future research to understand their risks in the context of climate and social change.

KEYWORDS: Wildfire smoke; homelessness; PM2.5; time-stratified case-crossover

O-OP-117 Contributions of Biomass Burning Events to Daily PM10 Concentrations and The Short-Term Associations with Hospital Admissions in Malaysia

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BACKGROUND AND AIM: Despite serious biomass burning in the Southeast Asian region, there is a lack of epidemiological studies that directly evaluate the health effects of particulate matter attributed to biomass burning. This study aims to estimate the short-term effects of particulate matter ≤10μm (PM_{10}) on hospital admissions in Peninsular Malaysia, distinguishing between PM_{10} originating from biomass burning and other sources.

METHODS: We identified biomass burning by evaluating daily hotspot information from MODIS satellite sensor and the HYSPLIT backward wind trajectories at five districts during 2005 – 2015. Days with wind trajectories passing through biomass burning were known as "haze days". We estimated PM_{10} concentrations attributed to biomass burning by decomposing total concentrations using the moving mean of PM_{10} on non-haze days. We fitted district-specific quasi-Poisson regression models to estimate associations of PM_{10} attributable to biomass burning and non-biomass burning with daily hospitalizations due to respiratory and cardiovascular diseases (ICD-10: J00-J99 and I00-I99, respectively). To obtain a regional average, we pooled district-specific results using random-effects meta-analysis.

RESULTS: We analyzed respiratory (210,960 cases) and cardiovascular (178,952 cases) hospitalizations. On average, 50% of study period was identified as haze days (PM_{10} due to biomass burning >0μg/m³). Average PM_{10} levels attributed to biomass burning and non-biomass burning were 6.6μg/m³ (SD: 51.7) and 41.6μg/m³ (SD: 20.6) respectively. Increases of 10μg/m³ biomass burning PM_{10} and non-biomass burning PM_{10} during non-haze day (lag 0–1 days) were associated with increases in respiratory hospital admissions of 0.44% (95% CI: 0.06, 0.82%) and 0.86% (95% CI: 0.31, 1.41%), respectively. We could not see any significant associations for cardiovascular hospital admissions. District-specific estimates of the associations appeared to be homogeneous.

CONCLUSIONS: PM_{10} from both biomass burning and other emission sources were positively associated with respiratory hospitalizations in Peninsular Malaysia.

KEYWORDS: Biomass burning event, Particulate matter, Hospital admission, Respiratory disease

ORAL PRESENTATIONS SESSION 23: Child health and exposure to pesticides and other chemicals

O-OP-118 Associations between urinary paraben concentrations and measures of cardiometabolic risk in pre-school children of the ENVIRONAGE birth cohort

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BACKGROUND AND AIM: Parabens are widely used as antimicrobial preservatives in personal care products. Endocrine-disrupting effects have been described previously, but studies investigating obesogenic or cardiovascular effects have shown discordant results. Cardiometabolic changes associated with paraben exposure and predictive for later life health conditions may already be visible in early life.

METHODS: Paraben concentrations [methyl (MeP), ethyl (EtP), propyl (PrP), and butyl (BuP)] were measured by ultra-performance liquid chromatography/tandem mass spectrometry in 300 urinary samples from 4-6-year-old children of the ENVIRONAGE birth cohort. Values below the limit of quantification (LOQ) were imputed by censored likelihood multiple imputation. The association with anthropometric and cardiovascular measurements (BMI z-scores, waist circumference, blood pressure and retinal microvasculature) was analyzed in multiple linear regression models with a priori selected covariates. Effect modification by sex was investigated by including interaction terms.

RESULTS: The geometric means (geometric SD) of urinary MeP, EtP, and PrP levels above the LOQ were 32.60 (6.64), 1.26 (3.50), and 4.82 (4.11) µg/L respectively. for BuP 97% of all measurements were below the LOQ. In adjusted models with log-transformed paraben values MeP was associated with central retinal venular equivalent (β = 1.33, p = 0.029) and inversely associated with BMI z-scores (β = -0.065, p = 0.019). PrP was associated with the retinal tortuosity index (β = 0.0018, p = 0.0034). Additionally, EtP was significantly associated with BMI z-scores in boys (β = 0.12, p = 0.012).

CONCLUSIONS: The inverse association between MeP and BMI z-scores could illustrate underlying biological mechanisms related to endocrine-disrupting properties of parabens.
Associations between parabens and retinal microvasculature in pre-school children may indicate adverse effects on cardiometabolic health even at a young age and provide a starting point for further research on paraben-related modes of action.

KEYWORDS: Parabens, BMI z-scores, blood pressure, retinal microvasculature, ENVIRONAGE birth cohort

O-OP-119 Persistent organic pollutant exposure and thyroid function among 12-year-old children

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BACKGROUND AND AIM: Polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and per- and polyfluoroalkyl substances (PFASs) are persistent organic pollutants (POPs) globally spread in environment with numerous toxicological properties, including thyroid endocrine disruption. We aimed to assess the associations between various POPs and thyroid hormones among boys and girls aged 12 years, accounting for puberty stages.

METHODS: Exposure to 4 PCBs, 3 OCPs and 6 PFASs was assessed through blood-serum measurements at age 12 in 476 children of the PELAGIE mother-child cohort (France). Thyroid function was assessed in blood-serum by measuring free triiodothyronine (fT3), free thyroxine (fT4) and thyroid-stimulating hormones (TSH). Puberty status was assessed by clinical examination according to the Tanner stages. Associations were estimated with linear regression for each POPs and each hormone (both log-transformed), and adjusted for potential confounders. Exposure levels were categorized when a non-linear dose-response relation was suggested. Analyses were performed for girls (n=227) and boys (n=249) separately.

RESULTS: Among boys, hexachlorobenzene and Perfluorodecanoic acid were associated with decreased fT3 (β=-0.07 95%CI=[-0.12,-0.02] and β=-0.03 95%CI=[-0.06,-0.00] respectively). Perfluorohexanesulfonic acid (PFHxS) was associated with increased fT4, with higher beta coefficients for the 2nd tercile (compared to 1st tercile reference). After stratification on pubertal Tanner stages, PCBs and OCPs seemed associated with increased TSH in the early puberty group (stages 1 and 2); but, decreased TSH in the stage 3 and late puberty group (stages 4 and 5).
Among girls, PFHxS was associated with decreased TSH (β=-0.15 95%CI=[-0.29,-0.00]) and Perfluorooctanoic acid was associated with decreased fT3 (β=-0.06 95%CI=[-0.12,-0.01]). After stratification on pubertal status, no evidence of heterogeneity has been observed.

CONCLUSIONS: Consistently with literature, this study showed associations between some POPs and thyroid hormone levels. Furthermore, some of these associations seemed heterogenous among boys according to pubertal status.

KEYWORDS: persistent organic pollutant, thyroid hormones, adolescence

O-OP-120 Association of Prenatal Exposure to Persistent Organic Pollutants and Childhood Lipid Levels: The Rhea Birth Cohort (Greece)

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BACKGROUND AND AIM: Lipid disorders in childhood are associated with an earlier onset and greater risk of cardiovascular disease in adulthood. Prenatal exposure to persistent organic pollutants (POPs) has been linked to cardiometabolic risk factors in childhood, but there are limited studies evaluating the persistence of these associations into early adolescence. We assessed the impact of in-utero exposure to POPs on lipid profiles during childhood in the RHEA birth cohort in Greece.

METHODS: Maternal serum concentrations of several polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethene (DDE), and hexachlorobenzene (HCB) were measured in first trimester. We measured triglycerides (TG), total cholesterol (TC), HDL- and LDL-cholesterol at 4, 6, and 11 years. Generalized estimating equations and multivariate regression models assessed the associations with repeated and single time-point measures, respectively. We also tested effect modification by sex.

RESULTS: We did not find any strong evidence of lipid levels at age-four being associated to prenatal POPs exposure. DDE exposure in the third tertile (>2846 ng/mL) was associated with higher TC (β= 8.01 mg/dL, 95% CI:1.66, 14.36), HDL (β= 3.25 mg/dL, 95% CI: 0.04, 6.46) and LDL (β= 6.29 mg/dL, 95% CI: 0.78, 11.79). HCB in the second tertile (69 – 102.5 ng/mL) was associated with lower TC (β= -7.27mg/dL, 95% CI: -13.36, -1.19) and HDL (β= -3.34 mg/dL, 95% CI: -6.40, -0.27). We observed strong negative associations between all POPs and age-six TG levels. Similarly, HCB and PCB118 were associated with lower TC and LDL levels at 11 years. In GEE models of repeated outcome measures DDE was associated with higher TC and HDL levels. No clear differences by sex were observed.

CONCLUSIONS: Our data indicate that in utero exposures to POPs may be associated with changes in child circulating lipids. These findings require further exploration in other settings and larger cohorts.

KEYWORDS: prenatal, POPs, lipids, children

O-OP-121 Association of prenatal exposure to heavy metal mixtures and anogenital distance in newborns

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BACKGROUND AND AIM: Although the association between prenatal exposure to multiple metals and newborns' anthropometrics has been extensively studied, little is known about the reproductive toxicity and the endocrine disturbance characteristics of these metals. Hence, this study aimed to investigate the associations between prenatal exposures to a wide scope of metals to newborn's anogenital distance, as a marker of endocrine disruptions.

METHODS: We used data of 889 mother-infant pairs, from two major hospitals in Israel. Associations between eight metals (arsenic, cadmium, chromium, mercury, lead, nickel, selenium and thallium) detected in maternal urine samples from day of delivery to anogenital distance index (AGI) at birth were examined. Adjusted estimates were calculated separately for males and females, using single-exposure models, and weights-quantile sums (WQS) models accounting for metals mixtures.

RESULTS: Females found more susceptible to prenatal metals exposure as their z-scaled anoclitoris distance index (AGIac) was positively associated to chromium (β = .158 [95%CI:.061–.256]), nickel (β = .083 [95%CI:.005–.161]) and thalium (β = .140 [95%CI:.022–.258]). Their Z-scaled anofourchette distance index was positively associated to nickel (β = .079 [95%CI:.001–.158]). Z-scaled anoscrotal distance index (AGIas) was the only measure found associated to exposure in the WQS models (β = -.329 [95%CI:-.629– -.030]) and was associated to nickel and selenium. In the single-exposure models, chromium found positively associated (β = .111 [95%CI:.017–.206]) to the Z-scored anoscrotal distance index (AGIas) among males.

CONCLUSIONS: The results suggest prenatal exposure to chromium, nickel and thallium may be associated to alterations of females AGD, while chromium, nickel and selenium to changes in males AGD. Since AGD alterations could represent wider endocrine interruptions, the effects of these metals on biological and chemical mechanisms during the vulnerable period of pregnancy should be further investigated.

KEYWORDS: Prenatal Exposure; Pregnancy; Anogenital-Distance; Metals; WQS;

O-OP-122 Mixture exposure to plastic-related short half-life chemicals and associations with childhood asthma and allergies: The Hokkaido Study

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In recent years, exposure to environmental chemicals is thought to be one of the factors contributing to allergies. However, studies examining the effects of mixture chemical exposures on allergies are limited. The aim of this study is to examine the associations between exposure to mixtures of phthalates, phosphorous flame retardants (PFRs), bisphenols (BPs) and childhood allergies.

This study is a part of an on-going birth cohort, the Hokkaido Study. Wheeze, rhino-conjunctivitis, and eczema were defined by the ISAAC questionnaire at age 7. Morning void urine of children was also collected at age 7 for exposure measurements. We included 346 children who were selected based on a case-cohort design (n=400) and we completed exposure measurements of all three classes of chemicals. We measured 10 and 13 urinary metabolites of phthalates and PFRs respectively using LC-MS/MS, and 7 BPs using GC-MS/MS. Associations between the chemical mixtures and allergies were examined by Weighted Quantile Sum (WQS) analyses adjusted for sex, BMI, and environmental tobacco smoke. The exposure levels were corrected by individual urinary creatinine and ln-transformed.

The most dominant urinary markers of phthalates, PFRs and BPs were 5cx-MEPP (median 38.5 ng/mL), BCIPHIPP (0.38 ng/mL), and BPA (0.89 ng/mL), respectively. In WQS analyses, exposure to mixtures of chemicals was associated with increasing risks of wheeze (OR, 95%CI: 2.0, 1.3-3.1), rhino-conjunctivitis (1.8, 1.1-3.1), and eczema (1.8, 1.2-2.8). The contributions of each chemical were BDCIPP (33%) and cx-MiNP (13%) for wheeze, BPF (13%) and BPA (10%) for rhino-conjunctivitis, and BBOEHEP (23%) and 5oxo-MEHP (18%) for eczema, respectively. Compounds showing high contributions to rhino-conjunctivitis and eczema were consistent with previous reports examining single exposures. However, the interpretation should be considered with caution, as urinary concentrations were measured only once, and the study was cross-sectional with a modest sample size.

KEYWORDS: Mixture exposure, childhood allergies, cross-sectional study

O-OP-123 Oxidative stress of glyphosate, AMPA and metabolites of pyrethroids and chlorpyrifos pesticides among primary school children in Cyprus

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BACKGROUND AND AIM: Exposure to pyrethroids and chlorpyrifos has been previously associated with adverse effects on children's health. Evidence on the human toxicity of glyphosate (GLY) and its primary metabolite, aminomethylphosphonic acid (AMPA) is limited, particularly for children. This study aimed to i) assess the exposure determinants of the pesticides measured in children in Cyprus, and ii) determine the association between urinary pesticides and biomarkers of DNA and lipid oxidative damage.

METHODS: A children's study was set up in Cyprus (ORGANIKO study) being aligned with the methodology of the European Human Biomonitoring Initiative (HBM4EU). Urinary GLY and AMPA, pyrethroid metabolites and the chlorpyrifos metabolite TCPy were measured in 177 children aged 10-11 years old, using mass spectrometry. Oxidative stress was assessed with 8-iso-prostaglandin F2a (8-iso-PGF2α) and 8-hydroxy-2'-deoxyguanosine (8-OHdG), both measured with immunoassays. Questionnaires about demographics, pesticide usage, and dietary habits were completed by parents. Multivariable regression models examined associations between pesticides and biomarkers of effect using two creatinine adjustments (cr1: adding it as covariate and cr2: biomarkers of exposure and effect were creatinine-adjusted).

RESULTS: Parental educational level was a significant predictor of urinary pyrethroids but not for GLY/AMPA. Median[interquartile range, IQR] for GLY and AMPA were <LOQ[<LOQ, 0.19] µg/L and 0.18[0.10, 0.29] µg/L, respectively, while a moderate correlation was shown between GLY and AMPA (r=0.45). The 8-OHdG was positively associated with AMPA (beta=0.17; 95% CI: 0.02, 0.31, p=0.03 cr2, and beta = 0.12; 95% CI: -0.0,0.24, p=0.06, cr1), albeit not with GLY (p>0.05). Similar significant associations with 8-OHdG were shown for 3-PBA and the chlorpyrifos metabolite (TCPy). No associations were observed between the aforementioned pesticides and 8-iso-PGF2α (p>0.05).

CONCLUSIONS: This is the first children's health dataset demonstrating the association between AMPA and DNA oxidative damage, globally. More data is needed to replicate the observed trends in other children's populations around the globe.

ORAL PRESENTATIONS SESSION 24:
Light at night, sleep and impacts of urbanicity on health

O-OP-124 Artificial light at night exposure and sleep behaviors in adults of Shahedieh Cohort Study

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BACKGROUND AND AIM: More than 60% of the world's population lives under light-polluted skies which are growing exponentially. Artificial light at night (ALAN) exposure has been suggested to be associated with different health outcomes such as sleep problems which could be the precursor of other disorders. In this study, we evaluated the association between ALAN exposure and sleep behaviors in a cohort of adults in Iran.

METHODS: We used the data from the Shahedieh cohort study (a branch of the PERSIAN Cohort), with 10,000 participants aged 35-70 years. Outcomes were sleep duration (in hours), sleep latency (in minutes), daytime dysfunction (yes/no), habitual sleep deficiency (in minutes), and using sleep medication. We used satellite remote sensing data maintained by the National Oceanic and Atmospheric Administration's Earth Observation Group to estimate ALAN exposure (nanoWatts/cm2/sr) at participant's residential addresses. Multiple linear (for sleep behaviors) and logistic regression (for medication use) models were adjusted for various personal and contextual covariates (all associations are for an IQR increase in ALAN).

RESULTS: The mean age of participants was 48.2 (SD=9.53), and 50.9% were women. ALAN intensity was in the range of 9.35 to 64.1 nanoWatts/cm2/sr [IQR:7.27]. A significant association was observed between ALAN exposure and habitual sleep deficiency (β=0.364; 95% CI: 0.046, 0.682). An increase in ALAN exposure was associated with an increase in time to fall asleep at night (β=1.541; 95% CI: 0.066, 3.017). Increased odds of using sleep medication was associated with an increase in ALAN exposure (odds ratio: 1.191; 95% CI: 1.018, 1.393). The findings were not significant for sleep duration (β=-0.016; 95%CI: -0.073, 0.041), and daytime nap duration (β=1.257; 95% CI: -0.772, 3.285).

CONCLUSIONS: ALAN can be regarded as a threat to healthy sleep behaviors and in larger scope general health.

KEYWORDS: Artificial light at night; Sleep; Urbanization; Environmental epidemiology

O-OP-125 Light at night exposure and risk of depression and other mental disorders: a systematic review

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BACKGROUND AND AIM: In modern society, individuals are increasingly exposed to artificial light at night (LAN) i.e., different sources of light altering the natural day-night cycle. Emerging evidence suggests a possible association between LAN exposure and physiological and behavioral changes, with implications on mood and mental health at the population level. We performed a systematic review of observational studies to investigate if LAN exposure, may be associated with an increased risk of mental diseases in humans.

METHODS: We reviewed the epidemiological evidence about the association between LAN exposure as assessed either via satellite photometry (outdoor LAN) or via measurements of bedroom brightness (indoor LAN), and risk of mental disorders. We systematically searched the PubMed, Embase and Web of Science databases up to April 1, 2022. Studies were included if they assessed the link between exposure to indoor or outdoor LAN and one or more mental disorders.

RESULTS: Nine eligible studies were included in this review: six studies had a cross-sectional design, two had a longitudinal design with a median follow-up of 24 months, and one was a case-cohort study. Studies were published between 2002 and 2022. Seven studies were conducted in adult populations, one in adolescents, and one in children. Mental disorders investigated include anxiety and mood disorders, depression, bipolar disorder and autism.
Overall, we found moderate evidence of a positive association between LAN exposure and depressive symptoms and to a lesser extent other mental disorders, though the number of studies was limited and potential residual confounding such as socioeconomic factors, noise, or air pollution may have influenced the results.

CONCLUSIONS: Although more robust evidence is needed, the epidemiological evidence produced so far seems to support an association between LAN and risk of depressive disorders.

KEYWORDS: mental disorders; light at night; depression; systematic review, environmental risk factors

O-OP-126 External exposome and sleep outcomes in the Nurses' Health Study

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BACKGROUND AND AIM: Multiple environmental exposures, including greenness, light-at-night, and air pollution, have been associated with sleep. However, these associations have not been investigated using large longitudinal cohorts with repeated measures. We examined the association between multiple environmental exposures and sleep duration and quality in the Nurses' Health Study (NHS).

METHODS: Between 2000 and 2014, 81,202 NHS participants self-reported sleep duration on biennial questionnaires, and in 2000, 81,294 NHS participants self-reported sleep quality. We estimated annual average greenness using Landsat Normalized Difference Vegetation Index (NDVI) in 270m buffers, annual average light-at-night (LAN) from the U.S. Defense Meteorological Satellite Program's Operational Linescan System, and predicted PM2.5 from validated nationwide spatiotemporal models at each residential address. Due to evidence of non-linearity, we modeled exposures in quintiles. Sleep duration was dichotomized (≥7 hours; <7 hours) and modeled with generalized estimating equations. Sleep quality was dichotomized (difficulty sleeping none/a little/some of the time; difficulty sleeping a good bit of/all the time) and modeled using logistic regression. We estimated odds ratios (OR) of adverse sleep outcomes comparing the highest and lowest quintile and 95% confidence intervals (CI) for each exposure. We adjusted for individual-level risk factors and included all exposures simultaneously for mutual adjustment.

RESULTS: In mutually-adjusted models, higher annual average residential greenness exposure was associated with suggestive lower odds of short sleep duration (OR: 0.97 95% CI: 0.94, 1.00) with similar associations for poor sleep quality (OR: 0.97; 95% CI: 0.90, 1.00). Higher exposure to LAN was associated higher odds of with short sleep duration (OR: 1.18 95% CI: 1.14, 1.23) and poorer sleep quality (OR: 1.12; 95% CI: 1.03, 1.22). Higher exposure to PM2.5 was not associated with sleep outcomes.

CONCLUSIONS: In the NHS cohort, lower residential greenness and higher LAN exposures were associated with lower self-reported sleep duration and quality.

O-OP-127 Association between outdoor light at night, sleep duration, and sleep quality in the US based-Health Professionals Follow-Up Study

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BACKGROUND AND AIM: Artificial illumination on the Earth's surface has increased over time. Light plays a central role in regulating circadian rhythm, the body's internal clock, mainly by inhibiting the production of the sleep promoting hormone melatonin. The increase in artificial light at night (LAN) has negative consequences for human health, as circadian disruption is a risk factor for weight gain, cardiovascular disease, and cancer. We evaluated whether exposure to outdoor LAN is associated with sleep duration and sleep quality in the US based-Health Professionals Follow-up Study (HPFS).

METHODS: HPFS consists of 51,529 men enrolled in 1986 aged 40-75, our study is limited to men who reported a home address at baseline. We estimated participants' LAN with 1 km2 resolution using data from the US Defense Meteorological Satellite Program's Operational Linescan System to geocoded address histories. Participants self-reported their sleep duration in 1987, 2000, and 2008 and answered 5 questions regarding their sleep quality in 2004. We used multinomial logistic regression to estimate odds ratios and 95% confidence intervals adjusting for participants' age, population density, and neighborhood SES (nSES).

RESULTS: The mean level of LAN at baseline was 30.8 nW/cm2/sr. The distribution of age was similar, but population density and nSES differed across levels of LAN. An interquartile increase in LAN was associated with increased odds of sleeping ≤6 hours compared to 7-8 hours (OR: 1.20, 95%CI: 1.12,1.29), never feeling rested compared to most of the time (OR: 1.18, 95%CI: 1.05,1.34), and difficulty falling asleep (OR: 1.18, 95%CI: 1.02,1.36).

CONCLUSIONS: We found positive associations between LAN and measures of sleep duration and sleep quality in a large cohort of older adult men. This aligns with findings from other studies that living in areas of greater LAN has a negative impact on sleep health.

O-OP-128 Physical Environmental Hazards and Major Depression in Older U.S. Adults: The Health and Retirement Study

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BACKGROUND AND AIM: Major depression is a leading cause of disability. Although much research focuses on individual risk factors and interventions, environmental risk factors may also play an important role in major depression. We quantified associations of road noise and light at night with prevalent major depression.

METHODS: We used data from the 2008-2016 biennial interviews of the Health and Retirement Study, a nationally-representative cohort of older adults in the United States. Major depression status was determined using the Composite International Diagnostic Interview Short Form, with a cutoff of ≥5. We estimated average road noise and light at night for the year prior to each interview at participant residences using the Department of Transportation Road Noise Model and satellite imagery from the Defense Meteorological Satellite Program, respectively. To estimate prevalence ratios, we used a modified Poisson regression model that accounted for sampling weights and design effects, adjusted for demographic characteristics, individual and neighborhood SES, time, co-exposures, and geographic area.

RESULTS: There were 23,874 participants with complete data. The mean baseline age was 63 years, 53% were female, 74% were Non-Hispanic White, and 15% ever reported major depression. Compared to the lowest exposure quartiles, those in the highest quartiles of noise and light exposure were more likely to be Black, have less than a high school education and reside in an urban area. In fully adjusted models, interquartile differences in both noise and light were suggestively associated with an approximately 10% greater prevalence of major depression (PR per IQR of noise: 1.08, 95% CI: 0.98, 1.20; and light: 1.12, 95%CI: 0.96, 1.31).

CONCLUSIONS: Exposure to noise and light at night may increase depression in older adults, possibly by disrupting health sleep. Modifying physical hazards in the environment may be a way to reduce the burden of depression.

KEYWORDS: Noise, Light, Depression

ORAL PRESENTATIONS SESSION 25: Environment and cardiovascular disease

O-OP-129 Long-term exposure to transportation noise and incidence of ischemic heart disease: A pooled analysis of nine Scandinavian cohorts

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BACKGROUND AND AIM: Transportation noise may induce cardiovascular disease, but the public health implications are unclear. This study aimed to assess exposure-response relationships for ischemic heart disease (IHD) associated with road, railway and aircraft noise exposure.

METHODS: We performed pooled analyses for nine cohorts from Denmark and Sweden, including 132,801 subjects. Time-weighted long-term exposure to road, railway, and aircraft noise, as well as air pollution, was estimated based on residential history. Hazard ratios (HR) were calculated using Cox proportional hazards models, following adjustment for lifestyle and socioeconomic risk factors, and exposure-response relationships were evaluated using cubic splines.

RESULTS: A total of 22,459 incident cases of IHD, including 7,682 cases of myocardial infarction, were identified from national registers over an average of 20 years of follow-up. The adjusted HR for IHD was 1.03 (95% confidence interval 1.00, 1.05) per 10 dB Lden for both road and railway 5-year mean noise exposure. Moreover, for road traffic noise, a deviation from linearity in the exposure-response function was indicated, with a threshold around 55 dB Lden. Higher risks appeared for IHD excluding angina pectoris (12,399 cases), with HRs of 1.06 (1.03, 1.08) and 1.05 (1.01, 1.08) per 10 dB Lden for road and railway noise, respectively. Corresponding HRs for myocardial infarction were 1.02 (0.99, 1.05) and 1.04 (0.99, 1.08). Increased risks were also observed for aircraft noise but without clear exposure-response relations.

CONCLUSIONS: Long-term exposure to road, railway and aircraft noise was associated with an increased risk of IHD, particularly after the exclusion of angina pectoris cases, which are less well-identified in the registries. A threshold of around 55 dB Lden was suggested in the exposure-response relation for road traffic noise and IHD.

KEYWORDS: road traffic noise, railway noise, aircraft noise, ischemic heart disease, myocardial infarction, exposure-response function

O-OP-130 Association between long-term exposure to air pollution and cardio-metabolic phenotypes – A MRI-data based analysis

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BACKGROUND AND AIM: Long-term exposure to ambient air pollution is supposed to affect both the cardiovascular system and adipose tissue (AT) metabolism. However, its role in the early subclinical stages of development before manifestation of cardiometabolic disease is unclear. Thus, we aimed to investigate the impact of long-term exposure to air pollution on cardiometabolic phenotypes derived from magnetic resonance imaging (MRI).

METHODS: Phenotypes of left (LV) and right cardiac ventricle, whole body AT, and organ AT were obtained by whole-body MRI in 400 participants of the population-based KORA cohort. Land-use regression models were used to estimate residential long-term exposures to several air pollutants, including particulate matter (PM) with different diameters and nitrogen oxides (e.g. NO_2). Associations between exposures and MRI phenotypes were modeled using confounder-adjusted linear regression. Additionally, we performed several stratified analyses, e.g. for diabetes status, hypertension, or age group.

RESULTS: Participants' mean age was 56±9 years, 42% were female. Increasing levels of several air pollutants were associated with decreased LV wall thickness; a 6.0µg/m³ IQR (interquartile range) increase in NO_2 was significantly associated with a -1.89% decrease (95% confidence interval [95%-CI]: -3.70;-0.09) in mean global LV wall thickness. We also found significant associations between various air pollutants and increased cardiac AT. A 2.1µg/m³ IQR increase in PM_{10} was associated with an 8.83% [95%-CI: 1.19;16.49] increase in mean total epi- and pericardial AT. Similar effects were seen for mean diastolic (8.53% [95%-CI: 0.84;16.23]) and systolic (8.57% [95% CI: 0.10;16.17]) pericardial AT, respectively. We saw a similar trend for liver and renal AT. Associations with whole-body AT were only detected in participants with diabetes in the stratified analysis.

CONCLUSIONS: Our results indicate that long-term exposure to air pollution is associated with subclinical cardiometabolic disease states, particularly in metabolically vulnerable subgroups.

KEYWORDS: cardiometabolic phenotypes, ambient air pollution, magnetic resonance imaging.

O-OP-131 Association of short-term exposure to ambient PM1 with total and cause-specific cardiovascular disease mortality

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BACKGROUND AND AIM: The acute effects of exposure to ambient particulate matter with an aerodynamic diameter ≤1 μm (PM1) on cardiovascular disease (CVD) mortality remain poorly understood. We aimed to investigate the association of short-term exposure to ambient PM1 with total and cause-specific CVD mortality, and estimate the corresponding excess mortality.

METHODS: Using the Jiangsu provincial mortality surveillance system, we conducted a time-stratified case-crossover study among 988 446 CVD deaths in Jiangsu province, China during 2015-2019. Daily residential PM1 exposures for each subject was assessed using a validated grid data. Conditional logistic regression models integrated with distributed lag linear or nonlinear models were performed to conduct exposure-response analyses.

RESULTS: Each 10 μg/m3 increase of PM1 exposure during the same day of CVD death and 1 day prior was significantly associated with a 1.46% (95% confidence interval [CI]: 1.27%, 1.66%), 1.46% (0.15%, 2.78%), 1.93% (1.24%, 2.64%), 1.25% (0.93%, 1.57%), 1.37% (1.07%, 1.66%), and 1.71% (1.22%, 2.21%) increase in odds of mortality from total CVDs, chronic rheumatic heart diseases (CRHD), hypertensive diseases, ischemic heart diseases (IHD), stroke, and sequelae of stroke, respectively. The excess fraction of total CVD mortality attributable to PM1 exposure was 5.72%, while the cause-specific excess fractions ranged from 5.34% for IHD to 8.25% for CRHD. Significantly higher associations and excess fractions were identified for mortality from total and/or certain cause-specific CVDs in adults 80 years or older.

CONCLUSIONS: Short-term exposure to ambient PM1 was associated with increased risk of total and cause-specific CVD mortality, which may lead to a considerable excess mortality especially among older adults. Our findings highlight a potential approach to prevent premature deaths from CVDs by reducing ambient PM1 exposures and provide essential quantitative data for the formulation of future air quality standards for ambient PM1.

KEYWORDS: Cardiovascular diseases; PM1; Mortality; DLM; DLNM; Case-crossover study.

O-OP-132 Association of Volatile Organic Compound Exposure with Blood Pressure in the National Health and Nutrition Examination Survey (2011-2016)

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BACKGROUND AND AIM Volatile organic compounds (VOCs) are environmental pollutants generated from a variety of different combustion sources, consumer and household products, and tobacco smoke. Exposure to VOCs has been associated with cardiovascular disease (CVD) risk factors, such as increased blood pressure (BP); however, limited research has been conducted in the general population. We hypothesized that higher levels of VOC exposure are associated with higher BP.

METHODS: To examine the relationship between VOC exposure and BP, we acquired and combined three cycles of data from the National Health and Nutrition Examination Survey (NHANES) over the years 2011-2016 for a final sample size of n=5,616 participants. Ultra-performance liquid chromatography/mass-spectrometry was used to measure the levels of 27 urinary VOC metabolites. Metabolites were adjusted for urinary creatinine and multiple measures of systolic and diastolic BP were averaged. Linear regression models adjusted for age, sex, race, education, BMI, smoking status, HDL, cholesterol, triglycerides, diabetes, blood pressure medications, eGFR, and NHANES cycle year were used to estimate associations between VOC metabolites and BP.

RESULTS: Participants were 52% female, median age of 47, 32% had hypertension, and 7.4% had diabetes. Urinary VOC metabolites were higher among tobacco users than non-users, except for metabolites of benzene, cyanide, and toluene. We found a 0.6 (95% CI: 0.2, 1.0) mmHg higher systolic BP per interquartile range of 1,3-butadiene metabolite, DHBMA. In subgroup analysis, this association was independent of age and persisted in women, non-tobacco users, Mexican Americans, and individuals not diagnosed with CVD or hypertension. Urinary metabolites of acrolein were associated with systolic BP in non-tobacco users, Non-Hispanic Blacks, women, and individuals not diagnosed with CVD or hypertension.

CONCLUSIONS:These results suggest exposures to VOCs, particularly acrolein and 1,3-butadiene, may be relevant, yet understudied contributors to CVD risk in the general population.

KEYWORDS: blood pressure, vocs, cvd, chemicals

O-OP-133 Residential exposure to petroleum refining and stroke in the southern United States

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BACKGROUND AND AIM: The southern United States (U.S.) sustains a disproportionate burden of incident stroke and associated mortality, compared to other parts of the U.S. A large proportion of this risk remains unexplained. Petroleum production and refining (PPR) is concentrated within this region and emits multiple pollutants implicated in stroke pathogenesis. The relationship between residential PPR exposure and stroke has not been studied. We aimed to investigate the census tract-level association between residential PPR exposure and stroke prevalence for adults (≥18 years) in seven southern U.S. states in 2018.

METHODS: We conducted spatial distance- and generalized propensity score-matched analysis that adjusts for sociodemographic factors, smoking, and unmeasured spatial confounding. PPR was measured as inverse-distance weighted averages of petroleum production within 2.5km or 5km from refineries, which was strongly correlated with measured levels of sulfur dioxide, a byproduct of PPR.

RESULTS: The prevalence of self-reported stroke ranged from 0.4% to 12.7% for all the census tracts of the seven states. Hispanic population and people with low socioeconomic status resided closer to petroleum refineries. The non-Hispanic Black population was exposed to higher PPR, while non-Hispanic White population was exposed to lower PPR. Residential PPR exposure was significantly associated with stroke prevalence. One standard deviation increase in PPR within 5km from refineries was associated with 0.20 (95% confidence interval: 0.08, 0.33) percentage point increase in stroke prevalence. PPR explained 5.5% (2.1, 9.0) of stroke prevalence in the exposed areas. These values differed by states: 1.0% (0.4, 1.7) in Alabama to 11.1% (4.2, 17.9) in Mississippi, and by census tract-level: 0.08% (0.02, 0.12) to 23.8% (9.0, 38.6).

CONCLUSIONS: PPR is associated with self-reported stroke prevalence, suggesting possible links between pollutants emitted from refineries and stroke. The increased prevalence due to PPR may differ by sociodemographic factors.

KEYWORDS: Stroke Belt; Oil industry; Environmental justice

O-OP-134 Phthalates and Incident Diabetes in Midlife Women: The Study of Women's Health Across the Nation (SWAN)

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BACKGROUND AND AIM: Phthalates are hypothesized to contribute to diabetes, but longitudinal evidence in humans is limited. We examined whether phthalate exposure was associated with a higher incidence of diabetes in a racially/ethnically diverse cohort of midlife women.

METHODS: In the Study of Women's Health Across the Nation-Multipollutant Study, we followed 1308 women without diabetes in 1999/2000 for six years. Eleven phthalate metabolites were measured in spot urine samples in 1999/2000 and 2002/2003. Incident diabetes was ascertained between 1999/2000 and 2005/2006. Cox proportional hazards models with time-varying exposure were used to estimate the hazard ratio (HR) of diabetes associated with each phthalate metabolite, adjusting for demographic, lifestyle, and health-related factors. Effect modification by race/ethnicity was examined with interaction terms.

RESULTS: Sixty-one women developed diabetes over six years (cumulative incidence = 4.7%). Among all women, several high-molecular-weight (HMW) phthalate metabolites were associated with a higher incidence of diabetes, but none were statistically significant. There was effect modification by race/ethnicity. Among White women, each doubling of phthalate metabolite concentrations was associated with 22-77% higher incidence of diabetes (HR = 1.22, 95% confidence interval (CI): 0.87, 1.72 for mono-n-butyl phthalate; HR = 1.77, 95% CI: 1.27, 2.46 for ∑HMW phthalate metabolites). In contrast, phthalate metabolites were not associated with diabetes incidence in Black or Asian women. Post-hoc analyses showed positive associations between phthalates and insulin resistance in non-White women, suggesting non-White women were not immune to phthalates.

CONCLUSIONS: Some phthalate metabolites were associated with a higher incidence of diabetes over six years of follow-up, but the associations were inconsistent across racial/ethnic groups. Different susceptibility to phthalates is unlikely to explain racial/ethnic differences. Whether phthalates cause diabetes requires further investigation.

KEYWORDS: phthalates, diabetes, women

ORAL PRESENTATIONS SESSION 26: Environmental equity: environmental inequalities and health implications (2)

O-OP-135 Interrogating the use of "maternal" in environmental epidemiology: opportunities for increasing linguistic and substantive precision

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BACKGROUND AND AIM: The term "maternal" is used ubiquitously, yet often imprecisely, in environmental epidemiologic research of parental exposures occurring during pre-conception and gestation that influence fetal, infant, and childhood outcomes. Without a clear definition, the term "maternal" can be non-specific, since co-parenting arrangements such as those involving queer women may involve more than one mother; similarly, the term may inaccurately conflate the individual who experiences pregnancy with the person/people who perform the labor of post-birth parenting, as with cases of surrogacy and adoption. Additionally, the term may be non-inclusive, for example, of many trans men and gender-nonconforming people who have uteruses and experience pregnancy but may not be appropriately described using a "maternal" classification.

METHODS: We (1) present a conceptual model of unacknowledged familial relationships relevant to exposure measurement in pre-conception, gestational, and post-natal windows, (2) address methodological shortcomings that follow from the unconsidered use of "maternal" (e.g. exposure misclassification, population selection) and how these challenges may be addressed in common administrative datasets, and (3) discuss the opportunities presented by more specific language use, including explicit inclusion of LGBTQ+ and other family structures within environmental health literature.

RESULTS: We find that the term "maternal" is both non-specific and non-inclusive, which has methodological and ethical implications that are especially relevant in environmental epidemiologic studies of perinatal exposures. Terms that are more substantively precise for the exposures and covariates being measured, such as "gestational" or "caregiver," may more accurately capture the relevant exposures and covariates for a given analysis. We provide guidance on determining how characteristics of study design and cohort construction may inform the specification of parental variables.

CONCLUSIONS: Linguistic specificity and inclusivity in environmental epidemiology is important both methodologically and ethically, and will promote clearer science communication about exposure measurement and variable operationalization.

KEYWORDS: gestational parent, maternal, exposure misclassification, LGBTQ+

O-OP-136 Sociodemographic disparities and metal concentrations in US drinking water supplies

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BACKGROUND AND AIM: Few drinking water studies have examined metal contamination in the context of environmental justice and fewer have investigated drivers. This study explores associations between sociodemographic disparities and metal concentrations in US public water systems (PWS) and whether these associations are mediated by the availability of best available technologies (BAT).

METHODS: We assessed arsenic, total chromium, manganese, and selenium concentrations for over 380,000 water samples collected between 1975-2017 from 13,000+ PWS in 15 states from a national drinking water database curated by the Environmental Working Group. We queried PWS characteristics, including BAT use, from the US EPA and averaged sociodemographic data from the 2017 US Census and environmental factors from the USGS and PRISM Climate Group within PWS service area boundaries. We developed a two-step Hurdle model to first predict the probability of metal detection and secondly, among detections, predict chemical concentrations.

RESULTS: We found significant relationships between sociodemographic variables and metal concentrations, although directionality varied by metal. Higher percentages of non-English speakers were associated with increasing detection probability for arsenic (0.17, 95% confidence interval [0.06, 0.28]), but decreasing detection probabilities for chromium (-0.18 [-0.28, -0.07]) and manganese (-0.43 [-0.55, -0.32]). Arsenic (binomial: 0.18 [0.08, 0.28]; regression: 0.07 [0.02, 0.12]) and manganese (binomial: 0.33 [0.02, 0.33]; regression: 0.10 [0.04, 0.16]) indicated uniform positive associations with respect to increases in Black population percentages. We did not find evidence that these associations were mediated through BATs.

CONCLUSIONS: We found some evidence that linguistically isolated communities and communities of color are associated with higher metal concentrations in drinking water. Since we did not find BAT to be a mediator, other local policies, such as historic zoning, may explain these associations. Future work may explore disparities at other spatial levels and consider how financial and operational procedures affect drinking water metal pollution.

O-OP-137 Environmental health impacts and inequalities in green space and air pollution exposures in six European cities

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BACKGROUND AND AIM: The GoGreenRoutes project (Horizon 2020/869764) aims to introduce co-created nature-based solutions (NBS) as interventions to enhance access to green space in six medium-sized European cities (Burgas, Lahti, Limerick, Tallinn, Umea, and Versailles). We analyzed the spatial distribution and health impacts associated with unequal exposure to air pollution and green space prior to the implementation of these NBS interventions in each city.

METHODS: We retrieved air pollution (NO_2 and $PM_{2.5}$) and green space (NDVI and % Green Area proxies) data at a 250m x 250m grid-cell level for each city, in addition to population and mortality data for 2015. We compared baseline exposures to WHO guidelines and calculated the exposure differences at the grid-cell level. We applied a comparative risk assessment methodology to estimate the mortality burden attributable to not achieving the WHO guidelines. We evaluated exposures and attributable mortality distributions and their associations to understand current urban environmental inequalities.

RESULTS: We found high variability in air pollution and green spaces levels between and within all six cities. Around 60% of the population lacked green space and 90% of the population were exposed to air pollution above WHO guidelines. Overall, we estimated a city range between 3-37 and 2-71 deaths/100,000 persons were attributable to exceedances in WHO NO_2 and $PM_{2.5}$ limit values, respectively; 4-13 deaths/100,000 persons were associated with lack of Green Area; and 18-35 deaths/100,000 persons were linked to NDVI levels below the city target. Green space and air pollution were highly spatially correlated, likewise their attributable burdens.

CONCLUSIONS: Our results suggest that urban populations in the analyzed cities are affected simultaneously by lack of green space and increased air pollution. We expect NBS interventions will contribute to reducing the environmental health burden and inequalities in the GoGreenRoutes cities.

KEYWORDS: Health impact assessment; urban health; health equity; nature-based solutions.

O-OP-138 DDT for malaria elimination: an ethical dillema

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From the year 2000, an estimated 500,000 kg of DDT has been imported for Indoor Residual Spraying (IRS) and applied in Zambian homes without any studies conducted to ascertain its fate in the environment and resultant effects on humans. This study aimed to quantify DDT exposure, identify community exposure pathways and establish neurodevelopmental outcomes in children of selected communities in Zambia.
Samples of top layer soils and water from drinking sources were collected from communities in Zambia. The DDT and its metabolites were extracted by QuECHERS method and Solid Phase Extraction for soils and water respectively. Analyses were by Gas Chromatography tandem Mass Spectrometry. A questionnaire was used in the community survey and Neurodevelopment assessments were conducted on Mother and child pairs with the use of the Ages and Stages Questionnaire.
Median levels of of DDT and its metabolites were found at 100.4 ng/g (IQR 90.9-110) and 725.4 ng/l (IQR 540-774.5) for Soils and Water respectively. Both were above reference values of World Health Organization (WHO) and Food and Agriculture Organization (FAO). The study revealed multiple community exposure pathways through water, crops and edible livestock implying significant Human Health Risks particularly among poorer populations. Highly negative significant associations were found between DDT soil levels and Gross Motor, Problem Solving and Personal Social domains. Variables including mother's age, educational level, income, child's age and complications during pregnancy were associated with neurodevelopment in children.
The presence of DDT in these media suggests possible limitations in environmental safeguards put in place during Indoor Residual Spraying. These health risks fall disproportionately among poorer communities with poor housing and socio-economic status. There is need for a holistic malaria elimination approach which should place more emphasis on preventive measures such as improvement of housing structures to reduce reliance on toxic substances.

DDT Exposure Children Ethical

O-OP-139 Work environment characteristics of environmental epidemiologists and mental health conditions – A cross sectional survey among ISEE members

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BACKGROUND AND AIM: Working environment (verbal/physical abuse, threats, difficulties of publishing due to other than scientific interests, political interests) of environmental epidemiologists (EEs) is largely unknown. The aim of this study was to assess; a) working environment factors b) health situation of EEs and 3) associations between working environment and health situation of EEs.

METHODS: A cross-sectional survey among the ISEE members was conducted in February 2022. We assessed socio-demographics (age, gender, education), employment status, working environment and stress, depression, and anxiety. Descriptive statistics were conducted with the full sample at baseline to characterize employment status and employment related events (past and current). In addition to descriptive statistics, we explored the associations between working conditions and mental health conditions by calculating multiple linear regression analyses.

RESULTS: Majority of the participants (N=442) were females and from North America (316, 47% followed by Europe (139, 21%). As regards to work most were faculty members (298, 50%) and assistant or associate professors (270, 47%) with main areas of research of air pollution (187, 37%), chemicals (151, 30%) and climate change (75, 15%). Almost half of participants reported verbal abuse (246, 46%) and one-fifth threats of physical abuse at the workplace. Research was reported to be forbidden to get published by 11%. Increasing age was inversely associated with depression, anxiety and stress symptoms. Verbal and threats of physical abuse and difficulties to disseminate results were related to increased levels of depression, anxiety and stress symptoms. Political pressure was not related to increased levels of mental health conditions.

CONCLUSIONS: Study findings suggest that a comprehensive workplace prevention program accompanied by research identifying scientists job stress in different workplaces is critical. To prevent exposures and improve the mental health conditions of EEs, workplace violence prevention procedures at the organizational and at the societal level are needed.

ORAL PRESENTATIONS SESSION 27: In search of epigenetic signatures of environmental exposures

O-OP-140 HDMAX2: A framework for High Dimensional Mediation Analysis with application to maternal smoking, placental DNA methylation and birth outcomes

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BACKGROUND AND AIM: High-dimensional mediation analysis is an extension of unidimensional mediation analysis that includes multiple mediators, and is increasingly used in environmental epidemiology to evaluate the indirect epigenetic effects of environmental exposures on health outcomes. However, analyses involving high-dimensional mediators raise several statistical issues. While many methods have recently been developed to tackle those issues, no consensus has been reached about the optimal combination of approaches.

METHODS: We developed HDMAX2, a new multi-step approach to mediation that combines latent factor regression models for epigenome-wide association studies with max-squared tests for mediation, and considers CpGs and aggregated mediator regions (AMR). HDMAX2 was carefully evaluated on simulated data, and compared to state-of-the- art multi-dimensional epigenetic mediation

METHODS: Then it was applied to assess the indirect effects of exposure to maternal smoking (MS) on term birth weight (BW) and gestational age (GA) at delivery in a study of 470 women from the EDEN cohort.

RESULTS: HDMAX2 resulted in increased power compared to state-of-the-art multi-dimensional mediation methods, and identified several AMRs not identified in previous mediation analyses of exposure to MS on BW and GA. The results provided evidence for a polygenic architecture of the causal pathway with an overall indirect effect of CpGs and AMRs of 44.5g lower BW (32.1% of the total effect size). HDMAX2 also identified AMRs having simultaneous effects both on GA and BW. Among the top hits of both GA and BW analyses, regions located in COASY, BLCAP and ESRP2 also mediated the relationship between GA on BW, suggesting a reverse causality in the relationship between GA and the methylome.
DISCUSSION: This study brought up several statistical improvements of high-dimensional mediation analyses, which revealed an unsuspected complexity of the causal relationships between exposure to MS and BW at the epigenome-wide level.

KEYWORDS: Mediation; high dimension; causal inference; epigenetics; DNA methylation; pregnancy

O-OP-141 Arsenic Exposure, Blood DNA Methylation and Cardiovascular Disease

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BACKGROUND AND AIM: Epigenetic dysregulation has been proposed as a key mechanism for arsenic-related cardiovascular disease (CVD). We evaluated differentially methylated positions (DMPs) as potential mediators on the association between arsenic and CVD.

METHODS: Blood DNA methylation was measured in 2321 participants of the Strong Heart Study (SHS), a prospective cohort of American Indians. We identified DMPs that are potential mediators between arsenic and CVD. In a cross-species analysis, we compared those DMPs with differential liver DNA methylation following early life arsenic exposure in the apolipoprotein E knock-out (apoE-/-) mouse model of atherosclerosis. We conducted replication in three independent cohorts: the Framingham Heart Study, Women's Health Initiative and the Multi-Ethnic Study of Atherosclerosis.

RESULTS: A total of 20 and 13 DMPs were potential mediators in the SHS for the association between arsenic and CVD incidence and mortality, respectively, several of them annotated to genes related to diabetes. Eleven of these DMPs were similarly associated with incident CVD in the three replication cohorts. In the mouse model, differentially methylated regions (DMRs) in 20 of those genes and DMPs in 10 genes were associated with arsenic.

CONCLUSIONS: Differential DNA methylation might be part of the biological link between arsenic and CVD. The gene functions suggest that diabetes might be an important mechanism for arsenic induced cardiovascular risk in populations with a high burden of diabetes.

KEYWORDS: Arsenic, DNA methylation, cardiovascular disease, epigenetics, American Indians

O-OP-142 Epigenetic Mediation of Prenatal Tobacco and Alcohol Exposure and Infant Neurodevelopment in a South African Birth Cohort: A High-Dimensional Mediation Analysis

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BACKGROUND AND AIM: Prenatal tobacco exposure (PTE) and prenatal alcohol exposure (PAE) have been associated with an increased risk of delayed neurodevelopment in children as well as differential newborn DNA methylation (DNAm). However, the biological mechanisms connecting PTE and PAE, DNAm, and neurodevelopment are largely unknown. Here we aim to determine whether differential DNAm in cord blood mediates the association between PTE and PAE and neurodevelopment in 113 children of 6 months of age from the South African Drakenstein Child Health Study.

METHODS: PTE and PAE were assessed antenatally using urine cotinine measurements and the ASSIST questionnaire, respectively. DNAm was measured from cord blood using the EPIC and 450K BeadChips. Neurodevelopment was measured at 6 months across five domains (cognitive, language, motor, adaptive behavior, socioemotional) using the Bayley Scale of Infant and Toddler Development, Third Edition. We conducted a high-dimensional mediation analysis using a novel approach called the divide-aggregate composite null test (DACT), followed by causal mediation analysis to estimate the average causal mediation effects (ACME) and total effect (TE).

RESULTS: In this population, 35% of mothers actively smoked and 23% of mothers consumed alcohol during pregnancy. We identified 31 CpG sites and 8 CpG sites to have a significant mediating effect (ACME and TE P <0.05) between PTE and cognitive and motor development, respectively. for PAE, 16 CpG sites and 1 CpG site had a significant mediating effect on motor and adaptive behavior development, respectively.

CONCLUSIONS: These findings suggest that changes in the methylome may in part explain the biological mechanisms underlying the relationship between PTE and PAE and infant neurodevelopment. The identification of significant CpG sites could provide novel insights for early detection of disease and potential prevention targets in translational research and community interventions in at-risk populations.

KEYWORDS: epigenomics; mediation analysis; neurodevelopment; prenatal smoking; prenatal alcohol exposure

O-OP-143 Prenatal wildfire exposure associates with differential placental DNA methylation and pregnancy traits

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BACKGROUND AND AIM: As the effects of anthropogenic climate change increase the frequency and severity of wildfires in arid regions, the impacts of prenatal wildfire smoke exposure (WFE) on prenatal health will become relevant to an increasing number of pregnant women. Prior investigations have found associations between WFE and pregnancy complications, and postulated DNA methylation as a potential contributing mechanism for this effect. This preliminary study will investigate the placental DNA methylation changes associated with prenatal WFE, and search for differential methylation patterns that could inform the relationship between prenatal WFE and adverse pregnancy outcomes.

METHODS: DNA was extracted from 136 unique placental samples (124 not exposed to 2008 CA wildfires during pregnancy, 12 exposed) associated with metadata on wildfire exposure as well as other traits of interest. DNA underwent bisulfite conversion and subsequent whole genome bisulfite sequencing to reveal placental methylome. Placental methylomes were used to perform comethylation network analysis via the Comethyl package, generating modules of correlated methylation patterns across samples. Comethylation modules were then tested for association with sample metadata, including wildfire exposure.

RESULTS: Four comethylation modules (darkorange, darkred, saddlebrown, and plum2) were associated ($p<0.05$) with prenatal WFE. Two of these modules (darkorange and plum2) were also associated with maternal weight gain or gestational diabetes, with these modules being enriched for genes implicated in endothelial, vascular, neuronal, and DNA repair pathways. The darkred comethylation module was also associated with child and paternal Hispanic ethnicity characteristics, with the module itself being enriched for genes involved in mitochondrial chain respiratory pathways.

CONCLUSIONS: A significant association exists between prenatal WFE, placental DNA methylation, and maternal weight gain. Larger cohorts of WFE samples are required to bolster the associations identified in this discovery analysis.

KEYWORDS: wildfires, prenatal, methylation

O-OP-144 Exposure to Ambient Gaseous Pollutants, Serum miRNA Networks, Lipid Metabolism, and Non-Alcoholic Fatty Liver Disease in Young Adults

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BACKGROUND AND AIM: Exposure to gaseous ambient air pollutants (GP) has been associated with altered lipid metabolism in young adults. MicroRNA (miRNA) networks regulate gene expression and may mediate this relationship. This work aimed to investigate associations of serum miRNA networks with GP, lipid metabolism, and non-alcoholic fatty liver disease (NAFLD) in young adults.

METHODS: Participants were 124 young adults (17-22 years) from the Metabolic and Asthma Incidence Research (Meta-AIR) cohort. Residential GP exposure (nitrogen dioxide [NO_2]; 24-hour and 8-hour maximum ozone [O_3]; redox-weighted oxidative capacity [Ox]) was spatially interpolated from monitoring stations via inverse-distance-squared weighting. Liver fat was imaged by MRI and NAFLD was defined by ≥5.5% hepatic fat fraction. Serum miRNAs were assayed via NanoString and networks were constructed by weighted gene correlation network analysis (WGCNA). The first eigenvector (z-score) of each network represents the similarity of an individual's miRNA profile to a given network. Multivariable linear and logistic regression models adjusted for age, sex, ethnicity, and body mass index. Effect estimates are scaled to one standard deviation of exposure. Pre-specified metabolic pathways pertinent to lipid metabolism were examined for enrichment with DIANA-mirPath which extracts experimentally-validated mRNA targets from TarBase and facilitates KEGG pathway analysis.

RESULTS: Prior-month 24-hr O_3 and Ox and prior-year NO_2 were inversely associated with the miRNA eigenvector (β=-0.018, p=0.046; β=-0.016, p=0.026; β=-0.019, p=0.022, respectively) of the network comprised of miR-130a-3p, miR-148b-3p, miR-191-5p, miR-199-3p, miR-223-3p, miR-23a-3p, and miR-320e. This miRNA eigenvector was also inversely associated with LDL-cholesterol (β=-6.26, p=0.028) and associated with lower odds of NAFLD (OR=0.37, p=0.007). The mRNA targets of these miRNAs were enriched in the fatty acid biosynthesis pathway ($p<0.001$).

CONCLUSIONS: Exposure to GP may contribute to dysregulated lipid metabolism and NAFLD risk among young adults by perturbation of miRNA networks governing fat metabolism.

KEYWORDS: microRNA, biomarker, NAFLD, ozone, NO_2, air pollution

O-OP-145 Mitochondrial DNA Copy Number Dynamics from Birth through Adolescence in a Population of Dominican and African American Children

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BACKGROUND AND AIM: Mitochondria are vital for cellular energy production, metabolism, and signaling; however, they are uniquely susceptible to damage from environmental toxicants. Mitochondrial DNA copy number (mtDNAcn) is a widely used biomarker in human population studies and is associated with several exposures, including air pollution and metals. Yet, little is known about the dynamics of mtDNAcn throughout childhood and its longitudinal associations with key population characteristics. Our objective was to profile mtDNAcn from birth through adolescence to better inform future environmental health research.

METHODS: Data were collected from a cohort of mother-child pairs from New York City recruited 1998-2006 and followed through 18 years. Using duplexed qRT-PCR we quantified mtDNAcn relative to nuclear DNA from 662 participants using blood collected from the umbilical cord (n=450), children aged 5-7 (n=510), and adolescents aged 15-18 (n=278). We examined mtDNAcn across childhood with linear mixed-effects models (LMM) and latent class growth models (LGCM). We then examined associations with key population characteristics (maternal lifestyle during pregnancy and birth outcomes).

RESULTS: Relative mtDNAcn was lowest at birth (mean ± SD: 0.67 ± 0.35) and increased in childhood (1.24 ± 0.50) then slightly declined in adolescence (1.13 ± 0.44). MtDNAcn values across visits were moderately correlated (r=0.32-0.44). LGCM identified two trajectories of mtDNAcn: a high group (n=615) and a smaller low group (n=47). We observed no differences in mtDNAcn by sex or by race/ethnicity. In LMMs, longitudinal mtDNAcn was positively associated with prenatal environmental tobacco smoke exposure but negatively associated with maternal education and maternal receipt of public assistance at birth. No associations were observed with child birth outcomes.

CONCLUSIONS: MtDNAcn levels were dynamic through childhood and are associated with prenatal factors. These results underscore the need for the investigation of mtDNAcn dynamics and predictors for environmental health research.

KEYWORDS: Biomarkers, mitochondria, mtDNA, children's environmental health

ORAL PRESENTATIONS SESSION 28: The exposome and health

O-OP-146 Metabolomics links lifestyle variables to breast cancer in the Long Island Breast Cancer Study Project

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BACKGROUND AND AIM: Healthy lifestyle has been associated with decreased risk of developing breast cancer. Using untargeted metabolomics profiling, we aim to identify the molecular mechanisms connecting lifestyle and breast cancer through network analysis.

METHODS: A total of 50 post-menopausal women with breast cancer and 50 cancer-free controls were selected from the Long Island Breast Cancer Study Project (LIBCSP). We measured untargeted plasma metabolomics using liquid chromatography- high resolution mass spectrometry (LC-HRMS). Using 'enet', we retained metabolites found in active molecular network (AMN) clusters for analysis. LASSO was used to explore associations between cancer status and metabolites; 14 lifestyle related variables including smoking, physical activity, alcohol consumption, meat consumption, fruit and vegetables consumption, supplemental vitamin use; and 20 covariates including various reproductive factors. LASSO was repeated to explore associations between selected lifestyle factors and metabolites. Results were displayed as a network to uncover biological pathways linking lifestyle factors to breast cancer.

RESULTS: After filtering, 1797 metabolomics peaks in the plasma samples remained. of these, 851 "active" metabolites were retained in 197 correlation AMN clusters. Through LASSO, breast cancer status was associated with 66 "active" metabolites. Several of these metabolites were also associated with lifestyle variables including meat consumption, alcohol consumption, and supplemental β-carotene, B12 and folate use. No individual lifestyle factors were directly associated with breast cancer status through LASSO, suggesting that metabolites may act as biological intermediaries between healthy lifestyle factors and breast cancer. In particular, 13-HPODE, a metabolite linked with inflammation, was associated with breast cancer status and connected to β-carotene supplement usage through an AMN.

CONCLUSIONS: We found several plasma metabolites associated with both lifestyle factors and breast cancer status. These results suggest that inflammation may play a mechanistic role linking supplement usage to breast cancer status.

KEYWORDS: breast cancer, lifestyle factors, metabolomics, network analysis

O-OP-147 External exposome and all-cause mortality in two large administrative cohorts: Rome (Italy) and Greece

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BACKGROUND AND AIM: Many studies reported associations between long-term exposure to several environmental stressors and mortality, however little is known on the complex interplay between the urban exposome and health. We characterized the external exposome through a limited number of exposure domains and investigated their association with mortality in two large cohorts (Rome and Greece).

METHODS: Within the EXPANSE project, we analyzed two population-based cohorts: Rome (Italy) (30+ years; 2011-2019) and Greece (37+; 2014-2019). Multiple exposures were assigned at the residential addresses, and were divided into three a-priori defined domains: 1) land-built environment (NDVI, imperviousness surfaces, distance to water); 2) air pollution (fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), black carbon (BC) and warm-season ozone (warm-O_3)); 4) temperature (annual, cold-season and warm-season mean and standard deviation (SD)). Each domain was synthesized through Principal Component Analysis (PCA). We applied Cox proportional hazards regression models using the obtained principal components as exposures.

RESULTS: In each cohort and for each domain, we selected the first principal component. It explained more than 55% of variance, ranging from 57.4% (land-built environment for Rome) to 83.3% (air pollution for Rome). We estimated a protective effect between the land-built environment domain and all-cause mortality, with hazard ratios (HR) of 0.984 (95%CI: 0.977-0.991) in Rome and 0.980 (0.976-0.984) in Greece, per interquartile range increments. Associations with the air pollution component were positive and statistically significant, with HR of 1.011 (1.005-1.018) and 1.060 (1.051-1.068), respectively. The air temperature domain was associated with mortality only in the Greek cohort. Results were similar in multi-component analyses.

CONCLUSIONS: We found associations between different components of the external exposome and mortality in two large administrative cohorts. The same approach will be applied in the other administrative cohorts of EXPANSE: Switzerland, Sweden, Netherlands and Catalunya (Spain).

KEYWORDS: exposome, population-based cohort, principal component analysis.

O-OP-148 The urban exposome and type 2 diabetes: A deep learning approach

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BACKGROUND AND AIM: Type 2 diabetes (T2D) is a chronic disease with high individual and societal burden. Risk of T2D is partly influenced by urban characteristics, such as air pollution, or indirectly through their relation with lifestyle behaviours (e.g. walkability, food environment). Environmental characteristics are generally studied individually in their association with T2D, but occur simultaneously in real life, and may associate with T2D in nonlinear and non-additive ways. We aimed to identify which factors of the urban exposome are associated with T2D by applying artificial neural networks (ANN). In addition, we compared results of ANN model with penalized regression LASSO, as a more conventional method.

METHODS: We analyzed baseline data from 14,829 participants of the Occupational and Environmental Health Cohort study living across the Netherlands. Self-reported questionnaire data were used to identify participants diagnosed with T2D (n=676(4.6%)). Exposome variables (n=86) were linked to individual home addresses, including air pollution, traffic noise, green-space, chemicals in drinking water, built environmental and neighborhood socio-demographic characteristics. Models were adjusted for individual socio-demographic variables. Nested cross-validation was used to determine the optimal model parameters of both approaches (ANN and LASSO), and the cross-validated predictive accuracies were compared.

RESULTS: One exposure was selected by each approach. Living in neighborhoods with a higher share of non-Western immigrants (selected by ANN) was associated with a higher risk of T2D. Higher average home value in residential neighborhood (selected by LASSO) was associated with a lower risk of T2D. Cross-validated prediction error logLoss (sd) was 0.177 (0.0060) for ANN and 0.167 (0.0022) for LASSO.

CONCLUSIONS: Neighborhood socio-demographic characteristics are associated with the risk of T2D. Accuracy of the ANN model was lower than LASSO, which might be due to the low prevalence of diabetes and relatively weak signal in the data.

KEYWORDS: Multiple exposures, Machine learning, Neighborhood socio-demographic characteristics

O-OP-149 Exploring early life exposome related to low birth weight through machine learning methods

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BACKGROUND AND AIM: Regarding the multifactorial etiology of low birth weight (LBW), the contribution of environmental hazards is increasing. Exposome refer to totality of a life's exposure including multiple pollutants, lifestyle and sociodemographic factors should provide a holistic view on LBW. This study aims to explore early life exposome related to LBW and identify important factors through machine learning

METHODS: We recruited 486 mother-infant pairs from Taiwan Birth Panel Study, with LBW defined as birth body weight below 2500 gm. Early life factors included 27 environmental pollutants measured in cord blood or maternal urine, estimated outdoor air pollutants (particulate matter 2.5 (PM2.5), nitrogen dioxide (NO2) and greenness (Normalized Difference Vegetation Index (NDVI)) and questionnaires on socioeconomic levels, health behaviors and diet during pregnancy. The association between exposome and LBW were examined by five machine learning methods including Naïve bayes, Support vector machine (SVM), Random forest, XGBoost (eXtreme gradient boosting) and Ensemble learning. Model performance was evaluated by area under Receiver operator characteristic (ROC) curve. And, features selection was used to identify important features.

RESULTS: SVM method and Random forest provided the best prediction based on AUC= 0.73 and 0.74, respectively. The top five important features selected from best model prediction of Random forest include: perfluorooctyl sulfonate (PFOS) in cord blood, uranium and zinc in maternal urine, maternal pre-pregnancy body mass index, maternal gestational weight gain.

CONCLUSIONS: Machine learning approaches could be useful tools for modeling early life exposome associated with LBW. Environmental pollutants and maternal weight status are critical for LBW risk.

KEYWORDS: exposome, machine learning, environmental pollutants, low birth weight

O-OP-150 Impact of residential relocation on environmental exposures in European cohorts: an exposome-wide approach

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BACKGROUND AND AIM: Residential relocation can cause simultaneous changes in multiple environmental exposures and provides a unique opportunity to examine the health impacts of interventions on the external exposome. However, the likelihood of relocation can be influenced by various individual, household, and neighbourhood characteristics that can also influence health. Including Swedish and Dutch adults (SDPP, AMIGO, mean age 49 years) and children (PIAMA, BAMSE, 0-20 years) cohorts, we investigated the factors associated with relocation and changes in multiple environmental exposures across life stages.

METHODS: We used uni- and multivariable logistic regression to identify predictors of moving (yes/no) including age, sex, ethnicity, education and chronic cardio-respiratory diseases (asthma, hypertension) at baseline. We then conducted multivariable linear regression to identify predictors of changes in individual exposures (air pollution, green space, blue space, impervious surfaces) among participants who relocated during the first four years of follow-up.

RESULTS: On average, 7% of the participants relocated each year. Before relocation, movers consistently presented higher levels of air pollution than non-movers. Predictors of moving in adults cohorts included younger age, past and current smoking, lower levels of education, but not sex or pre-existing asthma or hypertension. In children cohorts, moving was associated with higher levels of socioeconomic status and parental education. These characteristics were also associated with moving to greener, less polluted areas. Among movers in adults cohorts, older individuals moved to areas with increased pollution and grey space. However, relocating to areas with higher levels of pollution and less green space was associated with higher education levels in SDPP, and lower education levels in AMIGO.

CONCLUSIONS: Several individual characteristics including age, smoking and education were associated with residential relocation. Among movers, the predictors of exposure change due to relocation varied across cohorts and life stages.

KEYWORDS: external exposome; air pollution; built environment, residential relocation

O-OP-151 Metabolic Pathways Altered by Air Pollution Exposure in Association with Lipid Profiles in Young Adults

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BACKGROUND AND AIM: Air Pollution is a risk factor for obesity and cardiometabolic diseases in children and adults. We aim to examine the metabolic perturbations associated with air pollution and cardiometabolic health.

METHODS: In year 2014 – 2018, we conducted a cross-sectional study assessing lipid profiles (triglycerides, total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, very-low-density lipoprotein (VLDL) cholesterol), untargeted serum metabolomics using liquid chromatography-high-resolution mass spectrometry, and one-month and one-year averaged air pollution exposures to NO2, O3, PM2.5 and PM10 at residential addresses among 132 young adults in southern California. A Metabolome-wide association study was conducted to identify metabolomic signatures associated with air pollution exposure. Mummichog pathway enrichment analysis was used to assess altered metabolic pathways, followed by annotations of metabolomic features. Principal component analysis (PCA) of 36 metabolites with confirmed identity was performed to reduce dimensionality and identify clusters. Lastly, regression models were used to analyze the associations of metabolomic PC scores with air pollution and lipid profiles.

RESULTS: In total, 4937 and 4372 metabolomic features were detected using HILIC positive and C18 negative modes, with 2047 and 1228 features significantly associated with at least one air pollutant in positive and negative ion mode, respectively ($p < 0.05$). Metabolic pathways associated with air pollution exposure included fatty acid, glycerophospholid, tryptophan, and tyrosine metabolism. PCA of 48 metabolites involved in the identified pathways indicated that one-month O3, PM10, PM2.5 and one-year NO2 air pollution exposure was positively associated with free fatty acids and oxidative byproducts-related PC score ($p < 0.05$). This PC score shown to be negatively associated with total cholesterol and LDL cholesterol ($p < 0.05$).

CONCLUSIONS: This study indicated that air pollution exposure is associated with dysregulated fatty acid and lipid metabolism.

KEYWORDS: Air Pollution; Metabolomics; Cardiometabolic Health; Lipolysis; Pathway Analysis

ORAL PRESENTATIONS SESSION 29: Impacts of environmental exposures on COVID-related outcomes

O-OP-152 A Spatial and Contextual Exposome-Wide Association Study of COVID-19 Hospitalizations in Florida, USA

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BACKGROUND AND AIM: Recent studies suggested that long-term environmental exposures may be important determinants of COVID-19 severity. However, very few environmental factors have been studied, and often separately without considering the totality of the environment (i.e., the exposome). To address this gap, we conducted a spatial and contextual exposome-wide association study (ExWAS) of COVID-19 hospitalizations in Florida, USA (US).

METHODS: We obtained electronic health records data of 50,368 patients 18 years and older with a positive SARS-CoV-2 PCR/Antigen lab test or a COVID-19 diagnosis between March 2020 and October 2021 from the OneFlorida+ Data Trust. Patients' exposures to 211 spatial and contextual exposome factors during 2015-2019 were integrated and spatiotemporally linked to their residential addresses. A two-phase analytical procedure was used. (1) A random 50:50 split divided the data into discovery and replication sets. Associations between COVID-19 hospitalizations and individual exposome factors were examined using mixed-effect logistic regression models, with multiple comparisons addressed. (2) A multivariable regression model including all variables that were statistically significant from both the discovery and replication sets was fitted. Odds ratio for each standard deviation increase (ORSD) and 95% confidence interval (95% CI) were reported.

RESULTS: A total of 12 and 21 variables were statistically significant in the discovery and replication sets, respectively. Among the 7 variables included in Phase 2, 3 variables remained statistically significant, including (1) hydrochloric acid (ORSD: 1.93, 95% CI: 1.11, 3.38), obtained from the US Environmental Protection Agency's National Air Toxics Assessment, (2) density of fitness and recreational sports centers (ORSD: 0.94, 95% CI: 0.92, 0.97), assessed using the US Census Business Pattern, and (3) neighborhood deprivation index (ORSD: 1.09, 95% CI: 1.06, 1.12), derived using the American Community Survey.

CONCLUSIONS: Long-term exposures to three spatial and contextual exposome factors were associated with COVID-19 hospitalizations in Florida, USA.

O-OP-153 Spatial Analysis of Ambient Air Pollution and COVID-19 Death in a Hospitalized Cohort of Confirmed Cases in Southern California

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BACKGROUND AND AIM: Recent evidence links ambient air pollution to COVID-19 incidence, severity, and death, but few studies have analyzed individual-level health data with high quality exposure models.
OBJECTIVE: We sought to assess whether air pollution exposures led to greater risk of death during or after hospitalization in confirmed COVID-19 cases among patients who were members of the Kaiser Permanente Southern California (KPSC) healthcare system.

METHODS: We used 1 km resolution chemical transport models (CTMs) to estimate ambient concentrations of several common air pollutants, including ozone, nitrogen dioxide, and fine particle matter (PM2.5). We also derived estimates of pollutant exposures less-commonly available in epidemiological studies, including ultra-fine particulate matter (PM0.1), PM chemical species, and PM sources. We used Cox proportional hazards models to assess associations between air pollution exposures and death from COVID-19, while controlling for potential individual and contextual confounders.

RESULTS: We found significant associations between COVID-19 death and several air pollution exposures, including: PM2.5 mass, PM0.1 mass, PM2.5 nitrates, PM2.5 elemental carbon, PM2.5 on-road diesel, and PM2.5 on-road gasoline. Based on the interquartile (IQR) exposure increment, effect sizes ranged from hazard ratios (HR) = 1.12 for PM2.5 mass and PM2.5 nitrate to HR ~ 1.06-1.07 for other species or source markers. Humidity and temperature in the month of diagnosis were also significant predictors of COVID-19 death and inverse modifiers of the air pollution effects.
CONCLUSION: Higher air pollution exposures were associated with a greater risks of COVID-19 death in a cohort of patients hospitalized for COVID-19 in Southern California.

O-OP-154 COVID-19 disease severity in hospitalized patients is associated with short- and long-term exposure to air pollutants

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BACKGROUND AND AIM: Existing evidence suggests that exposure to air pollutants (AP) such as particulate matter (PM2.5 and PM10), nitrogen dioxide (NO2) and black carbon (BC) is associated with COVID-19 infection rates and mortality. We investigated whether exposure to AP was associated with COVID-19 disease severity in a cohort of hospitalised COVID-19 patients.

METHODS: 329 COVID-19 patients were recruited at the time of admission to hospital. Clinical parameters and outcomes were collected from medical records, including the duration of stay, the early-warning score (EWS), oxygen saturation, and PaO2/FiO2 ratios. Daily exposure levels for PM2.5, PM10, NO2 and BC were modelled using a high-resolution spatiotemporal model. Black carbon particles in blood were quantified using femtosecond pulsed laser illumination. Associations between exposure to air pollutants and clinical outcomes were modelled using multiple regression models while adjusting for potential confounders.

RESULTS: The duration of stay increased by 1 to 6 days for an interquartile range (IQR) increase in average exposure to AP in the week before admission (PM2.5: +5.2 days, NO2: +5.8 days). Similarly, an IQR increase in long-term exposure (to AP was associated with increased duration of stay (PM2.5: +2.8 days, NO2: +3.2 days, BC: +2.8 days). Furthermore, an increase in PM2.5 exposure 1 week before admission was associated with higher EWS (+0.40). Finally, IQR increases in long-term exposure to PM10, BC and NO2 as well as blood black carbon load were associated with odds of admission to the intensive care unit (OR: +1.32, +2.12, +2.46 and +1.19 respectively).
CONCLUSION: Exposure to AP was associated with duration of stay and EWS scores at the time of admission, which implies a potential link between AP exposure and COVID-19 disease severity, and a significant influence of AP exposure on the pressure on medical care systems during the COVID-19 pandemic.

O-OP-156 Antibody Response after COVID-19 Vaccination in Healthy Adults Exposed to Perfluoroalkyl Substances in Ronneby, Sweden

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BACKGROUND AND AIMS: Per- and polyfluoroalkyl substances (PFAS) are widely used, environmentally ubiquitous chemicals. Inhabitants in Ronneby, Sweden, have had long-term, moderate to high PFAS-exposure through drinking water contaminated by firefighting foams.
PFAS has been associated with decreased vaccine-induced antibody responses in children. Effects in adults have been poorly investigated, in part owing to lack of well-designed trials of primary immunizations in PFAS exposed populations.
The novelty of vaccination against COVID-19 and the associated clinical trials, offers a unique opportunity to investigate if PFAS decrease vaccine-induced antibody response in adults.

METHODS: Healthy, COVID-19 unvaccinated adults, 20-60 years old, from Ronneby (n=319; Perfluorooctanesulfonic acid (PFOS) median 46 ng/mL, range 1-543) and referents from neighboring Karlshamn (n=41; PFOS median 4 mg/mL, range 1-36), were vaccinated with two doses of the mRNA vaccine Spikevax® (Moderna). Seven PFAS were measured in serum before vaccination. Serum IgG antibodies against the spike antigen were measured before vaccination, and at five weeks (n=350) and six months (n=329) after the second vaccination.
Regression analyses of antibodies were fitted against serum PFAS levels, quartile groups, smooth splines and between exposed and reference areas, adjusting for sex, age, smoking and previous SARS-CoV-2-infection.

RESULTS: Participants from Ronneby and referents had similar, high antibody levels (100% positive) five weeks and six months post vaccination, with waning levels over time.
Regression models showed no clear pattern between antibody levels at five weeks or six months after vaccination and PFAS exposure. Results were replicated using different exposure indices, covariate adjustments and sensitivity analyses, and consistent for seven different PFAS compounds.

CONCLUSIONS: In this clinical trial, with a wide PFAS exposure range and a low dropout rate, we assessed no indication that moderate to high PFAS exposure adversely affected antibody production in adults after COVID-19 mRNA vaccination.

KEYWORDS: PFAS, Immunotoxicity, Antibody, COVID-19 Vaccination

O-OP-157 The association of COVID-19 incidence with temperature, humidity, and UV radiation – A Global multi-city analysis

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BACKGROUND AND AIM: The possible associations of COVID 19 transmission and meteorological factors is a topic of scientific debate. A multitude of studies have been conducted worldwide, with inconsistent findings. However, often these had methodological issues, e.g. did not exclude important confounding factors, or had limited geographic or temporal resolution.

METHODS: We analysed data from 455 cities across 20 countries around the globe over an observation period before the vaccine roll out began, ranging from 3 February to 31 October 2020. We used a time-series analysis that assumes a quasi-Poisson distribution of the cases and incorporates distributed lag non-linear modelling for the exposure association at city-levels while considering effects of autocorrelation, long-term trends and day of the week. The confounding by governmental measures was accounted by incorporating the Oxford Governmental Stringency Index. The effects of daily mean air temperature, relative and absolute humidity, and UV radiation were estimated by applying a meta-regression of local estimates with multi-level random effects for location, country, and climatic zone.

RESULTS: We found that air temperature and absolute humidity influenced the spread of COVID-19 over a lag period of 15 days. Pooling the evidence globally showed that overall low temperatures (7.5°C compared to 17.0°C) and low absolute humidity (6.0 g/m³ compared to 11.0 g/m³) were associated with higher COVID 19 incidences (RRtemp=1.33 with 95%CI: 1.08; 1.64 and RRAH=1.33 with 95%CI: 1.12; 1.57). for RH and UV no evidence of an association was found. These results were robust to sensitivity analysis. However, the study results also emphasised the heterogeneity of these associations in different countries.

CONCLUSIONS: Globally, our results suggest that comparatively low temperatures and low absolute humidity were associated with increased risks of COVID 19 incidence. However, this study underlines regional heterogeneity of weather-related effects on COVID-19 transmission.

KEYWORDS: Temperature, Humidity, UV Radiation, COVID-19

ORAL PRESENTATIONS SESSION 30: Child health, air pollution exposure and greenspace

O-OP-158 Air quality and children allergic diseases and neurodevelopmental disorders - A nationwide birth cohort follow-up approach

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BACKGROUND AND AIM: Air pollution was associated with decreased lung function and intelligence. However, sizeable prospective follow-up studies with pre-and postnatal exposure considerations are scarce. The research is urgent due to the potential life-long lung and brain functional effects and the new WHO air quality guideline. In addition, extensive data-based investigations of two distinguished disorders might help examine potential confounders. The goal is to investigate prenatal exposure to nitrogen dioxide (NO2) and postnatal allergic diseases and neurodevelopmental disorders in a national-wide birth cohort.

METHODS: We used the National Health Insurance Research Database (NHIRD) and the Taiwan Maternal and Child Health Database (TMCHD) to establish a national birth cohort born from 2007-to 2011 to follow the cumulative incidence of children's allergic diseases neurodevelopmental disorders till 2017. As a result, there were 759,142 infant-mother pairs finally included in the cohort without significant abnormalities. In addition, we utilized hybrid land-use regression models and machine learning methods to assess daily exposure to nitrogen dioxide (NO2) air pollutants, adopting the data of 76 national air-monitoring stations.

RESULTS: The children experienced significantly increased allergic diseases [Hazard Ratio (HR), atopic dermatitis: 1.42 (Confidence Interval 1.38~1.45); asthma 1.21 (CI 1.19~1.23); allergic rhinitis: 1.22 (1.20~1.24)] and neurodevelopmental disorders [HR, autism: 1.52 (1.41~1.63); attention deficit hyperactivity disorder: 1.41 (1.36~1.46)] but not for epilepsy [HR, 1.04 (0.97~1.12)] with the 3rd tertile exposure to NO2 concentration (≥ 20.0 ppb) as compared to the lower (≤ 15.1 ppb) prenatally, adjusted for paid insurance amount, maternal smoking status, and parental history of the individual examined diseases in the Cox's model.
CONCLUSION: The incidence of children's allergic diseases and neurodevelopmental disorders increased significantly at the 3rd tertile of NO2 concentration before birth. Therefore, our result also corresponded to the new WHO guideline of optimized 20 ppb for NO2.

O-OP-159 In-utero exposure to air pollution and blood pressure in children from the Rhea birth cohort study, Greece

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BACKGROUND AND AIM: High blood pressure (BP) in childhood has been linked with hypertension and impaired cardiovascular health within adulthood. Exposure to air pollution has been associated with elevated BP in children but only a few studies evaluated the persistence of these associations into early adolescence. We investigated the association between pregnancy exposure to air pollution and BP through childhood in the Rhea birth cohort in Greece.

METHODS: Residential exposure to particulate matter <10 μm (PM10) and <2.5 μm (PM2.5) during pregnancy was estimated with temporally adjusted land-use regression models. We measured systolic (SBP) and diastolic (DBP) blood pressure at 4, 6, and 11 years. Hypertension was defined as DBP or SBP ≥95th sex-, age- and height-percentiles. Generalized estimating equation and multivariate regression models assessed the associations (per 5 μg/m³) with repeated and single time-point measures, respectively. We also tested effect modification by sex and maternal smoking.

RESULTS: Median (IQR) levels of PM2.5 and PM10 during pregnancy were 14.4 (2.4) μg/m3 and 35.6 (2.3) μg/m3, respectively. PM10 was associated with higher SBP and DBP in boys but lower in girls (p-interaction= 0.025 and 0.036) at 4 years. We also observed higher risk for hypertension overall (1.62; 95% CI: 1.04, 2.53) and in boys (2.01; 95% CI: 1.07, 3.79), and in children born to non-smoking mothers during pregnancy (2.14; 95% CI: 1.25, 3.66). Higher PM2.5 was associated with lower SBP in boys at 6 (β= -3.75 mmHg; 95% CI: -7.14, -0.36) and 11 years (β= -4.49 mmHg; 95% CI: -9.09, 0.11; p-interaction= 0.068 and 0.072). Sex differences in BP trajectories were also observed.

CONCLUSIONS: This study suggests that prenatal air pollution exposure may affect blood pressure during childhood. Further research is needed to understand sex differences and the role of co-exposure to maternal smoking.

KEYWORDS: Blood pressure, childhood, air pollution, prenatal

O-OP-160 Short-term air pollution exposure and anxiety symptoms in children from Mexico City

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BACKGROUND AND AIM: Short-term air pollution exposure has been linked to mental health conditions in adults; however, there is limited research in the younger populations in which symptoms often first arise. In this study, we examined the association between recent fine particulate matter (PM2.5) exposure and symptoms of anxiety in a cohort of 8–9-year-olds in Mexico City.

METHODS: Participants included 455 mother-child pairs from a longitudinal birth cohort study in Mexico City. Anxiety symptoms were assessed at the 8–9-year study visit by trained psychologists using the Spanish version of the Revised Children's Manifest Anxiety Scale. Daily PM2.5 predictions were estimated using a 1km satellite-based exposure model and averaged over several recent exposure windows including 1-12 months and 1-4 weeks prior to anxiety assessment. We additionally used recent weekly exposure averages in distributed lag models. Linear regression models were used to estimate the change in continuous anxiety symptoms with each 5-µg/m3 increase in PM2.5. Models were adjusted for maternal education, maternal age, child's age at study visit, child sex, and season of study visit. We additionally assessed sex-specific effects by including an interaction term between PM2.5 and sex.

RESULTS: A 5-unit increase in PM2.5 exposure averaged over the 1 month prior to study visit was associated with higher anxiety symptoms in the child (β= 0.65, 95% CI: 0.01, 1.30). These associations were primarily seen in females (β= 1.05, 95% CI: 0.10, 1.95, p-int: 0.10). Using DLM approaches, we identified a critical window for exposures 0-2 weeks prior to anxiety assessment.

CONCLUSIONS: Fine particulate matter exposure was associated with elevated levels of child anxiety symptoms, particularly for more recent exposures.

KEYWORDS: air pollution, mental health, LMIC, child health

O-OP-161 Prenatal exposure to residential green space and cord blood DNA methylation: epigenome wide association studies in the ENVIRONAGE cohort

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BACKGROUND AND AIM: DNA methylation may be an underlying mechanism between green space and health. Although newborn DNA methylation is sensitive to environmental influences during prenatal life, the impact of green space has not been studied yet. This study evaluated whether prenatal exposure to residential green space is associated with cord blood DNA methylation.

METHODS: We conducted epigenome-wide association studies using data from two subpopulations (N=198 and 349) of the ENVIRONAGE cohort. Cord blood DNA methylation was measured by Illumina HumanMethylation 450K and EPIC BeadChip arrays, respectively in the two subpopulations. High (vegetation >3m), low (vegetation <3m) and total (including both) green space exposure was estimated within 100 and 1000 m distance around the maternal residence using high-resolution data. We used linear mixed models to identify differentially methylated sites, and two different approaches (ENmix-combp and DMRcate) to identify differentially methylated regions. Functional analysis was performed by associating green space with cord expression of the genes mapped to the identified signals.

RESULTS: Prenatal exposure to total, low and high residential green space within 100 and 1000 m was associated with six differentially methylated regions (annotated to COL9A3, GPR27, LINC00612, LINC01973, PARD6G-AS1, ZNF274 genes), in common to the two subsets. Methylation at 7 CpGs was associated with prenatal exposure to total and high green space at 100 and 1000 m distance, with no overlap between the two subsets. Expression level of the FSTL3 gene decreased with prenatal exposure to total green space at 1000 m buffer.

CONCLUSIONS: Our results demonstrate that prenatal residential exposure to green space is associated with cord blood DNA methylation, mainly at loci organized in regions, and that these signals may have functional relevance.

KEYWORDS: Residential green space, Epigenomics, Gene expression

O-OP-163 Assessment of the joint effects of PM2.5 and pollen on childhood asthma exacerbation in the Philadelphia metropolitan region, 2011-2016

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BACKGROUND AND AIM: Mechanistic evidence suggests synergism of PM2.5 and pollen in their effects with asthma exacerbation (AE). Nevertheless, few epidemiologic studies have investigated health impacts of their joint exposures. We conducted a time-series study for the interactions between both triggers during the pollen season (Mar 18 – Oct 30) within the Philadelphia region.

METHODS: PM2.5 levels were averaged from the nearest monitor values for asthmatic individuals identified through electronic health records from the Children's Hospital of Philadelphia, and pollen concentrations from a National Allergy Bureau-certified monitor in Center City, Philadelphia. We applied quasi-Poisson regression in distributed lag non-linear model (DLNM), with both PM2.5 (natural spline, 3df) and pollen (total/oak tree, grass, total/ragweed and other) (piecewise linear terms) in addition to interaction terms, and adjusted for temperature, relative humidity, long-term/seasonal trends, day-of-week, and holidays. for each PM2.5/pollen combination, one was treated as the main exposure, the other, the effect modifier in categorical terms for strata-specific estimates.

RESULTS: We observed increased RRs for the association between same-day total tree pollen and daily AE rates (90th vs. 0) at higher PM2.5 levels, 7-day preceding the exacerbation event (low: 0.95, 95% CI: 0.79 – 1.16; medium: 1.10, 95% CI: 0.93 – 1.31; 1.05, 95% CI: 0.86-1.28). Same-day association for late-season grass pollen was stronger, when followed a high PM2.5 concentration 5-day before the event (1.05, 95% CI: 0.97-1.14), than when following low PM2.5 (1.02, 95% CI: 0.95-1.09). However, we also observed decreased RRs for association between PM2.5 and AE, at increased tree/late-season grass pollen concentrations.

CONCLUSIONS: Our study provides evidence suggesting interactions for several exposure combinations; however, many had no association with AE, and others suggested antagonistic effects. With mixed evidence, continued epidemiologic studies are called in the total impact of concurrent environmental asthma triggers.

KEYWORDS: PM2.5, pollen, interaction, children, asthma exacerbation (AE)

O-OP-277 Characterization of shed baby tooth metal concentrations in Project Viva

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BACKGROUND AND AIM: Shed baby teeth can provide retrospective information on early life metal exposure. We described the associations of baby tooth metal levels with maternal blood metal levels during pregnancy and other characteristics.

METHODS: Project Viva participants (recruited in early pregnancy 1999–2002 in eastern Massachusetts) provided shed baby teeth for metal analysis (As, Ba, Bi, Cd, Co, Cr, Cu, Li, Mg, Mn, Mo, Ni, Pb, Sn, Sr, Zn) using laser ablation-inductively coupled plasma mass spectrometry (LA-ICP-MS, measurement range: 21 weeks before birth to 55 weeks after birth). We measured maternal erythrocyte metals in the first trimester (As, Ba, Cd, Cr, Cu, Mg, Mn, Pb, Sn, Zn) and the second trimester (Pb and Mn) using ICP-MS. We calculated Spearman correlations between erythrocyte metals and dentine metals and used multivariable linear regression to evaluate associations of participants' characteristics, including mother's age at enrollment, race/ethnicity, highest educational attainment, household income, smoking during pregnancy, parity, and child's sex with dentine metal levels.

RESULTS: Participants (N=144) were mostly white (72%) and 81% were college graduates, 67% had household incomes >$70,000/year, and 13% smoked during pregnancy. We observed significant positive correlations between erythrocyte and dentine Pb, with the strongest correlation observed between 2nd-trimester erythrocyte Pb and mean of pre-birth dentine Pb ($r=0.78$, $p<0.001$, $N=86$). Smoking during pregnancy, mother's age, and race/ethnicity were associated with metal levels in the baby tooth. for example, after adjusting for all characteristics mentioned in the methods, smoking during pregnancy was associated with higher dentine Sr (both pre and post-birth) and higher dentine Li post-birth.

CONCLUSIONS: Maternal blood Pb strongly correlated with prenatal and postnatal dentine Pb. Dentine metal levels varied by some maternal characteristics, which may be useful for understanding the relationship of dentine metal levels with health outcomes in future work.

ORAL PRESENTATIONS SESSION 31: Air pollution, cognitive function and dementia-related health outcomes

O-OP-164 The 2018 Japan Floods increased prescriptions of anti-dementia drugs among disaster victims: a retrospective cohort study based on a national health insurance database

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BACKGROUND AND AIM: The occurrence of weather-related disasters is increasing with the progression of global climate change. Natural disasters increase the risk of impaired cognitive function of elderly victims. It is not clear what effects such natural disasters have on the prescriptions of drug treatment for dementia. Thus, we evaluated the effect of the 2018 Japan Floods, the second-largest water-related disaster in Japan, on the prescriptions of anti-dementia drugs (ADD) for elderly people.

METHODS: From the National Database of Health Insurance Claims, we extracted prescription data in Hiroshima, Okayama and Ehime prefectures for one year before and after the disaster. From the database, 1,710,119 people aged 65 years or over were selected as the study participants. Sex- and age-adjusted odds ratios (ORs) of victims for new ADD prescriptions were calculated using logistic regression models. A difference-in-difference analysis was conducted to take into account the trends for the ORs before the disaster. Furthermore, among continuous ADD users, the effects of disaster on the increasing trend for ADD prescriptions (daily dose or number of drug types) was also evaluated.

RESULTS: of 1,710,119 people enrolled, 15,994 (0.9%) were recorded as a disaster-victims, and 112,289 (6.6%) were prescribed ADD. Among original non-users, victims were more likely to start using ADD after the disaster than non-victims [adjusted OR=1.33 (95% CI:1.16–1.52)]. Among continuous users, an increasing trend for ADD prescriptions was more often observed for victims than non-victims [1.61 (1.13–2.31)]. These associations were maintained even after considering the pre-disaster trend of ADD use.

CONCLUSIONS: The natural disaster results in an increased number of users of anti-dementia medications. Special attention to such neurological shifts and welfare support is needed for elderly victims of a large-scale natural disaster.

O-OP-165 The challenge of pre-enrollment selection bias in estimating the effects of air pollution on cognitive decline and other dementia-related outcomes

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BACKGROUND AND AIM: Research on air pollution's (AP) association with dementia-related outcomes has proliferated; however, selection bias is a concern. Past research has addressed selection bias from differential post-enrollment attrition, but differential pre-enrollment selection may also be influential depending on who survives to the eligible age of enrollment and enrolls. In this project, we quantify potential biases arising from differential selection into studies of older adults through simulations based on real-world studies of AP and cognitive decline.

METHODS: We simulated 1,000 cohorts of 100,000 hypothetical participants. Participants were assigned a realistic AP exposure based on prior studies, plus an unmeasured binary covariate value (U). Our simulation models specified that AP had no effect on cognitive decline, whereas U had a small positive effect. We selected 10,000 participants from each cohort to form 1,000 analytic samples, where the probability of selection depended on both AP and U. We quantified the magnitude of the resulting "collider-stratification" selection bias by comparing the average estimated effect of AP on cognitive decline across our analytic samples with the true (unbiased) value of zero. We also explored whether these biases were sensitive to AP-U interactions.

RESULTS: The association between AP and cognitive decline was upwardly biased when lower AP exposure and the presence of U increased the probability of selection. The bias magnitude was particularly sensitive to multiplicative AP-U interactions. Importantly, we could replicate prior observational study findings without resorting to extreme parameter values.

CONCLUSIONS: Pre-enrollment selection bias can lead to qualitatively inaccurate effect estimates in studies of older adults. These cohorts are often highly selected by virtue of their survival to eligible study age and willingness to enroll. Bias analyses (e.g., our simulation-based approach) can help identify key assumption violations that could nullify or reverse environmental effect estimates.

KEYWORDS: Air pollution; Cognitive decline; Selection bias

O-OP-166 The impact of long-term exposure to fine particulate matter on incident dementia among U.S. older adults

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BACKGROUND AND AIM: Growing studies link long-term fine particle (PM2.5) exposures to increased risk of Alzheimer's disease and other dementias, but there is a lack of comprehensive evaluation of these findings using causal inference modeling approaches.

METHODS: Based on the Medicare Chronic Conditions Warehouse (2000-2018), we constructed two nationwide U.S. population-based cohorts of enrollees aged ≥65 for dementia and Alzheimer's disease (AD), respectively. Coupled with high-resolution population-weighted air pollution exposure data, we estimated the effect of long-term exposure to PM2.5 on dementia and AD incidence using five distinct statistical approaches. Two traditional regression approaches for confounding adjustment: 1) Cox proportional hazards model, and 2) Poisson regression; two causal inference modeling approaches rely on the potential outcomes framework and generalized propensity scores (GPS). These approaches adjust for measured confounders (demographic characteristics, Medicaid eligibility, and ZIP-level covariates) using 1) matching by GPS, and 2) weighting by GPS. We further applied the difference-in-differences approach that controls for unmeasured confounders by design.

RESULTS: We identified ~5.0 million incident dementia cases (N=18,442,459; dementia cohort) and ~2.4 million incident AD cases (N=19,092,115; AD cohort). Using the five distinct approaches, we found that an increase in annual PM2.5 by 5 μg/m³ leads to a statistically significant 6-10% and 10-16% increase in dementia and AD risk, respectively.

CONCLUSIONS: Our study provides comprehensive evidence of the link between long-term PM2.5 exposure and increased incidence of dementia and AD, raising awareness of the continued importance of assessing the impact of air pollution exposure on neurological disorders among older adults.

KEYWORDS: fine particulate matter, Alzheimer's disease and dementias, causal inference modeling

O-OP-167 PM2.5 and dementia – APOE-ε4 and odor identification ability as moderators

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BACKGROUND AND AIM: There is growing evidence that long term exposure to air pollution increases the risk of dementia. However, more research regarding possible moderators and mediators are needed in order to identify vulnerable populations, and to better understand the complicated pathways between air pollution and dementia. The aim of this study was to investigate 1) the associations between PM2.5 exposure and dementia incidence, and 2) the possible mediating or moderating role of APOE-ε4 and odor identification ability, two known risk factors of dementia.

METHODS: Data was drawn from the Betula project, a longitudinal study on aging, memory, and dementia in Sweden. DNA was extracted via blood samples to allow for genotyping of the APOE gene. Odor identification ability was assessed using the Scandinavian Odor Identification Test (SOIT). Variation in within-city annual mean PM2.5 concentrations were obtained from a dispersion-model and matched at the participants' residential address. Proportional hazard regression was used to calculate hazard ratios.

RESULTS: of 1846 participants, 348 developed dementia during the follow up period. Each 1 µg/m3 increase in annual mean PM2.5-concentration was associated with a hazard ratio of 1,24 for dementia (95% CI: 1,02–1,51). Both APOE status and odor identification ability acted as moderators, as in subsequent analyses, significant associations persisted only for APOE-ε4 carriers, and low performers on the SOIT.

CONCLUSIONS: Locally emitted PM2.5 was associated with an increased risk of dementia in this moderately polluted setting. APOE-ε4 carriers, and those with below average odor identification ability were particularly vulnerable.

KEYWORDS: Air pollution, Alzheimer's disease, vascular dementia, apolipoprotein E, olfaction.

O-OP-168 Association between ambient air pollution exposure and plasma β-amyloid levels in the French Three-City study : preliminary results

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BACKGROUND AND AIM: Existing research suggests an association between air pollution exposure and Alzheimer's Disease (AD). However, underlying biological mechanisms are still unknown. We aimed to evaluate if air pollution exposure was associated with plasma β-amyloid (Aβ) levels.

METHODS: We selected 287 participants of the Three-City study who were cognitively unimpaired at 12-year follow-up. Aβ levels were measured on plasma samples stored at baseline and at 10 years (INNO-BIA plasma Aβ forms kits (Innogenetics)). Land-use regression models were used to estimate fine particulate matter (PM2.5), nitrogen dioxide (NO2) and black carbon (BC) exposure at participants' residential address over the 5-year preceding the baseline visit. Linear regression was performed to assess the association of each pollutant with plasma Aβ levels at baseline and with their evolution over time.

RESULTS: Participants' median age at baseline was 68.8 (IQR: 5.1), and 56.1% were women. Median levels (IQR) of plasma Aβ at baseline were 158.8 (37.5) pg/mL for Aβ1-40 and 41.4 (11.9) pg/mL for Aβ1-42. Median Aβ1-42/Aβ1-40 ratio was 0.255 (IQR: 0.065). We found that exposure to the three air pollutants was associated with decreased Aβ1-42/Aβ1-40 ratio at baseline. for instance, an IQR increase in PM2.5 (1.8 µg/m3) was associated with a 0.0119 decrease in the Aβ ratio (95% CI: -0.0209; -0.0029). There were no significant associations between air pollutants and Aβ evolution over time.

CONCLUSIONS: In our cognitively unimpaired population, exposure to air pollution was associated with decreased plasma Aβ ratio at baseline. These results seem to corroborate previous ones on air pollution detrimental effect on cognition, as a decreased plasma Aβ ratio may predict AD. Further longitudinal studies using cutting edge methods to quantify plasmatic Aβ levels and brain Aβ deposits are still needed to better understand the influence of air pollution on the neuropathological process in AD.

KEYWORDS: Air pollution, Alzheimer's Disease, Biomarkers

O-OP-169 Associations of particulate matter exposures with brain cortical thickness and white matter hyperintensities: effect modification by c-reactive protein

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BACKGROUND AND AIM: Numerous studies have shown the effect of particulate matter exposure on brain imaging markers. However, little evidence exists about whether the effect differs by the level of systemic inflammation, a mechanism of neurotoxicity of particulate matter. We investigated whether the level of c-reactive protein (CRP; a marker of systemic inflammation) modifies the associations of particulate matter exposures with brain cortical thickness and white matter hyperintensities (WMH).

METHODS: Adults with no dementia or stroke were recruited. Concentrations of particulate matter ≤10 μm in diameter (PM10) and ≤2.5 μm (PM2.5) at each participant's home address were estimated. Mean cortical thickness (n=874) and WMH volumes (n=397) were estimated from brain magnetic resonance images. We built generalized linear and logistic regression models for mean cortical thickness and WMH volumes (higher versus lower than median), respectively. Significance of the CRP group (higher versus lower than median) difference in the association was expressed as p for interaction.

RESULTS: Particulate matter exposures were significantly associated with a reduced mean cortical thickness only in the higher CRP group among men (p for interaction=0.012 for PM10 and 0.006 for PM2.5). A 10 μg/m3 increase in PM10 was associated with having higher volumes of total WMH (odds ratio, 1.67; 95% confidence interval, 1.01–2.76) and periventricular WMH (1.81; 1.10–2.98). A 1 μg/m3 increase in PM2.5 was associated with having a higher volume of periventricular WMH (odds ratio, 1.53; 95% confidence interval, 1.01–2.33). These associations did not significantly differ by the level of CRP.

CONCLUSIONS: Particulate matter exposures were associated with a reduced mean cortical thickness in men with a high level of systemic inflammation. Particulate matter exposures were associated with having a high volume of WMH, with no evidence of effect modification by the level of systemic inflammation.

KEYWORDS: air pollution; neuroimaging; inflammation

ORAL PRESENTATIONS SESSION 32: Health consequences of meteorological events and precipitation

O-OP-170 The influence of rainfall measurement on the associations between rainfall and acute gastro-intestinal illness in North Carolina

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BACKGROUND AND AIM: Climate change and extreme weather are predicted to have a significant impact on diarrheal diseases. However, rainfall depends on local conditions and studies use varied measurements (e.g., absolute rainfall, heavy rainfall, or antecedent conditions) to define exposures. We systematically explored the influence of different rainfall measures on the association between acute gastrointestinal illness (AGI) and rainfall in North Carolina.

METHODS: Common measures of rainfall were derived from recent studies (e.g., absolute rainfall (mm); heavy rainfall (90th, 95th, 99th percentile) and constructed from PRISM gridded daily weather data spatially aggregated to the ZIP code level. Rate ratios between rainfall (lagged 0-7 days) and AGI were estimated using quasi-Poisson time series models. All-cause AGI was defined by the daily emergency department (ED) visits per ZIP code using ICD-9 diagnosis codes from North Carolina's syndromic surveillance system (2008-2015). Unadjusted and adjusted (for mean temperature and relative humidity) model estimates and goodness-of-fit measures were compared across rainfall measures.

RESULTS: Between 2008-2015, there were 1.07M ZIP code-days with at least one ED visits for all-cause AGI per ZIP code per day in North Carolina. Adjusting for lagged mean temperature and relative humidity, we observed a 4.2% increase (RR=1.035; 95% CI: 1.029-1.040) and 5.1% (1.051; 1.035-1.067) in AGI ED visits respectively following lagged 90th and 99th percentile rainfall (1 day lag), with similar patterns for lags 2-7. By contrast, a 0.1% change in AGI ED visits was associated with a 1 mm increase in rainfall depending on the lag (e.g., lag 1: 1.001-1.001, 1.002 vs. lag 7: 0.999; 0.999-1.000).

CONCLUSIONS: Heavy rainfall was associated with an increase in AGI rates, but absolute rainfall had a much smaller and ambiguous effect. These results suggest the importance of rainfall measurement and adjustment for other weather variables.

KEYWORDS: diarrhea, rainfall, weather, climate, time series, exposure measurement

O-OP-171 Exploring the association between precipitation and mental health hospitalizations in Switzerland

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BACKGROUND AND AIM: While several studies proved the relationship between temperature and mental health, limited evidence exists on the effect of other weather factors, such as precipitation. The aim of this study was to assess the impact of precipitation on mental disorders in Switzerland between 2009–2019.

METHODS: Daily hospitalizations between 2009–2019 were obtained from Switzerland's Federal Office of Statistics. Daily precipitation was taken from 2km gridded maps developed by MeteoSwiss. We conducted aggregated case-crossover analysis with a conditional quasi-Poisson regression to assess the association up to 7 days after the exposure. We considered daily precipitation in millimeters (mm), and persistent extreme precipitation events (PEP90.2) when daily precipitation exceeded the 90th percentile for more than 2 days. The analysis was conducted separately in eight Swiss main cities (Basel, Bern, Geneva, Lausanne, Lugano, Luzern, St. Gallen, and Zurich) and stratified by sex, age (<65years, ≥65years), and group of diagnosis (ICD-10). Models were adjusted by daily mean temperature.

RESULTS: The total number of hospital admissions included in the study was 147,768. On average, the risk of hospitalization increased by 38% (95%CI:1.30-1.46) for every 10mm increase in daily precipitation and by 52% (95%CI:1.33-1.74) for PEP90.2 events. Larger risks were found in males (1.67;95%CI:1.42-1.96, vs 1.38; 95%CI:1.17-1.63 in females) and under 65 years old (1.53;95CI:1.33-1.77 vs 1.45;95%CI:1.17-1.80 in ≥65years) for PEP90.2 events. By sub-diagnosis categories, larger risks were found for adult personality disorders (F60-F69) in daily precipitation (1.61;95%CI:1.42-1.83) and PEP90.2 (1.94;95%CI:1.34-2.80), while no evidence was found for developmental disorders (F80-F98) and similar risks to the average in the remaining groups. We observed a positive association in all cities with higher risks in Luzern for daily precipitation (1.68; 95%CI:1.43-1.97) and PEP90.2 (2.22; 95%CI:1.33-3.69).

CONCLUSIONS: Our findings suggest that extreme precipitation events could have adverse impacts on mental health in Switzerland.

KEYWORDS: Precipitation; Climate change; Mental health

O-OP-172 Sex and Age Characteristics of Thunderstorm Asthma Emergency Department Visits in a Midwest Metropolitan Environment (2007-2018)

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BACKGROUND AND AIM: Severe asthma has been shown to occur in the combined presence of high pollen and thunderstorm conditions, also known as 'thunderstorm asthma.' Studied as severe epidemic events, recent work has explored less dramatic, but more persistent chronic occurrences. We explore thunderstorm asthma-related emergency department (ED) visits in the Minneapolis-St. Paul region and evaluate unknown risk differences by sex and age groups.

METHODS: We define a thunderstorm asthma exposure event as daily occurrence of 2 or more lightning strikes during high pollen periods. We use daily counts of asthma-related ED visits from the Minnesota Hospital Association (2007-2018). We estimate relative and absolute risk of severe asthma during thunderstorm asthma events for the full population and sex and age subgroups.

RESULTS: The overall population had a 1.055 (95% CI: 1.019, 1.093) relative risk of asthma-related ED visits during thunderstorm asthma conditions. We observe a greater relative risk on the day of the exposure for males (RR 1.07; 95% CI: 1.02, 1.12) compared to females (RR 1.04; 95% CI: 1.00, 1.09), and observed age 18-44 years and 45 and up to be most vulnerable. Children have no significant increase in ED visits during thunderstorm asthma events. Absolute risk counts show similar patterns to these age and sex results, but age-sex subgroups show more variation in absolute vs relative risk for males compared to females.

CONCLUSIONS: Our results support an association between ED visits and thunderstorm asthma, and provide evidence of varying risk by sex across the life course. Thunderstorm asthma shows a unique pattern where middle-aged males and older females show the greatest risk, unlike baseline asthma incidence that is greatest in male children and middle-aged females. These patterns have implications for unrecognized at-risk groups and provide clinical information for this unique asthma exposure.

KEYWORDS: Climate change, thunderstorm asthma, pollen, ED visits

O-OP-173 Dust Storms and Respiratory Emergency Department Visits in the Southwestern United States

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BACKGROUND AND AIM: Climate change is projected to increase the risk of dust storms, particularly in the southwestern US. Research on dust storm impacts is hindered by challenges in dust storm identification. This study assesses the potential link between dust storms and respiratory-related emergency department (ED) visits in the southwestern US.

METHODS: We acquired data for 2005-2016 from IMPROVE (Interagency Monitoring of PROtected Environments) monitoring sites in California (n=2), Arizona (n=5), Nevada (n=2), and Utah (n=1). Applying a validated algorithm that identifies dust events of natural origin, dust storm days at each IMPROVE site were identified. We acquired patient-level ED visit data from state agencies and selected visits for respiratory diseases, asthma, and chronic obstructive pulmonary disease (COPD) among patients residing within 50 km of a monitoring site. Using a case-crossover design, we estimated associations of ED visits and dust storms, controlling for meteorology, ozone, and holidays.

RESULTS: During 2005-2016, 37 dust storm days occurred at the 10 IMPROVE sites. Mean PM10 and PM2.5 levels were 3-6 times greater on dust compared to non-dust storm days. We observed associations of respiratory ED visits and dust storms, with strongest associations at lag 3 [odds ratio of 1.049 (95% confidence interval: 1.002-1.098)]. Results were driven by Arizona, with an odds ratio for respiratory ED visits of 1.068 (95% confidence interval: 1.008-1.133). Associations for asthma were similar, although with larger uncertainty given fewer ED visits. Associations for COPD were consistent with the null.

CONCLUSIONS: Using a monitoring-based exposure metric, we observed associations among respiratory ED visits and dust storms. The results add to growing evidence of the health threat posed by dust storms. The dust storm metric was limited by lack of daily monitoring data; future research will incorporate satellite and models for enhanced dust storm characterization.

KEYWORDS: Climate, Dust, PM, Morbidity

O-OP-174 Risk of preterm birth associated with heat: a multi-country multi-city analysis

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BACKGROUND AND AIM: Recent studies have suggested that heat may trigger preterm birth (PTB), which is assumed a risk for infant mortality and childhood and adult health. However, evidence is still limited. Our objective was to investigate the short-term association between the exposure to heat during the last days of pregnancy and the risk of PTB in multiple locations from different geoclimatic zones.

METHODS: The analysis was restricted to all singleton births born in the warm season (5 hottest months) in 106 locations across 7 countries included in the MCC network, Canada(19 cities), Ecuador(2), Estonian(4), Japan(47), Paraguay(1), Switzerland(16) and Spain(51), between 1979-2015. A two-stage design was applied with first conditional quasi-Poisson regression with distributed lag nonlinear models to estimate the association between daily mean temperature (lags 0-4) and PTB in each location. A multivariate meta-analytic model was then fitted to pool individual estimates at the country level.

RESULTS: Daily mean temperature ranged from 6ºC (Estonian) to 26ºC (Ecuador). The PTB percentage ranged from 3.8% (Thurgau, Switzerland) to 11.2% (Asunción, Paraguay). Overall, the PTB risk increased by 10% (95% CI: 6.6-13.5) for moderate heat (95th centile of temperature), and by 11.3% (8-14.7) for extreme heat (99th centile) compared to the minimum risk temperature (1th centile). Robust increases were found in all countries except Ecuador. The lowest heat-related PTB risk was found in Switzerland (6% (1.5-10.6) and 5.5% (0.4-10.8) for moderate and extreme heat, respectively), whereas the highest risk was found in Estonian (18% (8.3-28.5) and 23.3% (12.2-35.4)).

CONCLUSIONS: Our preliminary findings support previous findings suggesting that hot temperatures may be a serious threat for perinatal health. This is the first study of its kind at a word-wide scale. Ongoing analyses on a broader set of locations within the MCC network will contribute to complete the picture.

KEYWORDS: Temperature, heat, pregnancy outcomes, Risk assessment

ORAL PRESENTATIONS SESSION 33: Air pollution and emerging health outcomes

O-OP-175 A cohort study of the multi-pollutant effects of PM2.5, NO2, and O3 on C-reactive protein levels during pregnancy

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BACKGROUND AND AIM: Individual air pollutants and green space are associated with inflammation in pregnancy, but their combined effects are not well understood. Our objective was to study the multipollutant effects of PM2.5, NO2, and O3 on C-reactive protein (CRP) levels in maternal blood (a marker of inflammation implicated in adverse pregnancy outcomes).

METHODS: We analyzed data collected from 1,170 pregnant Canadian women enrolled in the MIREC Study. Maternal blood concentrations of CRP were measured in the third trimester. Residentially-based ambient concentrations of PM2.5, NO2, and O3 during the 14 days prior to blood draw were estimated using satellite-derived concentrations and land use regression models. Green space was measured using the Normalized Difference Vegetative Index (NDVI). We fit multipollutant linear regression models using 14-day average estimates of PM2.5, NO2, and O3. We also evaluated the effects of pollutant mixtures using Weighted Quantile Sum Regression (WQSR), and by calculating the Air Quality Health Index (AQHI), a Canadian risk communication tool that derives a weighted average of the pollutants.

RESULTS: In multipollutant models that included NO2 and O3, each interquartile range (IQR) increase in 14-day average PM2.5 (IQR: 6.9 µg/m3) was associated with 27.1% (95% CI: 6.2, 50.7) higher CRP concentrations. In air pollution mixture models, each IQR increase in AQHI was associated with 37.7% (95% CI: 13.9, 66.5) higher CRP levels; and an IQR increase in the WQSR was associated with 78.6% (95% CI: 29.7, 146.0) higher CRP levels. Associations between air pollution and CRP were not confounded or modified by NDVI.

CONCLUSIONS: We provide evidence for stronger effects of the combined mixture of PM2.5, NO2, and O3 on inflammation levels during pregnancy compared with individual pollutants. This research emphasizes the importance of examining multipollutant analyses in future investigations.

KEYWORDS: PM2.5, NO2, O3, green space, C-reactive protein, pregnancy

O-OP-176 Association between environmental air pollution and olfactory functioning among Italian adolescents and young adults in Northern Italy

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BACKGROUND AND AIM: Olfaction is a critical physiological process with various functions in humans and olfactory impairments are associated with neurodegenerative disease and decreased quality of life. Olfactory receptors are in direct contact to ambient air, and thus, olfactory function is uniquely vulnerable to airborne pollutants. Here, we investigate associations between ambient air pollutant exposure and olfactory function in adolescents and young adults in the province of Brescia, Italy.

METHODS: This study included 207 subjects (52.7% female, 15-25 years) enrolled in the ongoing longitudinal Public Health Impact of Metals Exposure (PHIME) study. All participants completed a baseline (2008-2014) and follow-up (2017-2021) olfactory performance assessment using the "Sniffin' Sticks", a psychophysical test to assess odor threshold, discrimination and identification. Spatial annual average concentrations of particulate matter (PM) PM10, PM2.5 and nitrogen dioxide (NO2) were estimated for the target area between 2016-2019 on a 4 x 4 km2 spatial resolution grid by means of the Chemical Transport Model ARIA Regional. We applied multivariable beta regression models to test for associations between each pollutant and olfactory functions.

RESULTS: All air pollution annual average values were below European air quality standards (mean +/- SD □g/m3 PM2.5 = 18.4 +/- 5.1; PM10 = 21.0 +/- 5.3; NO2 = 32.1 +/- 9.8). We observed a significant negative association between NO2 and olfactory threshold score; a 14% decrement (approximately 2 score points) for each 10 unit increase in NO2 (p = 0.042), adjusting for age, sex, Sniffin' identification baseline score, having a cold and/or allergic rhinitis, IQ and passive smoking exposure.

CONCLUSIONS: These results suggest increased NO2 exposure is associated with reduced olfactory function in these Italian adolescents and young adults. The identification of risk factors for olfactory functions can help prevent reduced quality of life and improve recovery.

KEYWORDS: Olfactory functions; air pollution; NO2; PM2.5; PM10

O-OP-177 Air pollution, telomere length, and related health outcomes in the UK Biobank Cohort

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BACKGROUND AND AIM: Ambient air pollution (AP) has been associated with shorter telomere length (TL), which is a hallmark of biological aging and may lead to respiratory and cardiovascular disease, and lung cancer. We investigated the association between AP and TL and associated health outcomes.

METHODS: Data was from the UK Biobank (n=412,575). Participants aged 40 to 70 were recruited from 2006-2010. Baseline leukocyte TL was measured as T/S ratio. Residential AP estimates from 2010 included annual means of NO2, PM10, and PM2.5 in µg/m3. AP levels were associated with TL using linear regression models. Logistic regression models were used to link AP or TL to incident coronary artery disease (CAD) (n=26,345 cases) and lung cancer (n=4,079 cases) through 2021. Covariates included age, sex, ethnicity, education, Townsend deprivation index, BMI, smoking status, alcohol intake, physical activity, and greenspace (1000m buffer).

RESULTS: We confirmed that longer TL was associated with reduced risk of incident CAD (OR=0.95 per SD increase in TL, p=1.51×10-15) but increased risk of incident lung cancer (OR=1.05 per SD increase in TL, p=0.003). Higher NO2 or PM2.5 was significantly associated with shorter TL (β=-0.021, -0.020, 0.002 SD comparing NO2 in (20, 30], (30, 40], >40 to NO2≤20, overall p=4×10-6; β=-0.010 SD comparing PM2.5>10 to PM2.5≤10, p=0.012). Both also were associated with increased risk of CAD (OR=1.11, 1.11, 1.09 comparing NO2 in (20, 30], (30, 40], >40 to NO2≤20, overall p=1.3×10-5; OR=1.04 comparing PM2.5 >10 to PM2.5≤10, p=0.027) but not risk of lung cancer. In contrast, PM10 was not associated with TL, incident CAD or lung cancer.

CONCLUSIONS: NO2 or PM2.5 concentrations were associated with shorter TL and risk of CAD. TL may play a mediation role in the relationship between AP and CAD.

KEYWORDS: coronary artery disease, lung cancer, NO2, PM10, PM2.5

O-OP-178 Association of air pollution with incidence of end stage renal disease in two European cohorts and effect modification by chronic conditions

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BACKGROUND AND AIM: End-stage kidney disease (ESKD) poses a high burden on patients and the health system. While studies indicating associations of air pollution with chronic kidney disease are accumulating, studies on ESKD are still scant. We investigate the association of long-term exposure to nitrogen dioxide (NO_2), fine particulate matter ($PM_{2.5}$) and black carbon (BC) with ESKD in two large population-based European cohorts.

METHODS: Individuals in the Rome Longitudinal Study (RoLS) and the Vorarlberg Health Monitoring and Prevention Program (VHM&PP) were followed up with Dialysis and Transplant Registries from 1985 to 2019 and 2011 to 2019, respectively.
Long-term exposures to NO_2, $PM_{2.5}$ and BC were approximated by concentration at residence determined with Europe-wide hybrid land use regression models at 100x100m scale.
Hazard ratios (HR) were determined from Cox-proportional hazard models with age as time axis and adjusted for individual and neighbourhood confounders; effect modification by various factors was tested.

RESULTS: RoLS contributed 3,231 cases from 1,939,461 individuals (mean age 52.4 years; crude incidence rate (CIR) 0.22 per 1,000 person years) and VHM&PP 501 cases from 136,823 individuals (mean age 42.1 years; CIR 0.14).
In RoLS, ESKD was significantly associated with $PM_{2.5}$ In RoLS (HR 1.37 [1.06, 1.76] for an increase of 5 $\mu g/m^3$) whereas in VHM&PP, ESKD was associated with BC (HR 1.17 [0.98,1.39] for 0.5*10-5m-1), and NO_2 (HR 1.14 [0.96,1.35] for 10 $\mu g/m^3$).
Statistically significant effect modification was found in RoLS for all pollutants with higher HRs in diabetic and hypertensive subjects. for example, comparing non-diabetics and diabetics, respectively, the HRs for $PM_{2.5}$ was 1.24 (0.96,1.60) vs 1.86 (1.44,2.40) in RoLS.

CONCLUSIONS: Air pollution was associated with ESKD in both cohorts and in Rome may possibly be a potent trigger for ESKD in persons with chronic conditions.

O-OP-179 Medium- and Long-Term PM2.5 Exposures and Sudden Cardiac Death in a Prospective Cohort of US Women

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BACKGROUND AND AIM: Previous studies have reported associations between short-term exposure to fine particulate matter (PM2.5) and acute cardiac events. However, the effect of long-term exposure to PM2.5 on the risk of sudden cardiac death (SCD) is unknown. We prospectively examined associations between medium- and long-term exposures to PM2.5 and incidence of SCD in the Nurses' Health Study (NHS) cohort, a nationwide prospective cohort of female nurses in the US.

METHODS: Women in NHS (N=117,358) were followed via biennial questionnaires. Spatiotemportal prediction models were used to estimate monthly time-varying, residential exposure to PM2.5. To enable examination of different time windows of exposure simultaneously, given the high correlation between time windows, we calculated cumulative average PM2.5, the difference between the cumulative average and 12-month moving average, the difference between the 12- and 3-month moving averages, and the difference between the 3- and 1-month moving averages. Confirmed SCD cases 1988-2013 were identified by medical records and next-of-kin reports. We used time-varying Cox proportional hazards models adjusted for preexisting conditions, demographics, socioeconomic status, region, and season to calculate hazard ratios (HR) and 95% confidence intervals (CI) for each exposure time window (in separate and co-adjusted models). We explored deviations from linearity with cubic splines.

RESULTS: During 2,070,412 person-years of the study, there were 320 confirmed SCDs. There was no evidence of deviations from linearity, therefore we present HRs from continuous models per 10μg/m3 increase in each of the time windows of PM2.5. In multivariable adjusted models, only the difference in exposures between the 12- and 3- month moving averages was associated with risk of SCD (HR=1.06; 95%CI: 1.00, 1.12).

CONCLUSIONS: The results of the study suggest an association between medium-term PM2.5 exposure and SCD, suggesting that seasonal exposures may be an important time window of susceptibility.

KEYWORDS: Particulate matter, air pollution, sudden death

O-OP-180 Metal Constituents of Fine Particulate Matter Mass and Incident Depression: A Community-based Cohort Study in China

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BACKGROUND AND AIM: Little is known about the effects of chemical constituents of fine particulate matter (particles with aerodynamic diameter ≤ 2.5 μm, PM2.5). This study aims to estimate the associations between constituents of PM2.5 and incident depression.

METHODS: This large cohort study recruited the local adults in Ningbo, a southeastern coastal city in China. Depression cases were ascertained from local Health Information System. Daily PM2.5 samples were collected at seven monitoring sites for the 10th-16th seven consecutive days and further measured for ten PM2.5-bound metals. Land-use regression models were conducted to predict the residential PM2.5-bound metals exposure. We conducted three cox proportional hazards models which respectively employed single constituent, constituent adjusting for PM2.5 and constituent residual calculated by PM2.5 as exposures to estimate the effect of constituents on incident depression. Environmental Risk Score (ERS) and Weighted Quintile Score (WQS) were utilized to estimate the overall effect of all metals.

RESULTS: In fully adjusted constituent models, the higher concentrations of ambient Lead(Pb), Nickel(Ni), Mercury(Hg), Chromium(Cd) and Beryllium(Be) were significantly associated with higher risk of incident depression. In ERS analyses, one main effect (Tl), three squared terms (Hg, Cd and Al) and twelve pairwise interactions (Tl & Pb, Tl & Be, et al) were selected by adaptive elastic-net (AENET) for construction of ERS of incident depression-related ambient metal mixtures. The ERS index was positively and significantly associated with depression incidence. and similar results were found for WQS index which suggesting that Al, Sb, Hg, Tl, Mn and Be contributed the most to the association.

CONCLUISIONS: These findings highlighted the associations of exposure to PM2.5-bound metals with incident depression. Further studies are needed to confirm the findings and examine the underlying mechanisms.

KEYWORDS: PM2.5-bound Metal, depression, Cox Proportional Hazardous Regression, ERS, WQS.

ORAL PRESENTATIONS SESSION 34: Exposure to chemicals and adverse health outcomes

O-OP-181 Exposure To Perfluoroalkyl Substances and Risk of Hepatocellular Carcinoma In The Multiethnic Cohort

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BACKGROUND AND AIM: Exposure to per- and polyfluoroalkyl substances (PFAS), a class of persistent organic pollutants, is ubiquitous. Animal studies suggest that PFAS may increase risk of fatty liver and hepatocellular carcinoma (HCC) via impacts on hepatic lipid, amino acid, and glucose metabolism, but human data are lacking. We examined associations of PFAS exposure, altered metabolic pathways, and risk of non-viral HCC.

METHODS: In this nested case-control study, prediagnostic plasma PFAS and metabolomics were measured in 50 incident HCC cases and 50 individually matched controls from the Multiethnic Cohort Study (MEC). Cases and controls were matched by age, sex, race, and study area. PFAS exposure and risk of HCC were examined using conditional logistic regression. A metabolome wide association study and pathway enrichment analysis was performed for PFAS exposure and HCC risk, and key metabolites/metabolic pathways were identified using a meet in the middle approach.

RESULTS: High perfluorooctane sulfonic acid (PFOS) levels (90th percentile from NHANES>55 µg/L) were associated with more than 4 fold increased risk of HCC (OR=4.5; 95% CI: 1.2-16.0). The pathway enrichment analysis showed that PFOS exposure was associated with alterations in amino acid and glycan biosynthesis pathways, which were in turn associated with HCC risk. We identified four metabolites linking PFOS exposure with HCC, including glucose, butyric acid (a short chain fatty acid), α-Ketoisovaleric acid (a branched-chain α-keto acid), and 7alpha-Hydroxy-3-oxo-4-cholestenoate (a bile acid), each of which was positively associated with PFOS exposure and risk of HCC.

CONCLUSIONS: Exposure to high levels of PFOS was associated with increased risk of HCC, and the likely mechanisms were via alterations in glucose, amino acid, and bile acid metabolism. Larger studies are warranted to confirm these findings.

KEYWORDS: Chemical exposure, exposome, perfluorinated alkyl substance, hepatocellular carcinoma, metabolome, bile acid, metabolic pathway

O-OP-182 Metabolic changes associated with polybrominated biphenyls and polychlorinated biphenyls in the Michigan PBB registry

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BACKGROUND AND AIM: Polybrominated Biphenyls (PBBs) and Polychlorinated Biphenyls (PCBs) are endocrine-disrupting chemicals (EDCs). In Michigan, people were exposed to PBBs during a time-limited contamination event in the 1970s and are continuously exposed to PCBs. Using high-resolution metabolomics (HRM), this study aimed to identify biological mechanisms underlying human health effects of PBB and PCB exposure.

METHODS: HRM profiling was conducted on serum samples from the Michigan PBB Registry collected from a subset of 500 individuals representing both F0 (directly exposed to PBB) and F1 (exposed through parents) generations from 2011 to 2014. This study measured PBB-153 stratified by generation and ΣPCB (PCB-118, PCB-138, PCB-153, and PCB-180) in the total combined subset (as all experienced direct PCB exposure). Metabolite and metabolic pathway perturbation were evaluated using an untargeted HRM workflow.

RESULTS: Both exposure measures had high detection levels. Mean levels were 1.75-ng/mL (SD: 13.9) for PBB-153 and 1.04-ng/mL (SD: 0.788) for ΣPCBs. 124 and 86 metabolomic features were significantly associated with PBB-153 in F0 and F1 ($p<0.005$), respectively. There were 2,861 features associated with ΣPCB (FDR corrected $p<0.2$). Pathway enrichment analysis revealed perturbations associated with ΣPCB in numerous oxidative stress and inflammation pathways (e.g., carnitine shuttle, glycosphingolipid, and vitamin B9 metabolism). Perturbations associated with PBB-153 in F0 were related to oxidative stress pathways (e.g., pentose phosphate and vitamin C metabolism) and in F1 were related to energy production (e.g., pyrimidine, aminosugars, and lysine metabolism). Authentic chemical standards were used to confirm the chemical identity of 29 metabolites associated with ΣPCB levels and 10 metabolites associated with PBB-153 levels.

CONCLUSIONS: Our results demonstrated that serum PBB-153 and ΣPCB levels were associated with perturbations in inflammation and oxidative stress-related pathways, which differed when stratified by generation. These findings support future investigations of molecular mechanisms underlying PBB and PCB exposure on health, emphasizing exposure timing.

O-OP-183 Relations between concentrations of perfluoroalkyl substances (PFAS) in drinking water and serum in adults living near PFAS hotspots

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BACKGROUND & AIM: Contaminated drinking water (DW) is a major source of exposure to per- and polyfluoroalkyl substances (PFAS) at locations around PFAS production facilities, airports and air force bases with extensive use of firefighting foam. We investigated quantitative relations between concentrations in DW and serum of nine perfluorinated alkyl acids (PFAAs), a very persistent PFAS subgroup, in Swedish adult populations living near PFAS hotspots.

METHODS: We established a data set that consisted of paired concentration measurements in DW and serum from 261 subjects in four areas receiving PFAA-contaminated DW and from 137 subjects living in an area with non-contaminated DW. The relations between PFAAs in DW and serum were examined using linear regression analysis. The regression equations enabled us to derive (i) PFAA serum concentrations due to background exposure from sources other than the local DW (e.g. food, dust and textiles), (ii) population-mean PFAA serum-water ratios (SWR) and (iii) PFAA concentrations in DW causing serum PFAA concentrations significantly elevated above background (DWES).

RESULTS: PFAA concentrations in DW varied widely (2.5-1790 ng/L for ΣPFAA). The estimated mean background serum concentrations ranged from below 0.1 ng/mL (PFPeA, PFHpA, PFBS) to 5.2 ng/mL (PFOS). The increases in serum PFAA with increasing concentration in DW were statistically significant for all PFAAs except PFPeA and PFDA. SWR estimates were <10 for short-chained PFAAs and >30 for long-chained PFAAs. Calculated DWES ranged between 18 ng/L (PFOA) and 178 ng/L (PFHxA).

CONCLUSIONS: Health risks from PFAAs are related to the body burden, reflected by their concentration in serum. for population exposure assessment, it is easier and less expensive to measure PFAA concentrations in drinking water and the relationships derived herein should be helpful in the risk assessment and risk management of PFAA in drinking water.

KEYWORDS: drinking water, perfluoroalkyl substances, human biomonitoring

O-OP-184 Exposure of the Portuguese population to metals and metalloids: results from a national study

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Metals and metalloids are elements present in the environment that can originate from natural and anthropogenic sources. However, exposure to some of these elements can cause adverse health effects due to their toxicological potential. As such, it is important to assess their levels in the human body, which can be done through human biomonitoring. Several studies assessed these elements' levels in the Portuguese population, but were mainly focused on hotspots or specific groups. As such, the aim of this work was to assess the exposure to metals and metalloids in the Portuguese population using samples collected in the study "Exposure of the Portuguese Population to Environmental Chemicals: a study nested in INSEF 2015" (INSEF-ExpoQuim).
INSEF-ExpoQuim was an epidemiologic study including 297 participants aged 28-39 years, living in Portugal for ≥ 12 months and able to follow an interview in Portuguese. Fieldwork was developed between June 2019 and February 2020 following the guidelines of the HBM4EU project. First morning urine samples were collected along with data on sociodemographic characteristics, living conditions and residential history, habits/lifestyle, nutrition, health, occupation and substance specific information. Total concentrations of arsenic (As), lead (Pb), cobalt (Co), copper (Cu), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se) and zinc (Zn) were determined by inductively coupled plasma mass spectrometry.
As, Cu, Mo, Se and Zn were detected in the majority of the samples analysed, while Mn was detected in around half and Pb, Co and Ni were detected in less than half. Results will be presented, including a description of the biomarkers' levels in the Portuguese population.
This study is the first developed in Portugal to provide an assessment of the exposure at a national level and its results may support the development and implementation of policy measures aimed at minimizing exposure and improving the population's health.

O-OP-185 Occupational exposure and asbestos related disease in Brazil, 2007 to 2021

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Occupational asbestos exposure is a major public health problem, resulting in more than 222.000 deaths per year globally and several socioeconomic impacts. Brazil is historically one of the world's largest producer and consumer of asbestos, which is mainly used in cement and mining activities. This work describes the notifications of work-related diseases of individuals exposed to asbestos in Brazil.

METHODS: We gathered data on work-related asbestos' disease from the Notifiable Diseases Information System (Sinan) from 2007 to 2021, considering Pneumoconiosis and Cancer. Absolute and relative frequencies of sociodemographic and epidemiological characteristics were described.

RESULTS: From 2007 to 2021, 2,246 cases of work-related Pneumoconiosis and Cancer with asbestos exposure were registered. 2008 was the year with most records (n=625), followed by 2017 (n=511), with an annual average of 149 cases. Most cases occurred among male workers (96.0%), aged between 50-69y (64.5%), white (12.8%) or black (8.5%), with low educational level – up to 4 years (10.0%). Top five occupations were: workers from construction material facilities, (32,7%), urban construction (13,4%), metal handling facilities (4,3%), potters (4,2%) e masonry (3,2%). The State of São Paulo, where is located most of the companies that used asbestos in Brazil, and has relatively good surveillance of asbestos disease, concentrated 84.2% of all notified cases.

CONCLUSIONS: Despite the important underreporting of chronic diseases, there is a high burden of asbestos diseases in Brazil, mainly affecting elderly men (due to the disease's long latency) and less-skilled occupations. Thus, it is essential to strengthening public policies, health surveillance, and care, considering the particularities of asbestos-related diseases and territories.

O-OP-186 Addressing Commercial Determinants of Health in African Pesticide Research

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Pesticide research, particularly in low- and middle-income countries (LMICs) continues to identify exposure risks and why pesticide poisonings continue (e.g., poor surveillance, weak legislation, use of highly hazardous pesticides, high-risk use and application practices). Focus often is on highlighting specific pesticide products, exposure risk contexts and vulnerable populations, as well as behaviours of farmers, workers and consumers. What is, however, less often assessed in pesticide research is the impact of commercial determinants on health (CDoH), which is referred to as "strategies and approaches used by the private sector to promote products and choices that are detrimental to health", and the role of corporate capture. In this review, the aim was to identify the key components of CDoH impacting on health outcomes for populations, particularly in Southern Africa, exposed to pesticides. Five strategies of the pesticide industry were identified that result in exposure risks and negative health outcomes. These strategies and concepts include: the social responsibility approach (e.g., responsible and safe use), mis- and lack of information (e.g., confidential business information), corporate capture (e.g., revolving staff door with regulators), apportioning blame (e.g., "misuse"), and uncertainty science (e.g., products are innocent until proven guilty, corporate research funding). The findings and complexity of each of these strategies will be presented. The impact of epidemiological research for evidence policy making will continue to be undermined as long as the CDoH are not addressed along side research. It is recommended that researchers include an analysis of pesticide commercial determinants as part of epidemiological research and that environmental health curricula include training on commercial determinants of environmental health. Young pesticide researchers need guidance on navigating corporate research funding, conflicts of interest and the long-term impact on their careers. To reduce pesticide poisonings in LMICs, CDoH need to be identified and addressed by researchers.

Wednesday, September 21

ORAL PRESENTATIONS SESSION 35: Occupational exposures and respiratory outcomes

O-OP-187 Exposure Trends and Half-lives of Per- and Polyfluoroalkyl Substances (PFAS) in Australian Firefighters

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFASs) are persistent manmade compounds used in aqueous film forming foam (AFFF). The extensive use of AFFF has led to widespread environmental PFAS contamination and exposures to firefighters. The aim of this study is to determine PFAS blood serum concentration trends and apparent serum elimination half-lives in firefighters after the replacement of AFFF.

METHODS: Current and former employees of an Australian corporation providing aviation firefighting services, where AFFF had been used in the past, were recruited to participate in this study. Special focus was placed on re-recruiting participants who had provided blood samples five years prior. Participants were asked to provide a blood sample and complete a questionnaire. Serum samples were analysed for 40 different PFASs using HP LC-MS/MS.

RESULTS: A total of 799 participants provided blood samples. of these, 130 previously provided blood serum five years prior. Mean serum concentrations of perfluorooctane sulfonate (PFOS, 27 ng/mL), perfluoroheptane sulfonate (PFHpS, 1.7 ng/mL) and perfluorohexane sulfonate (PFHxS, 14 ng/mL) were significantly higher than the levels in the general Australian population. Serum concentrations were associated with the use of PFOS/PFHxS based AFFF. Participants who commenced service after the replacement of this foam had serum concentrations similar to those in the general Australian population. Average individual apparent half-lives were estimated to be 5.0 years (perfluorooctanoic acid (PFOA)), 7.8 years (PFHxS), 7.4 years (PFHpS) and 6.5 years (PFOS).

CONCLUSIONS: This study shows how workplace interventions such as replacement of AFFF, can benefit employees at risk of occupational exposure.

KEYWORDS: Biological Monitoring; Occupational Exposure; Firefighters; Follow-Up Studies; Half-Life

O-OP-188 Atrazine use and cancer risk within the Agricultural Health Study (AHS) cohort: An update

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In the United States, atrazine is a common agricultural herbicide. Few epidemiologic studies have evaluated cancer risks associated with this ubiquitous chemical. A previous analysis within the Agricultural Health Study (AHS) in 2011 found limited evidence of cancer risk based on 3,146 exposed cases. Here, we updated that analysis with additional follow-up time and exposure information.

Information about lifetime pesticide use was reported on questionnaires at enrollment (1993-1997) and follow-up (1999-2005). Among 53,508 pesticide applicators in Iowa (IA) and North Carolina (NC), there were 6,401 incident exposed cancer cases identified through linkage to state cancer registries through 2017 (IA) and 2014 (NC). We evaluated cumulative intensity-weighted lifetime days of atrazine use. Atrazine exposures were categorized into quartiles among users and compared to a non-exposed referent group. Poisson regression was applied to estimate rate ratios (RR) and 95% confidence intervals (CI) adjusting for age, smoking status and pack-years, alcohol use, family cancer history, and correlated pesticides. We also stratified by age at cancer diagnosis.

Approximately 71% of applicators reported ever using atrazine. Greater use of atrazine was associated with increased risk of cancers of the lung (RRQ4=1.21, CI=0.95-1.55, p-trend=0.19, n=551 cases), and prostate (RRQ4=1.12, CI=0.98-1.28, p-trend=0.10, n=2,521); the association was stronger for aggressive prostate cancer (RRQ4=1.37, CI=1.02-1.84, p-trend=0.07, n=553). The association with prostate cancer was most pronounced among those diagnosed <50 years of age (RRQ4=3.53, CI=1.34-9.29, p-interaction=0.012). Associations with lung cancer did not vary by age.

Our findings with an average of 8.5 years of additional follow-up and twice as many cases compared to a previous analysis, suggest increased risk of prostate and lung cancers is associated with atrazine use. The associations with prostate cancer were most notable among those diagnosed at younger ages and those with aggressive disease. Further work is needed to investigate the reasons for these observations.

O-OP-189 Pesticide exposure, genetic susceptibility, and prostate cancer risk in the Agricultural Health Study

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BACKGROUND AND AIM: Specific pesticides have been associated with risk of prostate cancer, but interactions with genetic susceptibility loci have rarely been studied. We examined the joint associations of pesticides and genetic variants with prostate cancer risk.

METHODS: We studied 1,162 cases (588 aggressive) and 2,206 frequency-matched controls nested in the Agricultural Health Study cohort. History of pesticide use was self-reported at enrollment. Genotyping was conducted using the OncoArray-500K BeadChip (Illumina Inc). Logistic regression models estimated the joint associations of pesticides previously linked to prostate cancer (fonofos, terbufos, malathion, aldrin, linuron, and dimethoate) and 256 individual genetic variants and an aggregated polygenic risk score (PRS) with risk of total and aggressive prostate cancer. Likelihood ratio tests assessed multiplicative interaction.

RESULTS: We observed multiplicative interaction between fonofos and the PRS in relation to risk of total and aggressive prostate cancer. Compared to the reference group (non-exposed, PRS scores <median), those with fonofos exposure and PRS scores >median had elevated risks of total (OR 1.35, 95% CI 1.06-1.73, p-int=0.03) and aggressive (OR 1.49, 95% CI 1.09-2.04, p-int=0.19) prostate cancer. There was also evidence of interaction between the six pesticides and individual genetic variants occurring in genomic regions associated with 1) cancer signaling pathways, 2) hormonal perturbations relevant for prostate cancer, 3) DNA damage response and 4) neurological traits; many of the examined pesticides have known neurologic mechanisms.

CONCLUSIONS: Joint exposure to the organophosphate insecticide fonofos and genetic susceptibility may further elevate the risk for total and aggressive prostate cancer, above the independent effects of each. These results, as well as those observed for individual genetic markers, suggest potential mechanisms by which these pesticides may increase prostate cancer risk.

KEYWORDS: Prostate Cancer, Pesticides, Occupational exposure, Genetic susceptibility

O-OP-190 Exploration of occupations as risk factors for lung cancer in hierarchical and penalization penalized regression models accounting for multiple known exposures

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BACKGROUND AND AIM: Traditional occupational epidemiological analysis typically emphasize on disease risks associated with specific single exposures or single occupations. We used hierarchical and regularization models to explore occupational risks at the job-title level associated with lung cancer while accounting for exposures to multiple known lung carcinogens.

METHODS: We pooled lung cancer case-control study subjects from 14 European and Canadian studies. Associations between ever employment in 1,288 five-digit ISCO-68 occupations and lung cancer were screened using two approaches: Bayesian hierarchical and LASSO penalized regressions. Both modeling approaches account for age, smoking, sex, study, and fully quantitative exposures to six known occupational lung carcinogens: asbestos, chromium, diesel engine exhaust, nickel, PAHs, and silica. False positive findings in the Bayesian hierarchical and LASSO models were controlled using horseshoe priors and stability selection, respectively. Lung cancer odds ratios for selected occupations were estimated using unconditional logistic regression model with identical covariates.

RESULTS: Our final analyses included 16,901 lung cancer cases and 20,965 controls. There were notable overlaps in jobs selected by the hierarchical and penalization modeling approaches. Occupations selected by both modeling approaches with positive associations with lung cancer after controlling for known exposures include carpenters (OR: 1.77; 95CI: 1.36, 2.33) and construction bricklayers (OR: 1.40; 95CI: 1.17, 1.67). Similarly selected occupations but with negative associations with lung cancer include secondary school teachers (OR: 0.36; 95CI: 0.23, 0.55), production managers (OR: 0.65; 95CI: 0.53, 0.79), and government executive officials (OR: 0.7; 95% CI: 0.61, 0.79).

CONCLUSIONS: We demonstrated viable agnostic approaches in identifying employment risk factors for lung cancer. Future work involves investigations of factors that contribute to the observed elevated or lower cancer risks, which may involve gaps in current exposure assessment and modeling framework, and/or exposures to other lung carcinogens yet to be elucidated.

O-OP-191 Lung Cancer Risk in Relation to Jobs Held in a Nationwide Case-Control Study in Iran

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BACKGROUND AND AIM: Globally, lung cancer is the most frequent occupational cancer, but the risk of lung cancer related to the occupations in Iran is not clear. We aimed to assess whether workers in various occupational groups would experience an increased lung cancer risk.

METHODS: We used the IROPICAN nationwide hospital-based case-control study including 658 incident lung cancer cases and 3477 controls. We assessed the risk of cancer in relation to ever working in major International Standard Classification of Occupations (ISCO-68) groups and specific jobs, while controlling for individual potential confounders including cigarette smoking and opium consumption.

RESULTS: We observed elevated odds ratio (OR) for lung cancer in male construction workers (OR=1.4; 95% confidence interval (CI), 1.0- 1.8), and petroleum industry workers (3.2; CI, 1.1- 9.8), and in female farmers (2.6; CI, 1.3- 5.3), and female bakers (5.5; CI, 1.0, 29.8). The positive trend has been observed for the duration of employment as a construction worker in men (p trend < 0.004), and farming in women (p trend < 0.5). Increase risk of squamous cell carcinoma (SCC) was associated with ever construction industry workers for males (1.9; CI, 1.2- 3.0), whilst both SCC and adenocarcinoma subtypes were associated with working as farmers for females (3.8; CI, 1.4- 9.9), even more pronounced for adenocarcinoma (4.3; CI, 1.1- 17.2).

CONCLUSIONS: Although we did observe association between some occupations and lung cancer, we recommend developing an occupational exposure assessment tool specific for working conditions in Iran to allow the study of specific occupational agents.

KEYWORDS: Occupational cancer, Lung cancer, Exposure, Carcinogen, Iran

O-OP-192 Study of Parental Occupational Exposures to Solvents and Risk of Autism Spectrum Disorder in Offspring

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BACKGROUND AND AIM: Solvents can accumulate in fat and later metabolize during pregnancy. Additionally, these toxicants could lead to germline mutations. We investigated associations between multiple parental occupational solvent exposures and odds of autism spectrum disorder (ASD) diagnosis in offspring.

METHODS: Using population-based data from the Danish National Patient Registry, we identified a subset of ASD cases from 1982 to 2016 and 1:100 sex and birth-year matched controls obtained from the Central Population Register. We determined parental occupation history from age 16 years through 6 months post-childbirth from the Danish Pension Fund and estimated cumulative benzene, methylcyclohexane, toluene, trichloroethylene, perchloroethylene, and 1,1,1-trichloroethane exposure for mothers and fathers based on job exposure matrices (JEMs). Conditional logistic regression was used to estimate adjusted odds ratios (aOR) and 95% confidence intervals (CI) for exposures one year prior to conception and during pregnancy.

RESULTS: In analysis of data from 1898 people with ASD and 141,702 without ASD, there were no observed associations between maternal solvent exposures during pregnancy and risk of ASD in offspring. However, analysis for maternal benzene exposure one year prior to conception revealed higher adjusted odds for those with any exposure (aOR=1.55; 95% CI 1.02, 2.37). Additionally, although there were no significant associations between paternal solvent exposures during pregnancy and ASD risk, there were significantly increased odds of ASD in offspring whose fathers were exposed to benzene (aOR=3.07; 95% CI 1.72, 5.46) and toluene (aOR=1.66; 95% CI 1.05, 2.62) one year before conception.

CONCLUSIONS: Although previous studies have suggested parental solvent exposure during pregnancy can contribute to pathogenesis of ASD, our findings suggest that risk may be increased through exposures prior to conception. However, unavoidable non-differential misclassification from the use of JEMs may have masked truly increased risk during pregnancy.

ORAL PRESENTATIONS SESSION 36: Air pollution: maternal and neonatal health

O-OP-193 Exposure to ambient fine particulate matter (PM2.5) from local sources during pregnancy may reduce birth weight: An administrative cohort study from southern Sweden

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INTRODUCTION: While prenatal exposure to air pollution has been shown to reduce birth weight, epidemiological studies where source-specific exposure data is available are still very few. The aim of the present study was to investigate the associations between source-specific exposure to ambient fine particulate matter (PM2.5) from different local sources during pregnancy and birth weight of the child.
MATERIALS AND

METHODS: We defined an administrative cohort using data on 40,245 singleton births in southern Sweden. Exposure to ambient PM2.5 at the residential address during pregnancy was modelled with 100 x 100 m spatial resolution. Concentrations of PM2.5 from all local sources (all-source PM2.5), tailpipe exhaust, vehicle wear-and-tear, and small-scale residential heating were investigated separately. The relationship between birth weight (continuous) and low birth weight (<2,500 grams) were analysed using linear and logistic regression, respectively, in crude and adjusted models.

RESULTS: There were associations between each local source of PM2.5 and birth weight as a continuous variable in the adjusted models. Birth weight decreased by an average of 34 grams (95% confidence interval, CI: 26–43) in association with a 1 μg/m3 increase in all-source PM2.5 in the adjusted models. Tailpipe exhaust seemed to have the greatest effect per 1 μg/m3 increase, with a mean reduction of 278 grams (95% CI: 207–349), followed by vehicle wear-and-tear: mean decrease of 106 grams (95% CI: 81–132). for small-scale residential heating, the corresponding decline was 36 grams on average (95% CI: 14–57). The only local source of PM2.5 associated with low birth weight (<2500 g) was small-scale residential heating, with an adjusted odds ratio (OR) of 1.50 (95% CI: 1.12–2.03).

CONCLUSIONS: Locally produced prenatal exposure to all-source PM2.5, tailpipe exhaust, vehicle wear-and-tear, as well as small-scale residential heating may all reduce newborns' birth weight.

O-OP-194 Air Pollution Exposure during Pregnancy and Childhood, APOE ε4 Status and Polygenic Risk Score for Alzheimer's Disease, and Brain Structural Morphology in Preadolescents

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BACKGROUND AND AIM: Air pollution exposure is associated with impaired neurodevelopment, altered structural brain morphology in children and neurodegenerative disorders. Differential susceptibility to air pollution may be influenced by genetic features. We aimed to evaluate whether the apolipoprotein E (APOE) genotype or the polygenic risk score (PRS) for Alzheimer's Disease (AD), modify the association between air pollution exposure during pregnancy and childhood and structural brain morphology in preadolescents.

METHODS: We included 1186 children from the Generation R Study. Concentrations of 14 air pollutants were calculated at the participants' home address during pregnancy and childhood using land-use-regression models. Structural brain images were collected at age 9–12 years to assess (sub)cortical brain volumes. APOE status and PRS for AD were examined as effect modifiers. We conducted single-pollutant analyses with a two-way interaction between air pollution and APOE status or PRS for AD and multi-pollutant analyses with the two-way interaction.

RESULTS: Higher pregnancy PMcoarse and childhood PAHs exposure was differentially associated with larger cerebral white matter volume in APOE ε4 carriers compared to non-carriers (29485 mm3 [95% CI 6189, 52781] and 18663 mm3 [469, 36856], respectively). Higher pregnancy PMcoarse exposure was differentially associated with larger cortical grey matter volume in children with higher compared to lower PRS for AD (19436 mm3 [825, 38046]).

CONCLUSIONS: APOE status and PRS for AD have a possible modifying effect on the association between air pollution exposure and brain structural morphology in preadolescents. Both seem to modify the association towards the typical development of the brain, with increasing cortical volumes, highlighting the possibility of the antagonistic pleiotropic effect (i.e., protective effect in early life but altered neurodegenerative processes in adulthood). Future studies should research this antagonistic pleiotropic effect and study trajectorial brain development using a longitudinal design.

KEYWORDS: environmental pollution, neurodevelopment, neuroimaging, genetic modifiers

O-OP-195 A population-based cohort study of traffic congestion and term birth weight using vehicle telematics data

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BACKGROUND AND AIM: Over 11 million Americans reside within 150 m of a major highway, an area of high air pollution exposure. Traffic congestion further contributes to this problem but has not been evaluated in epidemiological studies to-date. We hypothesize that degraded air quality due to traffic congestion will have an adverse impact on infant birth weight.

METHODS: Using a population-based birth cohort in 2015-2016 for the State of Texas, we limited our study population to addresses within 1,000 m of a road in this database. We calculated traffic congestion around each geocoded maternal address at delivery for 100 m, 300 m, and 500 m buffer distances. We leveraged novel congestion and vehicle volume measurement data from the Texas Most Congested Roads database, which contains measurements of traffic volume, delay, and emissions from connected vehicle and device data. We used linear regressions to evaluate the association between traffic congestion and term birth weight, adjusting for sociodemographic characteristics and vehicle volume.

RESULTS: Among 580,992 births, we find consistent negative associations between traffic congestion and term birth weight. We observed a 15.8 g reduction in term birth weight (95% CI: -20.5, -11.1) among the highest quintile of delay exposure at 500 m compared to births with no delay exposure in this buffer distance. Results are similar, though attenuated, for truck-specific congestion. When we calculate excess vehicle emissions from congestion, we observe a -17.6 g reduction in term birth weight (95% CI: -21.4, -13.9) when comparing the highest and lowest quintiles.

CONCLUSIONS: Our study provides important new evidence that traffic congestion is associated with adverse infant health outcomes, in addition to total traffic volumes on nearby roads. Therefore, programs to reduce traffic congestion may have positive co-benefits for infant health with respect to birth weight.

KEYWORDS: traffic-related air pollution, infant health, birth weight

O-OP-196 Geospatial determinants of maternal and child exposure to fine particulate matter in Kintampo, Ghana: Levels within the household and community, by building density and nearby roadways

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BACKGROUND AND AIM: Personal exposure to fine particulate matter ($PM_{2.5}$) from household air pollution is well-documented in Sub-Saharan Africa, but spatial patterns of exposure are poorly characterized. Our study aimed to evaluate personal exposure to $PM_{2.5}$ when within the household and community, and during typical hours of cooking, among mothers and children in rural communities near Kintampo, Ghana. We also explored other geographic determinants of exposure.

METHODS: Our study included 259 sessions of geolocated, gravimetrically-calibrated one-minute $PM_{2.5}$ measurements from participants in the GRAPHS Child Lung Function Study. Household boundaries were defined using a 50-meter buffer around participants' homes. Community boundaries were developed by applying a spatial clustering algorithm to an open-source dataset of building footprints in Africa. for each GPS location, we estimated building density (500m buffer) and proximity to roadways (100m buffer). We estimated the percentage change in logarithm $PM_{2.5}$ by location (household, community), time of day (morning/evening cooking hours versus nighttime), building density and proximity to roadways using linear mixed effect models.

RESULTS: Relative to nighttime household exposures, $PM_{2.5}$ exposure during evening cooking hours increased by 175% (95CI=162-188%) and 75% (95CI=50-105%) in the household and community, respectively. Exposures were elevated in areas with the highest versus lowest quartile of building density (Q1vsQ4=28%, 95CI=14-45%). The effect of building density was strongest when modeled jointly with evening cooking hours, and influenced levels in both the household and community (64% and 82% increase from Q1 to Q4, respectively). Being proximal to a tertiary or trunk roadway increased $PM_{2.5}$ exposure by 44% (95CI=24-67%) and 13% (95CI=4-22%), respectively.

CONCLUSIONS: Our findings suggest that neighbors' cooking and other community $PM_{2.5}$ sources contribute substantially to personal $PM_{2.5}$ exposure. Building density may exacerbate community exposures when multiple households are cooking simultaneously. Proximity to tertiary or trunk roadways increase personal $PM_{2.5}$ exposure.

KEYWORDS: Air pollution; exposure assessment; spatial statistics

O-OP-197 Effects of a liquefied petroleum gas cookstove and fuel intervention on fetal and neonatal outcomes: a multi-country randomized controlled trial conducted by the Household Air Pollution Intervention Network (HAPIN) trial

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BACKGROUND AND AIM: Household air pollution (HAP) from cooking with solid fuels used during pregnancy has been associated with adverse pregnancy outcomes. The HAPIN trial is a randomized controlled trial of liquefied petroleum gas (LPG) stoves and fuel distribution in 3200 households conducted across Guatemala, India, Peru, and Rwanda. We describe the effects of the LPG intervention on fetal/infant stillbirth, neonatal mortality and congenital anomalies.

METHODS: Pregnant women (18-35 years of age; gestation confirmed by ultrasound at 9-20 weeks) were randomly assigned to an intervention arm (n=1593) or control arm (n=1607). Participants were monitored for stillbirth (fetal death ≥ 20 weeks gestation), neonatal mortality (death of any live-born infant in first 28 completed days of life), and congenital anomalies (any structural/functional anomalies that occur during intrauterine life). Analyses were performed according to intention-to-treat (ITT) analysis, and binary outcomes were compared between the two arms using log binomial models.

RESULTS: Pregnant women were enrolled in the study and received their LPG stoves at 15.4 (SD 3.1) weeks gestation. We recorded 47 congenital anomalies (23 intervention, 24 control), 56 stillbirths (28 intervention, 28 control), and 41 neonatal deaths (20 intervention, 21 control) between enrollment and 28 days of live of the infant. Compared to the control arm, the relative risk among women randomized to the intervention was 0.96 (95% CI: 0.55, 1.70) for congenital anomaly, 1.01 (95% CI: 0.60, 1.70) for stillbirth and 0.97 (95% CI: 0.53, 1.77) for neonatal mortality.

CONCLUSIONS: We did not find a significant reduction in incidence of stillbirth, neonatal mortality and congenital anomalies. The small number of cases may have contributed to the lack of power and the intervention was introduced after the first trimester, which may be too late to find a protective effect.

KEYWORDS: household air pollution; congenital anomalies, stillbirth, neonatal mortality.
intention-to-treat, HAPIN trial

O-OP-198 Effect of Ramadan fasting during pregnancy on birth weight of term newborns: Modification by biomass fuel use in Kaduna, Nigeria

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BACKGROUND AND AIM: Ramadan fasting during pregnancy linked with low dietary intake could adversely affect fetal growth. However, previous studies report mixed findings on the effect of fasting on infant birth weight. Therefore, this study of term newborns aims to estimate the association between Ramadan fasting during pregnancy and birth weight and evaluate the effect modification by maternal biomass fuel exposure.

METHODS: Our study included 1,514 mother-child pairs recruited from Kaduna in northwestern Nigeria. The outcome variable was birth weight. The exposure was Ramadan fasting based on the overlap between Ramadan and index pregnancy, cooking fuel type, categorized as biomass fuel or liquefied petroleum gas and kerosene (reference). We estimated the covariate-adjusted association between Ramadan fasting and birth weight. In addition, we performed stratified analysis and estimated interaction to compare the association between biomass fuel and birth weight for various trimesters of Ramadan fasting exposure.

RESULTS: 639 (42%) mothers were exposed to Ramadan fasting during pregnancy; first (338, 53%), second (187, 29%), and third trimester (114, 18%). Adjusting for maternal age, education, parity, BMI at birth, and child sex, mothers exposed to Ramadan fasting delivered infants weighing an average of 31g lighter (95%CI −80 to 18) than the unexposed. The association between biomass fuel and birth weight was not significantly different for women exposed and unexposed to fasting (Pinteraction=0.77). But we observed a disparity by trimester of fasting exposure in the association of biomass fuel with birth weight; first (-146g 95%CI -294 to 1), second (-58g 95%CI -240 to 125), and third trimester (-57g 95%CI -396 to 282).

CONCLUSIONS: Ramadan fasting during pregnancy is not associated with birth weight. Furthermore, maternal biomass fuel use is significantly related to reduced birth weight only among mothers exposed to Ramadan fasting during the first trimester.

KEYWORDS: Ramadan fasting; biomass fuel; birth weight; Nigeria

ORAL PRESENTATIONS SESSION 37: Using metabolomics to understand mechanisms of environmental exposures

O-OP-199 Agricultural pesticide exposure related to metabolic changes in Parkinson's disease patients

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BACKGROUND AND AIM: There are currently 13,543 pesticide products with 1059 active ingredients registered in California, potentially exposing residents of agricultural regions through drift and contamination. In order to comprehensively study agricultural pesticide exposure in a population-based study of Parkinson's (PD), we determined networks of pesticide co-exposures due to living near agricultural applications (Central Valley, California). We estimated the risk of PD with patterns of co-exposure and assessed how PD-implicated co-exposures were related to the metabolome of patients in order to help understand biologic mechanisms and responses to exposure.

METHODS: We used lifetime participant address histories (n=1653), land-use maps, and the pesticide use reports database to estimate residential proximity-based exposure to 722 pesticides over a 40-year period. We applied an unsupervised, weighted pesticide co-exposure model based on WGCNA and exposure correlations to determine co-exposure modules, assessed influence on PD risk, and performed an exposure-related untargeted metabolome wide association study using LCMS data (5072 metabolites).

RESULTS: Our co-exposure model identified seven co-exposure modules based on 288 pesticides applied near the home of >25 participants. of these, two were related to an increased risk of PD. Most strongly, one module representing co-exposures to 35 pesticides (OR=1.21 per SD, 95% CI=1.09, 1.38). Among the PD patients, this pesticide co-exposure module was related to differential intensity of 442 metabolites at $p<0.05$ (73 FDR<0.10, 10 FDR<0.05). This metabolite set was most strongly enriched for glycosphingolipid (p=0.002) and glycerophospholipid (p=0.003) metabolism pathways.

CONCLUSIONS: Agriculturally, pesticides are rarely applied in isolation. We identified co-exposure modules related to PD risk. Among patients, the exposure mixture was strongly related to disturbances in biologic pathways relevant to PD pathogenesis (e.g., glycosphingolipids linked to inflammation and mitochondrial function in PD) and also known to be targeted by a number of pesticides (e.g., glycerophospholipids and choline/cholinergic pathways).

KEYWORDS: Pesticides; Metabolomics; Co-exposures; Parkinson's disease

O-OP-200 Air pollution, proteomics, metabolomics, and cardiometabolic health in the Framingham Heart Study

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BACKGROUND AND AIM: We examined whether proteomic and metabolomic correlates of air pollution exposure were associated with prevalent and incident cardiometabolic health outcomes (CVD, defined as cardiovascular disease or cardiometabolic multi-morbidity).

METHODS: We linked annual average black carbon (BC) and particulate matter (PM2.5) with metabolomic and/or proteomic data (quantified using liquid chromatography/tandem mass spectrometry and SomaScan platform, respectively), and with CVD status among Framingham Offspring Study participants at examination cycle five [1991-1995; n=2409]). Adjusting for age, sex, smoking, body mass index, physical activity, and batch (for proteins), we used linear models to examine associations between each -omic biomarker and each air pollutant, and logistic models to examine the likelihood of 1) having CVD at examination cycle five and 2) developing CVD or CVD-related mortality through 2018. We used Reactome to conduct an overrepresentation analysis for pathways enriched among the significantly ($p<0.05$) associated -omics biomarkers. Pathways were considered enriched if the false discovery rate (using the Benjamani-Hochberg method) was <0.05.

RESULTS: of 220 metabolites, eight were associated with PM2.5 (e.g., citrate, a cholesterol ester, a phosphatidylcholine), four were associated with BC (creatinine, phenylalanine, symmetric dimethylarginine, and triiodothyronine), 73 were cross-sectionally associated with CVD, and 94 were longitudinally associated with CVD/CVD-related mortality. A diacylglycerol was associated with PM2.5 and both CVD variables. Phenylalanine was associated with BC and incident CVD/CVD-related mortality. of 1373 proteins, we found associations for 160 with PM2.5, 66 with BC, 138 with cross-sectional CVD, and 137 with incident CVD/CVD-related mortality. Proteins associated with one or both air pollutants and both health outcomes were overrepresented in 21 pathways (e.g., mitogen-activated protein kinase signaling and cascade, platelet degranulation and platelet activation, formation and dissolution of fibrin clots, and extracellular matrix organization).

CONCLUSIONS: Proteomic and metabolomic markers associated with air pollution exposure may provide insight into how air pollution relates to cardiometabolic health.

O-OP-201 Salivary metabolomic signatures and body mass index (BMI) in Italian adolescents: a pilot study

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BACKGROUND AND AIM: The prevalence of childhood obesity remains high in several Southern Mediterranean countries, reaching approximately 20%. In adolescents, obesity surveillance is scarce and little is known about the metabolomic profiles underlying obesity. Metabolomics can enable a better understanding of the mechanisms involved in environmentally-associated obesity. We characterized the molecular signatures of Italian adolescents associated with body mass index (BMI).

METHODS: We collected saliva samples and assessed BMI in a subset of n=93 adolescents enrolled in the Public Health Impact of Metal Exposure (PHIME) study during 2007-2014. A total of 217 untargeted metabolites were identified using LC-HRMS. Robust linear regression analyses (univariate, adjusted for socio-demographic factors and location, and sex-stratified) were used to cross-sectionally assess the associations between metabolomic signatures and age- and sex-specific BMI z-scores (z-BMI).

RESULTS: This subset of PHIME adolescents (median age 12 years; 52% female) were of medium socioeconomic status and had normal z-BMIs (median, IQR: 20.1, 17.8-22.1 kg/m2). A higher z-BMI was observed in boys compared to girls. In adjusted analyses, deoxyadenosine and uridine metabolites were inversely related to z-BMI ($p<0.02$). In females, one bile acid (hyocholic acid), one benzenoid (2,3-dihydroxybenzoic acid), and two aspartic acids were associated with higher z-BMI ($p<0.05$). In males, four metabolites (deoxycarnitine, deoxyadeno sine, hyodeoxycholic acid, and trigonelline) were downregulated and three metabolites (allantoin, D-alanine, theobromine/theophylline/paraxanthine) were upregulated in relation to z-BMI ($p<0.05$). In univariate analyses, several benzenoids were additionally identified to be upregulated in relation to z-BMI.

CONCLUSIONS: Metabolites related to purine and nucleotide metabolism, as well as benzenoids, amino acids, and bile acids were altered in relation to BMI in adolescents, particularly in males. Given that obesity rates are higher among males than females, future metabolomic studies with larger sample size may help understand the mechanisms underlying sex-dimorphic obesity and improve prevention strategies.

KEYWORDS: BMI, obesity, metabolomics, adolescents

O-OP-202 Using High-Resolution Metabolomics for Identifying Metabolic Profiles Associated with Ambient Air Pollution in the Cancer Prevention Study-II Nutrition Cohort

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BACKGROUND AND AIM: Mechanisms underlying ambient air pollution toxicity remains largely unknown despite the established links between air pollution and numerous adverse health effects. There is growing interest in applying high-resolution metabolomics (HRM) to study air pollution and health. Broad application of HRM is limited, however, due to concerns over statistical power and study generalizability.

METHODS: Using previously collected data, we conducted a cross-sectional metabolomics wide association study among 1,263 postmenopausal women within the American Cancer Society Cancer Prevention Study-II Nutrition Cohort. Modeled estimates of PM2.5 (1999-2004), NO2 (2006), and O3 (2002-2004) concentrations were linked to the participant residence at enrollment. Metabolic profiling on serum samples collected between 1998-2001 was measured by mass spectrometry-based platforms. We followed an untargeted metabolome-wide association study framework to evaluate metabolite and metabolic pathway perturbations associated with chronic exposures to air pollution.

RESULTS: We detected and analyzed 1,186 metabolites in serum samples, with an average technical intraclass correlation coefficient of 87% and coefficient of variance of 23%. Sixty-five unique metabolites were significantly associated with at least one air pollutant (false positive discovery rate <0.05), after controlling for covariates, including sociodemographic, smoking status, and year of blood draw. We observed perturbations in several inflammatory and oxidative stress related metabolic pathways associated with lipid, xenobiotic, amino acid, and vitamin metabolism. We subsequently confirmed the chemical identity of 43 unique metabolites with level 1 evidence, including diacylglycerol, taurine, docosapentaenoate, alpha- carboxyethylhydroxychroman, and palmitoyl ethanolamide.

CONCLUSIONS: In this large cross-sectional analysis of air pollution and serum metabolites in postmenopausal women, we identified several novel metabolic markers and pathways associated with long-term exposures to air pollution and replicated others. These results support future development of sensitive metabolic markers of air exposures, as well as corresponding investigation into the specific molecular mechanisms and disease etiologies indicated by these markers.

KEYWORDS: Air Pollution, Metabolomics

O-OP-203 Mapping the mechanistic evidence of wood smoke and wildfire studies in humans

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BACKGROUND AND AIM: Wood smoke is a complex mixture of gases, chemicals, and fine particles generated by wood-burning and wildfires. We are conducting a cancer hazard evaluation of wood smoke for possible listing in the U.S. Report on Carcinogens. The database of cancer epidemiology studies for exposure to wood smoke, but not wildfire, is adequate to conduct an evaluation. As mechanistic evidence may inform the overall hazard evaluation, especially for wildfires, we mapped the published evidence by biomarkers for the key characteristic of carcinogens (KCC), focusing here on studies in exposed humans.

METHODS: We systematically searched three bibliographic databases for relevant biomarker studies on wildfire and wood smoke exposure. for selected studies reporting on the three most common KCCs (genotoxicity, oxidative stress, immune biomarkers), we extracted information including specific KCC biomarkers (e.g., mutations), results, study design, and population, and presented the data in an interactive evidence map.
RESULTS: Wood smoke: Most human studies (26) found positive associations with KCCs, consistent with the >70 non-human studies (in vitro and in vivo). Inflammation, inflammatory cytokines, and lipid peroxidation were the most common KCCs in humans. The studies were primarily intervention or cross-sectional in populations cooking or heating with wood or randomized studies of controlled exposure.
Wildfires: Human studies (15) were largely positive for immune biomarkers but inconsistent for genotoxicity and oxidative stress, whereas non-human studies (17) were generally positive for all endpoints. Most studies measured KCCs in firefighters (13) before or after exposure (e.g., work shift or natural wildfire event).

CONCLUSIONS: Wildfires are increasing in frequency and intensity due to climate change, and exposure to wood smoke remains a worldwide concern. This mechanistic evidence will help inform the cancer hazard evaluations of these exposures. Ongoing risk-of-bias evaluations may explain heterogeneity in human wildfire studies.

KEYWORDS: Wood smoke, wildfires, biomarkers, exposed humans

O-OP-204 Air pollution exposure during pregnancy and placental metabolomics

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BACKGROUND AND AIM: Prenatal exposure to air pollution has been shown to adversely affect birth outcomes and child health. But few studies have applied metabolomics approach to understand the relevant biological mechanisms. We aim to investigate the metabolomic profiling in the placenta associated with prenatal air pollution exposure.

METHODS: This pilot analysis included twenty healthy, non-smoking pregnant women delivered at Anzhen Hospital in Beijing, China in 2017. Untargeted metabolomic profiling was performed on maternal placental tissues using UPLC-MS/MS. Maternal exposure to PM2.5 throughout pregnancy at residential and working addresses was estimated by a high-resolution hybrid spatiotemporal model. Linear regression and pathway enrichment analysis were performed to identify metabolites and metabolic pathways associated with trimester-specific and whole-pregnancy air pollution exposure, adjusting for maternal age, gestational age, pre-pregnancy BMI, and diet.

RESULTS: The means (SDs) of PM2.5 levels in the first, second, and third trimester, and the whole pregnancy were 107.6 (28.7), 64.3 (11.3), 53.3 (5.8), and 73.5 (12.1) μg/m3, respectively. A total of 897 known compounds were identified from the placental tissues. PM2.5 exposure during the first trimester was associated with changes in 65 metabolites in placental samples, but none remained significant after multiple comparisons (the false discover rate [FDR] at 0.05). We identified three placental metabolic pathways significantly associated with PM2.5 exposure in the first trimester, including valine, leucine and isoleucine biosynthesis (FDR <0.001), aminoacyl-tRNA biosynthesis (FDR =0.003), and arginine biosynthesis (FDR =0.006). We did not observe significant changes in individual metabolites or metabolic pathways in response to PM2.5 exposure in other two trimesters or during the whole pregnancy.

CONCLUSIONS: Prenatal exposure to air pollution might affect amino acids metabolism in the placenta and more studies are needed to further elucidate underlying mechanisms.

KEYWORDS: Air pollution, Pregnancy, Metabolomics

ORAL PRESENTATIONS SESSION 38: Greenspace, built environment, and health

O-OP-205 Neighborhood built environment, psychosocial stressors, and telomere length of birth parents and infants from San Francisco, California

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BACKGROUND AND AIM: Shorter telomere length is a biomarker of cellular aging previously associated with chronic stress and exposure to air pollution. Aspects of the neighborhood built environment can contribute to stress and air pollution exposures. We examine joint associations between residential greenspace, traffic, noise, and individual-level measures of psychosocial stressors on telomere length in birth parents and their newborns.

METHODS: Telomere length (T/S ratio) was measured in delivery cord blood of 490 newborns and 288 second trimester parental whole blood samples from the Chemicals in Our Bodies cohort from San Francisco, California. Three measures of neighborhood built environment were constructed from secondary data based on residential address: greenspace (normalized difference vegetation index [NDVI]), traffic volume, and noise. Perceptions of neighborhood quality, stress, and depression were collected via second trimester questionnaire. Measures hypothesized to be beneficial (NDVI, neighborhood quality) were reverse coded for ease of interpretation. We used quantile g-computation to assess joint associations between these exposures and newborn and parental T/S in separate models that controlled for age, race/ethnicity, education, parity, pre-pregnancy BMI, and gestational age (cord T/S only).

RESULTS: Parental and cord T/S were weakly correlated (Spearman rho = 0.21) but not strongly correlated with built environment or stress measures (rho from -0.12 to 0.13). A simultaneous one quartile increase in all exposures was associated with a mean change of -0.02, 95% confidence interval [-0.08, 0.04] in newborn T/S and -0.04 [-0.10, 0.01] in parental T/S. Effect estimates were stronger but less precise in paired samples (-0.06, [-0.16, 0.04] for newborn and -0.05 [-0.12, 0.03] for parental T/S), with depression assigned the largest negative weight.

CONCLUSIONS: Results from this cross-sectional study suggest prenatal exposure to adverse built environments and psychosocial stressors are associated with small reductions in telomere length of newborns and their birth parents.

KEYWORDS: urban, perinatal

O-OP-206 Residential Greenness and Depression in Older U.S. Adults: Evidence from The Health and Retirement Study

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BACKGROUND AND AIM: The physical environment influences mental health. In this study, we investigated residential greenness in relation to major depressive disorder (MDD), a leading cause of disability. We also tested effect modification by climate and urbanicity given that vegetation types and human interaction with vegetation differs across these settings.

METHODS: We used biennial survey data from 2008 through 2016 from a cohort of older U.S. adults. We calculated greenness at participant home addresses as the maximum normalized difference vegetation index (NDVI) for the year preceding each survey, averaged within 250m and 1km buffers. A score of ≥5 on the Composite International Diagnostic Interview Short Form indicated MDD. We used Köppen-Geiger classifications, which identify vegetation biomes, to characterize climate, and Beale codes for urbanicity. To estimate prevalence ratios, we used Poisson regression accounting for repeated measures and incorporated survey weights. Our models adjusted for individual and neighborhood socio-demographics, geography, sunshine, and bluespace.

RESULTS: We included 27,829 participants who contributed 91,479 observations to our analysis. Participants were 66 (±11) years old on average, 83% White, and 28% completed college, with a 12-month prevalence of MDD of 8%. In fully adjusted models, an interquartile range higher NDVI within 250m was associated with a 12% lower prevalence of MDD (PR:0.88, 95% CI:0.81-0.96). This association was stronger in cold (PR:0.82, 95% CI:0.73-0.92) climates (p-interaction: 0.091), and urban (PR:0.84, 95% CI:0.76-0.93) areas (p-interaction: 0.222). We found similar results for 1km NDVI.

CONCLUSIONS: More residential greenness was associated with less MDD, suggesting greening interventions could improve mental health. Since we found evidence of effect modification by climate and urbanicity, those planning interventions should consider vegetation types and prioritize areas where they may be particularly beneficial. Future studies could better identify vegetation types and communities most in need of greening interventions.

KEYWORDS: Mental health, greenspace, built environment

O-OP-207 Early Life Exposure to Greenspace and Autism Spectrum Disorder and the Mediating Effects of Air Pollution in Ontario, Canada

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BACKGROUND AND AIM: Early life exposure to greenspace is associated with health benefits on childhood development, but the pathways of this relationship are not completely understood. This study aimed to evaluate early life exposure to different greenspace metrics on the development on autism spectrum disorder (ASD) and whether these associations are mediated by reductions in ambient air pollution.

METHODS: This case-control study included 1,801 ASD cases and 9002 controls less than 5 years of age identified from 2012 to 2017 using health administrative databases in the province of Ontario, Canada. Greenspace metrics were estimated using the Normalized Difference Vegetation Index (NDVI), Green View Index (GVI) and percent tree canopy coverage using values within 250 m of participants' residential postal codes at birth. Conditional logistic regression was used to investigate associations between greenspace exposure and ASD while adjusting for maternal age, parity, maternal comorbidities, substance use (i.e. smoking and alcohol), socioeconomic status and urbanicity. We estimated the mediation effects of nitrogen dioxide (NO2), fine particulate matter (PM2.5), and ozone (O3) using causal mediation analyses.

RESULTS: In the adjusted model, we found that one interquartile range (IQR) increase in percentage tree canopy was associated with a 6% reduction in the odds of ASD (Odds ratio = 0.94; 95% CI: 0.90, 0.98). No associations were found for NDVI and GVI in relation to ASD. We found that 81.8% (77.6 – 85.9), 20.1% (16.6 – 23.6) and 13.6% (11.1 – 16.0) of the association between tree canopy exposure and ASD was mediated through reductions in NO2, PM2.5, and O3, respectively.

CONCLUSIONS: Early life exposure to greenspace might reduce the risk of ASD through reductions in ambient air pollution, in particular traffic pollution from NO2. Our findings may provide support to communities on the potential health benefits of greenspaces.

O-OP-208 Association of Greenspace Exposure at Midlife with Cognitive Decline Later in Life in a Study of US Women

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BACKGROUND AND AIM: Greenspace may slow cognitive decline by increasing opportunities for physical activity and social connection or reducing stress or air pollution. However, studies on the association between greenspace and cognitive decline are sparse. We investigated the prospective association between greenspace at midlife and cognitive decline later in life.

METHODS: Using data from the US-based Nurses' Health Study (mean age=61y), we assessed residential greenspace in a 270m buffer as the cumulative average from 1986 to 1994 using Landsat Normalized Difference Vegetation Index data. We examined 16,352 women who were enrolled in a substudy starting in 1995-2001 (74y) through 2008. Participants underwent up to four repeated measures of five cognitive tests. A global composite score was calculated as the average of all z-scores for each task to evaluate overall cognitive functioning. We evaluated the association between greenspace and subsequent cognitive decline using linear mixed models adjusted for age, education, neighborhood socioeconomic status, and depression.

RESULTS: In fully adjusted models, those living in the highest quintile of greenspace had an annual slope of decline that was slower by 0.01 units of the global composite score (95%CI 0.00001, 0.012) compared to those in the lowest quintile. To help interpret this estimate, we find that one year of age is related to a -0.01 unit mean annual difference for global cognition; thus, more greenspace appeared equivalent to slowing cognitive aging by one year. We found similar associations for the Telephone Interview for Cognitive Status (TICS); participants living in the highest greenspace quintile had an annual rate of decline that was slower by 0.04 units in the TICS score (95%CI 0.01, 0.07) compared to those in the lowest quintile.

CONCLUSIONS: Higher greenspace exposure in early adulthood is associated with a slower rate of cognitive decline later in life in this cohort of US women.

O-OP-209 Residential proximity to greenspace and human birth defects

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BACKGROUND AND AIM: Residential proximity to greenspace is associated with various health outcomes. We estimated associations between maternal residential proximity to greenspace and selected structural birth defects, including effect modification by neighborhood-level factors.

METHODS: Data were from the National Birth Defects Prevention Study (1997-2011) and included 19,065 infants with at least one eligible birth defect (cases) and 8,925 without birth defects (controls) from eight Centers throughout the United States. Participants provided their addresses throughout pregnancy, which were systematically geocoded and linked to greenspace, US Census and Department of Agriculture data. Greenspace was estimated using normalized difference vegetation index (NDVI); average maximum NDVI was calculated within 100m and 500m concentric buffers surrounding each geocoded address at conception to estimate residential NDVI. We used logistic regression to estimate odds ratios (ORs) and 95% confidence intervals comparing those in the highest and lowest quartiles of residential NDVI, and subsequently stratifying by rural/urban and neighborhood median income.

RESULTS: After multivariable adjustment, for the 500m buffer, inverse associations were observed for tetralogy of Fallot, secundum atrial septal defects, anencephaly, anotia/microtia, cleft lip ± cleft palate, transverse limb deficiency, omphalocele, and gastroschisis (aORs: 0.54-0.86). Significant heterogeneity was observed after stratification by rural/urban for hypoplastic left heart, coarctation of the aorta, and cleft palate with inverse associations only among those in rural areas. Stratification by neighborhood median income showed significant heterogeneity for secundum atrial septal defects, anencephaly, anotia/microtia, and anorectal atresia with inverse associations only among those in a high-income neighborhood (aORs: 0.45-0.81). Results were similar for 100m buffer analyses and similar patterns were observed for other defects, though results were less precise.

CONCLUSIONS: Our results suggest that perinatal residential proximity to more greenspace may contribute to a reduced risk of certain birth defects, especially among those living in rural or high-income neighborhoods.

KEYWORDS: Greenspace, birth defects, neighborhood, NDVI

O-OP-210 Air pollution, greenspace and active travel infrastructure impacts on stress while walking, cycling, or in motorized transport

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BACKGROUND AND AIM: Recent studies have shown that active travel is generally associated with lower levels of both perceived and measured stress. Specific microenvironmental conditions encountered during daily journeys, however, may lead to varying degrees of stress experienced at that moment. Our aim is to evaluate how travel mode-specific stress, as measured by Galvanic Skin Response (GSR), varies given different levels of Black Carbon (BC) and greenspace exposure, and by road type.

METHODS: BC and GSR were collected alongside confounders and travel information from 122 participants across 3 European cities for 3 weeks as part of the Physical Activity through Sustainable Transport Approaches (PASTA) study. Greenspace and road type were identified from the geo-locations recorded by a GPS device also worn by participants. A Bayesian Doubly Robust (BDR) estimation method via bootstrapping (which allows us to incorporate randomness originating from the random nature of the unobserved observations of GSR and to simulate the posterior distribution of GSR given the measured covariates) was employed to estimate the effect of BC, green space and road type on cycling-/walking-/motoring-specific GSR, while accounting for confounders such as physical activity, gender, and age.

RESULTS: BC significantly increases GSR when people are cycling or walking, but has no statistically significant effect on people in motorized transport. In reverse, greenspace and traveling on roads with active travel infrastructures (i.e. cycleways and/or pedestrian paths) both lead to lower GSR while walking and cycling, with again no effect on people in motorised transport.

CONCLUSIONS: Decreasing air pollution, improving active travel infrastructure and increasing greenspace along travel routes can reduce stress experienced during active travel. Reducing traffic and improving active travel microenvironments may thus further enhance benefits of walking and cycling in reducing stress in urban populations.

KEYWORDS: Built environment, urban planning, stress, air pollution, active travel, causal inference.

ORAL PRESENTATIONS SESSION 39: Reproductive outcomes and exposure to air pollution

O-OP-211 Ambient Black Carbon Particles Travel From Mother Into the Fetal Circulation and Organs During Gestation

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BACKGROUND AND AIM: Prenatal exposure to particulate air pollution has been linked to multiple adverse birth outcomes causing burden of disease later in life. To date, evidence is lacking whether ambient particulates can both reach and cross the human placenta to exert direct effects on fetal organ systems during gestation.

METHODS: We used white light generation under femtosecond pulsed illumination to detect black carbon particles in samples collected at the maternal-fetal interface. Maternal-perinatal and fetal samples were collected within the framework of two independent studies, including the mother-newborn ENVIRONAGE (ENVIRonmental influence ON AGEing in early life) Belgian birth cohort and the SAFeR (Scottish Advanced Fetal Research) Scottish cohort of electively terminated normally progressing pregnancies. Appropriate validation experiments were performed to confirm the carbonaceous nature of the identified particles.

RESULTS: Here, we provide evidence of (i) the presence of black carbon particles in cord blood, confirming their ability to cross the placenta and enter the fetal circulation, (ii) a strong correlation ($r \geq 0.50$; $p<0.0001$) between the maternal-perinatal particle load (in maternal blood (n=60), term placenta (n=60), and cord blood (n=60)) and residential ambient black carbon exposure during pregnancy, and (iii) the presence of black carbon particles in first and second trimester tissues (fetal liver (n=36), lung (n=36), and brain (n=14)) of electively terminated normally progressing pregnancies from an independent study.

CONCLUSIONS: This study provides, to the best of our knowledge, the first conclusive evidence that maternally inhaled carbonaceous air pollution particles can cross the placenta and then translocate into human fetal organs during gestation. Further research is now needed to assess their direct effects on fetal organ development and unravel the complexity of particulate air pollution-related health effects in early life.

KEYWORDS: ecotoxicology, developmental toxicology, epidemiology, air pollution particle exposure

O-OP-212 Traffic-Related Air Pollution and DNA Methylation of the Follicular Fluid

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BACKGROUND AND AIM: Higher exposure to traffic-related air pollution (TRAP) is related to lower fertility, with specific adverse effects on the ovary. Epigenetics, specifically DNA methylation (DNAm), may underlie this association but given its tissue specificity, exploring potential mechanisms in toxicological-relevant target tissues is essential. Our objective was to explore the relation between TRAP exposure and follicular fluid (FF) DNAm.

METHODS: Our study included 62 women undergoing in vitro fertilization at a fertility center in Boston, Massachusetts (2005-2015). TRAP exposure was defined using a spatiotemporal model to estimate residence-based daily nitrogen dioxide (NO2) concentrations in the 3 months prior. FF was collected during oocyte retrieval and DNAm levels were profiled using the Infinium MethylationEPIC BeadChip. We estimated epigenetic age via an existing granulosa cell clock and other common epigenetic clocks. We used linear regression to test whether accelerated epigenetic age, or differential DNAm across the genome, was associated with NO2 exposure while adjusting for surrogate variables and other confounders.

RESULTS: Epigenetic age as measured using the granulosa cell clock was moderately correlated with reported age ($r=0.48, p<0.001$). Other epigenetic age estimators performed poorly in the FF. There was no association between NO2 exposure and accelerated epigenetic aging ($\beta=-0.05$ 95%CI -1.20,1.10). NO2 exposure was associated with 8 differentially methylated regions and 22 differentially methylated positions, after adjusting the significance threshold for 704,169 tests. The genes annotated were enriched for GATA1 transcription factor binding and for DNA-methyltransferase activity (q-val<0.05). Some of the differentially methylated genes, including KCNQ1, VRK1, GPER, MLH1, and PLET1, have been linked to reproductive and fertility outcomes.

CONCLUSIONS: Our study suggests that differences in FF DNAm could be a plausible mechanism potentially linking TRAP exposure to ovarian dysfunction. Future work to improve assessment of epigenetic age in reproductive tissues, such as FF, is warranted.

KEYWORDS: Air pollution, Epigenetics, Ovary, Fertility

O-OP-213 Prenatal depression increases susceptibility to periconceptional ambient air pollution exposure in relation to risk of gestational hypertension

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BACKGROUND AND AIM: Exposure to air pollutants has been associated with elevated blood pressure during pregnancy. However, the influences of preconception and prenatal exposures to ambient air pollution on gestational hypertension (GH) remain unclear. Even less is known about the potential effect modification by individual risk factors, including depression.

METHODS: In 559 pregnant participants enrolled the Maternal and Developmental Risks from Environmental and Social Stressors (MADRES) study, we estimated daily levels of ambient particulate matter (PM_{10}; $PM_{2.5}$), nitrogen dioxide (NO_2), and ozone (O_3) using spatial interpolation. Gestational hypertension without proteinuria was ascertained from medical records by physician diagnosis or defined as two abnormally high blood pressure measurements after 20 gestational weeks (GW). We used distributed lag models with Poisson regression to identify sensitive exposure windows by estimating weekly associations of exposures from pre-conception week 12 to GW 24 with GH risk, adjusting for maternal and meteorological factors. Analyses were additionally stratified by the Center for Epidemiologic Studies Depression Scale score (CES-D, <16 vs. ≥16), median pre-pregnancy body mass index (BMI, <27.5 vs. ≥27.5 kg/m²), median age (<28 vs. ≥28 years), and newborn sex to explore differential susceptibilities.

RESULTS: Forty-two (7.5%) participants were diagnosed with GH. An IQR increase in $PM_{2.5}$ exposure in the window from GW6 to GW17 and PM_{10} from GW7 to GW14 was associated with 10.1% (95% CI: 9.5-10.8%) and 10.9% (9.7-12.2%) increased risk of GH, respectively. Among 163 participants with probable depression (CES-D≥16), per IQR increase in $PM_{2.5}$ exposure from GW6 to GW24 was associated with 26.8% (25.7-27.9%) increased GH risk.

CONCLUSIONS: Early-to-mid pregnancy exposures to ambient air pollution were associated with increased risk of GH. A wider sensitive window of $PM_{2.5}$ exposure and stronger effects were seen in participants with probable depression compared to those without.

KEYWORDS: air pollution, gestational hypertension, sensitive window, susceptibility, prenatal depression, preconception

O-OP-214 Upstream oil and gas production and risk of spontaneous preterm birth in California: A matched sibling study

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BACKGROUND AND AIM: Recent studies have reported associations between exposure to upstream oil and gas production and adverse birth outcomes, including preterm birth. Uncertainties remain about the potential for bias from unobserved confounders. Our aim was to determine whether exposure to oil and gas wells in the preproduction and production stages increased risk of preterm birth by leveraging variation in exposure among parents who gave birth two or more times during the study period.

METHODS: We examined the association between exposure to oil and gas wells and preterm birth risk using birth outcomes data linked to parental covariates from the California Office of Statewide Health Planning and Development and oil and gas production data from the California Geologic Energy Management Division. We undertook a matched sibling study with approximately 1.5 million births delivered to 660,000 multiparous gestational parents in California between 1998 and 2011, each geocoded to the parental residence at time of delivery. Our primary analyses focused on parents who moved 10 km or less between births. for each birth and trimester of pregnancy, we assessed exposure to the count of wells in preproduction and total sum of oil and gas production volume within 1 km. We estimated exposure-response curves using adjusted linear regression models with a fixed effect for the parent, which controls for potential unobserved, time-invariant parental confounders.

RESULTS: In within-parent (i.e., longitudinal matched-sibling) models, high exposure to preproduction wells was associated with 5% higher preterm birth risk and exposure to increased production volume was associated with 2% higher risk, both for delivery at 28-31 weeks. The results were not consistent across model specifications.

CONCLUSIONS: We did not observe consistent evidence of an association between upstream oil and gas production activities and preterm birth risk among parents with varying exposure between pregnancies, except under certain modeling specifications.

O-OP-215 Ambient air pollution concentrations and incidence of spontaneous abortion

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BACKGROUND AND AIM: Previous epidemiologic studies suggest that air pollution exposure may be a risk factor for spontaneous abortion (SAB), i.e., pregnancy loss before 20 weeks' gestation. However, most studies identified SABs from administrative records, which likely under-ascertain losses early in pregnancy. In a prospective preconception cohort study of couples trying to conceive, we examined the association between residential ambient air pollution concentrations and SAB incidence.

METHODS: Eligible female participants enrolled during 2013-2019. They were aged 21-45 years, residents of the United States or Canada, and trying to conceive without fertility treatments. Participants completed online questionnaires at enrollment, every 8 weeks during preconception, and about 8 weeks and 32 weeks of pregnancy. We restricted our analysis to the 5,513 participants who conceived within 12 cycles of follow-up. We estimated two-week average residential ambient concentrations of particulate matter <2.5 μm (PM2.5), nitrogen dioxide (NO2), and ozone (O3) using country-specific spatiotemporal models. We used Cox proportional hazards regression with gestational weeks as the time scale to estimate incidence rate ratios (IRRs) and 95% confidence intervals (CI) for an interquartile range (IQR) increase in exposure, adjusting for individual- and neighborhood-level confounders.

RESULTS: 19% of participants reported a SAB during follow-up; of these, 72% were early losses (<8 weeks of gestation, median=6 weeks). Air pollution concentrations were not appreciably associated with SAB incidence. Among US participants, IRRs for a one-IQR increase in concentrations during the two weeks before conception were 1.08 (95% CI: 0.93-1.24) for PM2.5 (IQR=3.0 μg/m3), 1.02 (95% CI: 0.90-1.15) for NO2 (IQR=5.4 μg/m3), and 1.00 (95% CI: 0.86-1.17) for O3 (IQR=10.7 μg/m3). Associations were similar among Canadian participants, and among those reporting early losses.

CONCLUSIONS: Air pollution concentrations showed little association with SAB incidence in this cohort of pregnancy planners.

KEYWORDS: air pollution, preconception cohort, pregnancy loss, spontaneous abortion

O-OP-216 Prenatal cadmium exposure in relation to placental and birth size: effect modification by fetal sex and genetic variation in the placental barrier transporter ABCG2

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BACKGROUND AND AIM: Cadmium accumulates in the placenta and may adversely impact fetal growth, however results have varied across epidemiological studies. Largely ignored in these studies are polymorphisms in genes encoding placental barrier transporters such as ABCG2, which reduces placental accumulation and fetal chemical exposures. We examined maternal cadmium concentrations in relation to placental and infant size at birth, evaluating effect modification by fetal sex and ABCG2 genotype.

METHODS: We measured urinary cadmium in each trimester and in term placenta from mothers participating in the UPSIDE-ECHO cohort (NY,USA; n=254). Birthweight, birth length, and placental weight were obtained from medical records and direct measurement; fetoplacental weight ratio(FPR) was calculated and ABCG2 C421A/Q141K(rs2231142) genotype was assessed. We fit multivariable linear regression models examining log-transformed urinary and placental cadmium concentrations in relation to birthweight, birth length, placental weight, and FPR, adjusting for covariates.

RESULTS: Cadmium was measurable in 85-91% of urine samples (by trimester; medians 0.18-0.30 μg/L) and 99% of placentas (median 4.4 μg/g). 17% of placentas had a reduced-function ABCG2 polymorphism (AA or AC genotype). A ln-unit increase in placental cadmium was associated with lower placental weight (β=-19.15g, 95%CI: -36.36,-1.93) and higher FPR (β=0.25, 95%CI: -0.02,0.51); associations with birthweight were inverse, but non-significant. Notably, cadmium was associated with reduced placental weight (β=-48.08g, 95%CI: -96.05,-0.12) and higher FPR (β=0.80, 95%CI: 0.15,1.46) in AA/AC participants, with null associations in wild-type CC participants. Associations with reduced placental weight were stronger in females (β=-24.93g, 95%CI: -49.38,-0.48) compared to males (β=-13.94g, 95%CI: -37.94,11.05). Few associations were observed between specific gravity-adjusted urinary cadmium and newborn/placental size.

CONCLUSIONS: Cadmium was associated with reduced placental growth and efficiency in female infants as well as participants with the reduced-function ABCG2 transporter variant, confirming prior in vitro studies. Individuals with ABCG2 polymorphisms may be particularly vulnerable to cadmium's developmental toxicity.

ORAL PRESENTATIONS SESSION 40: Child health and exposure to air pollution

O-OP-217 Accumulation of Black Carbon Particles in Placenta, Cord Blood and Childhood Urine on the Intestinal Microbiome Diversity and Composition in Four-to-Six-Year-Old Children

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The gut microbiome plays an essential role in human health. Despite the link between air pollution exposure and various diseases, its association with the gut microbiome during susceptible life periods remains scarce. In this study, we examined the association between black carbon (BC) particles quantified in pre- and post-natal biological matrices and bacterial richness and diversity measures, and bacterial families. 85 stool samples were collected from four-to-six-year-old children enrolled in the ENVIRONAGE cohort. We performed 16S rRNA gene sequencing to calculate bacterial richness and diversity indices (Chao1 richness, Shannon and Simpson diversity) and the relative abundance of bacterial families. BC particles were quantified via white light generation under femtosecond pulsed laser illumination in placental tissue and cord blood (pre-natal exposure biomarkers), and urine (post-natal exposure biomarker). We used robust multivariable-adjusted linear models to examine the associations between quantified BC loads and richness and diversity measures. Additionally, we performed differential relative abundance analyses of bacterial families while correcting for sampling fraction bias. Results are expressed as percentage change per BC doubling. Two diversity indices were negatively associated with placental BC (Shannon: -4.38%, p=0.04; Simpson: -0.90%, p=0.04), cord blood BC (Shannon: -3.28%, p=0.05; Simpson: -0.91, p=0.02), and urinary BC (Shannon: -3.39%, p=0.0007; Simpson: -0.89%, p<0.0001). The explained variance of BC on the above indices varied from 5.90 to 16.81%. Multi-exposure models showed stronger relationships with urinary BC loads for both indices. Placental BC was negatively associated with the bacterial families Defluviitaleaceae and Marinifilaceae, and urinary BC with Christensenellaceae and Coriobacteriaceae. These results show that BC particles quantified in pre- and post-natal biological matrices may influence the composition and diversity of the childhood intestinal microbiome, addressing the influential role of air pollution exposure during pregnancy and early life on human health.

KEYWORDS: gut, microbiome, air pollution, black carbon, pregnancy, early childhood

O-OP-218 Coal ash and depression in children aged 6-14 years old

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BACKGROUND AND AIM: When coal is burned for energy, coal ash, a hazardous waste product, is generated. Throughout the world, over 1 billion tons of coal ash is produced yearly. In the United States, over 78 million tons of coal ash was produced in 2019. Fly ash, the main component of coal ash contains neurotoxic metal(loid)s that may affect children's neurodevelopment and mental health. The objective of this study was to investigate the association between fly ash and depressive problems in children aged 6-14 years old.

METHODS: Children and their parents/guardians were recruited from 2015-2020. Tobit regression and Poisson regression were used to assess the association between coal fly ash and depressive problems. To determine fly ash presence, Scanning Electron Microscopy was conducted on polycarbonate filters containing PM10 from the homes of the study participants. Depressive problems in children were measured using the Depressive Problems DSM and withdrawn/depressed syndromic problem scales of the Child Behavior Checklist.

RESULTS: In covariate-adjusted Tobit regression models, children with fly ash on the filter had higher scores on the DSM Depressive Problems (3.14 points; 95% CI=0.40, 5.89) and the syndromic withdrawn depression (2.63 points; 95% CI = -0.20, 5.46) scales compared with children who did not have fly ash on the filter. Poisson regression supported these findings.

CONCLUSIONS: Coal ash is one of the largest waste streams in the U.S., but it is not classified as a hazardous waste by the Environmental Protection Agency. To our knowledge, no studies have assessed the impact of coal ash on children's mental health. This study highlights the need for further research into the effects of coal ash exposure on children's mental health, and improved regulations on release and storage of coal ash.

KEYWORDS: coal ash; fly ash; children's mental health; depression; children's environmental health

O-OP-219 Association of improved air quality with lung development from childhood until young adulthood: The BAMSE study

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BACKGROUND AND AIM: The beneficial effect of improving air quality on lung function development in children remains understudied. We assessed associations of changes in ambient air pollution levels with lung function growth from childhood until young adulthood in a Swedish cohort study.

METHODS: In the prospective birth cohort BAMSE (Children, Allergy, Milieu, Stockholm Epidemiology), spirometry was conducted at the 8-year (2002-2004), 16-year (2011-2013) and 24-year follow-ups (2016-2019). Participants with one spirometry measurement at 8 years and at least one another measurement in subsequent follow-ups were included (1509 participants with 3837 spirometry measurements). Ambient air pollution levels (particulate matter≤2.5 µm [PM2.5], particulate matter≤10 µm [PM10], black carbon [BC] and nitrogen oxides [NOx]) at residential addresses during the lifetime were estimated using dispersion modelling. Linear mixed-effect models were used to estimate the association between air pollution level change and lung function development.

RESULTS: Overall, individual air pollution levels decreased progressively during the study period. for example, median (interquartile range, IQR) of PM2.5 decreased from 8.2 (0.92) µg/m3 during 2002-2004 to 5.22 (0.67) µg/m3 during 2016-2019. Reduction of air pollution exposure was associated with higher rate of growth for both FEV1 and FVC. for each IQR decrease in PM2.5, the growth rate increased by 3.7 ml/year (95%CI: 1.3-6.0, P<0.001) for FEV1 and 7.9 ml/year (95%CI:4.3-11.4, P<0.001) for FVC. Significant associations with lung function growth were also observed for reduction of PM10, BC and NOx. These associations persisted after adjustment for potential confounders. The beneficial effect from improved air quality was not statistically modified by asthma, allergic sensitization, early-life air pollution exposure or dietary intake of antioxidants.

CONCLUSIONS: Long-term reduction of air pollution is associated with positive lung function development from childhood to young adulthood.

KEYWORDS: air pollution, lung function, spirometry, improved air quality, cohort

O-OP-220 Air Pollution Exposure during Pregnancy and Childhood, Cognitive Function, and Emotional and Behavioral Problems in Adolescents

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BACKGROUND AND AIM: Exposure to air pollution may impact neurodevelopment during childhood, but current evidence on the association with cognitive function and mental health is inconclusive and primarily focusses on young children. Therefore, we aim to study the association of exposure to air pollution during pregnancy and childhood, with cognitive function and emotional and behavioral problems in adolescents.

METHODS: We used data from 5,170 participants of a birth cohort in Rotterdam, the Netherlands. Concentrations of fourteen air pollutants at participant's home addresses were estimated during pregnancy and childhood, using land use regression models. We included four cognitive domains and an estimated full-scale IQ. Internalizing, externalizing, and attention problems were self- and parent-reported. We used linear regression models to assess the association of each air pollutant, with cognitive function and emotional and behavioral problems, adjusting for socioeconomic status and lifestyle characteristics. Then, we performed multipollutant analyses using the Deletion/Substitution/Addition (DSA) algorithm

RESULTS: Air pollution exposure was not associated with full-scale IQ, working memory, or processing speed. Higher exposure to few air pollutants was associated with higher fluid reasoning and verbal IQ scores (e.g. 0.22 points of fluid reasoning (95%CI 0.00; 0.44) per 1 µg/m3 increase in organic carbon during pregnancy). Higher exposure to some air pollutants was also associated with less internalizing, externalizing, and attention problems (e.g. -0.27 internalizing problems (95% CI -0.52; -0.02) per each 5 ng/m3 increase in copper during pregnancy).

CONCLUSIONS: Higher exposure to air pollution during pregnancy and childhood was not associated with lower cognitive function or more emotional and behavioral problems in adolescents. Based on previous literature and biological plausibility, the observed protective associations are probably explained by negative residual confounding, selection bias, or chance and do not represent a causal relationship.

KEYWORDS: air pollution; cognitive function; mental health; adolescents; traffic

O-OP-221 Agricultural burning in Imperial Valley, California and respiratory symptoms in children: a cross-sectional, repeated measures analysis

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BACKGROUND AND AIM: The open burning of agricultural fields after harvesting is an under-recognized and understudied source of air pollution in rural communities. Smoke from agricultural burning contains air toxics that may adversely impact respiratory health. Imperial County in southeastern California is a highly productive agricultural valley that heavily employs agricultural burning. We investigated associations between individual-level exposure to agricultural burning and parent-reported respiratory symptoms in children.

METHODS: We leveraged the Children's Assessing Imperial Valley Respiratory Health and the Environment cohort of 744 elementary school students in five predominantly Hispanic low-income communities in Imperial County. Parents reported children's respiratory health symptoms and family demographic characteristics in questionnaires collected at enrollment and in annual follow-up assessments from 2017-2021. Permitted agricultural burns in Imperial County from 2016-2021 were spatially linked to children's geocoded residential addresses. We used generalized estimating equations to evaluate associations between repeated measures of respiratory symptoms and exposure to agricultural burning within 5 km in the 12 months prior to each assessment.

RESULTS: Two-thirds (495, 68%) of children lived within 5 km of at least one agricultural burn during the study period. Children exposed to agricultural burns were generally similar to unexposed children. After adjustment for language of parent questionnaire, health insurance, child sex, grade, school, and asthma diagnosis at baseline, children living within 5 km of agricultural burning had greater odds of reported bronchitis (OR 4.30, 95% CI 1.74-10.7), bronchitic symptoms (OR 1.98, 95% CI 1.16-3.40), and asthma medication use (OR 1.90, 95% CI 0.96-3.76), compared to unexposed children.

CONCLUSIONS: To our knowledge, this is the first U.S. study of agricultural burning and children's respiratory health. This work suggests that reducing agricultural burning could improve children's respiratory health. Further research quantifying how air toxics may mediate the observed associations is forthcoming.

KEYWORDS: agricultural burning, children, respiratory, geospatial

O-OP-222 Exposure to Indoor Particulate Matter is Associated with Gastrointestinal and Respiratory Microbial Communities

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BACKGROUND AND AIM: Exposure to outdoor particulate matter (PM2.5) has been associated with the respiratory and gut microbiome. Despite this, it remains uncertain how PM2.5 exposure may impact these developing microbial communities in early life. This study aimed to characterize the associations between exposure to household PM2.5 and the infant gut and respiratory microbiota.

METHODS: This study included 80 infants (~6-months of age) from a pregnancy cohort in rural Bangladesh. PM2.5 exposure was assessed using in-home optical sensors and stool and nasal microbiota were characterized using 16S rRNA sequencing. Associations between PM2.5 and microbial taxa were examined using zero-inflated negative binomial regression and incidence rate ratios (IRR) and Benjamini-Hochberg Procedure adjusted p-values (FDRBH) are reported. PM-associated microbial profiles were identified using differential abundance analysis by examining the log-ratio of differentially ranked sub-operational taxonomic units (sOTUs). Associations between PM2.5 and diversity measures were examined via multivariable linear regression and Mantel tests. Analyses adjusted for antibiotic exposure and infant weight.

RESULTS: PM2.5 exposure was associated with 8 gut and 25 respiratory bacterial taxa (FDRBH < 0.1). for example, PM2.5 was associated with the gut bacterial class Fusobacteriia (IRR=1.02, FDRBH=0.08) and the genus Pseudoramibacter Eubacterium (IRR=0.92, FDRBH=0.004). Similarly, PM2.5 was associated with the respiratory bacterial family Planococcaceae (IRR=0.96, FDRBH=0.005) and the genus Arthrobacter (IRR=1.02, FDRBH=0.06). PM2.5 exposure was also associated with distinct gut bacterial profiles based on the log-ratio of differentially ranked sOTUs (R2=0.10, P=0.004). Further, PM2.5 was associated with gut microbial beta-diversity (P=0.03).

CONCLUSIONS: PM2.5 exposure was associated with the infant gut and respiratory microbiota. Several of these bacteria have been associated with the immune system. Namely, taxa within the class Fusobacteriia and Planococcaceae have proinflammatory and/or immunoregulatory effects. These results suggest that PM2.5 exposure may alter microbial communities with implications for immune function and inflammation.

KEYWORDS: Particulate Matter, Microbiome, Infancy, Development

ORAL PRESENTATIONS SESSION 41:
Heat stress, temperature, air pollution and health

O-OP-223 The Effects of Co-Exposure to Extremes Heat and Particulate Air Pollution on Mortality in California

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BACKGROUND AND AIM: Extremes of heat and particulate air pollution threaten human health and are becoming more frequent due to climate change. Understanding the health impacts of the co-exposure to extreme heat and air pollution is urgent.

METHODS: Death certificate data for California from January 1, 2014, to December 31, 2019 were used to identify all-cause, cardiovascular, and respiratory mortality. A case-crossover study with time-stratified matching and conditional logistic regression was used to estimate the mortality association with acute co-exposures to extreme heat and PM2.5. Several percentile-based threshold values (i.e., 90th, 95th, 97th, and 99th) were used to define a day as an extreme exposure day. for each case day (date of death) and its control days, daily average PM2.5, maximum and minimum temperature were assigned based on decedent's residence census tract. Age-stratified analyses were also conducted.

RESULTS: This study included 1.5 million all-cause, 0.5 million cardiovascular, and 0.14 million respiratory deaths. Based on a 99th percentile threshold, all-cause mortality risk increased 6.1% (95%confidence interval,CI: 4.1, 8.1) on extreme maximum temperature only days and 5.0% (95%CI: 3.0, 8.0) on extreme PM2.5 only days, compared to non-extreme days. Risk increased 21.0% (95%CI: 6.6, 37.3) on days with exposure to both extreme maximum temperature and PM2.5. Increased risk of cardiovascular and respiratory mortality on extreme co-exposure days were 29.9% (95%CI: 3.3, 63.3) and 38.0% (95%CI: -12.5, 117.7), respectively, and were more than the sum of individual effects of extreme temperature and PM2.5 only. A similar pattern was observed for co-exposure to extreme PM2.5 and minimum temperature; effect estimates were larger among those over age 75 years.

CONCLUSIONS: Short-term exposure to extreme heat and air pollution alone were individually associated with increased risk of mortality, but their co-exposure had larger effects beyond the sum of their individual effects.

KEYWORDS: extreme co-exposure, heat, air pollution, mortality

O-OP-224 Projection of combined vulnerability to air pollution and heat stress

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BACKGROUND AND AIM: Climate change caused by anthropogenic emissions is associated with increase in the frequency and intensity of climate extremes. Exposure to non-optimal temperature is related with 2-5 million deaths per year globally. In addition, air pollution has become a key concern for public health. Particulate matter less than 2.5 µm in diameter (PM2.5) is the largest environmental risk factor globally and is expected to worsen with projected increase in anthropogenic emissions. However, little is studied on vulnerability of combined exposure to these two environmental hazards under a changing climate.

METHODS: We use outputs from three CMIP6 models to project PM2.5 and Wet Bulb Global Temperature (WBGT) till end of the century under SSP126, 370 and 585 scenarios. We assessed the combined vulnerability of the exposed population, represented by vulnerability index(VI), to these two risk factors by factoring in the distribution of projected gross domestic product and education attainment (together termed socioeconomic indicator).

RESULTS: We find currently, 7% of the population (8% of the population above 65years) reside in regions with the highest vulnerability (mostly in Asia), which is projected to increase to 25% (and 32%) in 2050 under the SSP370 scenario. Globally, under all the three scenarios, percentage of population exposed to the most extreme VI was projected to increase till 2050, and decrease thereafter under SSP126, but under SSP585 and SSP370 scenarios, we found a significant increase in the population exposed to the most extreme VI.

CONCLUSIONS: To the best of our knowledge, we present the first results on projections of combined vulnerability from exposure to two of the most hazardous environmental risk factors,by identifying their collocational hotspots across the globe. Our results may be used to assist decision making targeted towards averting exposure and excess deaths from heat stress and air pollution in the future decades.

O-OP-225 Mediation of 8-hour Maximum Concentration of Ozone on Association between Temperature and Daily Mortality and Excess Mortality due to Climate Change in 7 Metropolitan Cities in Korea

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BACKGROUND AND AIM: Climate change is suspected to cause adverse health effects, and increased ozone concentration is one of proposed pathways. We examined the mediation of ozone on the association between temperature and daily mortality and estimated excess mortality due to increased temperature.

METHODS: Daily mean temperature, 8-hr maximum ozone concentration and daily number of non-accidental death from 7 metropolitan cities (Seoul, Busan, Daegu, Incheon, Daejeon, Gwangju and Ulsan) in Korea between Jan. 1, 2006 and Dec. 31, 2019 were used. The mediation of ozone was evaluated with Sobel test and causal mediation analysis. The causal mediation analysis with Poisson regression model was conducted in days with temperature over and under 25℃. Coefficients for temperature's direct effect and indirect effect mediated by ozone was estimated in each city and pooled to produce single exposure-response function. We calculated excess mortality due to direct and indirect effects of daily temperature exceeding average daily temperature of 1960 through 1990.

RESULTS: The daily mean temperature was 1.15±2.94℃ higher compared to average daily temperature of 1960 through 1990. The Sobel test in all 7 cities were significant. The pooled RR (for 1℃-increment) of direct effect in days with temperature over 25℃ was 1.2047 (95% confidence interval: 1.1101, 1.3174) and 1.0762 (1.0403, 1.1132) in days with temperature under 25℃. The RRs of indirect effects were 0.9994 (0.9987, 1.0001) and 1.0004 (1.0000, 1.0007) for over and under 25℃, respectively. The numbers of excess deaths during the study period were 63,430 and 81,906 due to direct effect in days over and under 25℃, respectively, and -223 and 462 due to indirect effect in days over and under 25℃, respectively.

CONCLUSIONS: In the present analysis, we observed mediation of ozone between temperature and daily mortality. There has been significant number of excess deaths due to climate change.

O-OP-226 Heat, Fine Particulates, and Diagnosis of Dementia: A Matched Case Control Study in North Carolina from 2003 to 2016

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BACKGROUND AND AIM: Dementia continues to pose a serious health concern for aging populations around the world and may be affected by fine particulate (PM2.5) air pollution. As our planet warms and climates shift, environmental factors may contribute to chronic health outcomes, including dementia. We aim to determine if any association between prior year average temperature and diagnosis of dementia is discernable using available medical records data.

METHODS: Using a random sample of University of North Carolina (UNC) electronic health records, we identified 318 individuals with any diagnosis of dementia. We utilized a 4:1 matched case-control design to link each case with hospital-based controls by birth year, sex, race, Census 2010 income and education tertiles, and climate zone. Climate data was derived from PRISM Climate Group data. Prior year average air temperature (min=12.26°C max=18.50°C), relative humidity (min=58.18% max=75.74%), and apparent temperature (min=11.86°C max=19.86°C) were calculated based on patient zip code. We also examined associations with prior year PM2.5 (min=5.50 µg/m3 max=15.56 µg/m3) estimated using an ensemble machine learning model and first diagnosis of dementia or first non-dementia diagnosis for controls. We conducted multivariable logistic regression models to estimate odds ratios (OR) and 95% confidence intervals (CI) adjusted for our matching variables and urbanicity.

RESULTS: We observed significant positive associations between diagnosis of dementia and increased PM2.5 (OR 1.18; 95%CI 1.09-1.28) per 1 µg/m3, and for relative humidity (OR 1.06; 95%CI 1.01-1.11) per 1%. Air and apparent temperature showed similar patterns (OR 1.16; 95% CI 0.99-1.35 and OR 1.17; 95%CI 1.02-1.34) per 1°C.

CONCLUSIONS: Our findings indicate that there are associations between both PM2.5 and year prior heat exposures and dementia. These findings suggest that further investigation into the role of heat and dementia is warranted. This abstract does not reflect EPA policy.

KEYWORDS: dementia, heat, climate change, air pollution

O-OP-227 Ambient heat exposure and COPD hospitalisations in England: A nationwide case-crossover study during 2007-2018

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BACKGROUND AND AIM: There is emerging evidence suggesting a link between ambient heat exposure and chronic obstructive pulmonary disease (COPD) hospitalisations. Individual and contextual characteristics can affect population vulnerabilities to COPD hospitalisation due to heat exposure. This study quantifies the effect of ambient heat on COPD hospitalisations and examines population vulnerabilities by age, sex, and contextual characteristics.

METHODS: Individual data on COPD hospitalisation at high geographical resolution (postcodes) during 2007-2018 in England was retrieved from the small area health statistics unit. Maximum temperature at 1 km×1km resolution was available from the UK Met Office. We employed a case-cross over study design and fitted Bayesian conditional Poisson regression models. We adjusted for relative humidity and national holidays, and examined effect modification by age, sex, green space, average temperature, deprivation and urbanicity.

RESULTS: After accounting for confounding, we found a 1.47% (95% Credible Interval 1.19% to 1.73%), increase in the hospitalisation risk for every 1oC increase in temperatures above 23.2oC (lags 0-2 days). We reported weak evidence of an effect modification by sex and age. We found a strong spatial determinant of the COPD hospitalisation risk due to heat exposure, that was alleviated when we accounted for contextual characteristics. Assuming a causal effect, 22 214 (95% CrI 18 907 to 24 947) COPD hospitalisations were attributable to heat exposure.

CONCLUSIONS: Our study suggests that resources should be allocated to support the public health systems, for instance through developing or expanding heat-health alerts, to challenge the increasing future heat-related COPD hospitalisation burden.

KEYWORDS: climate change, respiratory admissions, spatial effect modification

O-OP-228 Interactive effects of heat and air pollution on mortality in Europe using small area data – Results of the exhaustion project

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BACKGROUND AND AIM: Studies on the interactive short-term health effects of heat and air pollution are limited and mostly carried out in cities thus providing limited evidence at national level and on the effects in suburban and rural areas.

METHODS: We used daily data on natural, cardiovascular and respiratory mortality, air temperature, particulate matter (PM2.5, PM10) and ozone (O3) for administrative small areas (municipalities) in five regions of Europe (Norway, England and Wales, Germany, Italy, and the Attica Region, Greece) during the warm season. We applied a two-stage design, where area-specific data were analyzed in the first stage with over-dispersed Poisson regression models, and a random-effects meta-analysis was conducted in the second. The interaction between temperature and air pollutants was analysed by a response-surface model with a tensor smoother. The study reports the effects of air temperature for an increase from 75th to 99th percentile by levels of air pollutants (95th percentile=high, 50th=medium, 5th=low).

RESULTS: Overall results showed an effect modification by PM2.5 in the relationship between heat and mortality. for an increase in mean temperature, the overall risk of natural mortality increased by 6.6% (95% CI: -1.9%, 15.8%), 10.9% (95% CI: 2.7%, 19.7%), and 14.2% (95% CI: 4.5%, 24.9%) at the low, medium, and high levels of PM2.5, respectively. Stronger heat effects were observed for respiratory mortality with high PM2.5 levels (25.0%; 95%CI: 6.4%, 46.9%). for O3 we found a suggestion of effect modification in the relationship between heat and mortality, with a trend in effect estimates for increasing levels of O3. Among the five regions some heterogeneity in effect estimates and in the impact of effect modification by air pollution was observed.

CONCLUSIONS: Evidence of effect modification between heat and air pollutants on mortality during the warm period was found, with slightly heterogeneous patterns within regions.

ORAL PRESENTATIONS SESSION 42: Environment and health in low and medium income countries (2)

O-OP-230 The effect of landscape fires on child hospital visits and admissions: a time-series study in southern Mozambique

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BACKGROUND AND AIM: Epidemiological evidence linking exposure to landscape fires with child health remains limited. We assessed the association between day-to-day variation in landscape fires and child hospital visits and admissions in Manhiça district, Mozambique, an area affected by forest and cropland fires.

METHODS: We conducted a time-series analysis (2012-2020) using daily satellite-derived fire data (VIIRS 375m) and number of hospital visits and admissions from an ongoing pediatric morbidity surveillance system (children aged ≤ 15 years). Fires were extracted from the study area and a 100km surrounding buffer. We applied quasi-Poisson regression models controlling for temperature, day of the week, season and long-term trend, and offsetting by annual population-time at risk to examine associations between fires (lags 0-4) and hospital visits and admissions.

RESULTS: at least 114,443 fires (mean: 44/day; median: 13/day) and a total of 507,034 child hospital visits (mean: 154/day; 39.5% respiratory-linked) and 8,981 admissions (mean: 2.7/day; 26.7% respiratory-linked) occurred in 2012-2020. Almost half of the fires were forest fires. Fires explained 39% of temporal variability in PM2.5 from a local monitoring campaign. Comparing two days with identical values in the adjustment variables but differing by 40 fires (interquartile range) resulted in an increase of all-cause (0.95%; 95%CI: 0.46, 1.44) and respiratory-linked hospital visits (1.14%; 0.57, 1.69) the following day (lag 1). Significant associations were observed for other lags in fires including: lag 0-1 with all-cause (0.47%; 0.17, 0.77) and respiratory-linked visits (0.64%; 0.29, 0.99) and lag 2 with respiratory-linked visits (0.47%; 0.17, 0.77). We did not observe associations for hospital admissions.

CONCLUSIONS: Landscape fires were associated with all-cause and respiratory-linked hospital visits in children. Improved exposure assessment is needed to better quantify the contribution of air pollution due to landscape fires on child health in regions with limited air pollution monitoring.

KEYWORDS: Landscape fires, child health, Mozambique

O-OP-231 Effects of a liquefied petroleum gas stove intervention on gestational blood pressure: intention-to-treat and exposure-response findings from the Household Air Pollution Intervention Network (HAPIN) trial

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INTRODUCTION: Approximately 3-4 billion people worldwide are exposed to household air pollution (HAP) from burning solid fuels. HAP has been linked to increased blood pressure (BP) in pregnant women, although the literature is sparse and inconsistent.

METHODS: We recruited 3195 pregnant women in Guatemala, India, Peru, and Rwanda and randomly assigned half of them to receive a liquified petroleum gas (LPG) stove/fuel intervention over the pregnancy, while those in the control group continued cooking with solid fuels. We measured gestational BP and personal exposure to PM2.5, black carbon (BC), and carbon monoxide (CO) three times during gestation: once at baseline and twice post-randomization. We conducted an intention-to-treat (ITT) analysis and an exposure-response analysis to determine if exposure to HAP during gestation was associated with an increase in BP at the final measurement compared to baseline.

RESULTS: In the intervention group, 24-hour PM2.5 dropped from 84 µg/m3 at baseline to 24 µg/m3 after the intervention; BC and CO decreased similarly. ITT analyses showed an increase over gestation (as expected) in systolic BP (SBP) and diastolic BP (DBP) in both arms, but the increase was greater in the intervention group for SBP (0.69 mmHg, 95% CI 0.03 - 1.35) and DBP (0.62 mmHg, 95% CI 0.05 - 1.19) than controls. Exposure-response analyses showed that higher HAP exposures were associated with modest increases in SBP and DBP, but none of these associations were significant.

CONCLUSIONS: We found a greater increase in BP over gestation in the intervention group in ITT analyses. This was contrary to what we expected, though the increases were not considered clinically significant. In exposure-response analyses, we found a slight increase in BP with higher exposure, although no increases were significant. Overall, the LPG stove/fuel intervention did not markedly affect gestational BP.

KEYWORDS: Household Air Pollution, Blood Pressure, Pregnant Women

O-OP-232 Indoor air pollution and diet mediates the effects of social inequality on birth outcomes

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BACKGROUND AND AIM: The detrimental effect of social inequality on birth outcomes in the low to middle income countries (LMICs) can only be partially explained by lack of access to care and biomass fuel use. We aim to investigate other possible factors that can mediate the effects of SES on birth outcomes.

METHODS: The analyses were based on a pregnancy cohort of 723 mother-infant pairs with single live births between 2016-2017 in rural Bangladesh. Multivariable linear and logistic regressions, and mediation analysis were performed adjusting for demographic characteristics, maternal and infant-related factors, and air pollution from cooking sources. As potential mediating factors of SES (Lowest three quintiles of calculated Wealth Index were considered low SES), we considered other sources of indoor pollution (i.e., traditional lamp fuel and mosquito repellents), maternal diet, and stress during pregnancy.

RESULTS: Compared to households with high SES, adjusted mean birth weight was 64.2 g (95% confidence interval, CI: -121.6, -6.8) less and the odds of small for gestational age (SGA) was 40% (RR:1.40, 95% CI: 1.01, 1.99) higher among households with low SES. Exposure to other sources of indoor air pollution and lower amount of protein- and dairy-rich maternal diet during pregnancy mediated 50% and 25% of the effect of SES on birth weight and SGA, respectively. Indoor air pollution from non-cooking sources alone mediated 33% of the SES effect on birthweight and 18% on SGA.

CONCLUSIONS: This study highlights that non-cooking related household sources of air pollution and maternal diet are potential modifying factors in LMICs that can be addressed to reduce the effect of social inequity on birth outcomes.

KEYWORDS: Indoor air pollution, socioeconomic status, birth weight, low- and middle-income countries.

O-OP-233 Air pollution, physical activity, and incident gestational diabetes mellitus: a prospective cohort study

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BACKGROUND AND AIM: Physical activity (PA) during pregnancy has been linked to decreased risk of gestational diabetes mellitus (GDM). However, engaging in PA may increase exposure to air pollutants. We aimed to examine whether and how exposure to air pollution may affect the protective effect of PA on GDM.

METHODS: This study included 21,545 pregnant women from the Born in Guangzhou Cohort Study, China. Exposure to ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), particulate matter less than 10 microns in diameter (PM10), and less than 2.5 microns in diameter (PM2.5) were estimated by the inverse distance-weighted models. Information on PA was collected using a self-administrated questionnaire. We used generalized estimating equations to calculate covariate-adjusted relative risks (RRs) and 95% confidence intervals (CIs) for the associations of air pollution, PA, and the multiplicative interaction of the two with the risk of GDM.

RESULTS: The GDM risk was inversely associated with overall PA level (RR, 0.93; 95% CI: 0.89, 0.96). Per 10 μg/m3 increase in O3 concentration conferred a 12% (95%CI: 6%, 18%) increase in the risk of GDM. Higher overall PA was associated with a lower GDM risk among women with low O3 exposure (RR, 0.88; 95% CI: 0.81, 0.95), but not among women with high O3 exposure (RR, 0.97; 95% CI: 0.91, 1.04) (P interaction = 0.008). Exposure to other air pollutants did not modify the association between overall PA and GDM.

CONCLUSIONS: PA and exposure to air pollutants were associated with GDM risk in the opposite direction. O3 exposure, but not other air pollutants, attenuated the protective effect of PA on GDM. Our finding highlights the importance of improving air quality to keep the beneficial effect of PA.

KEYWORDS: air pollutants, gestational diabetes, physical activity, ozone

O-OP-234 Association of Ambient and Household Air Pollution with Lung Function in Young Adults in an Peri-urban Area of South-India: a cross-sectional study

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BACKGROUND AND AIM: Although there is evidence for the association between air pollution and decreased lung function in children, evidence for adolescents and young adults is scarce. for a peri-urban area in India, we evaluated the association of ambient and household air pollution with lung function for young adults who had recently attained their expected maximum lung function.

METHODS: We measured, using a standardized protocol, forced expiratory volume in the first second (FEV_1) and forced vital capacity (FVC) in participants aged 20-26 years from the third follow-up of the population-based APCAPCS cohort (2010-2012) in 28 Indian villages. We estimated annual average $PM_{2.5}$ outdoors at residence using land-use regression. Biomass cooking fuel (a proxy for levels of household air pollution) was self-reported. We fitted a within-between linear-mixed model with random intercepts by village, adjusting for potential confounders.

RESULTS: We evaluated 1,044 participants with mean age of 22.8 (SD=1) years (p25-p75: 22-24); 327 participants (31%) were female. Only males reported use of tobacco smoking (9% of all participants, 13% of males). The mean ambient PM2.5 exposure was 32.9 (SD=2.8) $\mu g/m^3$. 76% reported use of biomass as cooking fuel. The adjusted association between 1 µg/m3 increase in $PM_{2.5}$ was -27 ml (95%CI, -89 to 34) for FEV_1 and -5 ml (95%CI, -93 to 76) for FVC. The adjusted association between use of biomass was -112 ml (95% CI, -211 to -13) for FEV_1 and -142 ml (95%CI, -285 to 0) for FVC. The adjusted association was of greater magnitude for those with unvented stove (-158 ml, 95%CI, -279 to -36 for FEV_1 and -211 ml, 95%CI, -386 to -36 for FVC).

CONCLUSIONS: We observed negative associations between ambient and household air pollution and lung function in young adults who had recently attained their maximum lung function.

KEYWORDS: air pollution; lung function; India

O-SY-128 Using spatial data for sampling prioritization and prediction of PFAS chemicals in fish tissue in the Columbia River Basin

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BACKGROUND AND AIM: U.S. tribes and states are challenged with identifying and characterizing the extent of per- and polyfluoroalkyl substances (PFAS) contamination and human exposure to PFAS, as well as developing effective and cost-efficient ways to prioritize site investigation. In the Columbia River Basin (CRB), particularly in and around the region's tribal lands, the availability of PFAS occurrence data is limited and exposure is less characterized than in other parts of the country. This study aims to develop and pilot a predictive modeling workflow for prioritization of sampling locations that show potential for PFAS exposures in vulnerable populations in the CRB.

METHODS: AND

RESULTS: While previous studies have mainly developed predictive models for PFAS in groundwater, this study develops and evaluates predictive models for PFAS in fish tissue. Understanding PFAS levels in fish is particularly important in CRB because it can be a major component of tribal and indigenous peoples' diet. Existing spatial data in the region are leveraged including locations of known PFAS sources or contaminated sites and potential, yet unconfirmed, sources such as PFAS-related industry facilities, mining and refinery sites, airports, and landfills. Machine learning and statistical models employ these spatial data to predict PFAS concentrations in fish tissue in natural waters throughout the CRB and will be evaluated using empirical fish tissue occurrence data.

CONCLUSIONS: Model predictions help to identify areas in which high PFAS concentrations are likely to occur in fish tissue but sampling has not yet confirmed. This workflow for targeted prioritization of sampling investigations and the identification of contaminated natural resources will help U.S. tribes and states in the Columbia River Basin more efficiently manage waste, initiate clean-up activities, and identify opportunities for source reduction, thereby promoting healthy and resilient communities.

KEYWORDS: PFAS, spatial analysis, predictive modeling, fish tissue, Columbia River Basin

ORAL PRESENTATIONS SESSION 43:
Modelling techniques for exposure assessment

O-OP-235 UK hyperlocal air pollution model – Use of inverse modelling to increase the spatial detail of air pollution predictions

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BACKGROUND AND AIM: Air pollution models are increasingly able to provide forecasts of NOx, NO_2, O_3, $PM_{2.5}$ and PM_{10} at country scales (every 1-2km) and close to roads (every 10-20m). However, a significant limitation of these models is the lack of road traffic flow, speed and emissions.
AIM: To develop a hyperlocal model which predicts air pollution every 20m across all of UK's roads.

METHODS: Here we address the lack of detailed traffic counts, speed and emissions by utilising ~12,000 diffusion tube and local sensor measurements in the UK, with a road traffic emissions optimisation method (EOM). The EOM uses model sensitivity coefficients in Taylor series expansions of the models' response to varying emissions, allowing Monte Carlo emissions calibration to be performed at every monitoring location. This has allowed the creation of previously unavailable road emissions estimates, as well as the calibration of emissions on those roads that were already in the model. for other sources we used a combination of European, UK National Atmospheric Emissions Inventories. Air pollution was predicted using the WRF met. model and the CMAQ-urban coupled model.

RESULTS: The EOM has enabled an emissions calibration process of unprecedented scale – improving traffic emissions estimates and enabling air pollution predictions at 20m resolution for every road in the UK. The NOx, NO_2 and O_3 model performance compares favourably with out of sample measurements and the EOM addresses the uncertainty NOx, NO_2 emissions from road transport, which has hitherto been under predicted.

CONCLUSIONS: We have demonstrated what is possible with coupled CTM and local scale air pollution models, when combined with sufficiently detailed emissions inventories. This new approach is ideally suited for use with low cost sensor networks globally, providing data, including for $PM_{2.5}$ and PM_{10}, for local populations, policy development and health research, across entire cities and even countries.

O-OP-236 Assessing daily PM2.5 at every square kilometer of India over 2008-2020 using a machine learning framework

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BACKGROUND AND AIM: High levels of ambient particulate matter (PM) combined with sparse ground monitoring networks, specifically concentrated in urban areas in India, pose massive challenges to studying health effects of PM in India. Thus it is important to develop robust predictive models that provide exposure estimates at high spatiotemporal resolution across India.

METHODS: We used a machine-learning-based approach by ensemble averaging across four different learners to develop a model calibrated against ground-monitoring-based data from 1060 stations spanning 2008-2020. To counter the sparsity of available PM2.5, we also implemented a calibration model for the ratio of PM2.5 and PM10. Predictors encompassing all major areas such as, meteorology, land-use patterns, satellite observations, emissions inventories and chemical transport models were utilized. Overall cross-validation(CV) was conducted by leaving out monitors and performance was assessed at the daily level using R2, RMSE, bias and slope.

RESULTS: In the left-out 20% validation dataset, median estimated PM2.5 using ensemble averaging was 44.5 µg/m3 compared to the observed concentration of 45 µg/m3. The overall daily CV-R2 was 0.84 ranging between 0.73-0.92 across years, while daily RMSE ranged between 3.7-4.2 µg/m3. Among the learners, tree-based algorithms (gradient boosting, extreme gradient boosting and random forests) performed better than deeplearning, and ensemble averaging further improved the predictive performance. Among predictors, meteorology, reanalysis based PM2.5 and elevation were more predictive by the tree based learners while urban-rural classification and road density were high-rank predictors by the deeplearning algorithm.

CONCLUSIONS: We have developed a valuable resource for air pollution epidemiology in a LMIC scenario with both high levels of pollution and burden of disease. The resulting predictions can leverage existing, ongoing and future health studies all across India to accurately assess the burden of ambient PM2.5 on a multitude of health outcomes.

KEYWORDS: Particulate Matter, Machine learning, Ensemble averaging, India, Spatiotemporal

O-OP-237 Comparison of PM2.5 concentrations estimated using eleven different methods and their associations with cognitive outcomes in the ARIC cohort

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BACKGROUND AND AIM: Evidence of associations between fine particulate matter (< 2.5 µm aerodynamic diameter) ($PM_{2.5}$) and dementia-related outcomes remains mixed. Existing studies have used a variety of methods to estimate exposure, but the literature comparing the impact of estimation method on exposure and health effects is limited. This study aims to assess agreement between $PM_{2.5}$ concentrations across 11 estimation methods and to compare estimated associations between $PM_{2.5}$ and dementia-related outcomes using data from the Atherosclerosis Risk in Communities (ARIC) study cohort, which recruited in 1987-1989 from four regional sites: Forsyth County, NC; Jackson, MS; the suburbs of Minneapolis, MN; and Washington County, MD.

METHODS: Using the ARIC cohort, we estimated address-based mean $PM_{2.5}$ concentrations (2000-2007) using 11 different

METHODS: We assessed agreement between method-specific $PM_{2.5}$ concentrations using descriptive statistics and plots, overall and by site. We used adjusted linear and logistic regression to estimate associations between method-specific $PM_{2.5}$ concentrations and Visit 5 (2011-2013) cognitive scores and brain MRI outcomes, stratified by study site and then combined with random-effects meta-analysis.

RESULTS: $PM_{2.5}$ concentrations from most estimation methods had good agreement across sites and lower agreement within each site. Within-site exposure variation was limited for some

METHODS: Point estimates for $PM_{2.5}$-cognitive outcome associations varied by method and generally did not support associations between $PM_{2.5}$ and cognitive (n=4,460) or MRI (n=1,427-1,441) outcomes. Small, but statistically significant effect estimates were found for a few exposure method-outcome associations, but these associations were null when using $PM_{2.5}$ estimates from most other

METHODS:
CONCLUSIONS: Exposure estimation approaches agreed more across ARIC sites than within each site. Variability between exposure estimation methods for $PM_{2.5}$ within sites likely contributed to heterogeneity in estimated associations with cognitive outcomes. Choice of estimation methods may influence estimated exposure and findings in epidemiological studies when participants are concentrated in small geographic areas.

O-OP-238 Sources of measurement error for indoor carbon monoxide exposure – A simulation model

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BACKGROUND AND AIM: Carbon monoxide (CO) is toxic gas produced by incomplete combustion of carbon-based fuel. Random error in exposure measurements at the population level reduces the power of a study, making it more likely that real associations are not detected. The burden of CO poisoning and its related health effects are likely underestimated due to exposure misclassification. We reviewed exposure measurement methods used for indirect indoor CO measurement and identified key sources of error which could contribute to exposure misclassification. Using a simulation model, we aimed to quantify the impact that changes in error could have on relative risk (RR) health estimates.

METHODS: We identified potential sources of error associated with indoor CO monitoring methods used in studies based in Peru and the UK. Using error contribution data reported in the studies, and technical apparatus reports, we quantified the impact of error improvement on health risk estimates using a simulation model to calculate error contribution scenarios. Error contribution ranges of 5-15% and 10-50% were modelled for Peru and the UK respectively. for both studies, error improvement scenarios were modelled between 20-80%.

RESULTS: Monitor accuracy, positioning, inter-subject variability, and lack of detailed time activity patterns were identified as key sources of error. Under differing error contribution and improvement scenarios, the RR measures for the Peru and UK studies were improved by 0.32% and 1.13% at the lowest error contribution and improvement level to 3.99% and 26.28% at the highest error contribution and improvement level respectively.

CONCLUSIONS: Identification of sources of errors and quantification of their potential impact on measures of effect by simulation is feasible. We will apply this approach to design improved exposure assessment methods, with the aim to reduce misclassification and produce more valid estimates of CO effects on the population.

KEYWORDS: Measurement error, Carbon monoxide, Exposure, Indoor

O-OP-239 Air Pollution Models of High Spatiotemporal Resolution for the State of California to Identify Exposure Disparities of the Disadvantaged Communities

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BACKGROUND AND AIM: Disadvantaged communities face higher air pollution burden than advantaged communities, but current research has not developed high resolution daily air pollution models enabling to identify exposure disparities for disadvantaged communities across a highly populated state with large geographic scope. We aim to develop daily air pollution models and surfaces of high spatiotemporal resolution for the State of California – the most populous US state with more than 39.5 million people across 163,696 square miles (423,970 km2).

METHODS: We generated TBs of data from various platforms (including NASA and NOAA Remote Sensing data, Google Earth Engine data, and our research data), and integrated air pollution measurements from multiple instruments (e.g., Google Streetcar, government continuous monitoring and our research saturation monitoring) into a single modeling framework. We used the best-practice out-of-sample v-fold cross-validation Deletion/Substitution/Addition (D/S/A) technique to develop daily models of 30 m resolution for years 2012-2019 across California on nitrogen dioxide (NO2), fine particulate matter (PM2.5) and ozone (O3). We further identified exposure disparities for the disadvantaged communities based on census tract level race-ethnicity composition, socio-economic status and health endpoints.

RESULTS: With the integration of data in land use, land cover, traffic, remote sensing acquisition, daily weather conditions, plus their buffered statistics, we generated more than 2,000 covariates in modeling a single pollutant. Through data reductions strategy and the D/S/A modeling framework, we created air pollution models with a respectively adjusted R2 of 79.6%, 65.3% and 93.6% for NO2, PM2.5 and O3. We further identified significant air pollution exposure disparities for the disadvantaged communities.

CONCLUSIONS: We are the first in literature that generated TBs of high spatiotemporal air pollution surfaces through integrating TBs of data sources in a out-of-sample cross-validation machine learning algorithm for California.

KEYWORDS: Deletion/Substitution/Addition, nitrogen dioxide, fine particulate matter, ozone, State of California, disadvantaged, disparity.

O-OP-240 Personal exposures to PM2.5 in rural Beijing, China: Spatial-temporal variation patterns and modeling approaches

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BACKGROUND AND AIM: Household air pollution is a leading health risk factor for global morbidity and mortality. However, studies with high quality personal exposure data in settings of household air pollution are very limited. To investigate the levels and patterns of personal exposures to $PM_{2.5}$ in rural Beijing and develop a personal exposure model, we conducted measurements in over 500 households in 50 villages in rural Beijing over two winters.

METHODS: Adults (> 40-year-old) from 10 randomly selected households in each village were recruited to wear a personal exposure sampler (Ultrasonic Personal Aerosol Samplers, UPAS) to measure 24-h exposures. Indoor $PM_{2.5}$ was concurrently monitored in 300 households using calibrated low-cost sensors (Plantower) and outdoor $PM_{2.5}$ was monitored at the community levels using the same sensors. We also administered a survey to collect household socio-demographic information, fuel use patterns, and general physical activity patterns. Mixed-effects models and quantile regression were applied to investigate distributional effects in indoor and outdoor $PM_{2.5}$ and temperature, heating energy use, and other socio-demographic factors on personal exposures.

RESULTS: Personal $PM_{2.5}$ decreased by 39 (95%CI: 3.8-74) $\mu g/m^3$ for participants who shifted from solid fuel to clean energy for heating between study years, but the reduction in participants who continued using solid fuel was only 27 (95%CI: 9.9-44) $\mu g/m^3$. Indoor and outdoor $PM_{2.5}$ explained the largest proportion of personal $PM_{2.5}$ variance. Less wealthy participants who were current smokers and used solid fuels for space heating tended to have higher exposures. In quantile regression, at high quantiles of personal exposure levels, the influences of indoor $PM_{2.5}$ on personal exposures enlarged.

CONCLUSIONS: Transitions to clean energy for space heating improved indoor air quality and personal exposures. The influence of different variables on personal exposures varied by exposure levels, and it is essential to model personal exposures by exposure levels.

ORAL PRESENTATIONS SESSION 44:
Risk communication and participatory epidemiology

O-OP-241 PM2.5 attributable health disparities and distributional benefits of alternative National Ambient Air Quality Standards in the continental United States

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BACKGROUND AND AIMS: Racial, ethnic, and socioeconomic disparities in exposure to PM2.5 in the United States is well known. However, there is limited understanding of the magnitude of disparities in PM-attributable health effects and distributional benefits of policies, such as potential alternative National Ambient Air Quality Standards (NAAQS) currently being considered by EPA.

METHODS: We use fine scale air pollution, mortality and morbidity data, as well as new race- ethnicity stratified concentration response functions as inputs for a health impact assessment to determine the distribution of PM2.5 health burdens across race/ethnicity and poverty categories throughout the United States in 2015. Using a rollback approach, we examine the potential distribution of benefits of a 10 μg/m3 and 8 μg/m3 annual standard. We also explore the sensitivity of the model outputs to the different inputs.

RESULTS: In 2015, Black Americans experienced three times as many PM2.5-attributable related deaths per capita compared to all other races. The burden of PM-attributable asthma ED visits for non-white Americans were up to six times higher compared to white Americans. We find that an 8 μg/m3 alternative standard could avoid nearly 19,000 premature deaths and 11,500 respiratory emergency room visits. Mortality benefits for the 8 μg/m3 standard are three to four times higher than those for the 10 μg/m3 alternative standard. Per-capita mortality risk reductions for Black Americans are three times the rate of all other races and individuals with incomes ≤ 2X poverty line experience 30% higher mortality benefits under more protective PM NAAQS.

CONCLUSIONS: These findings indicate that more protective NAAQS would provide some reduction in the magnitude of racial/ethnic and socioeconomic disparities in health burdens of air pollution exposure. Despite this, significant residual disparities would remain, suggesting that supplemental policy approaches would be needed to further alleviate the disparity in PM-attributable health burdens.

O-OP-242 Pathway to WHO: Achieving clean air in the UK - Modelling air quality costs and benefits

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BACKGROUND AND AIM: The Clean Air Fund commissioned us to investigate whether the WHO interim target of 10 µg/m3 PM2.5 could be met by 2030 with assessment of the health benefits of these air pollution reductions, to inform consultation on targets for the UK Environment Bill.

METHODS: UK PM2.5 concentrations in 2030 were modelled from 2018 using CMAQ-Urban and emissions predictions from business as usual, electrification of vehicles Planned London specific policies (UK2030+LS1) or two further London scenarios (LS2/3) were added using the London, toolkit model.
Life-table analysis at ward level assumed 2030 concentrations were maintained until 2134. Morbidity outcomes from changes in NO2, PM10 and PM2.5 were quantified using summary estimates from the UK Committee on the Medical Effects of Air Pollutants, WHO and published meta-analyses. Monetary values were then applied.

RESULTS: for UK2030+LS1, concentrations in 2030 were below 10 µg/m3 across the UK except the centre of London, near major roads in cities, and industrial biomass burning locations. With LS2/3, the exceedances dropped to <1% of the area of London. Local authority population-weighted exposures above 10 µg/m3 reduced from 40% in 2018 to 1% in 2030 (UK2030+LS1) to 0% for LS2 and 3.
11.5 million life years were gained across the UK population from 2018–2134 for UK2030+LS1 compared with unchanged 2018 concentrations. 2 million life years were in London, increasing to 2.5 and 2.9 million life years for LS2/3.
Substantial health benefits were generated e.g. avoiding 388,000 asthmatic symptom days in asthmatic children and 3,077 new cases of coronary heart disease per year for UK2030+LS1.
The monetary benefits showed policies costing up to £383 billion between 2018-2134 would be justified.

CONCLUSIONS: The WHO interim target was met in most but not all locations by 2030 generating substantial health benefits.

KEYWORDS: PM2.5, WHO Guidelines, air pollution, health impact assessment.

O-OP-243 The impact of alternative fuel vehicles on health: a systematic review

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BACKGROUND AND AIM: Despite the increasing adoption of alternative fuel vehicles such as electric, hybrid, and clean diesel cars, trucks and buses, the health impacts of these vehicles (e.g., through changes in air quality) is largely unexplored. We reviewed the published literature to assess the state of the evidence on use of alternative fuel vehicles and health.

METHODS: We conducted a systematic literature search of MEDLINE, Embase, Global Health, CINAHL, Scopus, and Environmental Science Collection databases for articles published January 1990 to November 2021. We included articles presenting observed or modeled data on the association between alternative fuel vehicles and health-related outcomes. We abstracted data, categorized studies based on the type of alternative fuel and health outcomes studied, and summarized the results.

RESULTS: In our preliminary findings, 23 of 631 screened articles met our inclusion criteria. The most common vehicle types examined were electric or hybrid electric (n=18, 78%), clean diesel (n=5, 22%), and compressed natural gas (n=3, 13%). Overall, 17 articles (74%) assessed death as an outcome and 8 articles (35%) monetized health benefits. Only one study collected longitudinal data to assess the health impact on a population; the other articles all modeled data. All 23 articles observed some evidence of a positive health impact of adopting alternative fuel vehicles, although magnitudes varied. There was a paucity of information on the environmental justice implications of vehicle transitions (e.g., changing of the spatial distribution of air pollution, emphasis on adoption equity).

CONCLUSIONS: There is limited information, particularly real-world studies, on the health impact of adoption of alternative fuel vehicles. The current rapid transitioning of vehicle fleets to alternative fuels provides a unique opportunity to conduct natural experiments to quantify health impacts and assess environmental justice implications of alternative fuel adoptions.

KEYWORDS: alternative fuels, traffic, review

O-OP-244 Application of co-created citizen science in environmental epidemiology

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BACKGROUND AND AIM: Scientists and scientific institutions are adopting more extensive participatory models, hoping to bridge the gap between institutionalized science and society. Though citizen science has become more common in environmental monitoring, it is seldom utilized in environmental epidemiology. In the Cities-Health study, we co-created epidemiological studies with citizens in five European cities. The aim of this paper is to provide methodological insight into the application of co-created citizen science strategies in environmental epidemiology.

METHODS: We applied the CitieS-Health framework for citizen science, which is a framework that allows citizens to be involved throughout all the phases of the research projects, in five environmental epidemiology studies. Studies covered diverse environmental issues (e.g. urban air pollution, wood smoke, noise) in Spain, Italy, the Netherlands, Slovenia and Lithuania. Among other aspects this included co-identifying the research question, co-designing and submitting the research protocol for ethical clearance, co-collecting data, co-analyzing data, co-authoring scientific articles and further communication of results to diverse audiences.

RESULTS: Together with citizens, we were able to design and conduct environmental epidemiology studies reflecting their concerns and knowledge. Involvement of citizens occurred in all of the research phases with different levels of participation depending on the needs and characteristics of each pilot. Examples of citizens' impact on research done in the Dutch pilot study was the inclusion of an additional health outcome, exposure period analysis and interpretation of exposure settings. Online communication was a major component, affecting the number of citizens involved, but also study quality. Citizens remained interested and invested time throughout the duration of the projects, some even becoming pilot "community champions".

CONCLUSIONS: Integration of citizen science in environmental epidemiology is feasible and has the potential to improve the quality of research and civic trust in research and results.

KEYWORDS: Co- creation, citizen science, Participatory Epidemiology

O-OP-245 An Evaluation of the Air Quality Warning System for Vulnerable and Susceptible Individuals in South Korea

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BACKGROUND AND AIM: Since 1987, WHO has periodically published international air quality guidelines and standards, and governments around the world have set the Air Quality Index (AQI) to monitor air pollution according to the characteristics of individual countries. The set AQI is used for the operation of a forecast and alarm system for air quality. There are many studies on these forecast and warning systems, but evidence of their effectiveness is still limited.

OBJECTIVES: The purpose is to understand the effectiveness of the air quality alert system implemented in January 2015 through the change in the incidence rate of environmental diseases.

METHOD: The study adopted interrupted time series analysis with Poisson segmented regression to detect changes in the incidence rate of environmental diseases after implementing the Air Quality Warning System (AQWS) in Korea using data from 2010 to 2019. Seasonality, air pollutants (CO, NO2, SO2, PM10, and O3), temperature, and humidity are used for adjustment variables. The findings were validated using false policy study periods and digestive diseases as a control.

RESULT: After implementation of the AQWS, the incidence of COPD gradually decreased by 24% (relative risk (RR) 0.76, 95% confidence interval (CI) 0.65-0.88). Asthma and Heart Failure similarly tended to decrease (Asthma : RR 0.37 95%CI 0.21-0.65, HF : RR 0.37 95%CI 0.21-0.65), which was statistically significant. There was a gradual effect on the incidence rate of asthma in both children and the elderly, decreasing 44% and 22%, respectively. In the elderly, the same tendency was found in COPD (RR 0.81, 95%CI 0.70-0.94) and HF (RR 0.95, 95%CI 0.90-0.99).

CONCLUSION: In Korea, the AQWS was effective in most environmental diseases. It is expected that the health benefits of the policy can be maximized if AQWS warns the degree of risk reflecting the characteristics of vulnerable and sensitive individuals.

ORAL PRESENTATIONS SESSION 45: Maternal exposures and neurobehavioural outcomes

O-OP-246 Maternal per- and poly-fluoroalkyl substances exposures associated with higher depression scores among immigrant women in the San Francisco Chemicals in Our Bodies cohort

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BACKGROUND AND AIM: Exposure to per- and poly-fluoroalkyl substances (PFAS) remains an important public health issue, due to their widespread detection in environmental media, slow metabolism in humans, and potential impacts on physiological processes such as neurological signaling. Maternal depression is highly prevalent in pregnancy and is an important neurological outcome that is potentially sensitive to PFAS. The health risks of PFAS may be further amplified in historically marginalized communities, including immigrant women.
OBJECTIVE: We evaluated maternal concentrations of PFAS in association with depression symptoms during pregnancy and stratified by US born and immigrant women.

METHODS: Our sample included 263 United States (US) born and 213 non-US born pregnant people recruited in the Chemicals in Our Bodies cohort (San Francisco, CA). Serum samples were collected in the 2nd trimester to measure seven PFAS chemicals. Depression symptoms were assessed using the Center for Epidemiologic Studies Depression. Single pollutant associations were estimated using linear regression, adjusting for maternal age, education, and pre-pregnancy body mass index. Cumulative PFAS associations were estimated using quantile g-computation.

RESULTS: On average, all PFAS were lower in immigrant participants compared to US participants, which may be due to shorter time spent in the US. A natural log unit increase in two PFAS was associated with higher depression scores among all participants, and stratified analyses showed that this association persisted only among immigrant women ([95% confidence interval]: perfluorooctane sulfonic acid (1.25 [0.14-2.36]) and methyl-perfluorooctane sulfonamide acetic acid (1.68 [0.58-2.77]). Quantile g-computation estimated higher cumulative PFAS exposure was associated with modestly increased depressive symptoms among immigrant women (0.96 [-0.22, 2.15]) compared to US born women (0.003 [-0.94, 0.95]).

CONCLUSIONS: Findings provide new evidence that PFAS are associated with higher depression symptoms among immigrant women during pregnancy. Results can inform efforts to address environmental factors that may affect depression among US immigrants.

O-OP-247 Associations of exposure to phenols during pregnancy with non-nutritive suck in full-term infants in two US birth cohorts

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BACKGROUND AND AIM: Phenols are endocrine disrupting chemicals found in many consumer products. We examined the relationship between pregnancy exposure and non-nutritive suck (NNS), an early indicator of central nervous system integrity, in two diverse populations.

METHODS: The study involved two prospective birth cohorts in the national Environmental influences on Child Health Outcomes (ECHO) Program: Illinois Kids Development Study (IKIDS, n=49) and ECHO Puerto Rico (ECHO-PROTECT, n=145). In IKIDS, phenols were quantified in a pool of five maternal urine samples collected across pregnancy. In ECHO-PROTECT, urinary phenols were measured 1-3 times in pregnancy, and the geometric mean of each phenol was calculated for each participant. NNS was sampled from 1- to 8-week-olds using a pacifier attached to a pressure transducer for ~5 minutes. Associations of 2,4-dichlorophenol, 2,5-dichlorophenol, bisphenol-A (BPA), bisphenol-S (BPS), and bisphenol-F) with NNS were assessed using generalized linear models adjusted for child sex and assessment age and maternal age and education.

RESULTS: Only associations for the combined analyses were examined for the present analyses, although future work will also compare these relationships with those observed within IKDS and ECHO-PROTECT individually. Both 2,5-dichlorophenol and BPA were associated with longer NNS bursts (time sucking before pausing for breath; β[95%CL]: 2,5-dichlorophenol=7.72[-0.83,16.3], BPA=23.0[3.73,42.2]), greater NNS intraburst frequency (number of sucks/second within a burst; 2,5-dichlorophenol=7.84[-0.73,16.4], BPA=23.3[3.97,42.6]), more bursts/minute (2,5-dichlorophenol=8.04[-0.50,16.6], BPA=23.4[4.16,42.6]), and more suck cycles/burst (2,5-dichlorophenol=4.34[0.53,17.6], BPA=9.81[3.51,42.0]). BPA was also associated with more cycles/minute (β=22.0[2.59,41.3]), but BPS was associated with lower amplitude (sucking strength; β=-21.8[-45.4,1.72]).

CONCLUSIONS: Pregnancy exposure to some phenols (or their precursors) may be related to altered NNS patterning in infants. Future work will examine how NNS is related to later neuropsychological function. These results indicate NNS measures could allow for earlier detection of exposure-related neurological deficits which would allow for earlier intervention.

KEYWORDS: neurodevelopment, phenols, BPA, BPS, 2,5-dichlorophenol

O-OP-248 Prenatal exposure to endocrine disrupting chemicals and the association to behavioural outcomes in children at age seven in the SELMA study

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BACKGROUND AND AIM: Endocrine disrupting chemicals (EDCs) can interfere with the hormone action and are able to cross the placenta and thereby expose the foetus. If the foetus is exposed, it can have an effect on the development of the nervous system with neurobehavioral consequences. Thus, the aim of this study is to estimate the association between prenatal exposure to EDCs and neurobehaviour in children.

METHODS: Based on the pregnancy cohort Swedish Environmental Longitudinal, Mother and Child, Asthma and Allergy (SELMA) study, 700 mother-child pairs were selected to estimate associations between prenatal exposure to EDCs and neurobehavioural outcomes using the Strengths and Difficulties Questionnaire (SDQ). Associations were estimated for the total SDQ score and a 90th percentile cut-off to identify cases that might be of clinical importance. Linear, logistic and weighted quantile sum (WQS) regressions were used to estimate betas (β), odds ratios (ORs) and 95% confidence intervals (95% CI). The models were adjusted for urinary creatinine concentration, mother's education, smoking status, age and parity and child's sex and age at outcome assessment.

RESULTS: Prenatal levels of MBzP (methylbenzylphthalate) measured in the pregnant mothers' urine were found to be associated with significantly higher SDQ scores (more problems) in adjusted analyses: linear regressions (β 1.49, 95% CI 0.64-2.33) and logistic regression (OR 1.95, 95% CI 1.03-3.70). Further, MBzP was the chemical with the highest weight in the adjusted mixture analyses (WQS), in both the linear (β 0.49, 95% CI 0.22-0.75) and logistic regression (ORs 1.35, 95% CI 1.10-1.64). There were no sex differences in any of the analyses.

CONCLUSIONS: MBzP, a phthalate used in vinyl flooring and adhesives, seems to be a chemical of concern when assessing indicators for neurobehavioural outcomes in children. Further studies are needed to explain a possible biological mechanism behind these findings.

KEYWORDS: Endocrine disrupting chemicals, neurobehaviour

O-OP-249 Joint Effects of Indoor Air Pollution and Maternal Psychosocial Stress During Pregnancy on Trajectories of Early Childhood Psychopathology

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BACKGROUND AND AIM: Identifying modifiable risk factors for childhood psychopathology can increase quality of life for children and prevent adult psychopathology. Previous studies have shown that indoor air pollution (IAP) and maternal psychosocial stress (MPS) during pregnancy separately influence psychopathology, but their joint effects are not well understood. Here, we use environmental mixture methodology to estimate joint effects of IAP and MPS during pregnancy on trajectories of early childhood psychopathology.

METHODS: We used data from the Drakenstein Child Health Study (N=360), a South African birth cohort. Exposure to IAP and MPS was measured during the second trimester of pregnancy. The Childhood Behavior Checklist (CBCL) was administered at ages 2, 3.5, and 5 years to assess child psychopathology. CBCL trajectories were created using latent class linear mixed effects models. Joint effects of IAP and MPS were summarized using principal component (PC) analysis. Individual effects of IAP and MPS and their joint effects were estimated using polytomous logistic regression models, adjusted for maternal age, sex, ancestry, and socioeconomic status.

RESULTS: Three distinct classes of CBCL trajectory were identified (class 1 (reference): lowest, class 2: highest and increases, class 3: stable at a medium-high). We consistently observed adverse associations between IAP (e.g., toluene for class 3: OR [95% CI]; 1.35 [1.00, 1.80]) and MPS (e.g., intimate partner violence for class 3: 1.44 [1.03, 1.99)) and CBCL. In the joint effects analysis, PC2 (accounted for 13% of risk factor variation) was significantly associated with class 3 (1.23 [1.03, 1.46]) and class 2 (1.27 [1.04, 1.55]) compared to class 1.

CONCLUSIONS: Exposure to IAP and MPS during pregnancy was associated with CBCL trajectories indicating increased risk for psychopathology. Estimating joint effects of IAP and MPS is important to identify vulnerable subgroups for intervention to prevent childhood psychopathology.

KEYWORDS: indoor air pollution, psychopathology, exposure mixtures

O-OP-250 Air pollution during perinatal period and neurodevelopment in children: a national population study in Taiwan

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BACKGROUND AND AIM: Air pollutants have been associated with several neurodevelopment outcomes, including autism spectrum disorder- and attention deficit-related phenotypes, language delay, intelligence and mood disorders. This study aimed to evaluate the association between ambient PM2.5 during prenatal and postnatal period and infant neurodevelopmental parameters.

METHODS: We conducted a population-based birth cohort study using Taiwan Birth Cohort Study, recruiting representative 12% of all newborn in 2005. Participants were assessed for developmental conditions through home interviews and structured questionnaires at 6 and 18 months of age. Exposure to air pollutants during gestational and postnatal period was estimated using hybrid kriging/land-use regression based on data from the air monitoring stations. Logistic regression was then conducted to determine adjusted odds ratios (aORs) of neurodevelopmental delay in relation to PM2.5 adjusting for infant factors (gender, low-birthweight and birth order), maternal factors (education, age, breastfeeding and perinatal smoking), and household factors (urban living and family income).

RESULTS: A total of 17,046 term singletons without congenital malformations were included in the final analysis. PM2.5 during second trimester was associated with increased risks of delays in gross-motor neurodevelopmental milestones [aOR=1.087 per 10 μg/m3, 95% confidence interval (CI)=1.034-1.144 for walking with support; aOR=1.096, 95% CI=1.044-1.151 for walking steadily]. Personal and social neurodevelopmental milestones were related to PM2.5 exposure in the second and third trimester [aOR=1.11, 95% CI =1.052-1.17; aOR=1.057, 95% CI=1.006-1.111 for approaching when called upon, and also early gestational period [aOR=1.054, 95% CI=1.006-1.103 for drinking with both hands]. Fine-motor development was not found to be related to perinatal exposure to air pollutants.

CONCLUSIONS: Exposure to ambient PM2.5 during pregnancy was significantly related to the occurrence of delay in gross-motor and personal/social development in this population-based study.

KEYWORDS: neurodevelopmental delay, air pollution, PM2.5, prenatal and postnatal exposure

O-OP-251 Prenatal exposure to polycyclic aromatic hydrocarbons and behavioral problems in preschool and early school-aged children

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BACKGROUND AND AIM: Epidemiological study findings are inconsistent regarding associations between prenatal polycyclic aromatic hydrocarbon (PAH) exposures and childhood behavior. This study examined the associations of prenatal PAH exposure with behavior at age 4-6 years in a large, diverse, multi-region prospective cohort. Secondary aims included examination of PAH mixtures and effect modification by child sex, breastfeeding, and child neighborhood opportunity.

METHODS: The ECHO PATHWAYS Consortium pooled 1113 mother-child dyads from three prospective pregnancy cohorts in six U.S. cities. Seven PAH metabolites were measured in prenatal urine. Child behavior was assessed at age 4-6 using the Total Problems score from the Child Behavior Checklist (CBCL). Neighborhood opportunity was assessed using the socioeconomic and educational scales of the Child Opportunity Index. Multivariable linear regression with log2-transformed metabolite concentrations was used to estimate associations per 2-fold increase in each PAH metabolite, adjusted for demographic, prenatal, and maternal factors. Associations with PAH mixtures were estimated using Weighted Quantile Sum Regression (WQSR).

RESULTS: The mean child age at outcome assessment was 5.1 years (SD=1.0); 51% identified as non-White or Multiracial. In fully adjusted models, 2-hydroxynaphthalene was associated with a lower Total Problems score (Beta= -0.80, 95% CI = -1.51, -0.08). Associations were stronger in boys (Beta= -1.10, 95% CI = -2.11, -0.08) and among children breastfed 6+ months (Beta= -1.31, 95% CI = -2.25, -0.37), although there was no statistically significant evidence for interaction by child sex, breastfeeding, or neighborhood child opportunity. Associations were null for all other PAH metabolites, and there was no evidence of associations with PAH mixtures from WQSR.

CONCLUSIONS: In this large, diverse, and well-characterized prospective study of mother-child pairs, we did not observe evidence to support our hypothesis that prenatal PAH exposure was associated with adverse child behavior scores at age 4-6 years.

KEYWORDS: polycyclic aromatic hydrocarbons; behavior; neurodevelopment

ORAL PRESENTATIONS SESSION 46: Environmental health and the COVID pandemic

O-OP-252 Association between long-term exposure to ambient air pollution and COVID-19 severity - A prospective cohort study of confirmed SARS-CoV-2 cases in Ontario, Canada

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BACKGROUND AND AIM: Coronavirus disease 2019 (COVID-19) is causing a tremendous health burden globally. Identification of the determinants of COVID-19 severity is important for prevention and intervention. This study aims to explore long-term exposure to ambient air pollution as a potential contributors to COVID-19 severity given its known impact on the pulmonary system.

METHODS: Using a cohort of all confirmed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) cases aged ≥20 years and not residing in a long-term care facility in Ontario, Canada during 2020, we evaluated the association between long-term exposure to fine particulate matter (PM2.5), nitrogen dioxide (NO2), and ground-level ozone (O3) and risk of COVID-19-related hospitalization, intensive care unit (ICU) admission and death separately. Participants' long-term exposures to each air pollutant were ascertained based on their residential addresses from 2015 to 2019. We used logistic regression and adjusted for confounding and selection bias using various individual and contextual covariates obtained through data linkage.

RESULTS: Among the 151,105 confirmed SARS-CoV-2 cases in 2020, we observed 8,630 hospitalizations, 1,912 ICU admissions and 2,137 deaths related to COVID-19. for each interquartile range increase in exposure to PM2.5 (1.70 μg/m3), we estimated ORs of 1.06 (95% confidence interval (CI): 1.01 to 1.12), 1.09 (95% CI: 0.98 to 1.21) and 1.00 (95% CI: 0.90 to 1.11) for hospitalization, ICU admission and death, respectively. Estimates were smaller for NO2 but larger for O3.

CONCLUSIONS: In this large population-based study in Ontario during 2020, we found that chronic exposure to air pollution may contribute to severe outcomes following SARS-CoV-2 infection, with stronger evidence found with O3.

KEYWORDS: COVID-19 severity, long-term exposure to air pollution, death, hospitalization, intensive care unit admission

O-OP-253 Solving the short-term NO2 exposure and mortality dilemma: a natural experiment during the COVID-19 lockdowns

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BACKGROUND AND AIM: Current evidence is insufficient to establish an independent causal relationship between short-term exposure to nitrogen dioxide (NO_2) and mortality, mainly due to the usually moderate-to-high correlation between NO_2 and fine particulate matter ($PM_{2.5}$). Unprecedented lockdown measures were implemented worldwide to control the COVID-19 pandemic, leading to substantial decreases in NO_2 concentrations; however, changes in $PM_{2.5}$ concentrations were inconsistent among locations, with reductions comparable to those of NO_2, smaller reductions, or even increases. These disproportionate changes in pollutant concentrations provide a unique opportunity for a "natural experiment" study to disentangle the short-term effects of NO_2 versus $PM_{2.5}$ on mortality.

METHODS: We focused on regions that witnessed air pollution changes but limited COVID-19 cases during the lockdowns from January to May 2020: Jiangsu Province, China, and central-southern Italy. Counties or municipalities were divided into two groups: a treated group (considerable reduction in NO_2, but little to no reduction in $PM_{2.5}$) and a control group (changes in NO_2 and $PM_{2.5}$ comparable). A triple-difference (TD) approach was applied to assess the difference between the estimates for NO_2 in the treated and control groups, which captures the change in mortality risk induced by NO_2 alone. This method controlled for all temporal and spatial confounders and cancelled out the confounding effects that vary both over time and space.

RESULTS: Each 10-$\mu g/m^3$ increase in the 5-day moving average of NO_2 concentrations was significantly associated with increases of 11.21% (95% confidence interval [CI]: 1.60%, 21.73%) and 27.28% (95% CI: 14.51%, 41.46%) in daily all-cause mortality in Jiangsu and central-southern Italy, respectively. As negative controls, the TD estimates using 2019 data were close to null.

CONCLUSIONS: Our findings indicate that NO_2 exposure is an independent cause of increased mortality risk, not simply a surrogate for $PM_{2.5}$ exposure.

KEYWORDS: air pollution, mortality, causal inference, COVID-19

O-OP-254 COVID-19 national lockdown in morocco: Impacts on air quality andpublic health

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BACKGROUND AND AIM: On the 20th April 2020, the end of the first strict lockdown in Morocco, 2403410 cases of corona Virus were confirmed globally. The number of Morocco confirmed cases attended 2990 and 143 deaths were announced. All avoidable activities in the country were prohibited since the kingdom announced the general lockdown on 20th March 2020. This study aims at comparing air quality in Casablanca and Marrakech from Morocco, before the pandemic and during the confinement to show whether COVID-19 compelled lockdown may have saved lives by restraining air pollution than by preventing infection.

METHODS: We used the difference-in-difference and the Theil and Sen non-parametric approaches for univariate time series. We defined the before quarantine period as between the 16th February and the 19th March and the during quarantine as between the 20th March and 20th April. We assessed changes in air quality during vs. before the quarantine period in 2020 and compared these with corresponding changes in the same lunar calendar periods in 2016-2019. We calculated the avoided cause-specific mortality attributable to the decreases in NO2 and PM2.5 based on the available concentration-response functions.

RESULTS: We found that NO2 dropped by -12 µg/m³ in Casablanca and -7 µg/m³ in Marrakech. PM2·5 dropped by -18 µg/m³ in Casablanca and -14 µg/m³ in Marrakech. CO dropped by -0.04 mg/m³ in Casablanca and -0.12 mg/m³ in Marrakech. This air pollution reduction had created human health benefits and had reduced mortality and saved lives mainly from cardiovascular diseases.

CONCLUSIONS: Our results are in complete agreement with the worldwide studies. They should be interpreted carefully because of the potential common impacts NO2 and PM2·5 may have on health. Further investigation may be undertaken to explore the reduction in the concentrations of industry-related pollutants.

KEYWORDS: COVID-19, Lockdown, Air quality, Mortality, Public health, Morocco

O-OP-255 Urban greenspace and risk of mental illness following the COVID-19 lockdown – Results from the COVICAT-study, Spain

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BACKGROUND AND AIM: The COVID-19 pandemic has taken a substantial toll on mental health. Greenspace exposure is generally found to prevent mental illness, but the protective impact during the COVID-19 pandemic is insufficiently understood. We analysed if low exposure to and lack of greenspace views from home were associated with increased risk of depression following the COVID-19 lockdown.

METHODS: The COVICAT Study is a population cohort of over 10,087 individuals from northern Spain (Catalunya) who were recruited pre-pandemic and re-contacted after the confinement in 2020. The depression subscale (HADD) of the Hospital Anxiety and Depression Scale was used to measure mental health. Greenspace exposures were assessed by self-reports on views from home and by percentage of greenspace in residential buffer zones of 300, 500, and 1,000 m. We used log-binominal regression models to test the association between lack of greenspace views or low percentage and risk of moderate and severe depression, controlling for individual- and area-level covariates.

RESULTS: In our sample, 5.9% reported severe and 21.4% moderate depression. We found an increased risk of moderate (RR=1.37; 95%CI=1.22, 1.53) and severe depression (RR= 2.46, 95%CI=1.71, 3.56) among participants with lack of greenspace views from home. Low neighbourhood percentage of greenspace was related to higher risk of moderate depression in 300m and 1,000m buffer zones (RR=1.16; 95%CI=1.05, 1.28 and RR=1.14; 95%CI=1.03, 1.27 respectively), but no association was found to severe depression.

CONCLUSIONS: Our study suggests that, in particular, lack of greenspace views but also low percentage of greenspace, may increase risk of depression during the COVID-19 pandemic. This may be due to missing out on greenspaces' stress reducing impact, which can contribute to improved coping with challenging life situations, such as a lockdown. The findings should be considered in urban planning to support coping strategies during future pandemics.

KEYWORDS: Greenspace, COVID-19, depression

O-OP-256 Changes in health risks of pest control and disinfection workers after the COVID-19 outbreak in South Korea

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As the exposure patterns of pest control and disinfection workers have changed with the outbreak of COVID-19, the health risks of the workers have also changed. However, no studies have confirmed the health risks of pest control and disinfection workers before and after the COVID-19 outbreak. This study aims to identify the exposure patterns of biocides used by pest control and disinfection workers and compare the risks before and after the COVID-19 outbreak. A survey was conducted to evaluate the chemical exposure and clinical symptoms of workers before and after the COVID-19 outbreak. The health risks were compared by calculating the risks according to inhalation and dermal exposures by work type pre- and post-outbreak of COVID-19. Compared to before the COVID-19 outbreak, the non-carcinogenic and carcinogenic risks of all chemical substances during inhalation and dermal exposure have increased. In the worst exposure scenario (95th quartile), ADBAC/BKC (C12-16) had a hazard quotient of less than 1 before the onset of COVID-19, but greater than 1 after the outbreak of COVID-19 in both inhalation and dermal exposure. The carcinogenic risk of dichlorvos for inhalation and dermal exposure was above acceptable levels both before and after the outbreak and increased further after the outbreak. In addition, the number of workers who experienced clinical symptoms increased after the outbreak compared to before ($p<0.05$), with the most common symptoms in the order of muscle lethargy, Skin and face stinging, breath shortness, and neck pain. This study suggests that exposure patterns of pest control and disinfection workers have changed and that the health risks by chemical exposure have increased compared to before the COVID-19 outbreak.

KEYWORDS: health risk assessment, COVID-19, pest control, disinfection, occupational exposure
Acknowledgment: This study was supported by the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2021R1F1A1063967).

ORAL PRESENTATIONS SESSION 47: Water quality and health

O-OP-257 Socioeconomic vulnerability and public water arsenic concentrations across the US

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BACKGROUND AND AIM: Inorganic arsenic is known human carcinogen and is routinely detected in community water systems (CWSs) across the US. Significant inequalities in CWS arsenic concentrations exist across broad sociodemographic subgroups of the US population. We evaluated the county-level association between socioeconomic vulnerability and CWS arsenic concentrations across the conterminous US.

METHODS: We evaluated previously developed, population-weighted, county-level CWS arsenic concentrations (2006-2011), the Centers for Disease Control and Prevention's county-level socioeconomic vulnerability score (range: 0-1), median household income, and the proportion of adults with a high school diploma for 2,604 conterminous US counties. We used spatial lag models and evaluated the adjusted geometric mean ratio (GMR) of county-level CWS arsenic concentrations per interquartile range increase in socioeconomic vulnerability domain and in flexible spline models. We also stratified by region and by United States Department of Agriculture Rural-Urban Continuum Codes to assess potential effect measure modification by region and rurality.

RESULTS: Associations between socioeconomic vulnerability and CWS arsenic were modified by region, rurality, and socioeconomic domain. The fully adjusted GMR (95% CIs) of CWS arsenic per interquartile range increase in the proportion of adults with a high school education was 0.83 (0.71, 0.98) or 17% in the Southwest, 0.82 (0.71, 0.94) or 18% in the Eastern Midwest, and 0.65 (0.31, 1.36) or 35% in New England. Higher overall socioeconomic vulnerability was significantly associated with lower CWS arsenic, but only in counties in the Central Midwest and those with total populations less than 20,000.

CONCLUSIONS: Higher educational attainment was associated with lower CWS arsenic in the Southwest, Eastern Midwest, and New England regions. Findings likely reflect regional/local differences in both socioeconomic/socio-cultural context and regulated drinking water contaminant concentrations. Region-specific analyses at finer geographic resolutions evaluating components of overall socioeconomic vulnerability are needed to adequately characterize the association.

KEYWORDS: arsenic; drinking water; environmental justice

O-OP-258 Are current drinking water standards for nitrate sufficient for preventing adverse birth outcomes and childhood cancer– Findings from a cohort of over one million children in Denmark

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BACKGROUND AND AIM: Current standards for nitrate in drinking water in EU and the US are based on preventing methemoglobinemia a condition that occurs at high levels of exposure. There is growing evidence that exposure to nitrate in water is associated with adverse birth outcomes. Our aim is to summarize the findings from our nationwide studies of the population exposed to levels below the current standards in Denmark.

METHODS: We studied a cohort of all singletons liveborn to Danish-born parents from 1991–2013 (N=1,018,914). Data on birth weight, head circumference, body length, gestational age, birth defects and childhood cancer were obtained from Danish registers. Nitrate levels were estimated at the individual residential level. The analyses presented here were restricted to women who had pregnancy average exposures during their pregnancy that were lower than the current EU limit (50 mg/L N03).

RESULTS: Prenatal exposure to nitrate was found to be significantly associated with a decrease in birth weight ($p<0.001$), body length ($p<0.01$), and increased risk of small-weight-for-gestational age ($p=0.002$), all markers of fetal growth restriction. However, we did not observe evidence of an effect on head circumference or term low birth weight. Significant evidence of an exposure-response relationship was also observed for preterm births ($p<0.04$), eye cataracts ($p=0.004$), and for nervous system ($p=0.003$) and ear, face and neck ($p=0.01$) birth defects among women <25 years of age. A trend was not observed for childhood cancers, but a significant increase in central nervous system cancers was observed for the highest exposure group (>25 mg/L) with which was strongest for the preconception period (OR=1.82, 95%CI:1.09 to 3.04).

CONCLUSIONS: Our findings along with the results from other recent studies suggest that nitrate exposure from drinking water is associated with adverse birth outcomes and childhood CNS cancers at currently allowable levels.

KEYWORDS: nitrate, birth outcomes

O-OP-259 Private drinking water wells in Denmark: monitoring and predicting nitrate levels

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BACKGROUND AND AIM: Private wells are often not or poorly regulated while simultaneously supplying inferior drinking water quality. Therefore, exposure assessments of private well users are crucial when identifying highly-exposed groups. Here, we explore the available monitoring data for private wells in Denmark focusing on nitrate and apply a machine-learning approach to predict nitrate levels in unmeasured wells.

METHODS: We accessed information on private well location, abstraction depth, aquifer type, and, when available, nitrate samples, from the national monitoring database Jupiter. We used a gradient boosting decision tree algorithm to predict nitrate levels in unmeasured wells based on a suite of explanatory variables related to soil texture, geology, topography characteristics, water body proximity, land cover, redox conditions, nitrate leaching and hydrological simulations. We stratified our prediction model by abstraction depth and used an output resolution of 100x100 m.

RESULTS: The majority of private wells used aquifers in Quaternary sandy deposits, followed by carbonate fractured rocks and pre-Quaternary sandy deposits with relative shallow depths (median ± median absolute deviation: 24.5 ±11.1 m). of 49,821 private wells in Jupiter, 59% had at least one nitrate sample registered. for 28%, it was possible to establish a link to abstraction depth. In measured private wells, 60% had a significant nitrate contamination (>3 mg/L). The most important explanatory variables in the prediction model were georegion, topology, thickness of aquifer and Quaternary layer, and depth to redox interface. In unmeasured private wells, 64% were predicted to have nitrate levels >3 mg/L. We created probability maps stratified by abstraction depth layers.

CONCLUSIONS: Nitrate in Danish private wells is poorly monitored, but machine learning models can help predict levels, allowing exposure assessments of this highly-exposed group in epidemiological studies on health effects of drinking water nitrate.

KEYWORDS: water quality; drinking water; nitrate; exposure assessment; machine learning

O-OP-260 Inorganic arsenic in drinking water and breast cancer risk: a case-control study in Northern Chile

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BACKGROUND AND AIM: Exposure to arsenic in drinking water is a well-established cause of lung, bladder and skin cancer, however the relation between arsenic and breast cancer is less clear. Between 2014-2018, we conducted a breast cancer incident case-control study in Northern Chile, where from 1950-1970 the population was exposed to high levels of arsenic in drinking water (up to 900 µg/l).

METHODS: We analyzed 703 breast cancer cases and 491 population-based female controls with data collected on lifetime exposure to As and potential confounders. Using logistic regression, we tested whether exposure to higher levels of arsenic in drinking water related to differential risk of breast cancer. Initial causal models adjusted for age and education. Additional models included other known risk factors for breast cancer and several sensitivity analyses evaluated different exposure windows.

RESULTS: Both cases and controls were around 58 years of age and about half had finished high school or had additional studies. Cases, compared to controls, were exposed to lower median concentrations of arsenic (µg/L): 60 [interquartile range (IQR), 11-636] versus 70 (40-299). Adjusted odds ratios for category of highest single-year arsenic concentrations in water (<49, 50-199, 200-799, and ≥ 800 µg/L) were 1.00, 0.70 [95% confidence interval (CI), 0.52-0.94], 0.71 (0.51-1.01), and 1.02 (0.72-1.44), respectively. Results were similar after various adjustments, using different metrics of arsenic exposure, and windows of exposure.

CONCLUSIONS: Compared with women with the lowest levels of exposure to arsenic in drinking water, those with higher (up to 799 µg/L) arsenic exposure, had lower odds of breast cancer, in accordance with evidence implying a potentially therapeutic effect of arsenic exposure. Differential arsenic sensitivity of breast cancer cell types may explain differences in the direction of the effect and lack of precision for some exposure groups.

KEYWORDS: arsenic, breast cancer, drinking water

O-OP-261 Microplastic Pollution in Two Urban Rivers and an Associated Water Treatment Plant in Bangladesh

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BACKGROUND AND AIM: Microplastics in freshwater environments are less well understood than in marine environments. The present study is the first of its kind in Bangladesh which was aimed at providing the first description of the abundance and distribution of microplastics in two rivers, namely the Buriganga and Shitalakhya. The study also examined the abundance of microplastics in a drinking water plant, which receives water from these two rivers.

METHODS: Twelve (12) water samples were collected from two rivers and the water treatment plant. The samples were first treated with the wet peroxidation method and then characterized and quantified according to color, shape, and size using a light microscope and a scanning electron microscope (SEM). Several representative microplastics were also isolated for polymer identification using the Attenuated Total Reflectance–Fourier Transform Infrared (ATR–FTIR) spectroscopy.

RESULTS: The average abundance of microplastic was found to be 11,639 particles/m3 in the collected water samples. Over 90% of them were found to be less than 0.5 mm. The most frequent types of microplastic were microfilm (70.94%), followed by microfibre (15.76%) and microfragment (2.95%) and the dominant color was transparent (68.47%). The common polymer types were polyethylene terephthalate, polypropylene, polyethylene, polyvinyl chloride, and polystyrene. Interestingly, there were no significant ($p>0.05$) differences between the river water and the water sampled from the inlet and outlet of the water treatment plant vis-à-vis microplastic abundance.

CONCLUSIONS: This study reveals the contamination levels and characteristics of microplastics in the Buriganga and Shitalakhya rivers. The study also provides insights into the microplastic pollution in water treatment plants in the country. Further research is needed to find ways to reduce the abundance in freshwater niches and to develop technologies dedicated to microplastic removal in the water treatment plant.

KEYWORDS: Microplastics, Freshwater, Buriganga river, Shitalakhya river, Water treatment plant

O-SY-132 Association of arsenic and uranium concentrations in private wells and community water systems with urinary biomarkers in American Indian adults: The Strong Heart Family Study

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BACKGROUND AND AIM: Chronic exposure to inorganic arsenic (iAs) and uranium (U) has been associated with adverse health risks. High As and U levels occur in unregulated private wells and regulated community water systems (CWSs) serving tribal communities in the Southwest, Central Midwest, and Northern Plains. Our objective was to examine the contribution of CWS and private well As and U concentrations to urinary biomarkers of total internal dose in American Indian adults in the Strong Heart Family Study (SHFS).

METHODS: 2,688 SHFS participants had dietary recall information and spot urine concentrations of U and iAs, estimated as the sum of inorganic and methylated species, collected between 2001-2003. We assigned participants zip code level area- and population- weighted CWS and private well As and U estimates based on previously developed nationwide estimates derived from US Environmental Protection Agency and US Geological Survey datasets, respectively. We used generalized linear mixed models to evaluate the geometric mean ratio (GMR) of urinary iAs or U concentrations per log unit increase in water As or U, respectively. Models were adjusted for sex, age, reported intake of As- and U- containing foods, and smoking status. Random effects were applied for zip code and family group.

RESULTS: In fully adjusted models, the GMR of estimated iAs and U per log µg/L increase in CWS As and U was 1.11 (1.08-1.14) and 1.26 (1.15-1.39), respectively. The fully adjusted GMR of estimated iAs per unit (100%) increase in the probability of private well As >10 µg/L was 1.81 (1.35-2.41). Per log µg/L increase in mean private well U, the GMR of urinary U was 1.04 (0.91-1.19).

CONCLUSIONS: Both regulated CWSs and unregulated private wells are important sources of iAs and U exposure for tribal communities in the SHFS, as reflected in urinary biomarkers.

KEYWORDS: arsenic, uranium, environmental epidemiology

O-OP-054 Air Pollution, Climate Conditions and Risk of Psychotic Hospitalization in U.S. Residents

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OBJECTIVE: The physical environmental risk factors for psychotic disorders are poorly understood. This study aimed to examine the associations between residential exposure to ambient air pollution, key climate measures and risk of psychotic hospitalization in the U.S. general population and uncover potential disparities by demographic and community factors.

METHODS: Using data from Health Cost and Utilization Project (HCUP) State Inpatient Databases (SIDs), we applied zero-inflated negative binomial regression to obtain the relative risks of psychotic hospitalization associated with increases in residential exposure to ambient air pollution (fine particulate matter, PM2.5; nitrogen dioxide, NO2), temperature and cumulative precipitation. All the exposures were aggregated to ZIP code level, and later merged with admission data by ZIP code of residence and calendar year. The analysis covered all-age residents in eight U.S. states over the period of 2002 – 2016. We additionally investigated modification by age, sex, area-level poverty, percent of blacks and Hispanics via stratified models.

RESULTS: Over the study period and among the covered areas, we identified 1,211,100 psychotic admissions. for each interquartile (IQR) increase in exposure to PM2.5 and NO2, we observed a relative risk (RR) of 1.11 (95% CI = 1.09, 1.13) and 1.27 (95% CI = 1.24, 1.31), respectively. for each 1 ºC increase of temperature, the RR was 1.03 (95% CI = 1.03, 1.04). We did not find significant associations with precipitation in the total population. Older age residents (>= 30 yrs.) were more sensitive to PM2.5 and ambient temperature. Population living in economically disadvantaged areas were more affected by air pollution. Area percent of Hispanics level modified the associations in different directions depending on the exposure.

CONCLUSIONS: The study findings suggest that living in areas with higher levels of air pollutants and ambient temperature could contribute to additional risk of psychotic hospitalization in a U.S. general population.

ORAL PRESENTATIONS SESSION 48: Health consequences of extreme events

O-OP-263 Heat-related deaths and ambulance transports after typhoon-triggered power outages: a quasi-experimental study in the metropolitan areas of Japan

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BACKGROUND AND AIM: Air conditioning use is an effective adaptation measure to prevent heat-related health problems. Any electricity supply disruptions can expose a population to non-optimal temperatures with ill effects. This study examined the mortality and morbidity impacts of sudden disruption to electricity caused by a typhoon Faxai that affected the metropolitan areas of Japan on 9th September 2019.

METHODS: We collected data on the daily counts of heat-related illness ambulance transport (HIAT) and all-cause deaths in 7 prefectures from July to September 2019. We used the difference-in-differences method to estimate the average treatment effect on the treated of blackout, and effect modification analysis to examine the association of heat with daily HIAT and all-cause deaths by different intensities of electricity reduction using electricity consumption data. Possible nonlinear and delayed effects of temperatures were accounted for using the distributed lag non-linear model with quasi-Poisson regression.

RESULTS: A total of 14,921 HIAT and 74,064 all-cause deaths were recorded during the study period. In the first three days (9th-11th September) of the blackout, the incidence rate ratio between the blackout and non-blackout areas for HIAT and all-cause deaths were 2.5 (95% confidence interval (CI): 1.8, 3.3) and 1.1 (95% CI: 1.0, 1.2), respectively. Comparing 20% reduction of electricity to no reduction, the ratio of relative risks for heat exposure (95th vs. 50th percentile temperature) was 2.3 (95% CI: 1.4, 3.8) for HIAT and 1.1 (95% CI: 0.9, 1.3) for all-cause deaths.

CONCLUSIONS: Typhoon-triggered reduction of electricity by 20% was associated with two times higher risk of HIAT attributable to summer heat in the metropolitan areas of Japan, while there was no evidence for all-cause deaths. Our findings suggest that emergency preparedness against blackouts in hot temperature must be activated in the face of climate change.

KEYWORDS: Disaster epidemiology; Blackout; Heat-related illness

O-OP-265 Long-term Drought and Diarrhea among Children under Five and the Role of Water, Sanitation, and Hygiene Practices

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BACKGROUND AND AIM: Climate change is projected to intensify drought conditions, which may increase the risk of diarrheal diseases in children. However, evidence on the association between drought and diarrhea risk is scarce. This study aimed to quantify this association among children under five in 51 low- and middle-income countries (LMICs).

METHODS: Data on childhood diarrhea during 1990-2019 were obtained from the Demographic and Health Surveys program. Drought was represented by the 6-to-24-month scale Standardized Precipitation Evapotranspiration Index at ~9km resolution and was further dichotomized into mild or severe drought. Log-binomial generalized linear mixed models with random effects for survey cluster were constructed to examine the association, adjusting for sociodemographic characteristics. The mediating and interacting effects of water, sanitation, and hygiene-related (WASH) practices were evaluated.

RESULTS: Exposure to 6-month mild or severe drought was associated with an increased diarrhea risk of 5% (95% confidence interval 3%–7%) or 8% (5%–11%), respectively. The strongest association for severe drought was observed at the timescale of 6 months, whereas the association for mild drought exhibited a light, graded increase across 6 to 24 month timescales. WASH mediated 11.6% or 19.5% of the association with 6-month mild or severe drought, respectively. The association was stronger among children living in a household that needed longer time to collect water or had no access to water or soap/detergent for handwashing. The association for 24-month drought was strong in dry zones but weak or null in tropical or temperate zones, whereas for 6-month drought the association was only observed in tropical or temperate zones.

CONCLUSIONS: We observed associations between exposure to long-term drought and elevated diarrhea risk among children under five in LMICs. Our results suggest that the risk could be reduced through improved WASH practices.

O-OP-266 Wildfire Smoke Exposure During Pregnancy and Preterm Birth in California

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BACKGROUND AND AIM: Owing to climate change and fire suppression policy, wildfires in the Western United States are a significant source of air pollution that threatens to reverse decades of progress in air pollution reduction; effects of wildfires on preterm birth (PTB) are not well understood. We assessed associations between prenatal exposure to wildland fire (wildfire and prescribed fire) smoke and risk of PTB in California.

METHODS: The population included all live singleton births in California, 2007-2015. PTB was defined as gestational age <37 weeks. We assigned wildland fire smoke exposure to geocoded maternal residence at birth with weekly average concentrations of particulate matter ≤2.5 microns attributable to fires from USEPA's Community Multiscale Air Quality Model (fire PM2.5) and smoke frequencies (smoke days) from National Oceanic and Atmospheric Administration's Hazard Mapping System. We used logistic regression to estimate odds ratios (OR) for PTB associated with exposures in the final 6 weeks of pregnancy and Cox proportional hazard models to estimate hazard ratios (HR) for PTB in relation to weekly exposures. Models adjusted for maternal age, education, race/ethnicity, season, medical insurance, and smoking.

RESULTS: Our study included 3,342,267 births. A one-smoke day increase in any of the final 6 weeks of the pregnancy was associated with increased odds of PTB, ranging from OR=1.01 (95%CI:1.01-1.02) in the final week of pregnancy to OR=1.03 (95%CI:1.02-1.03) 5 weeks before birth. A 10µg/m3 increase in fire PM2.5 in the final 6 weeks was associated with ORs ~1.04 (95%CIs covered 1.02-1.06). In survival analyses, HR=1.01 (95%CI:1.01-1.02) for a one-day increase in smoke frequency and HR=1.03 (95%CI:1.02-1.04) for a 10µg/m3 increase in fire PM2.5.
CONCLUSION: Wildland fire smoke is modestly associated with PTB. Results can inform efforts to slow climate change, manage forests, and reduce wildfire smoke exposure to pregnant people.

KEYWORDS: wildfire; pregnancy; preterm birth; climate; air pollution

O-OP-267 The Effects of Hurricane Matthew on Racial Disparities in Birth Outcomes

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BACKGROUND AND AIM: Stressful events during pregnancy can have negative effects on birth outcomes. Further, there are well documented racial disparities in birth outcomes in the United States. It is likely the case that climate-sensitive stressors, like exposure to severe hurricane impact may worsen birth outcomes. We explore the relationship between hurricane exposure and adverse birth outcomes, specifically preterm births (PTBs) and low-weight births (LWBs), using vital data from Florida before and after Hurricane Matthew. We establish hurricanes as a potential mechanism in exacerbating racial disparities in birth outcomes.

METHODS: We combined vital records in Florida for the period between January 2015 and February 2017, county-level demographic data, and disaster declarations to create a novel longitudinal dataset. Difference-in-difference models compare weekly rates of LWBs and PTBs in counties that did not receive a FEMA disaster resolution to counties that received public assistance only (PA) and public and individual assistance. Models were run for the full cohort and then stratified by race.

RESULTS: Hurricane exposure was not associated with rates of LWBs or PTBs in the overall cohort. However, black mothers exposed to Hurricane Matthew in counties that received PA after Hurricane Matthew experienced higher rates of LWBs (IRR = 2.64, 95% CI = 1.09, 6.37) and PTBs (IRR = 2.25, 95% CI = 1.02, 4.96) in the week following the storm. Compared to unexposed Hispanics mothers, Hispanic mothers in counties that received public assistance only experienced decreased rates of PTBs (IRR = 0.33, 95% CI = 0.11, 0.98) immediately after Hurricane Matthew followed by a faster increase.
CONCLUSION: Our study suggests that hurricane exposure may be an important driver of short-term racial disparities in birth outcomes. Future research should continue to investigate the intersection of climate-sensitive hazards and birth outcomes disparities.

KEYWORDS: Hurricane, Race, Birth Outcomes, Health Disparities

O-SY-125 Climate change and health system preparedness: it never rains but it pours

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BACKGROUND AND AIM: Climate change is posing an increased burden on human health through both its long term consequences and its acute manifestations. National health systems need to increase their preparedness to these consequences. The geographical distribution of the manifestation of climate change is thought to widen inequalities in health system quality and accessibility already present across countries. The aim of this research is to assess the association between climate change impact and health system preparedness at country level, worldwide.

METHODS: All data was extracted from publicly available sources. Impact of climate change was measured with two variables: the Global Climate Risk Index (GCRI), which measures exposure and vulnerability of a country connected to weather-related loss events that have a socio-economic impact, and the Notre-Dame Global Adaptation Initiative index (ND-GAIN), measuring wider vulnerability to climate change. To assess healthcare system preparedness the Self Party Assessment Report Score (SPAR) was used, which measures healthcare system capacity to prepare for public health risks and emergencies. Regression models were adjusted for gross domestic product (GDP) per capita), Human Development Index, Peace Index, age structure of the population.

RESULTS: Preliminary results suggest a negative association between GCRI and SPAR suggesting that health systems worldwide are adapting well their preparedness to climate-related vulnerability as the preparedness was highest in those countries more frequently affected by climate-related events. A full analysis and interpretation of data will be presented.
CONCLUSION: Climate change consequence on human health are widening inequalities across countries. Lack of health system preparedness might contribute to the further widening of such inequalities and should be tackled by the international community and the World Health Organisation as matter of priority. This research will provide some important data to map existing resources and threats, and to inform public health priorities.

ORAL PRESENTATIONS SESSION 49: Impacts of exposure to chemicals on maternal and child health

O-OP-269 Variability of per- and polyfluoroalkyl substances concentrations among pregnant African American women and newborns

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BACKGROUND AND AIM: Longitudinal trends in PFAS levels across pregnancy have not been thoroughly examined, despite emerging evidence linking prenatal PFAS exposures with adverse birth outcomes. We sought to characterize variability of longitudinal PFAS concentrations during pregnancy and to examine maternal-fetal transfer rate of PFAS among African Americans (AA).

METHODS: We quantified serum concentrations of four PFAS in 376 participants and additional eight PFAS in 301 participants during early (8-14 weeks) and late (24-30 weeks) gestation, as well as levels of four PFAS in dried blood spots (DBS) from 199 paired newborns in the Atlanta AA Maternal-Child cohort (2014-2018). We characterized the variability of PFAS levels across gestation using intraclass correlation coefficients (ICC) and transfer rate. Multivariable linear regression models were fit to assess how maternal early or late serum PFAS concentrations predict newborn DBS PFAS levels.

RESULTS: Perfluorohexane sulfonic acid (PFHxS), perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and perfluorononanoic acid (PFNA) were detected in >95% of both maternal and newborn samples, with PFHxS and PFOS having the highest median concentrations. All PFAS median concentrations increased across pregnancy, except for PFOA and N-methyl perfluorooctane sulfonamido acetic acid (NMFOSAA), which decreased. Prenatal PFAS were weakly to moderately correlated with newborn PFAS ($-0.11 < r < 0.54$). Compared to late pregnancy, maternal PFAS in early pregnancy can better predict newborn PFAS while adjusting for covariates. We observed high variability in PFAS levels across pregnancy (ICC: 0.001-0.59), with the greatest change in PFHxS (ICC=0.001). The mean maternal-fetal transfer rate of PFAS decreased with increasing carbon chain length.

CONCLUSIONS: In AA mother-newborn dyads, we found most PFAS concentrations increased across pregnancy, and the magnitude of variability differed by PFAS species. Future studies are needed to understand the within-person variability of PFAS during and after pregnancy in relation to birth outcomes.

KEYWORDS: PFAS; pregnancy; variability; transfer rate.

O-OP-270 Mixtures of persistent and non-persistent chemicals and associations with pregnancy outcomes in the Atlanta African American Maternal Child Cohort

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BACKGROUND AND AIM: African Americans (AAs) experience high rates of adverse pregnancy outcomes relative to whites. Differential in utero exposure to environmental chemicals may partially explain these health disparities, as AAs are disproportionately exposed to environmental hazards. Few studies have examined the effects of multiple classes of non-persistant and persistant organic pollutants (POPs) together, which may better reflect real life exposures. Here, we examined the joint exposure effects of multiple POPs and non-POPs on gestational age and birthweight for gestational age z-scores among AAs.

METHODS: POPs and non-POPs were measured in 1st trimester serum or urine samples collected from 102 participants within the Atlanta African American Maternal-Child cohort. POPs included four per-and polyfluoroalkyl substances (PFOA, PFOS, PFHxS, PFNA), two polybrominated diphenyl ethers (PBDE-47, BDE-99), and two organochlorine insecticides (HCB, ppDDE), while non-POPs included eight urinary phthalates metabolites (MEP, MBP, MiBP, MBzP, MEHP, MEOHP, MEHHP, MECPP) and bisphenol A. Single pollutant associations were estimated using linear regression and mixture associations were estimated using quantile g-computation and Bayesian kernel machine regression (BKMR), adjusting for confounding factors and covariates.

RESULTS: An interquartile range increase in PFNA (β=-0.11, 95% confidence interval [CI]=-0.22, 0.00), BDE-47 (β=-0.19, 95% CI=-0.35, -0.04), and HCB (β=-0.17, 95% CI=-0.34, 0.00) was associated with lower birthweight z-scores in adjusted single pollutant models. Using quantile g-computation, the point estimate of effect for increasing all POPs and non-POPs by one quantile suggested a negative effect on gestational age and birthweight z-scores, although confidence intervals included the null. BKMR similarly showed that increasing all exposures in the mixture was associated with a modest decrease in gestational age and birthweight z-scores.
DISCUSSION: Using targeted exposure assessment and mixture analysis, we found that prenatal exposure to multiple classes of POPs and non-POPs may be associated with lower birth weight and gestational age at birth.

KEYWORDS: pregnancy, mixtures, disparities

O-OP-271 Mixture analysis of air pollution and endocrine disrupting chemicals in relation to Vitamin D concentrations in pregnancy

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BACKGROUND AND AIM: Over two-thirds of pregnant women in the U.S. have insufficient Vitamin D, which can adversely impact fetal health. Several environmental pollutants may affect Vitamin D concentrations, but they have not been examined as mixtures.

METHODS: We analyzed data from 336 general population controls from the case-control Early Markers for Autism study of children born in Southern California in 2000-2003. Maternal serum was assayed for Vitamin D and environmental chemicals; eleven polychlorinated biphenyls (PCBs), two organochlorine pesticides, six per- and polyfluoroalkyl substances, and six brominated flame retardants (BFRs) were detected in ≥ 60% of specimens and included in the study. Vitamin D was analyzed as a continuous variable, and concentrations <75 nMol/L were dichotomized as insufficient. Particulate matter <=10 microns (PM10) and <=2.5 microns, nitric oxide, nitrogen dioxide, and ozone data for 30 days preceding specimen collection were downloaded from monitoring stations near maternal addresses. Bayesian Kernel Machine Regression and Bayesian Hierarchical Modeling were used to assess an overall mixture effect of all chemicals and associations accounting for co-exposures, respectively, adjusting for demographic characteristics.

RESULTS: In the context of the mixture, PM10, BFRs as a group, and organochlorine trans-nonachlor were associated with lower continuous Vitamin D concentrations, while ozone was associated with higher concentrations. BFRs were also associated with increased odds of insufficient Vitamin D. Higher quantiles of combined exposures were associated with lower mean Vitamin D with wide credible intervals. Several null associations were also found.

CONCLUSIONS: We found associations of environmental pollutants with both lower and higher Vitamin D, though cumulative exposure was associated with lower concentrations. Some findings differed from non-mixture regressions, highlighting the importance of mixtures approaches for estimating real-world associations.

KEYWORDS: Mixtures, Vitamin D, air pollution, PM10, organochlorines, PBDE, PCB, PFAS

O-OP-272 Prenatal exposure to triclosan assessed through repeated urine samples and placental DNA methylation in the SEPAGES cohort

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BACKGROUND AND AIM: Previously we showed associations between elevated maternal urinary concentrations of triclosan in French pregnant women and increased placental DNA methylation in male fetuses, an effect potentially mediated by placental cell composition. Using a more recent cohort with improved exposure assessment, we aimed to replicate these findings and perform an exploratory study.

METHODS: We assessed triclosan in two pools of 21 urine samples each, collected during the second and third trimester among 395 pregnant women from the SEPAGES cohort. We used Infinium MethylationEPIC arrays to measure DNA methylation in placenta collected at delivery. We used adjusted linear regressions on 500 previously identified candidate CpGs and investigated differentially methylated regions (DMRs) within CpGs overlapping with our previous study. Additionally, we performed an exploratory epigenome-wide association study and DMR analysis on all CpGs available in the assay.

RESULTS: In the sex-stratified replication study, we found 75 triclosan-associated genes (three for males and 72 for females including imprinted FBRSL1, KCNQ1, RHOBTB3, and SMOC1). The effect estimates showed a similar pattern to our previous study for females but not males (correlation coefficient rho = 0.75 and 0.07, respectively), with most associations being positive but weaker. When both sexes were considered, 18 triclosan-associated genes were identified. The correlation with effect estimates of our previous study was 0.6. As previously, we showed that placental heterogeneity could mediate the associations between triclosan concentrations and DNA methylation. In the exploratory analysis, we identified only a few isolated sex-specific associations.

CONCLUSIONS: We observed several positive associations between pregnancy triclosan and placental DNA methylation similarly to our previous study, however most of the associations were identified for females but not males. Our results suggest that pregnancy exposure to triclosan could affect placenta through DNA methylation and that female placentas may be particularly vulnerable.

KEYWORDS: placenta, methylation, pregnancy triclosan, pooled biospecimens

O-OP-273 Relationships between levels of endocrine-disrupting chemicals and immune markers in maternal circulation during mid-pregnancy

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BACKGROUND AND AIM: Prenatal exposure to endocrine-disrupting chemicals (EDCs) has been linked to child neurodevelopmental disorders. Maternal immune activation during pregnancy is associated with adverse child developmental outcomes. Whether EDCs influence maternal immune physiology is unclear.

METHODS: We analyzed data from general population controls (n=439) of the Early Markers for Autism (EMA) Study, a case-control study of children born during 2000-2003 in Southern California. Eleven polychlorinated biphenyls (PCBs), 6 brominated flame retardants (BFRs), 2 organochlorine pesticides (OCPs), 6 polyfluoroalkyl substances (PFAS), and 22 cytokines/chemokines were measured in maternal serum samples collected 15-20 weeks into pregnancy. We assessed individual relationships between log-transformed EDC levels and immune markers with spearman correlations and adjusted linear regression models. We further explored overall associations of EDC mixtures with specific immune markers using Bayesian kernel machine regression (BKMR).

RESULTS: After adjustment for false-discovery rate, 28 correlations between EDCs and maternal immune markers were statistically significant (spearman rho ranging from -0.25 to 0.24). These top correlations comprised 14 chemicals (9 PCBs, 3 PFAS, 1 BFR, and 1 OCP), and 8 immune markers. In adjusted linear models, all PCBs were inversely associated with levels of soluble interleukin-2 receptor alpha (sIL-2ra), with PCB99 showing the strongest relationship (adj-β[95%CI]: -0.48[-0.69, -0.27]). In BKMR, increasing all congeners in the PCB mixture from their 50th to their 95th percentiles was associated with decreased sIL-2ra (adj-β[95%CrI]: -0.43[-0.84, -0.02] and PCB99 had the highest relative importance in this mixture. Among other EDCs, p,p´-DDE, an OCP, was inversely associated with multiple markers (IL-12p40, IL-13, and IL-1ra). In contrast, others, such as Et-FOSAA, a PFAS, were positively associated with multiple immune markers, including IL-12p70, GM-CSF, IL-1ra, and IL-10.

CONCLUSIONS: These findings suggest that specific EDCs may affect diverse immune and inflammatory pathways during pregnancy. These relationships may have implications for child development.

KEYWORDS: EDCs; prenatal; immune;

O-OP-274 Urinary phthalate metabolites and phenolics in women of childbearing age and their association with thyroid hormones: a comparison study of fasting status

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BACKGROUND AND AIM: Exposure to parabens and phthalates has been associated with thyroid hormones in humans. Epidemiologic observations, however, are often inconsistent depending on population, probably due to different susceptibility or other factors such as exposure misclassification. Fasting status may influence the urinary levels of many chemicals, especially when their major exposure pathways are related to diet. In the present study, we assessed the associations of urinary phthalate metabolites and phenolics with thyroid hormones in non-pregnant women of child-bearing age in Korea (20-49 years of age), considering fasting status.

METHODS: As a fasting population, we recruited women (n=254) who visited four hospitals after >9 hr of fasting between 2015 and 2016. From the fasting women, we measured phthalate metabolites and parabens in urine, and thyroid hormones in serum. Non-pregnant women of the same age group, who were not asked to fast, was chosen from KoNEHS Cycle 3 (2015-2017) (phthalate metabolites (n=341) and phenolics (n=340)).

RESULTS: Urinary concentrations of MEHHP, MEOHP, MBzP, and BPA were >2 folds higher in the non-fasting women, and those of MeP were higher in the fasting women. Regardless of fasting status, MeP and EtP levels showed significant negative association with both total and free T4. DEHP metabolites also showed negative associations with free T4 but positive associations with total T3. However, associations of MBzP and BPA with thyroid hormones varied by the fasting status, which might be due to the influence of diet on their urinary concentrations.
CONCLUSION: While certain chemicals like EtP and to lesser extent DEHP are known to be delivered through dietary factors, consistent associations with altered thyroid hormones regardless of fasting status are noteworthy.

KEYWORDS: thyroid hormones; fasting; phthalates; phenolics
[Acknowledgement] This work was supported by grants from National Research Foundation of Korea (NRF) (NRF-2020R1A2C3011269 and NRF-2022R1C1C2006982).

O-OP-162 Greenspace, air pollution and asthma exacerbations

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OBJECTIVE: Emerging evidence suggests a protective effect of greenspace against the adverse health effects of air pollution but the associations of greenspace and air pollution with asthma remain unclear. This study aimed to examine if greenspace modifies the effect of air pollution on asthma exacerbations.

METHODS: A time-stratified case-crossover design was used to quantify the association between air pollutants (PM2.5, PM10, NO2, and O3) and hospitalizations for asthma in Brisbane from 1st January 2013 to 31st December 2015. The modification effect of suburb-level greenspace on the association between air pollutants and asthma hospitalization was explored with a linear regression model. Greenspace was measured with normalized difference vegetation index (NDVI).

RESULTS: There were 6,226 asthma hospitalizations during the study period, with 3,098 occurring in children aged 0-14 years and 2,945 in males. Each 10μg/m3 increase in the concentrations of NO2 and O3 was associated with 19% (95% confidence interval (CI): 6%, 34%) and 7% (95% CI: 0%, 15%) increased risk of asthma hospitalizations, respectively. Individuals living in suburbs with low NDVI appeared to be more vulnerable to the effect of NO2 on the risk of asthma hospitalizations.

CONCLUSIONS: Our study shows that exposure to NO2 and O3 could increase the risk of asthma exacerbations, and greenspace may ameliorate the adverse effect of NO2 on asthma exacerbations, but there is no apparent modification effect of greenspace on the O3-asthma relationship.

ORAL PRESENTATIONS SESSION 50: Child health and metals exposure

O-OP-275 Prenatal heavy metals exposure and neurodevelopmental disorders in the Boston Birth Cohort: examining risk and protective factors

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BACKGROUND AND AIM: Although heavy metals are well-known neurotoxicants, few studies have assessed multiple neurodevelopmental disorders (NDs) or identified vulnerable sub-populations.
Aim: We aimed to assess independent effects of metals on an array of clinician-diagnosed NDs and identify effect modifiers.

METHODS: We measured lead, mercury, cadmium, manganese, and selenium in maternal red blood cells obtained 24-72 hours post-partum, in Boston Birth Cohort born in 2002-2012. We abstracted children's ever diagnoses of attention-deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), conduct disorder (CD), learning disability (LD), and developmental delay (DD) from electronic medical records. We estimated odds ratios (OR) of each ND compared to typically developing children (neurotypical) per interquartile range (IQR) increase in metals using logistic regression, adjusting for maternal age, education, obesity/diabetes, race/ethnicity, pregnancy fish intake, and sex. We assessed modification by pregnancy characteristics, preterm birth (PTB), and sex.

RESULTS: of 483 neurotypical and 520 children with NDs (184 ADHD, 53 ASD, 199 CD, 95 LD, 517 DD), majority were non-Hispanic Black (66%) or Hispanic (24%). An IQR increase in lead was associated with an LD OR of 1.27 (95% CI: 1.02, 1.57) and DD OR of 1.12 (0.97, 1.28) among boys, however, associations were not notable in total population. PTB and stressful pregnancies were vulnerable to higher cadmium and manganese, particularly for LD and DD. Mercury was consistently negatively associated with NDs, possibly due to residual confounding by fish consumption. Selenium was positively associated with NDs, particularly LD among boys (2.07 [1.35, 3.18]). We did not observe notable differences by folate.

CONCLUSIONS: In this traditionally understudied US minority birth cohort, prenatal exposure to toxic metals were widespread and associated with NDs, particularly LD and DD. Sex, PTB, stress, and fish intake modified some associations. These findings, if further confirmed, may inform the design of potential interventions to reduce metals neurotoxicity.

O-OP-276 Prenatal Trace Metal Exposures and Genetic Variants Inform Birth Weight-related Placental Isoform Expression

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BACKGROUND AND AIM: Placental gene expression patterns are increasingly recognized as functional targets associated with birth outcomes. However, studies to date do not capture transcript-level specification, an important resource for adaptive responses during fetal development. In this study, we conducted a genome-wide analysis to characterize differential transcript usage (DTU) in the placenta with respect to prenatal trace metal exposure, genetic variants, and birth weight.

METHODS: RNA sequencing was performed in placenta samples from the Rhode Island Child Health Study (n=199). A panel of essential and nonessential metals were measured in maternal toenails (Al, As, Cd, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Sn, U, V, Zn) and placenta (Ca, Cd, Co, Cu, Fe, K, Mg, Mn, Mo, Na, P, S, Se, Zn) using ICP-MS. DTU was assessed using the DRIMSeq R package to contrast infants small (SGA) and appropriate (AGA) for gestational age and infants above and below median trace metal exposure levels. Genetic variants that influence transcript usage were identified using the sQTLseeker R package.

RESULTS: We identified 82 genes demonstrating DTU in association with SGA status at an FDR < 0.05. Among the trace metals, placental transcript expression levels were most sensitive to Sn (n=377 genes) and Cd (n=73 genes) exposures measured in maternal toenails. Transcript proportions of LAMTOR4, a lysosome regulator implicated in neurodegenerative diseases, varied in association with SGA status, Sn and Cd levels measured in toenails, Ca levels measured in placenta, and genotypes across three local genetic variants (rs10231604, rs12878, and rs3736591).
DISCUSSION: We report a comprehensive genome-wide characterization of placental transcript usage and associations with prenatal trace metal exposure, genetic variants, and fetal growth restriction. These results highlight the utility of interrogating the transcriptome at transcript-level resolution to identify novel placental biomarkers of outcomes jointly impacted by genetic polymorphisms and environmental exposures.

O-OP-278 Exposure to a metal mixture is associated with decreased tremor in Italian adolescents

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BACKGROUND AND AIM: Children living near ferroalloy industry are commonly exposed to metals including manganese (Mn), copper (Cu), lead (Pb), and chromium (Cr). These metals are associated with adverse neurodevelopment outcomes, with evidence of non-linear associations for essential metals. Metals target brain regions involved in motor function, but motor function remains an understudied neurodevelopmental domain and little is known about the joint effects of metal mixtures.

METHODS: We used cross-sectional data from 618 adolescents (10-14 years; 51% female) to estimate associations between a metal mixture and postural tremor. Metal concentrations were quantified in hair and blood using inductively coupled plasma mass spectrometry. Neuropsychologists administered the Tremor Pen Test from the Coordination Ability Test System, which measures intensity and regularity of tremor in both hands at rest. We quantified joint associations between metals and adolescent tremor using quantile-based g-computation (qgComp) and Bayesian kernel machine regression (BKMR), adjusting for age, biological sex, and socioeconomic status.

RESULTS: The metal mixture was associated with decreased tremor intensity: using qgComp, a one quartile increase in the metal mixture was associated with 0.18 (95% CI: -0.29, -0.08) and 0.22 (95% CI: -0.33, -0.12) SD decrease in tremor intensity of the dominant and nondominant hands, respectively. Using BKMR, increasing levels of the mixture were associated with less intense tremor in the dominant hand (e.g., when all metals were at their 75th percentiles, compared to their 50th percentiles, β= -0.13 SD, 95% CI: -0.27, 0.01). Associations were driven by Cr and consistent between methods.

CONCLUSIONS: Increasing levels of the metal mixture were associated with smaller tremor magnitude, and associations were driven by Cr. Few epidemiological studies have examined the role of Cr in neurodevelopment, but our findings suggest that Cr may be beneficial for some aspects of motor function in adolescence.

KEYWORDS: metals, mixtures, motor function, neurodevelopment, chromium

O-OP-279 Associations of Prenatal Metals Exposure with Kidney Injury Biomarkers in Children

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BACKGROUND AND AIM: Prenatal exposure to toxic metal(loid)s, including arsenic (As), cadmium (Cd), mercury (Hg), and lead (Pb) during development may have nephrotoxic effects in children. We assessed associations between prenatal metal exposure and urinary kidney injury biomarkers in children.

METHODS: Analyses included 418 children participating in the PROGRESS birth cohort study in Mexico City. Concentrations of As, Cd, Pb, and Hg (urine only) were quantified in maternal second trimester (2T) blood and urine. Kidney parameters were assessed at 8-10 years of age. We examined associations between individual metals and 1) kidney injury biomarkers using linear regression and 2) a multi-protein kidney index using weighted quantile sum (WQS) regression. Associations of separate urine and blood metal mixtures with individual kidney injury biomarkers were assessed via WQS. Covariates included child's age, sex, body mass index z-score, urine creatinine, 2T socioeconomic status, and 2T smoking exposure.

RESULTS: In single metal analyses, doubling of urine Cd was associated with higher urinary TIMP metallopeptidase inhibitor 1 (TIMP1), alpha-1-microglobulin (A1M), clusterin, and cystatin C. Within the multi-protein index, the association with increased urinary As was predominated by albumin, fatty acid binding protein 1 (FABP1), and interferon gamma-induced protein 10 (IP10), and the association with increased urinary Cd was predominated by albumin, A1M, TIMP1, lipocalin, and FABP1. Decile increases in urine metal mixture was associated with increased urinary albumin, IP10, and cystatin C. Urinary As and Cd comprised 60-96% of the metal mixture weights contributing to the associations.

CONCLUSIONS: Prenatal urinary metals, individually and as a mixture were associated with increased urinary kidney injury biomarkers in healthy children. Prenatal metals exposure may lead to subclinical glomerular or tubular injury in school age children. Further research is required to ascertain resolution or worsening of subclinical kidney injury at later life stages.

KEYWORDS: Heavy metals; Renal health; Mixtures

O-OP-280 Early pregnancy metal exposure and epigenetic aging biomarkers at birth and in childhood in a US cohort

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BACKGROUND AND AIM: Epigenetic aging is a strong predictor of mortality and morbidity, potentially linking environmental exposures to health. We analyzed the extent to which prenatal metals were associated with epigenetic age acceleration (EAA) at birth and in childhood in the Project Viva cohort.

METHODS: Metal concentrations (As, Ba, Cd, Cr, Cs, Cu, Hg, Mg, Mn, Pb, Se, Zn) were measured in maternal erythrocytes. DNA methylation was measured in cord blood (N=361) and leukocytes in early (N=92, median=3.2 years) and mid-childhood (N=333, median=7.7 years). We calculated epigenetic clocks for gestational age (GA) (Bohlin clock), early- and mid-childhood age (Horvath and skin & blood clocks), and respective EAA measures. Horvath intrinsic EAA adjusting for estimated cell types was also calculated. We evaluated associations between each metal and EAA at each period using linear models and across ages using linear mixed effects models, adjusting for biologically relevant covariates.

RESULTS: Epigenetic GA (Bohlin clock) strongly predicted chronological GA ($r=0.80$, $p<0.001$) while the Horvath and skin & blood epigenetic age estimates were moderately correlated with chronological age in childhood (Horvath early childhood $r=0.48$, mid-childhood $r=0.43$; skin & blood early childhood $r=0.68$, mid-childhood $r=0.56$; $p<0.001$). Higher prenatal As was associated with greater Bohlin GA acceleration (B=0.40 days per doubling in concentration, $p=0.03$), early childhood Horvath EAA (B=0.14 years per doubling in concentration, $p=0.03$), early childhood Horvath intrinsic EAA (B=0.14, $p=0.03$), and Horvath intrinsic EAA across ages in longitudinal analyses (B=0.07, $p=0.02$). We also observed associations between prenatal Cs and early childhood Horvath EAA (B=0.41, $p=0.04$) and Horvath intrinsic EAA (B=0.41, $p=0.03$).

CONCLUSIONS: Prenatal As and Cs are associated with epigenetic biomarkers of accelerated aging, particularly for those independent of age-related immune changes or intrinsic aging, at birth and in childhood. Future studies may provide insight to the relationship between EAA and health in early life.

ORAL PRESENTATIONS SESSION 51: Air pollution, ultrafine particles, radon and various health outcomes

O-OP-281 Renal function and ambient air pollution at low exposure levels

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BACKGROUND AND AIM: Increasing evidence connects exposure to air pollution to decreased renal function. This has important public health implications, since chronic kidney disease is both an increasing global health threat and a risk factor for cardiovascular disease. In this study we investigate associations between low-level exposure to ambient air pollution and renal function.

METHODS: The Swedish CArdioPulmonary Study (SCAPIS, n = 30154) is a large population-based cohort of middle-aged men and women from six Swedish cities and includes extensive medical data. In these preliminary analyses, we use data from the Gothenburg subcohort (n = 6265). Longitudinal residential exposure to particulate matter (PM2.5 and PM10) and nitrogen oxide (NOx) was assigned from high-resolution dispersion models and averaged over 15, 5, and 2 year time-frames. We estimated the association between air pollutant exposure and estimated glomerular filtration rate (eGFR) and prevalence of a low eGFR, using multivariate-adjusted robust Poisson and linear regression.

RESULTS: In the SCAPIS Gothenburg subcohort average long-term exposure to PM2.5, PM10, and NOx was 8.19, 10.2 and 33.0 µg/m3, respectively, and median eGFR was 91.5 mL/min/1.73 m2. We did not find statistically significant associations between air pollutant exposure and renal impairment. However, there was a trend towards a negative association between two-year average exposure and eGFR (e.g., -0.29% (95% CI: -0.69–0.11%) lower eGFR per 10 µg/m3 higher two-year NOx). We found stronger associations in males, and in participants with low education level and with high alcohol consumption.

CONCLUSIONS: The results indicate an association between air pollution and lower renal function also at low exposure levels, although estimates were not statistically significant. Expanding the analysis to the entire SCAPIS cohort will permit analyses with higher power, greater exposure contrasts, and source-specific exposures.

KEYWORDS: Air pollution; Renal function; eGFR; Cross-sectional study

O-OP-282 Impact of ultrafine particles and total particle number concentration on natural-, cardiovascular, and respiratory mortality in three German cities

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BACKGROUND AND AIM: Exposure to ambient particulate air pollution has been associated with adverse effects on morbidity and mortality. However, the evidence for ultrafine particles (UFP; 10-100nm) remains inconsistent, and study designs vary considerably. We aimed to examine short-term exposures to UFP and total particle number concentrations (PNC; 10-800nm) and the risk of cause-specific mortality in the three German cities Dresden, Leipzig, and Augsburg.

METHODS: for these cities, we included daily counts of non-accidental, cardiovascular, and respiratory mortality between 2010 and 2017. We collected daily averages of UFP, PNC, and routinely monitored air pollutants (e.g., fine particulate matter and nitrogen dioxide) at four urban background and two roadside/traffic monitoring sites. We applied site-specific confounder-adjusted Poisson regression models. We investigated effects of air pollutants at aggregated lags (0-1, 2-4, 5-7, and 0-7) and used meta-analytical methods to pool the results across the sites. Additionally, we investigated effect modification by age, sex, and season and assessed interdependencies between pollutants using two-pollutant models.

RESULTS: for respiratory mortality, we found a delayed increase in relative risk of 4.32% [95% confidence interval (CI): 1.63%, 7.09%] per 3,207 particles/cm³ increase 5 to 7 days after UFP exposure. Effects for PNC and other lags showed smaller but comparable results. Two-pollutant models indicated independent effects of fine particulate matter. Effect modification analysis showed higher risks for women. We did not find any associations for cardiovascular or non-accidental mortality.

CONCLUSIONS: Consistent with previous studies from the same region, we found significant delayed effects for respiratory mortality after short-term exposure to UFP and PNC. To avoid greater heterogeneity between study designs and allow better comparison of evidence, future research should be guided by the good practice statements for UFP devolved and published by the World Health Organization in 2021.

KEYWORDS: ambient air pollution, ultrafine particles, cause-specific mortality, time series

O-OP-283 Exposure to ultrafine particles and mortality in the Netherlands

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BACKGROUND AND AIM: Epidemiologic research on long-term exposure to ultrafine particles (UFP) is limited. The aim of this study was to investigate the association between long-term UFP exposure and natural and cause-specific mortality (including cardiovascular disease (CVD), respiratory disease and lung cancer) in the Netherlands.

METHODS: A Dutch national cohort of 10.8 million adults aged 29+ years was followed from 2013 until 2019. Annual average UFP concentrations were estimated at the home address at baseline, using land-use regression models based on a nationwide mobile monitoring campaign. Cox proportional hazard models were applied, stratified by sex, with age as the underlying time scale and adjustment for potential individual and area-level socio-economic status confounders. Two-pollutant models with NO2, PM2.5, PM10 and elemental carbon based on dispersion modelling were additionally assessed.

RESULTS: A total of 945,615 cases of natural mortality occurred during 71,008,209 person-years of follow-up. The correlation of UFP concentration with other pollutants ranged from 0.59 (PM2.5) to 0.81 (NO2). We found a significant association between annual average UFP exposure and natural mortality [HR 1.012 (95% CI 1.010 – 1.015), per IQR (2723 particles/cm3) increment]. The association attenuated but remained significant when adjusting for co-pollutants in two pollutant models, e.g., HR 1.009 (1.006 – 1.013) after adjustment for NO2. Associations were weaker for CVD mortality [HR 1.005 (1.000 – 1.011)], whereas stronger for respiratory disease mortality [HR 1.022 (1.013 – 1.032)] and lung cancer mortality [HR 1.038 (1.028 – 1.048)].

CONCLUSIONS: Annual average UFP exposure was independently associated with natural and cause-specific mortality among adults in the Netherlands.

KEYWORDS: ultrafine particles, mortality, national cohort, air pollution, two-pollutant models

O-OP-284 Association between long-term exposure to air pollution and rhinitis and asthma comorbidities in the Constances cohort

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BACKGROUND AND AIM: Asthma and rhinitis are two related respiratory conditions. However, studies that investigated their associations with air pollution have considered them separately. We aimed to study the association between exposure to air pollution and phenotypes of current rhinitis (CR) and current asthma (CA) in Constances, a large French population-based adult cohort.

METHODS: CR was defined by the report of sneezing, runny or blocked nose in the last 12 months. CA was defined by the report of lifetime asthma plus having in the last 12 months: taken asthma medication or had an asthma attack, wheezed, woken up with breathing discomfort, been short of breath at rest or exercise, or woken up with shortness of breath. Four categories were considered: non-CR/non-CA, CR/non-CA, non-CR/CA, and CR/CA. Annual exposure to nitrogen dioxide (NO2), particulate matter ≤2.5 µm (PM2.5) and black carbon (BC) was estimated at the participants' residential address by land-use regression models. Cross-sectional analyses at inclusion were performed between air pollutants and the four phenotypes using a multinomial logistic model adjusted for age, sex, smoking, education level and French deprivation index.

RESULTS: Among the 173,805 participants included in this analysis (mean age: 47, 54% women), 108,637 (63%) were classified as non-CR/non-CA, 48,712 (28%) CR/non-CA, 6,282 (4%) non-CR/CA, and 10,174 (6%) CR/CA. Using non-CR/non-CA as reference, an increase of an interquartile range of BC (0.86 10-5m-1) was significantly associated with CR/non-CA (OR (CI95%): 1.17 (1.15-1.20)), non-CR/CA (1.10 (1.05-1.15)), and CR/CA (1.12 (1.08-1.16)). Similar associations were observed for PM2.5, NO2, and BC residuals. Regardless of pollutant, associations were significantly higher for the CR/non-CA than for the other groups.

CONCLUSIONS: Our results suggest that CR/non-CA phenotype may be more sensitive to the effects of air pollution and that among traffic related air pollutants, BC may be of special interest.

KEYWORDS: rhinitis, asthma, air pollution

O-OP-285 A prospective cohort study on the association between residential radon exposure and melanoma incidence in Switzerland

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BACKGROUND AND AIM: Radon is radioactive noble gas found in earth crust. It tends to accumulate in buildings, and is estimated to account for half of the ionizing radiation dose received by humans. Skin is the second most exposed organ to ionizing radiation from radon. The aim of this study was to evaluate the association between residential radon exposure and melanoma incidence in selected Swiss cantons.

METHODS: The study included 1.3 million adults (20+ years) from the Swiss National Cohort (SNC) who were residents in the cantons of Vaud, Neuchâtel, Valais, Geneva, Fribourg, and Ticino at the study baseline (04.12.2000). Cases of primary tumours (ICD-O-3: 8720-8790/3+ melanoma) were identified using data from these cantonal cancer registries, linked to the SNC. Long-term residential radon and ambient ultraviolet exposure from sun were assigned to each individual's addresses at baseline. We used Cox proportional hazard models with age as the underlying time scale and adjusted for birth cohort, canton, sex, socioeconomic position, educational attainment, civil status, mother tongue, outdoor occupation with potential sun exposure as fixed explanatory variables and stratified by follow-up period. Potential effect modifiers were also tested.

RESULTS: Among the study population, we observed 4937 incident cases of melanoma during an average 8.9 years of follow-up. The adjusted hazard ratio for per 100 Bq/m³ increase in residential radon levels at age 45 was 1.11 (95% CI: 1.00, 1.23). Radon effect was higher at younger ages and became null at higher ages. Ambient long-term UV exposure was not associated with melanoma incidence across all ages.

CONCLUSIONS: Residential radon exposure might be a relevant risk factor for melanoma incidence, especially for people at younger ages. Accumulation of radon gas is preventable via built-in solutions applicable to dwelling. Such measures are important for public health.

KEYWORDS: Radon exposure, melanoma incidence, prospective cohort, Switzerland

O-OP-286 The Association of ventilation device in kitchen with the reported respiratory symptoms of adults

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OBJECTIVE: To investigate the benefits of ventilation device in kitchen on respiratory symptoms of rural adults and to provide scientific evidences for indoor air pollution controlling and health promotion in rural China.

METHODS: We selected the information on the ventilation device in kitchen, the reported respiratory symptoms and the sociodemographic status from the database for the questionnaire investigation in 7 counties in Huaihe River Basin. The participants were local residents aged 20-75. The respiratory symptoms were investigated by the revised questionnaire based on American Thoracic Society's Division of Lung Disease and Logistic Regression Model was used to complete the analyses of the relationship.

RESULTS: Totally 11134 participants finished the survey and 1548 of them (13.9%) reported that there were ventilation devices in their kitchens. The reported rates of cough, chronic cough, expectoration, chronic expectoration, wheeze and shortness of breath were 15.4%, 9.6%, 15.1%, 10.8%, 9.9% and 22.9%, respectively. These rates among people with ventilation device in kitchen was significantly lower than those without ventilation device in kitchen (P<0.001). After adjusted the age, gender, education years, marriage status, farmer, smoking and family income, the multivariate logistic regression analysis showed that ventilation device in kitchen could significantly reduce the risk of chronic cough (OR=0.64, 95% CI:0.50~0.81), chronic expectoration (OR=0.61, 95%CI:0.48~0.77), wheeze (OR=0.70, 95%CI:0.55~0.88) and shortness of breath (OR=0.80, 95%CI:0.69~0.94).

CONCLUSIONS: The use of ventilation device in kitchen was associated with the decreasing of the reported respiratory symptoms among adults, which will benefit the human respiratory health.

KEYWORDS: Rural Area; respiratory symptoms; Ventilation Device; Kitchen

PECHA KUCHA SESSIONS

Monday, September 19

PECHA KUCHA SESSION 01:
Air pollution (from ambient and indoor sources) and health

THEMATIC 03: Air pollution (ambient & indoor) and Sources

O-PK-01 Associations between short-term ambient PM2.5, oxidant gases and respiratory hospitalizations in children: effect modification by PM2.5 transition metals, sulfur and oxidative potential

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BACKGROUND AND AIM: Exposure to particulate and gaseous pollutants impair the respiratory health of children. Mass-based measures of PM2.5 do not capture spatiotemporal variability in particle composition/toxicity. The aim of this study is to examine whether associations between short-term ambient PM2.5 or oxidant gases and respiratory hospitalizations in children are modified by metals or sulfur content in PM2.5, or particle oxidative potential.

METHODS: This is a case-crossover study of 10,500 children (0-17 years) in Canada. Daily PM2.5 mass concentration and the combined weighted oxidant capacity of NO2 and O3 (Ox) were collected. Monthly estimates of transition metals (copper, iron, nickel, manganese, zinc) and sulfur in PM2.5, and three metrics of particle oxidative potential (OPAA, OPGSH, OPDTT) were measured at each monitoring site. Conditional logistic regression models were used to estimate associations between PM2.5 or Ox and respiratory hospitalizations, above and below median metals, sulfur, and particle oxidative potential.

RESULTS: Without stratifying above and below median metals, sulfur, or particle oxidative potential, there were no associations between PM2.5 mass and respiratory hospitalizations (OR and 95% CI per 10 μg/m3 increase in PM2.5: 1.004 [0.955, 1.056]). However, when the analyses were performed above/below median metals, sulfur, and oxidative potential, positive associations were observed when metals, sulfur and OPGSH were above the median. for example, when copper was above the median, the OR and 95% CI per 10 μg/m3 increase in PM2.5 was 1.084 [1.007, 1.167], while the OR and 95% CI was 0.970 [0.929, 1.014] when copper was below the median. Stronger associations between Ox and respiratory hospitalizations were also observed when metals, sulfur and oxidative potential were above the median.

CONCLUSIONS: Stronger associations between short-term PM2.5, oxidant gases and respiratory hospitalizations in children were observed when metals, sulfur and particle oxidative potential were elevated.

KEYWORDS: PM2.5, respiratory health, children, oxidant gases

O-PK-02 The Spatial Modification of the Non-Linear Effects of Ambient Oxides of Nitrogen during Pregnancy on Birthweight in a South African Birth Cohort

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BACKGROUND: Birthweight is strongly associated with infant mortality and is a major determinant of infant survival. Several factors such as maternal, environmental, clinical, and social factors influence birthweight, and these vary geographically, including across low, middle, and economically advanced countries. The aim of the study was to investigate the geographical modification of the effect of oxides of nitrogen exposure on birthweight adjusted for clinical and socio-demographic factors.

METHODS: Data for the study was obtained from the Mother and Child in the Environment birth cohort study in Durban, South Africa. Pregnant females were selected from public sector antenatal clinics in low socioeconomic neighborhoods. Land use regression models were used to determine household level antenatal exposure to oxides of nitrogen (NOx). Newborns were assessed at the local hospitals by doctors or qualified midwives. Six hundred and seventy seven births were analysed, using the geoadditive model with Gaussian distribution and identity link function. Continuous covariates were modelled by thin-plate regression splines and smoothing was estimated by the generalized cross validation.

FINDINGS: A total of 677 births were analyzed. The newborns in the cohort had mean birthweight of 3106·5g (standard deviation (SD):538·2g and maternal mean age was 26 years (SD: 5·7). The mean prenatal exposure to NOx was found 31·5µg/m3 with standard deviation of 8·6 µg/m3. A spatially modified NOx exposure-related effect on birthweight was found across two geographic regions in Durban. Prenatal exposure to NOx was also found to have a non-linear effect on the birthweight of infants. The geoadditive model adjusted for maternal age, weight gain, and body mass index showed significant non-linear influences.

CONCLUSION: The study suggested that incorporating spatial variability is important to understand and design appropriate policies to reduce air pollution in order to prevent risks associated with birthweight and child development.

O-PK-03 Short-term effects of particulate matter and desert dust on mortality in Southern Europe, the Middle East and Eastern Asia

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BACKGROUND: Desert dust represents a threat to health, but the evidence is limited, as past studies were localised and adopted different exposure metrics and/or statistical approaches. We aim to evaluate the short-term effects of desert dust episodes and particulate matter (PM) on natural mortality in multiple cities from different geo-climatic zones.

METHODS: Daily death counts were collected for 21 cities in southern Europe (France, Greece, Italy, Portugal, Spain), the Middle East (Iran, Kuwait) and Eastern Asia (China, Japan, South Korea, Taiwan) from 2003-2018. Dust advection days were identified using satellite data, operational models and back-trajectories. Daily mean concentrations of PM10 (PM<10µm) and PM2.5 (<2.5µm) were available for 21 and 16 cities, respectively. City-specific quasi-Poisson regression models were fitted, adjusted for time trends and meteorology, and city-specific estimates were combined using random-effects meta-analysis.

RESULTS: The frequency of dust days ranged from 5% in Northern Italy to 61% in Northern China, with highest levels of PM10 and PM2.5 raised in Kuwait (191 µg/m3) and Xian (182 µg/m3). Overall, dust (yes/no), PM10 and PM25 (10 µg/m3) increased mortality at the same day by 0.52% (95% confidence interval: 0.04, 1.01), 0.14% (0.07,0.21) and 0.16% (0.02, 0.31), respectively. We found differential effects of PM on non-dust versus dust days: on non-dust days 10 µg/m3 increases in PM10 and PM25 increased mortality by 0.20% (0.11, 0.29) and 0.26% (0.05, 0.46) in non-dust days, while in dust days they increased mortality by 0.06% (95% confidence interval: 0.01, 0.10) and 0.05% (-0.04, 0.15), respectively.

CONCLUSIONS: Desert dust may have independent adverse health effects. Further investigation is needed to disentangle the complex role of dust on air quality and health. On-going analyses on a broader set of cities within the MCC network provide a promising opportunity for this purpose.

KEYWORDS: Desert dust; particulate matter; short-term effects; mortality

O-PK-04 Effects of a Liquefied Petroleum Gas Stove and Continuous Fuel Distribution Intervention on Anthropometric Outcomes at Birth

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BACKGROUND AND AIM: Air pollution may contribute to childhood stunting and impaired cognitive development. Potential anthropometric markers of poor growth and cognition include head circumference and length at birth. The Household Air Pollution Intervention Network (HAPIN) trial in India, Guatemala, Peru, and Rwanda was a randomized controlled field trial among 3200 pregnant women that assessed the effect of liquefied petroleum gas (LPG) stove and continuous free fuel intervention compared to cooking with biomass on health outcomes. We conducted an intention-to-treat analysis of the LPG intervention delivered during pregnancy starting at 9-19 weeks of gestation on head circumference and length at birth among offspring.

METHODS: Length and head circumference were measured in centimeters within 24 hours of birth. Birth length and head circumference z-scores were calculated using INTERGROWTH-21st standards which accounts for gestational age at birth. Separate linear regression models (adjusted for 10 strata, representing settings in Guatemala (1 site), Rwanda (1 site), India (2 sites) and Peru (six sites)) were created for head circumference, head circumference z-score, birth length and birth length z-score.

RESULTS: A total of 3060 live births were included in the analysis. The intervention had small or no effect on birth length (β=0.14, 95% CI -0.01 to 0.29), birth length Z-scores (β=0.09, 95% CI 0.01 to 0.16), head circumference (β= -0.01, 95% CI -0.11 to 0.09) and head-circumference Z-scores (β= -0.01, 95% CI -0.08 to 0.07). More than 90% of the women had a full-term pregnancy (94.6% in control and 94.1% in intervention group), and the mean (SD) time with the intervention was 21.23 weeks (3.67 weeks).

CONCLUSION: Our intervention strategy aimed at reducing household air pollution during pregnancy had small or no effects on length and head circumference at birth among offspring.

KEYWORDS: Household air pollution, liquefied petroleum gas, biomass fuel, head circumference, birth length, newborn

O-PK-05 Ambient fine particulate matter exposure and lung cancer risk in the NIH-AARP Diet and Health Study

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BACKGROUND AND AIM: Fine particulate matter (PM2.5) is an established cause of lung cancer; however, few studies have evaluated risk by histologic subtype.

METHODS: We estimated outdoor PM2.5 concentrations at the residential enrollment (1995-1996) address for 494,728 participants of the NIH-AARP Diet and Health Study, a cohort located in 6 states (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and 2 metropolitan areas (Atlanta, Georgia, and Detroit, Michigan). We used annual estimates from a national spatiotemporal model to assess PM2.5 concentrations for a 5-year pre-enrollment period (1990-1994). We used Cox regression to estimate hazard ratios and 95% confidence intervals (HR[CI]) for risk of incident lung cancer overall and by histologic subtype per 10µg/m3 increase in PM2.5. Models were adjusted for demographic characteristics, smoking status and intensity, and census-tract median household income. We also examined models stratified by smoking status, sex, and study catchment area at baseline, and we tested for statistical interaction via Wald tests.

RESULTS: 16,766 lung cancers were diagnosed in follow-up through 2011. We observed a small, nonsignificant increased risk for lung cancer overall (HR=1.02[0.96-1.08] per 10µg/m3). Associations were stronger for adenocarcinoma (HR=1.10[1.00-1.21]) and squamous cell carcinoma (HR=1.08[0.94-1.24]), whereas we found no association for small cell carcinoma (HR=0.98[0.83-1.15]). No significant differences in risk were noted by smoking status or sex (p-interaction all >0.05). Associations between PM2.5 and lung cancer overall varied widely among the 8 cohort catchment areas (p-interaction <0.01). State-specific associations for lung cancer ranged from HR=0.78[0.46-1.30] in Louisiana to HR=1.60[1.27-2.01] in Pennsylvania.

CONCLUSIONS: Our findings from this large U.S. cohort indicate that risk of lung cancer increases with PM2.5, particularly for adenocarcinoma and squamous cell carcinoma subtypes. Associations varied by region, suggesting that PM2.5 constituency may influence differences in lung cancer risk.

KEYWORDS: lung cancer, outdoor air pollution, particulate matter

O-PK-06 Prescribed Fires, Smoke Exposure, and Hospital Utilization Among Heart Failure Patients

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BACKGROUND AND AIM: Prescribed burns are used for land management, but their environmental health risks have been infrequently studied. We contrasted the health effects of prescribed burns and smoke exposure on heart failure (HF) patients in North Carolina.

METHODS: We used electronic health records from a North Carolina hospital-based cohort diagnosed with HF between 2014-2016. Prescribed fire data was obtained using the Satellite Mapping Automatic Reanalysis Tool for Fire Incident Reconciliation and the National Emissions Inventory. Smoke density data came from NOAA's Hazard Mapping System and was linked to patients based on the zip code of residence. Exposures were the number of prescribed burns within 1 km of the primary residence and the number of days of smoke exposure. Outcomes were the number of hospital visits and 30-day readmissions after HF diagnosis. We used a cross-sectional study design and quasi-Poisson models to model the number of hospital visits and zero-inflated Poisson models to model 30-day readmissions. Models were adjusted for age, sex, race, smoking status, urbanicity, poverty, education level, unemployment, median household value, and public assistance, and included an offset for follow-up time. Results presented are the percent change and associated 95% confidence interval (CI).

RESULTS: The number of prescribed burns within 1 km of a patient's residence showed weak evidence for an association with total hospital visits (-4.5%; 95% CI: -13.7%, 5.2%) and was not associated with 30-day readmissions. However, exposure to an additional medium or heavy smoke day was associated with an increase in both hospital visits (1.3%; 95% CI: -0.2%, 2.7%) and 30-day readmissions (5.3%; 95% CI: 2.3%, 8.5%).

CONCLUSIONS: Smoke exposure is associated with increased hospital utilization among HF patients, but no positive association with prescribed burns was seen. This work does not necessarily represent the views or policies of the US Environmental Protection Agency.

O-PK-07 DNA methylation as a potential mediator of the association between indoor air pollution and neurodevelopmental delay in a South African birth cohort

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BACKGROUND AND AIM: Prenatal exposure to indoor air pollution (IAP) has been linked to neurodevelopmental delay in toddlers. Changes in DNA methylation (DNAm) have been independently associated with both prenatal air pollution exposure and delayed neurodevelopment. Investigating DNAm as a mediator may help to elucidate the biological pathways driving the association between IAP and neurodevelopmental delay. In this study, we aim to identify differentially methylated CpG sites and gene regions that mediate this association.

METHODS: We analyzed data from 142 mother-child pairs enrolled in the South African Drakenstein Child Health Study. DNAm from cord blood was measured using the Infinium MethylationEPIC and HumanMethylation450 arrays. Particulate matter with an aerodynamic diameter of 10□m or less (PM10) was measured inside participants' homes during the second trimester of pregnancy. Neurodevelopment was assessed at age 2 years using the Bayley Scales of Infant and Toddler Development III in four domains (cognitive function, general adaptive behavior, language, and motor function). We used three high-dimensional mediation analysis techniques (HIMA, DACT and gHMA) to identify potential mediators, complemented with causal mediation analysis to assess the robustness of our results.

RESULTS: Differential methylation at 29 CpG sites and 4 gene regions (GOPC, RP11-74K11.1, DYRK1A, RNMT) was found to significantly mediate the association between prenatal PM10 exposure and cognitive neurodevelopment. Estimated proportion mediated (95%-confidence interval) ranged from 0.29 (0.01,0.86) for cg00694520 to 0.54 (0.11,1.56) for cg05023582.

CONCLUSIONS: DYRK1A and several of the genes our CpG sites mapped to, including CNKSR1, IPO13, IFNGR1, LONP2, and CDH1 are associated with biological pathways implicated in neurodevelopment and three of our identified CpG sites (cg23560546, cg22572779, cg15000966) have been previously associated with fetal brain development. These findings suggest that DNAm may mediate the association between prenatal PM10 exposure and cognitive neurodevelopment.

KEYWORDS: particulate matter, neurodevelopment, cord blood, epigenetics, newborn DNA methylation.

O-PK-08 Particle Components and Risk of Psychiatric Hospitalization in the U.S.

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OBJECTIVE: This study examined the associations between long-term exposure to ambient particle components and total psychiatric hospital admission risk among the U.S. general population.

METHODS: Using Health Cost and Utilization Project (HCUP) State Inpatient Databases (SIDs), we analyzed the relative risk of psychiatric hospitalization associated with increased exposure to 14 particle components in eight U.S. states over the period of 2002-2018. The particle components data was based on super-learning models. Exposure data was matched with each residential address based on ZIP code of residence and admission year. Single component models were conducted via fitting zero-inflated negative binomial regression on counts of admission per ZIP code per year for each component separately. A multi-components regression was modeled by including the four main mass components (organic carbon (OC), elemental carbon (EC), nitrate and sulfate). We also applied Nonnegative Matrix Factorization (NMF) to identify particle source factors and obtain the source-specific effect estimates. Generalized Weighted Quantile Sum (gWQS) Regression was applied to obtain an overall mixture effect.

RESULTS: Sulfate, Fe, Pb and Zn were associated with the largest risk increases in single-component models. for each interquartile (IQR) increase in OC and sulfate, we observed a relative risk (RR) of 1.10 (95% CI, 1.07 - 1.12) and 1.14 (95% CI, 1.12 - 1.16) respectively. Significant harmful associations were observed for multiple particle sources with the metal industry source (high loadings of Pb and sulfate) being the most influential. for one quartile increase in the WQS score of the components mixture, we observed an increased RR of 1.24 (95% CI, 1.21 - 1.26) adjusting for covariates.

CONCLUSIONS: Living in areas with higher annual average levels of particle components was associated with increased risk of psychiatric hospitalization among residents in eight U.S. states. Certain components (i.e. Pb, sulfate) and sources (metal industry) were the most related.

PECHA KUCHA SESSION 02:
Exposure assessment

THEMATIC 13: Exposure assessment

O-PK-09 Long-term exposure to air pollution, cause-specific mortality and incidence of stroke and acute coronary heart disease in the Rome Longitudinal Study: the BIGEPI project

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BACKGROUND AND AIM: Long-term air pollution exposure increases cause-specific mortality and incidence of cardiovascular diseases. Within the BIGEPI project, we aimed to investigate the association between long-term exposure to air pollutants, cause-specific mortality, incidence of coronary heart diseases and stroke in 6 large Italian administrative cohorts. We report preliminary results for Rome.

METHODS: We enrolled 1,739,277 adults from the Rome Longitudinal Study at 2011 census, and followed them up until 2018. We analysed natural, cardiovascular and respiratory mortality, stroke and acute coronary heart disease (CHD) incidence. We assigned annual mean concentrations of particular matter <10 µm (PM_{10}), PM <2.5 µm ($PM_{2.5}$), nitrogen dioxide (NO_2) and warm-season ozone (warm-O_3) at baseline residential addresses from satellite-based spatiotemporal models. We applied Cox proportional hazards models adjusted for individual and area-level covariates, in single- and two-exposure models. We investigated effect modification by age, sex, educational level, employment status and socioeconomic deprivation index.

RESULTS: We observed 167,300 deaths from natural causes (62,368 cardiovascular, 12,286 respiratory), 42,241 CHD incident cases and 24,835 cases of incident stroke. $PM_{2.5}$ was positively associated with natural, cardiovascular, respiratory mortality and stroke incidence: interquartile range (IQR) increases of 1.69 µg/m³ were associated with hazard ratios (HR) of 1.007 (95% confidence interval: 1.000-1.014), 1.018 (1.006-1.030), 1.028 (1.001-1.056) and 1.025 (1.007-1.044), respectively. We found positive associations between NO_2 and cardiovascular mortality (HR=1.021; 1.007-1.034 per IQR=11.53 µg/m³) and between warm-O_3 and CHD incidence (HR=1.024; 1.011-1.037 per 3.57 µg/m³). Associations tended to attenuate in two-exposure models. The effects were stronger for females and in the age group 30-64 years, with no major differences by individual or area-level socioeconomic indicators.

CONCLUSIONS: We estimated consistent associations between long-term air pollution exposure and cause-specific mortality and CVD incidence. Similar analyses will be conducted in other 5 administrative cohorts.

KEYWORDS: air pollution, cause-specific mortality, stroke, acute coronary heart disease.

O-PK-10 Mobile monitoring of air pollutants; performance evaluation of a mixed-model framework in relation to number of drive days

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BACKGROUND AND AIM: Because of the implicit uncertainty of mobile measurements due to the short-term nature of the measurements, most studies to date have used empirical modeling to stabilize predicted concentrations, thereby losing local spatial information. In a previous paper, we demonstrated that a mixed-model can stabilise the measurements by a land use regression (LUR) model, while allowing street segments to deviate from the LUR prediction based on between-segment variation of the measurements as a random effect. We analysed how many drive-days are needed for the mixed-effect model to improve predictions from LUR models and data-only mapping.

METHODS: We used black carbon data from the Air View study in Oakland, where every street segment was measured at least 50 times. We selected one drive day per street segment and compared the measurement, the LUR prediction and the mixed-model prediction with the average concentration based on 50 drive days of that street segment. We assumed that driving 50 times on a street segment reflects a robust long-term average concentration. We then sequentially added drive days to the dataset and computed the explained variance (R^2) and RMSE.

RESULTS: With one drive day on every street segment, the LUR model explained 63% of the variation, with very limited improvement in performance with increasing number of drive-days (65% for 50 drive days). The data-only map predicts less than 30% for one drive-day and more than 90% of the variance after 15 drive days, surpassing the LUR model in explained variance at 4-5 drive days. The mixed model outperformed the data-only and LUR model estimates, with 75% explained variance after 2 drive days and 90% after 12 drive days.

CONCLUSION: The mixed-model improves predictions compared to LUR and data already with two drive days and updates the model when more drives become available.

O-PK-11 Blood and urinary metal levels among exclusive marijuana users in the National Health and Nutrition Examination Survey (2005-2018)

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BACKGROUND AND AIM: Marijuana is the third most used drug in the world behind tobacco and alcohol; as more states legalize marijuana, recreational use continues to grow. Because cannabis, the marijuana plant, is a known scavenger of heavy metals, we hypothesized that individuals who use marijuana have higher metal biomarker levels compared to those who do not.

METHODS: To examine the relationship between marijuana use and metal exposures, we acquired and combined seven cycles of data from the National Health and Nutrition Examination Survey (2005-2018) for n=7,254 participants. Five metals were measured in blood and 16 in urine using inductively coupled plasma-mass spectrometry; urinary metals were adjusted for urinary creatinine. Individuals were grouped by: non-marijuana/non-tobacco use, current exclusive marijuana use, current exclusive tobacco use, and dual use; and by recent marijuana use: in the last 7 days, 30 days, or year. We built generalized linear models with non-marijuana/non-tobacco use as the reference.

RESULTS: We found 0.22µg/L (0.11, 0.34) and 0.18µg/g (0.06, 0.31) higher cadmium levels and 0.27µg/dL (0.07, 0.5) and 0.21 µg/g (-0.006, 0.50) higher lead levels in blood and urine, respectively, in participants reporting current marijuana use compared to non-marijuana/non-tobacco use when adjusting for sociodemographic factors, eGFR, and NHANES cycle year. We found 0.23µg/L (0.12, 0.35) and 0.20µg/g (0.03, 0.39) higher cadmium levels and 0.39µg/dL (0.11, 0.75) and 0.31µg/g (0.01, 0.70) higher lead levels in blood and urine, respectively, in those who had used in the last week compared to participants reporting no marijuana use.

CONCLUSIONS: Our results suggest that marijuana is a significant source of cadmium and lead exposure. Regulations regarding cannabis contaminants, particularly for metals, need to be addressed at the national level in order to address safety and public health concerns related to the growing number of cannabis users in the US.

KEYWORDS: metals, marijuana, cannabis

O-PK-12 Serum half-life of PFOA after end of exposure: a highly exposed community in the Veneto Region

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BACKGROUND AND AIM: Perfluoroalkyl substances (PFAS) are widely used, ubiquitous and highly persistent man-made chemicals. Groundwater of a vast area of the Veneto Region (North-Eastern Italy) was found to be contaminated by PFAS from a manufacturing plant active since the late 1960s. As a result, residents were exposed to PFAS through drinking water until autumn 2013. The aim of the present study was to estimate the decline rates in serum PFAS, and their corresponding serum half-lives, while characterizing their determinants.

METHODS: The population investigated in this study is a subgroup of the Regional health surveillance program target population consisting of subjects who enrolled in the second surveillance wave (n=2,619). The two blood samples were collected between January 2017 and December 2021. Four of the twelve measured PFAS were detected in greater than 50% of participants: PFOA (100%), PFOS (99.89%), PFHxS (99.01%) and PFNA (61.82%). Serum PFAS excretion rates and half-lives were estimated based on linear mixed effect models, adjusting for a set of contributing factors on PFAS pharmacokinetics such as age, sex, BMI, smoke-habit and eGFR.

RESULTS: Median initial serum concentrations were 62.6 ng/mL for PFOA, (range:0.6-1064), 4.6 ng/mL (range:0.5-142) for PFOS, 4.9 ng/mL (range:0.5-109.2) for PFHxS and, 0.6 (range:0.5-0.8) PFNA, with median declines of 61.18%, 36.96%, 40.82% and 41.67%, respectively. The median estimated PFOA's half-life was 2.90 years (95%CI:2.83-2.95). We found suggestive evidence that half-lives varied when stratified by gender and tertile of exposure, with more rapid elimination in men and higher tertiles of exposure.

CONCLUSIONS: Drinking water was the dominant route of exposure for PFOA so this study, the largest on PFOA half-life, offers great potential for studying interactions and risk modifications. Other PFAS longer half-lives than reported in other studies might be due to ongoing exposure to PFAS via other routes.
KEYWORDS: perfluoroalkyl substances; contaminated water; half-life.

O-PK-13 The challenge of assessing exposure to fast-elimination endocrine disruptors: When collecting? Which matrix? How many samples?

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BACKGROUND AND AIM: The assessment of human exposure to fast-elimination endocrine disruptors (FEED) such as phthalates, bisphenols or pesticides is usually based on urinary biomarkers. The variability of biomarkers concentration, due to rapid elimination from the body combined with frequent exposure is however pointed out as a major limitation to obtain reliable information. Collecting samples at specific times of the day, or increasing the number of samples have been suggested to improve the quality of exposure assessment. In parallel, the use of hair, less sensitive to short-term variations in the exposure, have also been proposed as a possible alternative. No consensus has however been reached yet on these points and providing a reliable information on exposure to FEED remains highly challenging.

METHODS: Urine and hair samples were repeatedly collected from 16 volunteers over a 6 months follow-up. 92 hair samples and 805 urines samples were collected and analyzed for 16 phthalate metabolites, 4 bisphenols and 8 pesticides metabolites.

RESULTS: 21 biomarkers were more frequently detected in urine, 6 in hair, and 1 was equivalent. Biomarkers were much more variable in urine, with intraclass correlation coefficients (ICC) ranging from 0.09 to 0.51, compared to 0.1 to 0.8 in hair. No preferred moment between first urine of the day, morning, afternoon and evening could be identified for urine collection. Algorithms demonstrated that between 10 (for monobenzyl phthalate) and 31 (for bisphenol S) samples were necessary to correctly classify 87.5% of the subjects into quartiles according to their level of exposure.

CONCLUSIONS: The study illustrates the complexity of assessing exposure to FEED and documents the respective advantages and limitations of urine and hair. These results provide new insights in exposure assessment based on biological matrices and will help to better design future biomonitoring strategies.

KEYWORDS: Exposure Biomarkers, Endocrine disruptors, Exposure assessment, Phthalates, Pesticides

O-PK-14 Spatiotemporally resolved daily relative humidity predictions across Germany during 2000-2021: a Random Forest approach

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BACKGROUND AND AIM: The lack of high-resolution relative humidity (RH) datasets and the limited ability of available weather stations to fully capture the spatiotemporal RH variability might lead to errors in exposure assessment for epidemiological studies and biased health effects estimates. We aimed to predict German-wide 1×1 km daily mean RH during 2000-2021 by using a machine learning approach.

METHODS: We used data from multiple sources, including RH observations, modelled precipitation and wind speed as well as remote sensing elevation, vegetation and the visible red, green and blue light bands. Our main predictor for estimating RH was modelled daily mean air temperature that we previously estimated in 1×1 km across Germany through a multi-stage regression-based approach incorporating two linear mixed models. Additionally, we included date in our RH model, capturing the day-to-day variation of the response-explanatory variables relationship. All the aforementioned predictors were included in a Random Forest (RF) model, which was separately developed for each year.

RESULTS: Ten-fold cross validation showed that the RF model achieved high accuracy (R^2=0.81) and low errors (Root Mean Square Error (RMSE)=5.26%). We also compared our output with an independent dataset from a dense monitoring network in Augsburg metropolitan area (R^2=0.81, RMSE=5.42%). Our models displayed high RH overall (21y-average RH=78.8%) and high spatial variability within a year across the country, exceeding 12.1% on average. RH distribution followed spatial patterns including urbanization, mountains, rivers and coastlines. for instance, the Alps and the North Sea coast were areas with elevated RH, while extended urban cores or individual cities were less humid than the surrounding rural settings.

CONCLUSIONS: Our findings indicate the proposed RF model as suitable for countrywide RH modeling at high spatiotemporal resolution, providing a reliable dataset for subsequent epidemiological analyses and other research purposes.

KEYWORDS: relative humidity, spatiotemporal modeling, random forest, exposure assessment

O-PK-15 Exposure Differences Between Measures of Residential and Smartphone Mobility Derived Greenness in the US-Based Nurses' Health Study 3 Cohort

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BACKGROUND AND AIM: Studies of greenness and health often rely on buffer-based residential measures which miss potential exposure occurring outside the home environment. We compared greenness measures obtained from traditional residence-based buffers and novel smartphone mobility-based estimates.

METHODS: We used data from the US-based Nurses' Health Study 3 mHealth study, which followed 348 participants who completed four 7-day sampling periods to capture seasonal variability across the year. We used Landsat Normalized Difference Vegetation Index (NDVI) data (30mx30m resolution) for both traditional and mobility-based greenness measures. We assessed two annual average residence-based estimates: 270m and 1230m. Mobility-based greenness exposure was calculated as seasonal NDVI values at GPS points captured every 10 minutes averaged across all four seasonal sampling periods. We compared measures using descriptive statistics, Bland Altman tests, and Generalized Additive Models.

RESULTS: Mean NDVI values from traditional residential buffers (270m=0.40, SD =0.12, 1230m=0.40, SD=0.12) were higher than those obtained using mobility derived NDVI (mean = 0.32, SD=0.11). The Bland Altman agreement bias was larger by 8.0% (95% CI: 7.0%, 9.0%) using the 270m residential measure and 7.3% (95% CI: 6.0%, 8.0%) using the 1230m residential measures compared to mobility derived NDVI. Spearman's rank correlations comparing the mobility and residential NDVI were 0.57 and 0.55 for the 270m and 1230m buffer respectively. The two residential buffers had a Spearman's rank correlation of 0.88. Lastly, for each 10% increase in both 270m and 1230m NDVI, was associated with 0.06 increase in mobility based NDVI (95% CI: 0.05, 0.07).

CONCLUSIONS: Results from our study indicate traditional residential estimates of greenness are higher than mobility derived metrics. These findings contribute to discussions surrounding the choice of an optimal spatial scale for greenness exposure.

KEYWORDS: Wearables, Mobility, Greenspace, Exposure Validation

O-PK-16 Biological and Environmental Sampling at ATSDR PFAS Exposure Assessment Sites

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BACKGROUND AND AIM: The Agency for Toxic Substances and Disease Registry (ATSDR) conducted biomonitoring exposure assessments (EAs) in communities near U.S. military installations that have documented PFAS in drinking water. PFAS in drinking water were mitigated prior to initiation of the EAs.

METHODS: EAs were conducted in ten communities using a community sampling design to evaluate PFAS serum concentrations in communities with PFAS in drinking water. PFAS in urine was measured in a subset of participants. PFAS in indoor dust and tap water were evaluated in a subset of households. All participants completed a questionnaire to gather information to characterize exposure and the responses were evaluated to identify demographic and exposure characteristics associated with PFAS levels in serum.

RESULTS: The relationships between PFAS levels in drinking water and concentrations of PFAS in serum will be presented for two locations, Hampden County Massachusetts and New Castle County Delaware. The primary PFAS elevated in serum included PFHxS, PFOS, and PFOA which were associated with drinking water exposure. PFAS levels in serum were compared to CDC's National Health and Nutritional Examination Survey (NHANES). Males had higher PFAS serum levels than females at both locations; additional site-specific findings regarding serum levels and demographic and exposure characteristics information will be presented. Dust sampling results indicated that non-drinking water sources of PFAS may contribute to exposure.

CONCLUSIONS: The results of testing at the PFAS EA locations presented indicate that levels of PFAS in drinking water are associated with increased levels of PFAS in serum. Additional environmental sampling is being conducted in partnership with U.S. EPA in Delaware and Massachusetts to evaluate potential non-drinking water exposures to PFAS.

KEYWORDS: Exposure, PFAS

The findings and conclusions in this presentation have not been formally disseminated by CDC/ATSDR and should not be construed to represent any agency determination or policy.

Tuesday, September 20

PECHA KUCHA SESSION 03:
Child health

THEMATIC 06: Children's environment and health

O-PK-17 Associations of prenatal exposure to per- and polyfluoroalkyl substances (PFAS) with measures of cognition in 7.5-month-old infants

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BACKGROUND: Per- and polyfluoroalkyl substances (PFAS) are man-made chemicals that are of health concern given their persistence in the environment and human body, and transmission to offspring during pregnancy. Studies examining the relationship between PFAS and neurodevelopment are inconclusive and largely have been conducted in older children. In the present study, we examined whether prenatal exposure to a mixture of PFAS was related to cognitive function in infancy.

METHODS: Pregnant participants were enrolled in the Chemicals in Our Bodies cohort and Illinois Kids Development Study, which together make up the ECHO.CA.IL cohort. Seven PFAS were previously measured in 2nd trimester maternal serum samples and were natural log transformed for analyses. Infant cognition was assessed at 7.5 months using a visual recognition memory task that tracks infant looking behavior using an infrared eye tracker. From the eye-tracking data, we calculated two measures of attention (based on infants shifting their looking between two stimuli, and the time it took them to reach cumulative looking criterion), information processing speed (based on how long infants looked at the stimuli before looking away) during the familiarization trial, and recognition memory (based on infants' looking at novel compared to the familiar stimulus) in the test trial. Bayesian kernel machine regressions (BKMR) were used to assess joint associations between multiple PFAS and individual cognitive outcomes (N=160).

RESULTS: Unexpectedly, prenatal exposure to the PFAS mixture was modestly associated with better attention, as indicated by faster shifts between stimuli, with PFNA, PFOS, PFHxS, and PFUdA contributing the most to the overall mixture effect. Increasing exposure to the PFAS mixture was weakly associated better information processing speed and attention although credible intervals include the null value.

CONCLUSIONS: Using a visual recognition memory task, we observed little evidence that prenatal PFAS exposure is associated with cognitive function.

KEYWORDS: PFAS, mixtures, neurodevelopment

O-PK-18 Effects of Artificial Light at Night on Body Mass Index and Islet Autoimmunity Development in Children in Bavaria, Germany

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BACKGROUND AND AIM: Worldwide, incidence of childhood obesity and early-onset type 1 diabetes (T1D) has risen over the past decades. Epidemiological studies have shown that in addition to genetic predisposition, environmental factors such as air pollution and temperature are associated with body mass index (BMI), T1D and its presymptomatic stage of autoimmunity to pancreatic islet cells. This study aimed to investigate the effect of exposure to light at night (LAN) on standardized BMI and islet autoimmunity (having 2 or more islet autoantibodies) in children in Bavaria, Germany.

METHODS: Exposure to LAN at baseline was assigned to the residential addresses of 52,636 children (<6 years of age) participating in the Fr1da study from 2015 to 2019. Information on demographic characteristics was extracted from self-administered questionnaires. We investigated the association of LAN with standardized BMI using linear regression and with islet autoimmunity using generalized additive models, segmented regression and quartile analysis. All models were adjusted for sex, age, family history of diabetes and area-level socioeconomic status (SES).

RESULTS: The mean standardized BMI was 0.12 ± 1.04 and 225 children showed islet autoimmunity. A 10 nW/cm2/sr increase in LAN was significantly associated with a 2.14% increase in standardized BMI (95% confidence interval (CI): 0.86-3.45). Also, LAN exposure was linearly associated with a significantly higher odds of islet autoimmunity in children with exposure levels up to 11 nW/cm2/sr (Odds ratio (OR): 1.98; 95% CI: 1.14-3.45). Similar, quartile analyses showed a greater risk of islet autoimmunity especially for the third quartile (Q3: 5.2-11.6 nW/cm2/sr) of LAN compared to the lowest quartile (Q1: 0.0-2.0 nW/cm2/sr; OR: 1.71; 95% CI: 1.19-2.47).

CONCLUSION: Exposure to LAN might be a further environmental risk factor contributing to higher BMI and islet autoimmunity in children.

KEYWORDS: Light at night, light pollution, body mass index, islet autoimmunity

O-PK-20 The association between ambient temperature exposure during infancy and overweight at age two years

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BACKGROUND AND AIM: Childhood overweight and obesity is increasing in prevalence globally and is a risk factor for metabolic disease in adulthood. We have previously described an association between exposure to higher ambient temperatures during infancy and rapid infant weight gain. We aimed to examine the association between ambient temperature exposure during the first year of life and overweight at age two years.

METHODS: A population-based cohort study using data from the Israeli network of public maternal and child health clinics from 2011 to 2018. The study population was restricted to children born with birthweight ≥2500g (N=579,404). We assessed exposure to ambient temperature using a high-resolution spatio-temporal model and calculated the average annual exposure during the first year of life for each infant based on daily temperature at their address. Overweight at two years was defined as >85th percentile in World Health Organization age and sex-adjusted body mass index. We calculated relative risks using log-linear models and fitted general additive models with thin plate regression splines while adjusting for sub-district, neighbourhood socio-economic index, ethnicity, month and year of birth and average ambient temperature during pregnancy.

RESULTS: We found a positive association between ambient temperature exposure and risk of overweight at age two years. Children exposed to the highest temperature quintile (≥22.0°C) had an adjusted relative risk of 1.16 (95% CI 1.12, 1.19) compared to those exposed to the lowest quintile (<19.6°C). Modelling temperature as a continuous variable using general additive models showed an increase in risk with higher temperature exposure up to approximately 23°C when the risk levelled out.

CONCLUSIONS: Exposure to higher ambient temperatures during infancy is associated with increased risk of overweight at age two years in Israel. Future studies should explore this association in other populations and examine possible biological mechanisms.

KEYWORDS: temperature, child health, climate

O-PK-21 Prenatal Exposure to Air Pollution and Childhood Lipid Levels: The Rhea Birth Cohort (Greece)

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BACKGROUND AND AIM: Abnormal blood lipid profiles in childhood are an important precursor to atherosclerosis and cardiovascular disease. Air pollution has been associated with lipid levels in animal models; however, evidence from human studies remains insufficient and inconclusive. We evaluated the associations of pregnancy exposure to air pollution with serum lipid profiles during childhood in the Rhea birth cohort, Greece.

METHODS: Residential exposure to particulate matter <10 μm (PM10) and <2.5 μm (PM2.5) during pregnancy was estimated with temporally adjusted land-use regression models. We measured triglycerides (TG), total cholesterol (TC), HDL- and LDL- cholesterol at 4, 6, and 11 years. Abnormal lipid levels in children were defined according to the US NHLBI guidelines. We assessed associations with multivariate regression models and effect modification by sex.

RESULTS: Prenatal PM2.5 and PM10 levels ranged between 13.0 and 18.7 μg/m3 and 34.9 and 54.6 μg/m3, respectively. PM10 concentrations over the 4th quartile were associated with lower TG levels overall (β= -5.25 mg/dL, 95% CI: -10.38, -0.11) and lower TC and TG levels in girls (β= -6.87 mg/dL, 95% CI: -13.78, 0.05; β= -9.03 mg/dL, 95% CI: -17.05, -1.01 respectively) at 4 years. at 11 years, higher prenatal PM10 levels were associated with both higher levels of TC and LDL (β= 7.75 mg/dL, 95% CI: -0.17, 15.68; β= 7.40 mg/dL, 95% CI: 0.36, 14.45) but also higher risk for elevated TC and LDL. Associations at 11 years were stronger in girls, indicating a sex-dependent effect. Associations with PM2.5 were in the same direction but not significant. No associations were observed at 6 years.

CONCLUSIONS: These results shed new light on the importance of controlling air pollution, which can contribute to abnormal blood lipid levels during childhood, an independent risk factor for adult cardiovascular disease.

KEYWORDS: prenatal, air pollution, lipids, children

O-PK-22 The relationship between pregnancy phthalate exposure and language development at 2 years of age

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BACKGROUND AND AIM: Phthalates are endocrine disrupting chemicals found in many consumer products. Pregnancy exposure has been associated with adverse neurodevelopmental outcomes, but few studies have examined their association with language development. Even less is known about replacements for commonly used phthalates.

METHODS: The MacArthur-Bates Communicative Development Inventories (CDI) was used to evaluate language development in 300 2-year-old children (average age of 27 months; 149 males, 151 females) in the Illinois Kids Development Study. Phthalate metabolites were quantified in a pool of five maternal urine samples collected across pregnancy. Associations of monoethyl phthalate (MEP) and the sums of metabolites of di(2-ethylhexyl) phthalate (ΣDEHP), di(isononyl) phthalate (ΣDINP), antiandrogenic phthalates (ΣAA), and di(2-ethylhexyl) terephthalate (ΣDEHTP) with each CDI outcome were assessed using generalized linear models. Models were adjusted for child age and sex, delivery type, and maternal age, education, verbal IQ, and parity.

RESULTS: Most mothers were white, non-Hispanic, college educated, approximately 30 years old, and gave birth vaginally. Most children were firstborn. All phthalate exposure biomarkers were associated with changes in vocabulary scores. MEP and ΣDEHTP were also associated with the mean of the three longest utterances (M3L) and with language complexity scores. MEP and ΣDEHTP were both associated with lower vocabulary scores (MEP β=-12.16,95% CI:-21.15,-3.17; ΣDEHTP β=-21.09,95%CI:-38.83,-3.36), M3L scores (MEP β=-0.12,95%CI:-0.25,0.02; ΣDEHTP β=-0.28,95%CI:-0.54,-0.02), and complexity scores (MEP β=-0.67,95%CI:-1.33,-0.02; ΣDEHTP β=-1.15,95%CI:-2.45,0.16). Associations of other biomarkers with vocabulary were specific to male children. ΣAA (β=-31.86,95%CI:-67.47,3.74) and ΣDEHP (β=-19.89,95%CI:-41.96,2.18) were associated with lower vocabulary scores in males while ΣDINP (β=12.50,95%CI:0.63,24.36) was associated with higher vocabulary scores in males.

CONCLUSIONS: Pregnancy exposure to some phthalates, particularly DEP and DEHTP, a replacement for DEHP, may be related to poorer language outcomes at 2 years of age, especially in male children.

KEYWORDS: language development, phthalates, neurodevelopment

O-PK-23 Big Data-Driven Korean CHildren's ENvironmental health Study (Ko-CHENS): Big-CHENS

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BACKGROUND AND AIMS: The Korean CHildren's ENvironmental health Study (Ko-CHENS) has been established in May 2015 and has recruited a total of 70,000 nationally-representative mothers with its two enrollment tracks (65,000 in the Main Cohort and 5,000 in the Core Cohort) from Jun 2015 through Feb 2021. Concurrently, we have launched a cohort titled "Big CHildren's ENvironmental health Study (Big-CHENS)" including all newborns and mothers in Korea, which is the target population of Ko-CHENS. Prior to Ko-CHENS, Big-CHENS commenced its mother registration in Jan 2015 and completed it in Dec 2021. Big-CHENS aims to investigate the nationwide association between environmental exposures and children's health.

METHODS: Big-CHENS is primarily based on medical records on delivery of mothers ("delivery code") provided by the National Health Insurance Service (NHIS) covering the entire Korean population, along with all Ko-CHENS participants. Based on the NHIS delivery code and PIN, Big-CHENS obtains medical records on newborns (up to 18 y) and parents (from 3-year before delivery to 1-year after delivery), and this registration procedure is expected to collect 97% of total births. Furthermore, Big-CHENS constructs the integrated-database including NHIS eligibility, medical utilization, periodic health screenings (up to 71 months), and neonatal deaths, via data linkages with NHIS, the Ministry of Education, and Statistics in Korea.

RESULTS: Since Jan 2015, over 1.7 million mother-child pairs (with 53,185 pairs from Ko-CHENS) have been registered in Big-CHENS, and 0.91 million male children and 0.86 million female children are included. Preterm birth and low birth weight rates were 7.1% and 6.1%. Big-CHENS also has been revealing the associations of environmental exposures with delivery and children's health outcomes.

CONCLUSIONS: The population-based Big-CHENS birth cohort is expected to identify the national effects of environmental exposures on health in childhood and provide scientific evidence for evidence-based life-course-persistent interventions for environmental health in childhood.

O-PK-25 Quantification of waste in schools: A case study in Danang City, Vietnam

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BACKGROUND AND AIM: Waste is a major problem that can affect the environment and health; especially in developing countries where there is often a lack of an appropriate system for waste treatment. Understanding the current situation of waste, its common type and amount are important to develop appropriate strategies for waste control, especially in a school-based setting. This study has been conducted to identify common types of waste that are disposed in schools and quantify such waste.

METHODS: This study used an audit method to identify the common types of waste and quantify such waste in Da Nang city in 2021.

RESULTS: There were four schools with a total number of 3064 students were participated in this study. The average total volume of waste that schools discharge in a day is 460kg (accounting for 7542 litres of storage volume); in which, organic waste has the largest volume of 261kg (57% of total volume) accounting for 2262 litres (30% of total volume); non-recyclable waste weights 175kg (38% of the total volume) with a maximum volume of 4524 litres (60% of the total volume); recyclable waste has a weight of only 22kg (5% of total volume) accounting for 719 litres (10% of total volume); The remaining types of waste are insignificant. This study also showed the presence of a large number of plastic bags (2128 pieces), multi-layer packaging (2036 pieces), milk cartons (1047 boxes), straws (772 pieces), plastic bottles (670 bottles), foam boxes (531 pieces), plastic spoons (400 pieces), polypropylene plastic cups (327 pieces) in the total waste produced in one day in these schools.

CONCLUSIONS: Schools are emitting a large amount of waste, significantly plastic waste. Intervention programs in the school-based setting are needed to reduce the amount of waste toward ensuring health for children and protecting the environment.

O-PK-27 High Ambient Temperatures and Child/Young Adult Injury Emergency Department Visits in NYC

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BACKGROUND AND AIM: Despite a growing literature on effects of ambient temperature and climate change on health, there remains little research quantifying associations between ambient temperature and violence-related or unintentional injury, particularly among children and adolescents. Here, we examined associations between ambient minimum daily temperature (Tmin) and emergency department (ED) visits for pediatric injury during warm months in New York City (NYC).

METHODS: We examined all ED visits among patients 0-25 years, during May-September 2010, with primary injury diagnosis (ICD-9) (n=108,447). We performed conditional logistic regression, in a case-crossover design, using distributed lag non-linear functions (DLNMs), adjusting for long-term time trends and daily relative humidity. We modeled the lag-response curve across lag days 0-5, estimating cumulative odds ratios (OR) across lag days, compared to odds at observed minimum-injury temperature (MIT, 42° F)). We also stratified analyses by age and injury type.

RESULTS: Across all ages and injury type, case-day Tmin was significantly associated with increased odds of injury, though associations were inconsistent across lag days. Across five-year age groups, children aged 5-9 (n =17,810) had the highest odds of injury [adj OR = 1.66 (95% CI: 1.24 - 2.24)] for days with Tmin >95th percentile (78 °F) compared to the MIT, with elevated risks of violence-related and unintentional injury (OR =1.74 (95% CI: 1.18-2.57) and OR = 1.66 (95% CI: 1.42-1.93, respectively)).

CONCLUSIONS: Elevated ambient temperature was associated with higher risk of ED visits for injury among ages 0-25. Future analyses will explore variation in effects of heat by socio-economic position and discriminatory race-based policies (e.g., redlining) over an extended observation period.

KEYWORDS: Climate change, pediatric environmental health, heat, injury, violence

O-PK-28 Injury occurrence and gender-related factors among child workers in Nicaragua: a crossectional study

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BACKGROUND AND AIM: Few studies have explored the effect of gender on injuries occurrence among child workers, despite multiple studies indicating gender often dictates occupations, tasks, and working conditions of boys and girls in developing countries. We aimed to assed the influence of gender-related factors on non-work-related (non-WRI) and work-related injuries (WRI) occurrence in child workers in Nicaragua.

METHOD: We performed a crossectional study among children (3 to 17 years of age) working in agriculture (n=120), street working children (n=108), and non-working referents (n=140) in 2019. We investigated self-reported non-WRI and WRI during the previous 12 months. Incidence rate (IR) per 1000 person-days, rate ratios (RR), and 95% CI were calculated by multivariate Poisson regression.

RESULTS: Child workers had a higher global incidence of injury than nonworking children (3.8 vs 0.7; p=0.001). Street workers had a higher incidence of WRI than agricultural workers (2.1 vs 1.6; p=0.022). When we analyzed only injuries occurring at work boys have a higher incidence than girls (2.3 vs 1.8; p=0.43) but when we included injuries that occurred when performing household chores girls had a higher incidence than boys (3.3 vs 2.2; p<0.0001). Moreover, girls had a higher incidence of severe injuries than boys (1.5 vs 0.9; p=0.012), Factors that increased the risk of WRI among all children, but with a higher impact among girls, were age ≤10 years), the number of working hours at work and home, single-parent family, living on the streets, out of school, alcohol or drug consumption, and pregnancy or parenthood.

CONCLUSION: Our data suggest girls are at higher risk of WRI than boys, especially for severe injuries, and that relevant risk factors are modifiable. A deeper gender analysis of injury occurrence and determinants may allow for more effective targeting of prevention efforts.

KEYWORDS: Injuries, child labor, gender, Nicaragua

THEMATIC 19: Reproductive outcomes

O-PK-19 Prenatal Exposure to Ambient Particle Radioactivity and Fetal Growth in Eastern Massachusetts

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BACKGROUND AND AIM: Particle radioactivity (PR) is a property of particulate matter (PM) originating from attached radon decay radionuclides. After PM is inhaled, radiation can continue to be emitted locally in the lungs or it can translocate to other parts of the body. PR has been previously associated with adverse pregnancy outcomes, and we investigated its association with fetal growth.

METHODS: We included singleton births with routine obstetric ultrasounds at an academic medical center in Massachusetts from 2011 through 2016. PR was represented by particle gross β-activity (mBq/m3) estimated from an ensemble model and was assigned based on residential zip-code. We considered two exposure windows: first 16 weeks of pregnancy and conception until fetal growth measurement (cumulative PR). Standardized (z-score) biparietal diameter (BPD), head circumference, femur length (FL), and abdominal circumference (AC) were examined on anatomic scans (<24 weeks' gestation) and growth scans (≥24 weeks' gestation), and weight was measured at birth. We used linear mixed models adjusted for PM ≤2.5 μg/m3, maternal risk factors, meteorological variables, and long-term trends.

RESULTS: Among 9.409 pregnancies, an interquartile range increase in cumulative PR was associated with reduced BPD (-0.07 [95% CI: -0.12, -0.01]) and FL (-0.07 [95% CI: -0.12, -0.01]) on anatomic scans and birth weight (-0.06 [95% CI: -0.11, -0.002]). While the association with AC was positive in early growth scans, it decreased with gestational age and was negative after week 35. First 16 weeks of gestation was not a critical window of exposure.

CONCLUSIONS: Prenatal PR was associated with fetal growth independently of particle mass, where the direction of the association depended on the fetal growth measure and the gestational age at measurement. Our findings are consistent with patterns previously observed among pregnancies with gestational diabetes and bring awareness to a novel environmental exposure.

KEYWORDS: air pollution, fetal growth, pregnancy

O-PK-24 Ambient Air Pollution and Preeclampsia Onset in Massachusetts, USA

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BACKGROUND AND AIM: Ambient particulate matter and gaseous air pollution have been linked to preeclampsia. However, despite the recognition that preeclampsia is likely a heterogenous syndrome with distinct pathogenic mechanisms, few studies have examined the association between air pollution and subtypes of preeclampsia. Our objective was to examine differential impacts of air pollution on early- vs. late-onset (i.e., diagnosed in or after 34th gestation week) preeclampsia among pregnant women in the Boston, Massachusetts based biorepository, LIFECODES.

METHODS: Preeclampsia was diagnosed according to the American College of Obstetrics and Gynecologists guidelines and each case was reviewed by a panel Maternal–Fetal Medicine–certified physicians. Women's exposures to ozone and fine particulate matter (PM2.5) during pregnancy were estimated based on geocoded residential addresses using U.S. Environmental Protection Agency's Fused Air Quality Surface Using Downscaling Files. Cox proportional hazards models and multinomial logistic regression were used to examine the associations of ozone and PM2.5 with preeclampsia and its onsets. Hazard ratio (HR), odds ratio (OR), and 95% confidence interval (95% CI) for each interquartile range increase in exposures were reported.

RESULTS: A total of 3,316 pregnant women were included. In the cox model, higher exposures to ozone during pregnancy were associated with higher hazard being diagnosed with preeclampsia (HR: 1.67, 95% CI: 1.16, 2.40). In the multinomial logistic regression model, ozone was significantly associated with early-onset preeclampsia (OR: 2.50, 95% CI: 1.48, 4.21) but not late-onset preeclampsia (OR: 1.34, 95% CI: 0.96, 1.88), and PM2.5 was significantly associated with both early- (OR: 1.62, 95% CI: 1.07, 2.45) and late-onset preeclampsia (OR: 1.32, 95% CI: 1.02, 1.71).

CONCLUSIONS: Exposures to ozone and PM2.5 were significantly associated preeclampsia. This association was significant with respect to ozone exposure in the earlier onset, but not later onset, preeclampsia. This study highlights the importance of assessing the heterogeneity in preeclampsia.

O-PK-26 Peri-conceptional exposure to ambient air pollution increases risk of gestational diabetes among pregnant participants in the Maternal and Developmental Risks from Environmental and Social Stressors (MADRES) study

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BACKGROUND: Exposures to air pollution potentially disrupt maternal metabolic adaptation during pregnancy. However, influences of preconception and prenatal exposures to ambient air pollution on gestational diabetes mellitus (GDM) remain unclear, and even less is known about sensitive windows for these exposures' effect on GDM.

METHODS: In 617 pregnant participants enrolled the Maternal and Developmental Risks from Environmental and Social Stressors (MADRES) study, we estimated daily levels of ambient particulate matter (PM_{10}; $PM_{2.5}$), nitrogen dioxide (NO_2), ozone (O_3) using spatial interpolation. GDM was ascertained from medical records by physician diagnosis or defined as abnormally high glucose challenge and tolerance test results. We used distributed lag models (DLM) with Poisson regression to identify sensitive exposure windows by estimating weekly associations of exposures from pre-conception week (PcW) 12 to gestational week (GW) 24 with GDM risk, adjusting for maternal and meteorological factors. Analyses were additionally stratified by median prenatal Perceived Stress Scale (PSS, 14), median pre-pregnancy body mass index (BMI, 27.5 kg/m^2), median age (28 years), and newborn sex to explore differential susceptibility to exposure effects.

RESULTS: Sixty (9.7%) participants were diagnosed with GDM. We identified sensitive peri-conceptional exposure windows for $PM_{2.5}$, PM_{10}, and NO_2 ranging from PcW5 to GW3 associated with increased GDM risk. An IQR increase in each pollutant was associated with 5% (95%CI: 3.3-6.7%), 6% (5.9-7.4%), and 11% (9.3-12.2%) increased GDM risk, respectively. In stratified analyses, effects of PM_{10} and NO_2 in the identified sensitive windows were greater among those ≥28 years old, with BMI≥27.5 kg/m^2, or with PSS≥14.

CONCLUSIONS: Peri-conception exposures to ambient air pollutants were associated with increased risk of GDM. Stronger effects in the identified sensitive windows were seen in participants who were older, had higher BMI, or higher perceived stress.

KEYWORDS: air pollution, gestational diabetes, sensitive window, susceptibility, perceived stress, preconception

Wednesday, September 21

PECHA KUCHA SESSION 04: Climate change and health

THEMATIC 07: Climate change and Health

O-PK-29 Premature mortality due to temperature changes by 2050 in Chile

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BACKGROUND AND AIM: Increases in daily average temperatures and in the intensity and frequency of heatwaves are expected to have several effects in the health of the population, including premature mortality, but it can vary by climate types. Due to its geography, Chile has 10 Koppen types of climates, from hot arid to ice caps.

METHODS: Groups of similar climate municipalities with more than 100.000 inhabitants were obtained through cluster analyses and exposure-response functions were fitted using DLNM models. A representative exposure-response function was developed for each of 6 climatic regions via meta-analysis.

RESULTS: The ER functions for each region of the country varied accordingly to their climate.
In the north, there was no effect of low temperatures. In the central zones, a U shape ER was obtained, with a higher risk for low and high temperatures. In the south and Austral regions, there was only an increase in risk for lower temperatures.
The increase in premature mortality by 2050 varied according to the region. In the north region, the increase was observed only in the warm season. In the central regions, the decrease in deaths in the cold season could not offset the increase in the warm season. Finally, in the southern regions, the net effect was a reduction in premature mortality due to the warming in the cold season. for the whole country a decrease of 650 (-1220 to -70) in the cold season, and an increase of 1,430 (210 to 2,660) deaths was compted, with a net effect of 790 (-150 to 1,700)

CONCLUSIONS: The impact of climate change on premature mortality varies in hot and mild climates there is a net increase, while in colder climates the opposite was observed. This has important implications for adaptation measures.

KEYWORDS: Climate change, temperature increase, heat waves, premature mortality

O-PK-30 Inclement Weather and Risk of Missing Scheduled Hemodialysis Appointments

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BACKGROUND AND AIM: Non-adherence to dialysis treatments results in health complications that are associated with increased morbidity and mortality in hemodialysis patients. We examined the association between different types of inclement weather conditions and missed dialysis treatments.

METHODS: We obtained health records on end-stage kidney disease (ESKD) patients who received hemodialysis at Fresenius Kidney Care (FKC) clinics across the Northeastern U.S. during 2001-2019. County-level daily meteorological data on rainfall, hurricane events, snowfall, snow depth, and wind speed were extracted through the National Oceanic and Atmosphere Agency (NOAA) database. A time-stratified case-crossover study design with conditional Poisson regression was employed to estimate the effect of inclement weather exposures on hemodialysis treatment adherence. We applied distributed lag non-linear model (DLNM) framework to estimate the delayed effect of inclement weather for up to one week.

RESULTS: We studied 28,620 ESKD patients from 27 northeastern counties who had any missed hemodialysis appointment. Overall, the missed appointment rate was higher for all of the inclement weather type (rainfall, hurricane, snowfall, snow depth, and wind advisory) compared to non-inclement weather days. The risk of missed appointment was highest at lag 0 for 10mm increase of rainfall (RR=1.027, 95% CI: 1.021, 1.032), snowfall (RR=1.019, 95% CI: 1.017, 1.021), and snow depth (RR=1.014, 95% CI: 1.013, 1.016). Hurricane events showed the highest RR at lag 5 (RR=1.163, 95% CI: 1.016, 1.332). Wind advisory showed sustained higher risk compared to non-exposure days through up to lag 5.

CONCLUSIONS: All types of inclement weather events showed increased risk of missed hemodialysis appointments. Since inclement weather events are projected to increase due to ongoing climate change, our findings suggest the need for enhanced climate readiness by health care delivery systems that include early warning systems disaster response plans for delivering uninterrupted dialysis-related health services.

KEYWORDS: inclement weather, climate change, hemodialysis

O-PK-31 Wildfire exposure and health care use among people who use durable medical equipment in Southern California

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BACKGROUND: Climate change-induced wildfires cause trauma, stress, and injury in affected communities, while exposing 70% of the US population to smoke particulate matter (PM2.5) annually and exacerbating cardiorespiratory disease. Few studies examine wildfire smoke exposure in vulnerable populations, and none evaluate residence near a fire.

METHODS: We identified 236,732 Kaiser Permanente Southern California members who used electricity-dependent durable medical equipment (DME). DME use is associated with respiratory illness and disability, indicating vulnerability to smoke exposure and difficulty evacuating disaster zones. Daily counts of outpatient, inpatient, and emergency healthcare visits made by DME users from 2016-2020 were linked with daily estimates of wildfire generated PM2.5 by residential ZIP code. We used historical maps to identify ZIPs within 20 km of the the 2018 and 2019 Getty and Woolsey fires. We performed negative binomial regression analyses using direct and lagged effects of wildfire PM2.5 and difference-in-differences analyses to evaluate the association between direct wildfire exposure and health care visit frequency. We adjusted for temperature, temporal effects, non-wildfire PM2.5, and spatial confounders.

RESULTS: Residence within 20 km of the Woolsey Fire was associated with fewer outpatient and more inpatient visits (RR = 0.98, 95% CI: 0.78, 0.87, RR = 1.45, 95% CI: 1.01, 2.11), while Getty Fire evacuation exposure was not associated with visit frequency. In contrast, increases in wildfire PM2.5 were associated with small and constant increases in outpatient visits 2-6 days after a change. Wildfire PM2.5 was not associated with frequency of inpatient or emergency visits at any lag.

CONCLUSION: DME users, presumed vulnerable to wildfire smoke exposure, may have sheltered in place during fires or took other precautions. However, the Woolsey Fire (which was 10 times larger than the Getty) may have produced health concerns in those directly affected when evacuation was necessary and sheltering in place impossible.

O-PK-32 Effect of different heat wave timing on non-accidental mortality in 20 French cities

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BACKGROUND AND AIM: Previous epidemiological evidence suggests that the impact of heat waves on mortality may change over time (within and between summer seasons). The consideration of heat wave timing could help to optimize the alert systems, especially under a warming climate. The aim of this study was to explore the effect of heat wave timing on mortality risk during the summer season in France.

METHODS: Summertime daily mortality data for 20 French cities from 2000 to 2015 were obtained from the French National Institute of Health and Medical Research. Heat waves were defined according to the official definition of Météo France. The order of heat wave over time, from June to September, was assessed. To quantify mortality risk for the first and second heat waves, quasi-Poisson with distributed-lag models were performed for each city.

RESULTS: Overall, we found that, compared with non-heat wave days, the first heat wave of the summer season was associated with a higher risk ratio (RR) for cardiovascular mortality (RR: 1.32, 95% Confidence Interval [CI]:1.18-1.47) as compared to subsequent heat waves within the same summer (RR, 95% CI: 1.28, 1.14-1.44). We found the opposite pattern for respiratory mortality with RRs of 1.59 (95%CI:1.35-1.88) and 1.66 (95%CI: 1.32-2.07) for the first and second heat waves respectively. We identified important heterogeneity in such patterns across all cities. for cities such as Paris or Nancy, the first heatwave of the season resulted in a greater mortality risk. In contrast, for cities such as Lille, Marseille, or Rouen, the second heat wave was more impactful regarding mortality risk.

CONCLUSIONS: The timing of heat waves events modulates heat-related risks in France. Such information could be used to update local heat action plans to optimize health benefits across French cities.

O-PK-33 The impact of weather changes on air quality and health in Brazil

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BACKGROUND AND AIM: Weather changes affect air quality that is also a leading contributor to disease burden. The current evidence on the relationship between weather changes and air pollution is mainly based on the environmental processes occurring in North America and Europe. As a response to this gap in knowledge, in this study, we quantified the past weather-related changes in ambient air pollution in Brazil over 16 years (2003-2018). Then we estimated the excess mortalities associated with this impact of long-term weather changes on air quality.

METHODS: We applied generalized additive models (GAMs) to fit adjusted (with meteorological variables) and unadjusted models. The difference of slopes estimated by the models without and with adjusting for these meteorological variables represents the impact of weather changes on pollutant trends, defined in our study as “weather penalty”.

RESULTS: Overall, ambient air pollution levels in Brazil during the period 2003-2018 have decreased in most of the Brazilian regions. We estimated significant trends in meteorological variables, indicating an increase in temperature, relative humidity, and wind speed in all Brazilian regions over the 16-study period. Our findings suggest that PM2.5 was the pollutant most impacted by weather changes. for the 16-year period of analysis, we estimated a weather penalty ranging from 1.58 µg/m−3 (CI 95%:1.25;1.91) to 0.41 µg/m−3 (CI 95%:0.28;0.53) among the different Brazilian regions. If weather parameters had remained constant, PM2.5 would have decreased by 1.10 µg/m3 (95%CI: 0.74; 1.46) in the South and by 2.25 µg/m3 (95%CI: 2.72; 1.79) in the Midwest. Over the 16-year study period, the weather impact on PM2.5 in Brazil was associated with over 6,500 excess deaths.

CONCLUSIONS: The evidence of historical weather penalty should be of interest to policy makers to devise future strategies related to environmental health and climate change.

KEYWORDS:
Air pollution, Climate Change, Long-term impact

O-PK-34 Associations between short-term ambient temperature exposure and kidney-related diseases in New York State: The influence of exposure spatial resolution and adaptation adjustment

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BACKGROUND AND AIM: Findings on the relationship between short-term temperature exposure and kidney diseases are divergent. Furthermore, the roles of temperature spatial resolution and climate adaptation are unclear. This study aimed to evaluate associations between short-term ambient temperature exposure and kidney-related diseases, as well as the influence of spatial resolution and adaptation adjustment.

METHODS: We estimated daily mean temperature at 1-km resolution in New York State (NYS) from random forest models, and obtained health data from the NYS SPARCS dataset (2007-2016). We used a symmetric case-crossover design analyzed by conditional logistic regression with distributed lag non-linear models, and evaluated spatial resolutions of 1-km, 5-km, 10-km, 20-km, and 35-km. To evaluate the influence of adaptation, we compared one-stage and two-stage models using temperature on the absolute or relative scales.

RESULTS: This study included 1,209,934 non-elective adult kidney-related hospital visits. We observed similar estimates from models with different spatial resolutions. When controlling for adaptation in one-stage models using temperature on the relative scale at 20-km resolution, for the 95th percentile of daily mean temperature compared to the minimum morbidity temperature at lag 0-6 days, we found odds ratios of 1.14 for acute kidney failure (95% confidence interval [CI]: 1.07, 1.22), 1.10 for renal tubulo-interstitial diseases (95% CI: 1.02, 1.18), 1.21 for urolithiasis (95% CI: 1.16, 1.26), 1.25 for dysnatremia (95% CI: 1.14, 1.37), and 1.27 for volume depletion (95% CI: 1.23, 1.31), but no significant associations for chronic kidney disease (CKD) or glomerular diseases (GD). Models not considering adaptation generated consistent association patterns, but somewhat different effect estimates.

CONCLUSIONS: Short-term exposure to high temperature was associated with increased risk for kidney-related diseases (except CKD and GD). The influence of exposure spatial resolution was negligible and of adaptation adjustment was modest.

KEYWORDS:
Temperature; kidney diseases; exposure assessment; adaptation

O-PK-35 Upstream oil and gas infrastructure and wildfire burn areas in the western U.S.: Assessing current and future risks

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BACKGROUND AND AIM: The extent and intensity of wildfires has worsened in recent years, a trend that is expected to continue as climate change worsens. The western U.S., a region with numerous oil basins, has a particularly high wildfire risk. Wildfires damage to oil and gas wells may result in emissions of air toxics and higher costs for safe well retirement. We aimed to determine the extent to which oil and gas wells were located within and near wildfire burn areas in the western U.S. in each year between 1984 and 2020 and to identify wells at high risk of wildfire exposure in present-day and under projected risk in mid- and late century

METHODS: We obtained oil and gas wells data from Enverus DrillingInfo, population data from the US Census Bureau, wildfire burn areas data from National Interagency Fire Center, and data on areas with high projected future wildfire risk from Argonne National Laboratory. We assessed which wells were inside or near (≤1 km) wildfire burn areas from 1984-2020 and estimated the number of people living near burn areas with wells. We then determined the count of active and plugged wells in areas with high current and projected wildfire risk.

RESULTS: We observed that an estimated 31,385 (1.9%) of the 1.65 million wells in the western U.S. were located in wildfire burn areas during the study period and an additional 52,815 (3.2%) were within 1 km of a burn area.

CONCLUSIONS: Wildfire damage to oil and gas wells may increase pollution in nearby communities, raise operator mitigation costs, and increase climate change through fugitive fossil fuel emissions. Policymakers may wish to consider wildfire risk in oil and gas operation regulation.

KEYWORDS: oil and gas, climate change, wildfire, exposure, spatial analysis

O-PK-36 Health impact assessment of climate change mitigation and adaptation policies

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BACKGROUND AND AIM: Current climate policy focuses on two key aspects: the relevance and extent of mitigation measures to avoid crossing the point of no return; and the necessity for adaptation measures considering socio-economic state and dynamics across the globe. Assessing properly the health benefits of policy measures geared towards adapting to climate change is a key requirement for accurate impact assessment of climate action.

METHODS: The climate exposome is the exposome of human population considering the climate change aspects relevant to the life course. The methodological framework for unravelling the climate exposome is presented and examples demonstrating its applicability and usefulness in climate policy are given. The new generation of integrated assessment models entail a model scheme based on enhanced data fusion and on the concept of ensemble modelling, supported by big data analytics for filling data gaps.

RESULTS: Drivers pertaining to direct impacts on climate are increased temperatures; precipitation extremes; extreme weather events; and sea level rise. To better understand the impacts of climate change, the environmental and institutional context is accounted for including land use change; ecosystem change; condition of the infrastructure; geography; agricultural production and livestock use. The social and behavioural context including age and gender; race and ethnicity; poverty; housing and infrastructure; education; discrimination; access to shared and community health infrastructure is a significant modifier of the impacts associated with climate change.

CONCLUSIONS: The climate exposome addresses interactions among activity sectors and the changing environment; exposure and effects of chemical, physical and biological stressors and waste; interactions among these stressors. Refined tools for understanding the impacts using high dimension biology techniques are crucial. The interplay between vulnerabilities and socio-economic factors affecting exposure profiles and individual susceptibility to these complex exposures determine the ultimate relationship between climate change and health.

KEYWORDS: climate change, health, exposome

THEMATIC 03: Air pollution (ambient & indoor) and Sources

O-PK-37 Long-term exposure to ambient fine particulate elements and leukocyte epigenome-wide DNA Methylation in older men: the Normative Aging Study

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BACKGROUND AND AIM: Several epigenome-wide association studies of ambient fine particulate matter (PM2.5) have been reported. However, none have been done on long-term exposure to PM2.5 elements (PEs). We hypothesized that significant changes in DNA methylation (DNAm) may vary by long-term exposure to PEs.

METHODS: We repeatedly collected blood samples in the Normative Aging Study and measured leukocyte DNAm with the Illumina HumanMethylation450K BeadChip. We predicted 15 PEs based on an ensemble of machine-learning algorithms. The spatial resolution was 50m × 50m for urban areas (majority in this study) and 1km × 1km for non-urban areas. We applied median regression with subject-specific intercepts for each of the 15 PEs and DNAm at individual cytosine-phosphate-guanine site, adjusting for PM2.5 mass. Significantly differentially methylated probes (DMPs) were identified by Bonferroni correction. We further conducted regional analyses and pathway analyses to identify differentially methylated regions (DMRs) and pathways. We also used nonnegative matrix factorization to identify source factors and obtained the source-specific effect estimates.

RESULTS: We included 672 men with 1,181 visits between 1999 and 2013. The significant DMPs, DMRs, and pathways varied by PEs. for example, lead was associated with one DMP and one pathway whereas organic carbon was associated with 45 DMPs and 30 pathways. The identified pathway by lead was involved in cardiovascular disease, whereas the pathways associated with organic carbon were related with reproductive function, nervous system, inflammation, etc. In addition, we identified four independent source factors, which had varied associations with DMPs, DMRs, and pathways. for example, source factor 1 (nitrate, ammonium) was associated with 43 pathways involved in cardiovascular disease, cancer, diabetes, aging, inflammation, etc.

CONCLUSIONS: Long-term exposure to different PEs were differentially associated with DNAm changes at multiple probes, regions, and along multiple pathways.

KEYWORDS: PM2.5 elements; Source factors; DNA methylation; Epigenome-wide association study; Pathway analyses

O-PK-38 Outdoor air pollution and risk of incident adult hematologic cancer subtypes in a large US prospective cohort

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BACKGROUND AND AIM: Outdoor air pollution and airborne particulate matter (PM) have been classified as Group 1 carcinogens for lung cancer. Previous research on childhood leukemias and adult cancer mortality suggest associations of outdoor air pollutants with blood cancers, which are etiologically diverse. However, detailed examinations of major air pollutants by histologic subtypes of incident adult hematologic cancers are lacking.

METHODS: The American Cancer Society Cancer Prevention Study-II Nutrition Cohort was used to examine associations of outdoor air pollutants with risk of incident hematologic cancers. Residential address at enrollment was used to assign census block-group level annual predictions of PM10, PM2.5, NO2, O3, SO2, and CO concentrations. Cox proportional hazard regression was used to estimate multivariable-adjusted hazard ratios (HR) and 95% confidence intervals (CI) for associations per each fifth percentile-mean difference in 1992-2015 average pollutant concentrations with risk of incident Hodgkin lymphoma (HL), non-Hodgkin lymphoma (NHL), myeloid leukemia and eleven specific histologic subtypes.

RESULTS: There were 2,659 total incident hematologic cancer cases identified among 108,002 participants followed from 1992-2017. Positive HRs were observed for several residential outdoor air pollutants and incident HL (n=54), with statistically significant elevated HRs observed for both NO2 (HR per 6.4 ppb=1.42; 95% CI=1.05-1.90) and SO2 (HR per 1.6 ppb=1.41, 95% CI 1.07-1.85). There were no clear positive associations observed for either NHL (n=2,276) or myeloid leukemias (n=329) and there was an inverse association observed for the chronic lymphocytic leukemia/small lymphocyte lymphoma subtype. In analyses by gender, the positive associations observed with incident HL strengthened among women.

CONCLUSIONS: Overall, there were few positive associations of outdoor particulate or gas residential air pollution concentrations and incident adult hematologic cancers observed. However, subtype analyses revealed some evidence for positive associations with HL, particularly among women, which require further investigation.

KEYWORDS: outdoor air pollution, particulate matter, lymphoma, leukemia

O-PK-39 Mortality and Morbidity Risk and residential exposure to municipal waste landfills in Italy: the ERAS-2 Lazio project

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BACKGROUND AND AIM: Evidence of health effects associated with living nearby municipal waste (MW) landfills is still controversial. Nine MW landfills have been operating in the Lazio region (Central Italy) for several decades. We evaluated the potential health effects associated with contamination from MW landfills using hydrogen sulphide (H2S) concentration as proxy of airborne contamination.

METHODS: A cohort of residents within 5 km of MW landfills was enrolled (residents on 1 January 1996 and those who subsequently moved into the areas until 2008) and followed up for mortality and hospitalizations until 31 December 2018. Assessment of exposure to the landfill (H2S as a tracer) was performed for each participant residential address at enrolment by using a Lagrangian dispersion model. The potential confounding effect of gender, age, socioeconomic position, outdoor PM10 concentration, and distance from busy roads and industries was considered. Cox regression analysis was performed [HRs, 95% CIs].

RESULTS: The cohort included 242,409 individuals. H2S exposure was associated with mortality from non-accidental causes (HR=1.02, 95% CI 0.97-1.08), total cancer (HR 1.07, 95% CI 0.98-1.07), and lung cancer (HR 1.24, 95% CI 1.04-1.49) when comparing 75° percentile vs <25° percentile of H2S concentrations. We also found associations with all cause hospitalization (HR 1.04, 95% CI 1.02-1.07), kidney cancer (HR 1.68, 95% CI 1.18-2.39), and respiratory diseases (HR=1.06, 95% CI 1.00–1.11) when comparing 75° percentile vs <25° percentile of H2S concentrations.

CONCLUSIONS: H2S Exposure was associated with non-accidental mortality and morbidity for respiratory diseases. The link with respiratory disease is plausible and coherent with previous studies, whereas the associations with cancers deserves confirmation through the study of cancer incidence.

O-PK-40 Long-term exposure to elemental components of fine particulate matter and natural and cause-specific mortality in a Danish nationwide administrative cohort

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BACKGROUND AND AIM: Fine particulate matter ($PM_{2.5}$) is an established risk factor for premature death, but it remains unclear which components and sources are most responsible. We investigated the associations between long-term exposure to $PM_{2.5}$ components and mortality from all-natural causes, cardiovascular disease (CVD), respiratory diseases (RD), lung cancer, diabetes, chronic kidney disease (CKD), dementia, and psychiatric disorders in a Danish nationwide administrative cohort.

METHODS: We followed all Danish residents aged ≥30 at January 1, 2000 (3,081,244) until December 31, 2017. Residential annual mean exposure $PM_{2.5}$ components levels (copper, iron, zinc, sulfur, nickel, vanadium, silicon, and potassium) were estimated by Europe-wide land-use regression models at a 100×100m scale, developed within the "Effects of Low-Level Air Pollution: A Study in Europe" project, with two modeling approaches: supervised linear regression (SLR) and random forest (RF). We used Cox proportional hazard models to evaluate the associations between each component and mortality, adjusting for demographic, socioeconomic factors, and $PM_{2.5}$ mass.

RESULTS: The cohort accumulated 46,992,890 person-years, and 803,373 died from natural causes. for natural mortality, we observed significant positive associations [hazard ratios (HRs); 95% confidence intervals per interquartile range increase] with SLR-silicon (1.04; 1.03-1.05) and SLR-potassium (1.03; 1.02-1.04) and with RF-iron (1.02; 1.01-1.02), RF-zinc (1.02; 1.01-1.03), RF-nickel (1.01; 1.00-1.02), RF-vanadium (1.02; 1.01-103), RF-silicon (1.01; 1.00-1.02), and RF-potassium (1.06; 1.05-1.07). Potassium and silicon were most strongly associated with all causes of death except CKD and diabetes, respectively, with the highest HRs observed for psychiatric disorders. Furthermore, iron was associated with RD, lung cancer, CKD, and psychiatric disorders, zinc with RD, CKD, and lung cancer, and nickel and vanadium with lung cancer.

CONCLUSIONS: We present novel findings that different $PM_{2.5}$ components were relevant to different causes of death. Potassium and silicon seemed most consistently associated with mortality in Denmark.

KEYWORDS: Long-term exposure, $PM_{2.5}$ components, mortality

POSTER DISCUSSION SESSIONS

Monday, September 19

POSTER DISCUSSION SESSION 01: Advances in Epidemiology and Statistical Methods | Exposure assessment

THEMATIC 01: Advances in Epidemiology and Statistical

P-0003 Application of High Spatiotemporal Air Pollution Surfaces and Participants' Activity Space for Identification of the Instantaneous Effect of Air Pollution on Rescue Medication Use for California Residents

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BACKGROUND AND AIM: Previous studies often used individuals' residential addresses as locations of exposure. Air pollution exposure can occur in the community, at work, at home, and at school. Digital sensors fitted onto inhalers can capture the date, time, and location of rescue inhaler use. The sensors also send out "heartbeats" every 3-4 hours and records the Global Positioning System (GPS) locations when paired with a smartphone. Evaluating the signals of all heartbeats and rescue inhaler uses over time can help characterize an individual's exposure space. The goal of this research was to identify the impacts of air pollution, modeled at high spatiotemporal resolution, on sub-acute respiratory disease symptoms represented by rescue inhaler use for California residents 01/01/2012-12/31/2019.

METHODS: The daily air pollution surfaces of nitrogen dioxide (NO2), fine particulate matter (PM2.5) and ozone (O3) of 30m spatial resolution were assigned to 3,386 participants' daily activity space. R packages random forest and glmmTMB with capability of dealing with excessive zeros and overdispersion were used to identify associations of daily air pollution exposure with daily rescue inhaler use.

RESULTS: Both advanced linear mixed models and random forest models identified that all the three pollutants had significant ($p < 0.001$) and positive associations with daily rescue inhaler use. In the linear mixed model, we identified that 10 ppb, 10 ug m-3 and 30 ppb increase in exposure to NO2, PM2.5 and O3 would result in, respectively, a 2.5%, 9.1% and 17.2% increase in daily rescue puffs.

CONCLUSIONS: The results of this project will help California policy makers characterize the health effects of regulatory programs. More importantly, the project will also provide the information needed to include respiratory disease symptoms as a new endpoint for California's health analysis.

KEYWORDS: rescue medication use, air pollution, linear mixed model, random forest model, State of California.

P-0006 Development of environmental risk score of the biomarker for chronic kidney disease in residents exposed to pollutant mixtures

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BACKGROUND AND AIM: To develop an environmental risk score (ERS) of biomarkers for chronic kidney disease (CKD) in residents exposed to multipollutant.

METHODS: Multipollutant with nine metals, four PAH metabolites, and four VOC metabolites measured in urine was constructed from the Forensic Research via Omics Markers (FROM) study in Korea (n=298). Beta-2-microglobulin (β2-MG), N-acetyl-β-D-glucosaminidase (NAG), and estimate glomerular filtration rate (eGFR) were used as CKD markers. Optimal models were selected among elastic net models (ENET), adaptive elastic net models (AENET), weighted quantile sum regression (WQS), Bayesian weighted quantile sum regression (BWQS), Bayesian kernel machine regression (BKMR), Bayesian additive regression tree (BART), and super learner (SL) by comparing mean squared error adjusted for sex and age. The selected models were stratified with a history of occupational chemical exposure (OCE) and additionally adjusted for urinary cotinine level. Variable importance (VI) was estimated to evaluate the associations between each pollutant and biomarkers of CKD.

RESULTS: The performance of ERS based on BKMR was the best-fitting model and ERS based on SL or BART performed better than other models. The model with BKMR could not be used due to overfitting as the number of covariates increased. When stratified with a history of OCE, the most effective metabolites for β2-MG, NAG, and eGFR were Sb (VI=0.47), Hg (VI=0.13), and Pb (VI=0.34) in the non-OCE group, and V (VI=0.39), Hg (VI=1.19), and 1-ohp (VI=0.10) in the OCE group, respectively.
CONCLUSION: This study suggests that ERS, especially the SL and BART model, stratified with a history of OCE were fitted when evaluating the association between multipollutant and CKD.

KEYWORDS: Metals, multipollutant, environmental risk score, machine learning, kidney disease

The Korea Environment Industry and Technology Institute through the Core Technology Development Project for Environmental Disease Prevention and Management, funded by the Korea Ministry of Environment (grant number 2021003320003).

P-0019 Capture of local sources variation using a hierarchical Bayesian spatiotemporal model for the spatial prediction of air pollution levels

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BACKGROUND AND AIM: The spatial predictions obtained from models based on land use regression (LUR), even the most advanced ones, do not fully capture local variations in the levels of air pollutants. This is because they do not control for unobserved variation, including spatial and temporal dependencies. Our objective is to present a hierarchical Bayesian spatiotemporal model for the spatial prediction of air pollution levels that, considering unobserved variation, both spatial heterogeneity and spatio-temporal dependence, controls for fine scale spatial variability.

METHODS: We use information on the hourly levels of air pollution for 2018-2019 from 116 monitoring stations located throughout Catalonia, Spain. The pollutants we are interested in for making spatial predictions are PM10, PM2.5, NO2 and O3. We carried out the spatial predictions at a point level. We specified a hierarchical spatiotemporal model using the Stochastic Partial Differential Equations of the integrated nested Laplace approximation. As predictors we use the levels of other air pollutants, both measured at the monitoring stations and high-resolution satellite and reanalysis data, and land use variables (altitude of the monitoring station, NDVI, land cover, density). We control for unobserved variation, both spatial heterogeneity (using unstructured random effects) and spatial and temporal dependence (using structured random effects), considering them non-independent but separable.

RESULTS: As preliminary results, the predictions using our model are much better than using an advanced LUR model. The mean absolute percentage error (MAPE, in %) and the root mean squared prediction errors (RMSPE, µg/m3) of our model are: PM10: 7.55-2.62 (MAPE-RMSPE), PM2.5: 9.99-4.50, NO2: 4.37-2.14; and O3: 6.83-2.78, while those of the LUR models are: 10.66-5.26, 15.99-5.61, 13.090-2.181, 33.21-13.85, respectively.

CONCLUSIONS: By controlling for unobserved variation, both heterogeneity and space-time dependency, our model can capture variation at the fine spatial scale and thus achieve more accurate spatial predictions.

P-0020 Benchmark dose in the presence of co-exposure to melamine and di-(2-ethylhexyl) phthalate and urinary renal injury markers in pregnant women

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Environmental exposures to mixtures of toxic chemicals are known to have potential interaction effects that may lead to hazard index exceeding one. However, current regulation levels such as tolerable daily intake (TDI) are mostly based on experimental studies on single chemical compound. In this study, we assessed the relationships between melamine and di-(2-ethylhexyl) phthalate (DEHP) exposures and their co-exposure on early renal injury markers N-acetyl -D-glucosaminidase (NAG), albumin/creatinine ratio (ACR), and microalbuminuria in 1236 pregnant women. We derived the benchmark dose (BMD) and the corresponding one-sided 95% confidence bound BMDL based on the estimated (covariate-adjusted) average daily intake of melamine and DEHP metabolites measured in spot urine of the women collected during third trimester. Various generalized linear models with interaction terms and Bayesian kernel machine regression model were used for the (co-)exposure response associations. Given a benchmark response of 0.1, the BMDL level of melamine (DEHP) exposure on NAG (ACR, microalbuminuria) was 2.67 (11.20, 4.45) μg/kg_bw/day ignoring mixture effect, and decreased to as low as 1.46 (3.83, 2.73) μg/kg_bw/day when considering co-exposure to DEHP (melamine) at 90th percentile. Both the exposure threshold levels of melamine and DEHP for early renal injuries in pregnant women were several-folds to one order lower than the current recommended TDIs by WHO and the US FDA and EPA, and were even lower considering co-exposure. Because of concurrent exposures in real-world environment, more conservative regulation levels are suggested for potential synergetic mixture effects.

P-0030 Comparison of machine learning methods for the prediction of cardiovascular mortality from environmental and socio-economic neighbourhood factors

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BACKGROUND AND AIM: Several environmental and socio-economic neighbourhood factors have been reported to majorly impact human health, but their interplay is not yet well understood as simultaneous analyses are sparse. We aimed to identify the driving contextual factors and assess their predictive ability for cardiovascular disease (CVD) mortality in a neighbourhood setting by comparing several machine learning methods.

METHODS: We obtained the number of CVD deaths per county for entire Germany for 2017. Most socio-economic factors (e.g. proportion of unemployed, foreigners, household income, deprivation index) were also only available on a county level, whereas most environmental factors (e.g. imperviousness, greenness, air pollution, noise, building density) could be gained on a higher spatial resolution (10m-2.4km). All data was aggregated to a 5km*5km grid to compile compliant prediction maps. In addition to traditional linear and additive regression models, we applied one neighbour-based method and several statistical, ensemble and deep learning approaches using a random search strategy for hyper-parameter tuning. Variable importance was assessed by SHapely Additive exPlanations (SHAP) values.

RESULTS: CVD mortality for the 5km grid ranged from 2.5 to 8.1 per 10,000 residents with a mean of 4.7 (standard deviation 1.0). The models performed well in the training phase with R^2 between 0.85-1.00, mean squared error (MSE) between 0.001-0.005, and moderate to well in our test data (R^2: 0.27-0.66; MSE: 0.011-0.024). Most models identified the deprivation index as the most important predictor followed by the proportion of foreigners, unemployed, median income and air pollution. Comparison of our predicted and observed CVD mortality rates showed high correlations for all models (Spearman r: 0.69-0.82), though prediction maps indicated heterogeneity in spatial patterns.

CONCLUSIONS: The selected approaches differed in their predictive ability but identified similar predictors as the main drivers for CVD mortality.

KEYWORDS:
Machine learning, prediction, cardiovascular mortality, environment, spatial predictors

THEMATIC 13: Exposure assessment

P-0818 Simultaneous assessment of chemical and biological contaminants in settled house dust

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BACKGROUND AND AIM: Settled house dust (SHD) is a reservoir for various contaminants, including endocrine-disrupting chemicals (EDCs), trace metals, and house dust mite allergens. This study aimed to characterize various chemical and biological contaminants in SHD and identify determinants of the indoor contaminants.

METHODS: In total, 106 SHD samples were collected from 106 houses in Seoul and Gyeonggi Province, Korea in 2021. Thirty of the 106 houses were recruited for collecting bedding dust samples. All participants completed a questionnaire comprised of housing and lifestyle-related factors. Samples were analyzed for 18 organophosphate flame retardants (OPFRs), 16 phthalates, five alternative plasticizers (APs), seven trace metals, and two house dust mite allergens (Dermatophagoides farinae type 1 [Der f1] and Dermatophagoides pteronyssinus type 1 [Der p1]). A multiple regression analysis was conducted to identify the determinants governing the concentrations and profiles of various contaminants.

RESULTS: OPFRs, phthalates, APs, and trace metals were detected in all SHD samples, indicating ubiquitous contamination in indoor environments. Among the three EDC groups, APs were detected most frequently with the highest concentrations, followed by phthalates and OPFRs. Der f1 was detected in all bedding dust samples with significantly higher levels than Der p1. The concentrations of OPFRs, plasticizers, and trace metals in SHD were significantly associated with the type and number of electronic appliances and combustion activities. Der f1 was significantly associated with the number of occupants and water penetration. Ventilation, vacuum cleaning, and wet cleaning or dry mopping significantly reduced the levels of most contaminants in SHD.

CONCLUSIONS: As residents are persistently exposed to a wide array of pollutants, comprehensive and adequate measures are required to prevent potential exposures.

KEYWORDS: Settled house dust; OPFR; Plasticizer; Alternative plasticizer; House dust mite allergens

P-0819 Comparison of PM2.5 air pollution exposure estimates at WHIMS participant locations based on different modelling approaches and impact on health effects estimation

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BACKGROUND AND AIM: Many approaches to quantifying air pollution exposures for use in epidemiologic analyses have been developed. However, whether exposure estimates from different approaches are comparable and whether choice of approach affects reported associations with health-related outcomes remains unclear. We compare PM2.5 concentrations at addresses from participants of the Women's Health Initiative Memory Study (WHIMS) derived using multiple estimation approaches and assess differences in associated health effects estimates.

METHODS: We linked annual PM2.5 exposure estimates from 1999 to 2004 from 12 different approaches to WHIMS participant addresses from across the continental United States and restricted analyses to data from participants with stable addresses within each calendar year. Approaches included geo-statistical interpolation approaches, geographic information system (GIS)-based statistical models, air dispersion and chemical transport models, and hybrid models. We used descriptive statistics and visualizations to assess relative and absolute agreement of exposure estimates from different approaches across space and time and examined the impact of estimation approach on associations between PM2.5 and non-accidental mortality, CVD-related mortality, and incident CVD events.

RESULTS: Annual PM2.5 exposure estimates were reasonably similar across approaches, although the specific shapes and ranges of the distributions varied. Interquartile ranges tended to be similar, though ranges were more variable. Relative agreement was consistently higher than absolute agreement. After controlling for putative confounders, associations of PM2.5 with mortality and CVD were similar regardless of estimation approach.

CONCLUSIONS: Agreement across different air pollution estimation approaches for PM2.5 was generally high when considering participants drawn from a broad geographic area, suggesting that all models predicted similar between-area differences. The implications of fine-scale variability between exposure estimation approaches warrants further investigation.

KEYWORDS: Air pollution, exposure assessment

P-0824 A Comparison of Measured Airborne and Self-Reported Secondhand Smoke Exposure in the MADRES Pregnancy Cohort Study

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BACKGROUND: Secondhand smoke (SHS) exposure during pregnancy is associated with several adverse birth outcomes, including reduced birthweight and preterm birth. Questionnaires are commonly used to assess SHS exposure; however, the wording of questions and their ability to capture true exposure can vary, limiting researchers' ability to harmonize SHS measures. Therefore, we compared the association of SHS self-reported exposure in the MADRES pregnancy cohort with measurements of SHS in particulate matter ($PM_{2.5}$) personal samples collected in the 3rd trimester.

METHODS: We measured SHS on 48-hour integrated personal $PM_{2.5}$ Teflon filters collected from 204 pregnant women using optical transmissometry. Self-reported SHS related to presence, intensity, and duration of exposure was ascertained via a 3rd trimester questionnaire and an exit survey at the time of personal monitoring. Descriptive statistics were calculated for SHS measures overall and by key demographics and environmental factors. Analysis of variance tests were conducted to test group differences in SHS concentrations by self-reported SHS exposure.

RESULTS: Participants were predominately Hispanic (81%), with a mean (SD) age of 28.2 (6.0) years. Geometric mean (SD) personal SHS concentrations were 0.14 (9.41) $\mu g/m^3$. There was a significant difference in mean SHS by education ($p = 0.015$), with participants with lower education having higher measured SHS. Mean SHS concentrations differed by reported time with windows open (none/a little of the time: 0.10 $\mu g/m^3$ vs. most/all of the time: 0.19 $\mu g/m^3$; $p = 0.047$). There was no association between measured SHS and self-reported SHS exposure; however, asking about the number of smokers nearby in the 48-hour monitoring period was most correlated with measured SHS (Two+ smokers: 0.30 $\mu g/m^3$ vs. One: 0.12 $\mu g/m^3$ and Zero: 0.15 $\mu g/m^3$; $p = 0.230$). CONCLUSION: Overall, self-reported SHS exposure was not associated with measured airborne SHS in personal $PM_{2.5}$ samples.

P-0826 Integrating Time-Activity and Air Sensors into Smartphone-based PM2.5 and Ozone Exposure Model for Epidemiologic Studies

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BACKGROUND AND AIM: Epidemiologic studies of fine particulate matter (PM2.5) and ozone (O3) often use outdoor concentrations as exposure surrogates, which can induce measurement error. The goal of this study was to improve PM2.5 and O3 exposure assessments for a repeated measurement study with 20 individuals in Philadelphia, Pennsylvania by applying a smartphone-based exposure model called TracMyAir.

METHODS: We developed TracMyAir, which is a smartphone (iPhone, Android) application that determines multiple tiers of individual-level exposure metrics in real-time for ambient and non-ambient PM2.5 and O3 using outdoor concentrations, home building characteristics, weather, time-locations, and time-activities. In this study, we extended TracMyAir by including (1) outdoor concentrations from an air quality model (CMAQ), (2) indoor and outdoor PM2.5 concentrations from low-cost air sensors (PurpleAir) and a building infiltration model, (3) a microenvironment model (MicroTrac) based on time-resolved smartphone geolocations, and (4) inhaled ventilation models based on physical activity data from smartphone and smartwatch accelerometers and heart rate sensors. The five tiers of exposure metrics with increasing information needs and model complexity include: residential air exchange rates (AER, Tier 1), infiltration factors (Finf_home, Tier 2), indoor concentrations (Cin_home, Tier 3), exposures (E, Tier 4), and inhaled doses (D, Tier 5). We applied TracMyAir to determine hourly PM2.5 and O3 exposure metrics for three consecutive days for 20 participants consisting of two age groups (18-30 years old, n=10; 55-75 years old, n=10).

RESULTS: The TracMyAir predictions showed considerable temporal and house-to-house variability of AER, Finf_home, and Cin_home (Tiers 1-3), and person-to-person variability of E and D (Tiers 4-5).

CONCLUSIONS: Our study demonstrates the capability of extending TracMyAir with air pollutant and time-activity sensors and models to estimate individual-level PM2.5 and O3 exposure metrics for an epidemiologic study, in support of improving risk estimation.

P-0839 Heavy metal contamination of soil in informal foundries and surrounding homes in South Africa

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BACKGROUND AND AIM: Despite the economic benefits, the growing informal sector in residential areas has a significant environmental impact. The present study aimed to determine heavy metals and evaluate the health risks caused by heavy metals in informal foundries and surrounding residential homes situated in rural and urban communities of South Africa.

METHODS: Five informal foundries and thirty-three surrounding residential homes were selected for this study. Four composite samples of soil were collected in each informal foundry. One composite sample was taken from a minimum of five houses situated around each of the selected informal foundries. Contamination levels were evaluated using a geoaccumulation index (Igeo), enrichment factor (EF), contamination factor (CF) and pollution load index (PLI). Sources of heavy metals and the correlation among metals were assessed using factor analysis and Pearson correlation, respectively. The measured concentrations of metals were used to estimate the health risk for children and adults.

RESULTS: The average levels for copper (Cu), iron(Fe), lead (Pb), manganese (Mn), nickel (Ni), strontium (Sr) and Zinc (Zn) were 280, 23980, 137, 493, 129, 459 and 1124 mg/kg, respectively for informal foundries; and 54, 26325, 31, 485, 172, 237 and 74 mg/kg respectively for residential homes. According to Igeo, EF, CF and PLI, contamination exist in the selected study sites. Factor analysis and Pearson correlation coefficient point to the potential roles of informal foundry activities. The health index (HI) for non-carcinogenic effects showed the ingestion route as the main contributor to the total risk, with the accumulative carcinogenic risk exceeding the maximum acceptable level.
CONCLUSION: This study provides evidence of the need to strengthen environmental and occupational health policies related to informal industrial operations. This will help protect individuals from exposure to potentially toxic elements and the associated health risks.

KEYWORDS: health risk assessment; technogenic soils; SUITMAs; environmental health

P-0844 Citizen science approach to mapping background radiation for environmental epidemiology

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BACKGROUND AND AIM
Volunteered geographic information from citizen scientists can provide alternatives to traditional exposure assessment for environmental epidemiological studies; whereby, facilitating access to data, providing continuous monitoring, improving exposure awareness for participants and the community, among others. Safecast is a participatory, open-source, citizen science centered radiation surveying project where international volunteers collect and openly share data on environmental radiation collected through mobile sensors. However, information is lacking on the potential use of the collected measurements for epidemiological research, especially regarding their validity for exposure assessment. We aimed to develop and validate maps of gamma radiation (GR) for Denmark and Switzerland, as part of a larger European-wide consortium, using measurements collected by the Safecast community.

METHODS: Spatial Bayesian mixed-effects models were fit to GR measurements from Safecast, using predictors of soil class, geology, land cover, and elevation from maps. Pointwise posterior means from these models were used to predict GR for the territory of each country at a resolution of 1x1km2. Internal validity was assessed using cross-validation (CV) with random assignment of either the measurements (random-CV) or area blocks defined by square grids (different cell sizes) to folds (spatial-CV). We also validated maps for Switzerland against personal exposure measurements (dosimeters worn over five consecutive days) in 149 children using linear regression and calculated the coefficient of determination(R2) and mean squared error.

RESULTS: Spatial variations in GR exposure was observed for each country. Predictors of GR from Safecast were associated with ambient dose rates, where models fit the data well, for example with a R2 of 0.5 in random-CV, with 0.77 model fit in Denmark.

CONCLUSIONS: Results highlight the potential for using open citizen science data for exposure assessments in radiation research. The association between GR and childhood cancers will be assessed.

KEYWORDS: Radiation, citizen science, geographic information systems, exposure assessment

P-0856 Land Use Regression modelling of airborne microbial markers in the vicinity of livestock farms: evaluation of stepwise linear regression and random forest modelling approaches

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BACKGROUND
Whilst being of likely public health relevance, microbial air pollution related to livestock farming is understudied. for epidemiological studies, it is important to accurately predict residential exposure. Thus far, exposure assessment has mainly focused on endotoxin, while residents living near livestock farms are exposed to a wide array of microbial agents. We evaluated different modelling approaches to predict residential exposure to airborne microbial markers in the vicinity of livestock farms.

METHODS: Residential exposure measurements were performed at 61 sites in a livestock-dense area in 2014-2015. at each site, three to four 14-day PM10 samples were collected. Quantitative-PCR was used to assess DNA concentrations in air of commensal Gram-negative Escherichia coli and Gram-positive Staphylococcus spp. as well as indicator antimicrobial resistance (AMR) genes (tetW, mecA). A local reference site was used for temporal variation adjustment. Modelling was performed using livestock-related characteristics of the surroundings. Two approaches were evaluated using 10-fold Cross Validation: stepwise linear regression (SLR) and random forest (RF).

RESULTS: for all four microbial markers, both approaches explained an acceptable percentage of spatial variation in residential exposure concentrations. RF models had a higher training R-squared compared to SLR (E.coli: 0.89vs0.65; Staph.: 0.64vs0.36; tetW: 0.82vs0.44; mecA: 0.74vs0.47). However, this did not equate to higher 10-fold CV R-squared except for tetW (0.31vs0.14) while performance was similar for E.coli and Staph. (approximately 0.38, 0.15, respectively) and lower for mecA (0.30vs0.41). This shows that one approach did not outperform the other.

CONCLUSIONS: Both modelling approaches, stepwise linear regression and random forest, had acceptable predictive ability for livestock-related microbial markers in ambient air. Application of these models seems promising for residential exposure estimation for epidemiological studies, enabling more insights into relevance of exposure to specific microbial air pollutants.

KEYWORDS:
Agricultural air pollution, ambient air, residential exposure, microbial emissions, Land Use Regression modelling.

P-0868 Investigating Population Exposure Assignment Methods for Air Pollution from Google Street View Polyline Data in Copenhagen, Denmark

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BACKGROUND AND AIM: Google Street View (GSV) cars provide air pollution (AP) data across thousands of streets in multiple cities. Various methods exist for linkage of such vector data with populations. While rasterization or near-analysis are possible methods, multiple streets often surround residences; thus, a composite value can be assigned for geo-locations. We aimed to identify best geospatial method for exposure assignment from such data.

METHODS: Long-term mean AP [ultra-fine particles (UFP), nitrogen dioxide (NO2), and black carbon (BC)] predictions across 30,312 streets (length = 15-60 m) were obtained from GSV-based mixed-effects LUR models developed for Copenhagen, Denmark. A near-analysis was used where Euclidean distances between each residence (out of ~77,000) and surrounding streets were calculated, nearest street was identified, and its AP values were assigned. Predictions were also assigned to mid-street centroid; using a systematic algorithm data were split to train (24,061; ~80%) and test sets (3,031; ~10%). Spatial averaging (SA), inverse distance weighting (IDW), ordinary kriging (OK), and natural neighbor (NN) models with multiple configurations for weighting and cell-size were developed. The coefficient of determination (R2) and RMSE were calculated on the test sets.

RESULTS: The mean (SD) of UFP, NO2, and BC were, respectively, 14,120 (8,849) particles/cm³, 16.8 (8.3) µg/m³, and 1.1 (0.4) µg/m³. Overall, 9 SA, 27 IDW, 45 OK, and 3 NN models were developed. NN with a cell-size of 15m was the best performing model. The R2 and RMSE for NN on the test sets were, respectively, 0.92 and 2543 pt/cm3 for UFP, 0.87 and 3.1 µg/m3 for NO2, and 0.88 and 0.15 µg/m3 for BC. The Spearman correlation between residential predictions from NN and near-analysis assignment method was 0.97 for UFP, 0.95 for NO2, and 0.93 for BC.

CONCLUSIONS: Although high correlation was observed for NN and near-analysis, the latter overestimated the concentrations.

P-0899 A Bayesian Spatio-temporal Multisource Air Pollution Exposure Model for the UK

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BACKGROUND AND AIM: New 2021 WHO Global Air Quality Guideline levels follow mounting evidence of premature deaths from air pollution exposure, give rise to an increased need for high-quality air pollution modelling strategies. Currently, many areas of the UK exceed the recommended annual PM2.5 level of 10 µg/cm3; however, ground monitoring stations for PM2.5 remain sparse. The aim of this study is to produce a 1km x 1km monthly-estimated PM2.5 exposure map for the UK between 2005-2020, from AURN ground monitored data, the Pollution Climate Mapping model, and corrected satellite-derived Aerosol Optical Depth, with additional climate covariates from the HadUK-Grid.

METHODS: Taking a Bayesian hierarchical approach, the model tackles firstly the misalignment issue from using multi-source data by fitting a spatio-temporal geostatistical model at the ground monitoring site locations. Then a Gaussian process-based approach is used to predict PM2.5 across the regions where AOD is available. The usual global stationarity assumption is restrictive for this purpose, so a new regionally-stationary approach has been considered. Finally, interpolation methods, for areas with missing AOD data, will be compared to formulate a complete exposure model.

RESULTS: Preliminary results from a locally-stationary Greater London model display clear spatial variability in ground monitored PM2.5, with different trends identified across site types; as well as a moderate non-linear relationship with temperature humidity and precipitation, creating an overall seasonality trend. The validation of the model via cross-validation technique is currently ongoing.

CONCLUSIONS: This model will be used to quantify the effects of air pollution exposure on mental health outcomes in the UK Biobank cohort. Through the use of a Bayesian approach, measurement and modelling uncertainties can be propagated from the exposure model to the mental health effect model. Extensions of this model could involve multiple pollutants and further environmental covariates.

POSTER DISCUSSION SESSION 02: Children's environment and health | Reproductive outcomes

THEMATIC 06: Children's environment and health

P-0414 Exposure to Surrounding Greenness and Air Pollution Related to Nasal Microbiota Among Asthmatic Children

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BACKGROUND AND AIM: Environmental exposures such as greenness and air pollution have been widely associated with asthma among children. However, the potential mechanisms have rarely been studied. Considering the nasal microbiota whose interactions influence asthma, we aimed to investigate the linkage between surrounding greenness and air pollution (fine particulate matter [PM2.5]; nitrogen dioxide [NO2]; ozone [O3]) and nasal microbiota among asthmatic children in Tainan City, Taiwan.

METHODS: The normalized difference vegetation index was used to estimate greenness exposure in each children's location. Spatiotemporal air pollutions variations were predicted using the integrated hybrid kriging-LUR with XG-Boost algorithm. The nasal microbiota was collected from 47 children during the recovery phase. A generalized additive model was applied to evaluate exposure-outcome associations. Several covariates such as personal information and home environment were also considered in the model adjustment. A sensitivity test was then performed to evaluate the robustness of the model estimates.

RESULTS: Considering short-term exposure, a significant negative association was found between air pollution with bacterial diversity of the microbiota, as 1 unit increment of PM2.5 and O3 significantly decreases the observed species (PM2.5: -0.59, 95%CI -1.13, - 0.05 and O3: -0.93, 95%CI -1.54, - 0.32) and species richness (PM2.5: -0.64, 95%CI -1.25, - 0.02 and O3: -0.68, 95%CI -1.43, - 0.07). However, considering the long-term effect, a significant positive association was identified for greenness related to observed species and species richness, as well as a significant negative association for all pollutants related to species richness.

CONCLUSIONS: This is a scarce investigation that confirmed the significant association between nasal microbiota and greenness also air pollution. The findings have the potential for further investigation of how environmental exposures might influence asthma phase trends.

KEYWORDS: air pollution; asthmatic children; nasal microbiota; recovery phase; surrounding greenness

P-0449 Pb, As, Cd and Hg mixture in cord blood and effects in birth outcomes – Bayesian analysis. PIPA Project - Brazil

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Lead, arsenic, cadmium and mercury have been the subject of studies regarding individual and combined effects. Both have been detected in umbilical cord blood and placenta, evidencing intrauterine exposure. Its effects on fetal and infant development can have consequences in childhood and adulthood. This study aimed to estimate the combined effect of exposure to Pb, As, Cd and Hg in umbilical cord blood on head circumference (HC) and birth weight (BW). This study is part of the PIPA project (Childhood and Environmental Pollutants Project). Data are from the pilot study, conducted between October 2017 and August 2018, a prospective cohort to investigate the effects of exposure to environmental pollutants on child health. Lead, arsenic, cadmium and mercury were measured in 117 umbilical cord samples and sociodemographic information on the mother and clinical data on the baby at birth were collected. for the concentrations of metals the natural log-transformation was performed. The well-established Bayesian kernel machine regression to estimate the joint effects. Convergence tests were performed to check agreement and convergence of two parallel chains starting from different values. The difference of the median multivariate exposure-response functions (EF) represents the estimated joint effect distance when all metals are fixed at a certain percentile and when all metals are fixed at their medians. The model has been adjusted for confounders. for BW EF P10 = 46.056 (IC 95% -176.112 268.223) while EF P90 = -85.827 (IC 95% -316.245 144.591). Regards HC, EF P10 = 0.852 (IC 95% 0.133 1.568) while EF P90 = -0.285 (IC 95% -1.061 0.491). Among the confounding variables considered, smoking had a negative impact on birth weight (-272.99 CI 95% -433.59, -111.39). The higher the joint concentration of metals, the smaller the baby's weight and head circumference.

Metal mixture; environmental exposure, cord blood; public health; children's envinronmental Health

P-0451 Urinary arsenic concentration and bronchial asthma prevalence in children from Arica, Chile

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INTRODUCTION:
Bronchial asthma is the most common chronic inflammatory disease in children. Globally, the asthma prevalence is estimated to be 10.8% in children aged 6 to 7 years and 13.8% in 13 to 14 years. Environmental factors have been associated with asthma, including exposure to metals. In Arica city, northern Chile, arsenic levels in soils of natural and anthropocentric origin have generated exposure in the population. Our study aim was to examine the association between urinary arsenic concentration and bronchial asthma diagnosis in children and adolescents from Arica.

METHODS: Cross-sectional design. A database of 2,026 subjects under 18 years of age enrolled in the Environmental Health Center between 2009 and 2021 was analyzed. Arsenic exposure was obtained through a urine sample and; diagnosis of bronchial asthma from the computerized system of management of explicit health guarantees. The association between urinary arsenic and bronchial asthma adjusted for confounding variables was assessed by logistic regression models.

RESULTS: The prevalence of bronchial asthma was 7.4%, and the median inorganic arsenic was 15 µg/L (IQ range: 7.0 - 26 µg/L). Children with urinary arsenic concentrations above the median were more likely to develop bronchial asthma [Odds Ratio (OR): 1.91 95% CI 1.26 - 2.91)] adjusted for sex, age, ethnicity, and urinary creatinine. Also, the adjusted model revealed a higher chance of developing asthma at concentrations ≥ 22 µg/L of arsenic (OR 1.90, 95% CI 1.12 - 3.20).
CONCLUSION: This study reveals that urinary inorganic arsenic concentration might be associated with the development of bronchial asthma in children and adolescents. Despite the inherent limitations of cross-sectional data analysis, it is necessary to reduce arsenic exposure to prevent possible chronic health effects in children.

P-0454 Cord blood transcriptome-wide association study identifying genes associated with metabolic disrupting chemicals and infant growth

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BACKGROUND AND AIM: Prenatal exposure to metabolic disrupting chemicals (MDCs) has been linked to childhood obesity, however, the underlying mechanism is not clear. The first two years of life are critical for the development of childhood obesity, with adverse consequences including adult obesity, diabetes, and non-communicable diseases. We aimed to elucidate the role of cord blood transcriptomic influence in prenatal MDC-induced increased infant growth.

METHODS: Cord blood samples were obtained from 192 Belgian mother-singleton pairs, and mRNA was profiled for gene expression using Agilent Whole Human Genome Microarray 4x44K. A linear regression-based transcriptome-wide association study (TWAS) was performed to identify transcriptomic features associated with prenatal MDCs [including dichlorodiphenyldichloroethylene (p,p'-DDE), polychlorinated biphenyls congener 153 (PCB-153), perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS)], measured in cord blood, and with infant growth, defined as body mass index z-score change between birth and 2 years. A triangulation approach, consisting of mediation analysis, pathway enrichment analysis and transcription factor enrichment analysis, was conducted to assess the functional activity of transcriptomics in the relationship between MDCs and infant growth.

RESULTS: TWAS identified 521 features associated with infant growth, and 940, 242, 711, 206 features associated with p,p'-DDE, PCB-153, PFOA, PFOS, respectively. Mediation analysis identified 58 genes mediating the indirect effects of MDCs on infant growth. Particularly, IL34 gene expression was found to mediate both p,p'-DDE and PFOA. No overlapping pathways or transcription factors were associated with MDCs and with infant growth.

CONCLUSIONS: Mediating effects of certain gene expressions on the associations between MDCs and infant growth were identified. This is the first study to investigate the relationship between prenatal MDCs and infant growth by exploring transcriptomic profiling in cord blood, and the triangulation approach provides new insights into the underlying mechanisms.

KEYWORDS: Prenatal exposures, Metabolic disrupting chemicals, Microarray, Infant growth

P-0461 Arsenic exposure and respiratory outcomes during childhood in the INMA study

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BACKGROUND AND AIM: Ingested inorganic arsenic (iAs) is a human carcinogen that is also linked to other adverse health effects, such as respiratory outcomes. Yet, among populations consuming low-arsenic drinking water, the impact of iAs exposure on childhood respiratory health is still uncertain. Here, it is investigated the association between iAs exposure and respiratory outcomes assessed at 4 and 7 years of age in children living in Spain. In Spain, low-arsenic drinking water is usually available and ingestion of iAs from food is considered the major source of exposure.

METHODS: Our study population of 400 children come from the INMA cohort study (INfancia y Medio Ambiente). The summation of 4-year-old children's urinary iAs, monomethylarsonic acid (MMA), and dimethylarsinic acid (DMA) was used as a biomarker of iAs exposure (∑As) (median of 4.92 µg/L). Children's occurrence of asthma, eczema, sneeze, wheeze, and medication for asthma and wheeze at each assessment time point (i.e., 4- and 7-year) was assessed with maternal interviewer-led questionnaires. Crude and adjusted Poisson regression models using Generalized Estimating Equation (GEE) were performed to account for the association between natural logarithm transformed (ln) urinary ∑As at 4 years and repeated assessments of respiratory symptoms at 4 and 7 years of age adjusting for covariates.

RESULTS: The GEE - splines function using Poisson regression showed an increased trend of the overall expected counts of respiratory symptoms with urinary ∑As. The adjusted expected counts (95% confidence intervals) at ln-transformed urinary ∑As 1.57 (average concentration) and 4.00 (99th percentile) were 0.63 (0.36, 1.10) and 1.33 (0.61, 2.89), respectively.

CONCLUSIONS: These findings suggest that even relatively low-iAs exposure levels, relevant to the Spanish and other populations, may relate to an increased number of respiratory symptoms during childhood.

KEYWORDS: Respiratory outcomes; Urinary arsenic speciation; Children; Inorganic arsenic.

P-0479 Nitrate exposure from drinking water during pregnancy and risk of small-for-gestational-age in infants from a population-based study in Denmark

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BACKGROUND AND AIM: Nitrate is commonly found in drinking water due to leaching from agricultural activity into the groundwater. Drinking-water nitrate has been linked to several adverse birth outcomes, such as fetal growth restriction, preterm birth and birth defects. However, only one prior study has examined the impact of drinking-water nitrate on small-for-gestational-age (SGA). We aim to investigate the association between prenatal exposure to nitrate in drinking water and SGA in a population-based cohort in Denmark, a country with extensive national registers and where drinking water is solely groundwater based.

METHODS: We linked a cohort of 1,078,892 Danish singleton live births from 1991-2015 from Danish-born parents where the mother resided in Denmark throughout the pregnancy to individual-level household estimates of nitrate in drinking water. Exposure was modelled categorically and as an ln-transformed continuous variable. SGA was defined as the bottom 10% of births by birth weight per sex and gestational age, while severe SGA was defined as the bottom 5%. Using multiple logistic regression with generalized estimating equations, we accounted for births from the same mother.

RESULTS: We found an increased risk of SGA in the second category of nitrate (>2-5 mg/L) (OR=1.04, 95% CI: (1.03, 1.06)) and in the third category (>5-25 mg/L) (OR=1.02, 95% CI: (1.00, 1.04)) compared to the referent category (≤2 mg/L), but not in the highest. There was strong (p=0.002) evidence of an increase in SGA with nitrate in the model with continuous exposure. Restricting to those with nitrate levels at or below current European Union regulatory standards (≤50 mg/L) showed no meaningful changes.

CONCLUSIONS: Given the ubiquity of nitrate, these findings suggest that the current regulatory standards for nitrate in drinking water may put unborn children at risk of SGA.

KEYWORDS: nitrate, drinking water, small for gestational age, SGA, severe small for gestational age

P-0481 Prenatal Exposure to Ambient Air Pollution and Offspring Cerebral Palsy in Ontario, Canada: A Population-Based Cohort Study

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BACKGROUND AND AIM: Air pollution has been linked with structural brain changes, disruption of neurogenesis, and elevated risk of adverse neurodevelopment. However, no study investigated the influence of air pollutants on risk of cerebral palsy (CP), the most common motor disability in childhood. This study aimed to evaluate the association between prenatal exposure to ambient air pollution and the risk of CP in children born at term gestation.

METHODS: This study included 1,587,935 singleton term births with valid outcome information between 2002 and 2017 from all hospitals at Ontario, Canada. Annual $PM_{2.5}$ (1 × 1 km), NO_2 (10 × 10 km), and O_3 (21 × 21 km) were estimated and spatiotemporally interpolated to obtain weekly average concentrations at the postal code level for maternal residence during pregnancy. CP cases were ascertained by a single inpatient hospitalization diagnosis or at least two outpatient diagnoses for children from birth to 16 years of age. Multi-pollutant Cox proportional hazard models were performed with distributed lags to estimate the covariate-adjusted weekly hazard ratios (HRs) of CP per interquartile range (IQR) increase in prenatal exposure to each pollutant.

RESULTS: We identified 3,170 (2.0‰) CP cases during the study period. We found significant associations between exposures to $PM_{2.5}$ over gestational weeks 10 - 20 and increased CP risk, with a cumulative HR of 1.11 (95% CI: 1.03, 1.12) per IQR increase (2.7 μg/m3) across pregnancy (up to 37 weeks). No associations or windows of susceptibility were found for NO_2 or O_3 in relation to CP.

CONCLUSIONS: $PM_{2.5}$ exposure during early- and mid-pregnancy was associated with an increased risk of CP. Further studies are needed to explore this association and its potential mediators, which could advance knowledge of the environmental risk factors of CP during early fetal life.

KEYWORDS: Air Pollution; Cerebral Palsy; Neurodevelopment; Windows of Susceptibility

P-0520 Attendance Benefits of the EPA's School Bus Rebate Program: A Randomized Design

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BACKGROUND AND AIM: While buses remain the safest school transport from an accident perspective, older buses can expose students to high levels of diesel exhaust. Since these exposures adversely impact health and can cause missed school, the US Environmental Protection Agency (EPA) has spent millions of dollars to transition school bus fleets to cleaner vehicles. We leveraged the randomized allocation of the EPA's 2012-2017 School Bus Rebate Program funding to causally assess the district attendance impacts of upgrading buses.

METHODS: We used classical intent-to-treat analyses for randomized controlled trials to compare changes in school district attendance rates after vs before the 2012-2017 lotteries by funding selection status. We evaluated heterogeneity of effect by quartiles of estimated ridership and model years (MY) of the replaced buses since emissions standards have strengthened over time.

RESULTS: Within our analytical sample, 383 of the 2,816 EPA applicants were selected for funding. We found that districts selected for funding had, on average, a 0.06 percentage point (pp) higher attendance rate in the year after the lottery (95% CI: -0.01, 0.13) compared to unselected districts. Impacts were larger for districts with the highest estimated ridership on applicant buses (0.14 pp; 95% CI: -0.05, 0.32) and who replaced the oldest buses (pre-1990 MY replacement: 0.45 pp; 95% CI: 0.26, 0.65). In the first year after the funding lotteries we estimate there were 350,000 (95% CI: -70,000, 770,000) additional student-days of attendance due to these EPA funds. Extrapolation of our results suggests that replacement of all pre-2000 MY buses nationwide would lead to 1.3 million additional student-days of attendance each year (95% CI: 250,000, 2,400,000).

CONCLUSIONS: We find evidence that the EPA's School Bus Rebate Program has improved student attendance, especially in districts that had high levels of ridership on the impacted buses and removed the oldest buses.

P-0538 Dose-response relation between maternal exposure to arsenic in drinking water and risk of congenital heart disease in offspring – A nationwide cohort study

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BACKGROUND AND AIM: Prenatal exposure to arsenic is suspected to increase the risk of birth defects including congenital heart disease.
The aim of the study was to examine the association between maternal exposure to arsenic in drinking water and risk of congenital heart disease in the offspring with focus on the dose-response relationship.

METHODS: A nationwide register-based cohort study was performed. All liveborn children in Denmark in the study period 1997-2014 was included. Arsenic concentrations in drinking water were available through the national well database (Jupiter) managed by the Geological Survey of Denmark and Greenland. Maternal addresses at fetal age 4 weeks were linked with arsenic concentration in drinking water in the water supply areas. Four categories of maternal exposure to arsenic in drinking water were applied (<0.5 µg/L, 0.5-0.9 µg/L, 1.0-4.9 µg/L, ≥5 µg/L). The outcome was congenital heart disease diagnosed within the first year of life overall and stratified as severe, septal defects, and valvular heart defect.
The association between maternal exposure to arsenic in drinking water and risk of congenital heart disease was examined using a logistic regression analysis. The association was adjusted for year of birth, mother's educational level and ethnicity.

RESULTS: A total of 1,042,413 children was included in the study. The number of children born with a congenital heart disease increased from 9.2 per 1,000 births at maternal exposure <0.5 µg/L to 12.3 per 1,000 births at maternal exposure ≥5 µg/L. Similar findings was seen for septal defects. The associations were similar for girls and boys.
CONCLUSION: The study showed that maternal exposure to arsenic in drinking water increased the risk of congenital heart disease in the offspring even at low concentrations (i.e., 0.5–0.9 µg/L).

KEYWORDS: arsenic concentration, drinking water, congenital heart disease, nationwide study

THEMATIC 19: Reproductive outcomes

P-1182 Associations of per- and polyfluoroalkyl substances (PFAS) and their mixture with oxidative stress biomarkers during pregnancy

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BACKGROUND AND AIM: Oxidative stress, caused by environmental insults, may interfere with redox signaling during pregnancy and is a known contributor to preterm birth. In vivo and in vitro studies indicate that PFAS generate reactive oxygen species, but this has been minimally investigated in humans and has not been examined during pregnancy. We investigated the effects of prenatal PFAS exposure on oxidative stress biomarkers, hypothesizing that PFAS would be positively associated with oxidative stress.

METHODS: Our analytic sample included participants enrolled in the Illinois Kids Development Study and Chemicals In Our Bodies prospective pregnancy cohorts between 2014 and 2019 (N=428). Seven PFAS were quantified in 2nd trimester serum. Urine levels of 8-isoprostane-prostaglandin-F2α, PGF2α, 2,3-dinor-8-iso-PGF2α, and 2,3-dinor-5,6-dihydro-8-iso-PGF2α were measured in the 2nd and 3rd trimesters as biomarkers of oxidative stress. We fit linear mixed-effects models to estimate the associations between single PFAS with one or two measurements of oxidative stress biomarkers. We used quantile g-computation and Bayesian kernel machine regression (BKMR) to assess mixture associations between multiple PFAS and oxidative stress biomarkers. All models were adjusted for cohort, maternal age, parity, education, and pre-pregnancy body mass index.

RESULTS: Linear mixed-effects models showed that an interquartile range increase in perfluorooctane sulfonic acid (PFOS) was associated with a 4.08% increase in 8-iso-PGF2α (95% confidence interval [CI]= -3.20, 11.91). Using quantile g-computation, a one-quartile increase in all PFAS concentrations was associated with a modest increase in 8-iso-PGF2α (β=0.09, 95% CI= -0.07, 0.25). In both quantile g-computation and BKMR, and across all oxidative stress biomarkers, PFOS contributed the most to the overall mixture effect.

CONCLUSIONS: Our study is the first to investigate the effects of PFAS exposure on oxidative stress biomarkers during pregnancy. Findings were consistent across mixture methods and indicated PFOS is associated with elevated levels of oxidative stress among pregnant people.

P-1189 Synthetic pyrethroids exposure among women from fertility clinic and embryological outcomes- is there an association?

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INTRODUCTION: Pyrethroids exposure has been associated with adverse reproductive outcome. However, there is no study that explore the effect of environmental exposure and embryological outcomes. This question was addressed in the prospective cohort of couples undergoing fertility treatment.

METHODS: We included 450 women aged 25-45 undergoing assisted reproductive technology (ART) cycle at Infertility Clinic in Poland. A urine sample were collected at the time of fertility procedure(s) to assess four urinary synthetic pyrethroids concentrations (3-phenoxybenzoic acid (3PBA), cis-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (cis-DCCA), trans-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (trans-DCCA), cis-2,2-dibromovinyl-2,2-dimethylocyclopropane-1-carboxylic acid (DBCA)) using validated gas chromatography ion-tap mass spectrometry and calculated for cycle-specific for each metabolite. To evaluate effect of environmental exposure to synthetic pyrethroids and embryological outcomes (methaphase II (MII) oocyte yield, top quality embryo, fertilization rate, implantation rate) multivariable generalized linear mixed analyses with random intercepts was prepared.

RESULTS: Urinary 3-PBA concentrations decrease MII oocyte count (p=0.007) in the four quartile (>75 percentyl) compared to women in the first quartile (≤ 25 percentyl). Additionally when 3-PBA was treated as continuous variable the negative association between exposure to pyrethroids and MII oocyte count was also observed (p=0.012). Exposure to other pyrethroids metabolities (CDCCA, TDCCA, DBCA) were not related to any of the examined embryological outcomes.

CONCLUSIONS: The exposure to synthetic pyrethroids may be associated with poorer embryological outcome among couples seeking fertility treatments. As this is the first study on this topic, the results need to be confirmed in further studies.

KEYWORDS: embryological outcomes, urinary pyrethroids concentrations, environmental exposure, IVF treatment

P-1191 Prenatal Mycoestrogen Concentrations in Relation to Placental and Birth Weights

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BACKGROUND AND AIM: Zearalenone (ZEN) is an estrogenic mycotoxin or 'mycoestrogen' that contaminates global grain crops. Worldwide consumption has resulted in detectable concentrations of ZEN and its metabolites, including the synthetic version alpha-zearalanol (ZER), in human populations. Despite in vivo and in vitro evidence of endocrine disruption by ZEN, there is limited investigation of how mycoestrogens impact human health. The aim of this study was to examine markers of fetal growth following prenatal exposure to ZEN.

METHODS: Placental samples were collected from participants (n= 240) in the UPSIDE cohort (Rochester, NY, USA). ZEN and its metabolites were analyzed using high performance liquid chromatography and tandem mass spectrometry and values were log-transformed. Birth and placental weights were obtained from medical records and direct measurement, respectively; fetoplacental ratio (FPR) was calculated by dividing birthweight by placental weight. Generalized linear regression models were used to examine ZEN, ZER, and total mycoestrogens (sum of ZEN, ZER and their metabolites) in relation to fetal and placental size, adjusting for covariates.

RESULTS: ZEN and its metabolites were detected in 82% of placentas (median ZEN: 0.013 ng/g). Lower fetoplacental ratios were associated with placental concentrations of ZER (-0.45, 95%CI: -0.74,-0.16) and total mycoestrogens (-0.26, 95%CI: -0.42, -0.10). Although not statistically significant, placental ZEN (-31g, 95%CI: -115, 53) and ZER (-83g, 95%CI: -205, 40) were associated with lower birthweight and ZEN was associated with lower fetoplacental ratio (-0.19, 95%CI: -0.47, 0.08). No associations with placental weight were observed.

CONCLUSIONS: Results from this first epidemiological study of prenatal mycoestrogen exposure and child health suggest that ZEN and its metabolites may alter placental efficiency, resulting in lower birthweight. Ongoing work in this cohort will additionally quantify urinary mycoestrogens across pregnancy and evaluate maternal estrogens in relation to ZEN exposure.

P-1214 Associations of Urinary Phthalate Metabolites and Inflammatory Biomarkers Characteristic of the Preeclamptic Pathway Among Pregnant Women in Puerto Rico

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BACKGROUND AND AIM: Phthalates are a ubiquitous environmental exposure that may be implicated in inflammatory processes, as demonstrated by previous in vivo and in vitro studies. Few human studies have substantiated these observations. This study sought to examine whether maternal phthalate exposures impact inflammatory processes, as measured by circulating inflammatory biomarkers, in the PROTECT cohort in northern Puerto Rico.

METHODS: Circulating inflammatory biomarkers were collected from maternal serum samples during pregnancy. Inflammatory biomarkers included matrix metalloproteinases 1, 2, and 9 (MMPs), C-reactive protein (CRP), vascular cell adhesion molecule-1 (VCAM), and intercellular cell adhesion molecule-1 (ICAM). 19 phthalate metabolites were assessed in urinary samples measured at three study visits across pregnancy. Phthalates with <50% of measurements above the limit of detection were excluded from analysis. We utilized linear mixed effect models to estimate associations between interquartile range increases in phthalate metabolite concentrations and percent changes in inflammatory biomarkers.

RESULTS: Our results revealed significant associations between mono-n-butyl phthalate (MBP) and higher MMP1 by 7.86% (95% CI: 0.49, 15.76) and between mono oxononyl phthalate (MONP) and higher MMP2 by 8.30% (95% CI: 2.22, 14.75). We observed negative or null associations between phthalate metabolites and MMP2, MMP9, ICAM, VCAM, and CRP. Many results were significantly modified by fetal sex, particularly those between di-2-ethylhexyl phthalate (DEHP) metabolites and MMP1 (p-interaction: MEHHP=0.01, MEOHP= 0.04, MECPP= 0.01) and MMP2 (p-interaction: MEHHP=0.03, MEOHP=0.01, MECPP=0.01), for which associations were positive among only women carrying female fetuses.

CONCLUSIONS: MMPs have been previously investigated as preeclamptic biomarkers given their role in artery remodeling. Hence, our findings suggest a potential role for phthalates in mediating the maternal inflammatory response, as well as significant sexual dimorphism in these relationships, which has implications for preeclampsia and other adverse pregnancy outcomes.

KEYWORDS: phthalates, inflammation, matrix metalloproteinase, PROTECT, pregnancy

P-1220 Fetal death: analysis of angiogenic factors during pregnancy

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BACKGROUND: Fetal mortality is still insufficiently studied.
Objectives: Analyze angiogenic factors (PlGF) in maternal-fetal interface and associate then with fetal mortality.

METHODS: This is part of a case control study from 15 public branch hospitals of Sao Paulo City were we selected fetal death and live births.
Inclusion criteria: Single pregnancy; fetus and live births: ≥ than 22 and ≤ than 45 weeks of gestation and/or birth weight ≥ 500g.
Exclusion criteria: Absence of judicial termination of pregnancy and of maternal death on birth room

RESULTS: We analized 23 patients case and 23 controls. Birth weight averaged was 2290 grams for case group and 3177 grams for control ($p < 0.001$) (Mann-Whitney). Gestational age ranged from 27 to 39 weeks in case group and from 32 to 42 weeks in control ($p < 0.001$) (Qui Square)
Maternal PlGF of case group had a mean of 433.9 and of the control had 132.6 ($p = 0.005$). Umbilical cord PlGF of case group had a mean of 358.2 and the control had 10.41 pg/mL ($p < 0.001$). Median PlGF of umbilical cord of pregnant women who had preterm birth was 358.7 and of those who had delivered at term was 15.1 ($p < 0.001$) (Mann-Whitney).
Comparing PlGF of the control group and the fetal death group (intrapartum or antepartum) we found difference between live births and mothers who had intrapartum fetal death. By Dunn's post hoc test, the difference for maternal PLGF is between live birth vs intrapartum ($p=0.012$), similarly for cord PLGF ($p<0.001$)

CONCLUSIONS: We found differences between the PlGF of the blood of the mother and the umbilical cord of the case and control. We intend to analyze the sFlt and relate them with the occurrence of fetal death and other obstetric parameters.

KEYWORDS: Fetal mortality, angiogenic factors and pregnancy

POSTER DISCUSSION SESSION 03: Respiratory disorders in children/adults | Neurobehavioral changes in children/adults | COVID-19 and the Environment

THEMATIC 06: Children's environment and health

P-0519 The effect of COVID-19 lockdown/post-lockdown and season on children's exposure to PM2.5 and time expenditure by environment type

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BACKGROUND AND AIM: $PM_{2.5}$ concentration differs by environment type (indoor, outdoor, automobile). Elevated $PM_{2.5}$ exposure is associated with children's poor cognitive/mathematical performance, a strong predictor of poor later academic performance. The Bridging the Environment and Neurodevelopment for Children's Health Study provided low-cost personal air quality sensors to 30 Washington, D.C. metro-area children to investigate the relationship between daily air pollution exposures and children's cognitive performance. We investigated whether, between COVID-19 lockdown and post-lockdown periods, there were significant differences between measured location-specific (indoor, outdoor, automobile) $PM_{2.5}$ values and time spent in these locations, as well as these exposures' correlation with children's cognitive performance.

METHODS: Each data collection round included children (age 8-11) wearing the air quality sensor for 3 days during which parents recorded their activities; on day 3, children completed cognitive assessments. We collected data during winter 2020-2021 (Round 1) and spring/summer 2021 (Round 2). We used: Friedman tests to assess differences in average $PM_{2.5}$ and time spent by activity location for each round, Wilcoxon signed-rank tests to evaluate change over time and Spearman correlation tests to evaluate correlation between location-specific $PM_{2.5}$/time exposure and cognitive performance.

RESULTS: We found that there were significant differences in $PM_{2.5}$ exposure by activity type during the post-lockdown period--$PM_{2.5}$ exposure outside was significantly greater than that measured indoors or in an automobile (median outdoors = 5.11 $\mu g/m^3$; indoors = 3.25 $\mu g/m^3$; automobile = 2.66 $\mu g/m^3$). There were significant differences based on average time spent (logged in quarter-hour increments) in these locations rounds 1 vs. 2: outdoors (median=0.92 hours vs. 2.17 hours) and in automobiles (median=1.25 hours vs. 2.75 hours). These exposures weakly correlated with cognitive performance.
CONCLUSION: Our findings suggest seasonal effects of place-based $PM_{2.5}$ exposure and the effects of the cessation/the resumption of "normal life" during the COVID-19 pandemic's phases.

KEYWORDS: --air pollution-child health-cognitive outcomes

THEMATIC 08: COVID-19 and the Environment

P-0643 Long term exposure to air pollution and COVID-19 incidence: a prospective population-based study in northern Italy

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BACKGROUND AND AIM: Most of studies on air pollution and COVID-19 are limited to the first pandemic wave and by their ecological design. We investigate the association between long-term exposure to airborne pollutants and SARS-CoV-2 incidence up to March 2021 in Varese city, Lombardy Region, one of the most polluted areas of Europe.

METHODS: A prospective study of Varese adult citizens as of Dec31st,2019, linked by residential address to 2018 average annual exposure to outdoor concentrations of PM2.5, PM10, NO2, NO and O3 (FARM chemical-transport model), and to Regional datasets for age, sex, residential care home living, population density, comorbidities, and COVID-19 case ascertainment (positive nasopharyngeal swab specimens) until March 2021. We estimate rate ratios and additional number of cases for 1µg/m3 increase in air pollutants from single- and bi-pollutant Poisson regression models, reporting how sensible our estimates are to residual confounding through the E-value.

RESULTS: The 62848 residents generated 4408 cases. Yearly average PM2.5 exposure was 12.5µg/m3. In single-pollutant models adjusting for age, residential care home living, history of stroke, medications for diabetes, hypertension and obstructive airway diseases, PM2.5 was associated with 5.1% increase in COVID-19 rate (95%CI:2.7%-7.5%), corresponding to 294 additional cases per 100000 person-years. Further adjustment for area-based indicators of social deprivation and use of public transportation slightly attenuated the risk excess to 3.6% (95%CI:0.9%-6.4%). To explain away this estimated effect, an unmeasured confounder would need a rate ratio of 1.23 (E-value) with both exposure and outcome besides measured covariates. Bi-pollutant models confirmed the association. Results for PM10, NO2 and NO were similar. O3 was associated with a 2% decrease in disease rate, the association being reversed in bi-pollutant models.

CONCLUSIONS: Our prospective study provides solid evidence to the association between long-term exposure to low-levels of PM2.5 and increased COVID-19 incidence.

KEYWORDS: air pollution, COVID-19, prospective study

P-0644 Detection and quantitative assessment of SARS-CoV-2 in wastewater influent in Mazovian District, Poland

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BACKGROUND AND AIM. Coronaviruses (CoVs; ssRNA) are responsible for human and animal respiratory and gastrointestinal infections. Although, CoVs are mainly transmitted through respiratory droplets, SARS-CoV-2 RNA has been detected in stool and urine samples of asymptomatic carriers and patients showing symptoms of COVID-19. Wastewater-based surveillance of the SARS-CoV-2 is used to monitor the population-level prevalence of the COVID-19 disease. The aim of this research was to assess the prevalence of SARS-CoV-2 in wastewater influent samples collected in wastewater treatment plants located in Mazovian District in Poland.

METHODS: Fifteen wastewater influent samples (1000mL) were collected into sterile glass containers in April 2021. The extraction of viral RNA was carried out with Kogene Power Prep Viral DNA/RNA Extraction Kit (Kogene Biotech, South Korea) according to the manufacturer's instructions to produce a final volume of 35 µL. Obtained RNA samples were stored in -20 °C until further analysis. RT-qPCR was performed using CFX96 real-time PCR thermocycler (BioRad, USA). The detection of SARS-CoV-2 was carried out with SARS-CoV-2 VIASURE Real-Time PCR Detection Kits (CerTest Biotec, Spain) with a detection limit of ≥ 10 RNA copies per reaction.

RESULTS: The performed RT-qPCR-based studies revealed the presence of SARS-CoV-2 and presumptive SARS-CoV-2 or other coronaviruses in 33.3% and 46.7% of samples, respectively. The concentration of viral nucleic acids in analyzed influent wastewater samples ranged between 1.57×104 gc/L and 6.12×104 gc/L for SARS-CoV-2 and 6.84×103 gc/L and 2.39×105 gc/L for presumptive SARS-CoV-2 or other coronaviruses.

CONCLUSIONS: The wastewater-based approach can provide an effective way for identifying community-level hotspots of the infection and may be useful as an early warning tool, providing extra time for actions to suppress the spread of infections before the availability of clinical surveillance information.

KEYWORDS: SARS-CoV-2, wastewater, RT-qPCR

P-0646 Predictive model for severe COVID-19 using SARS-CoV-2 whole genome sequencing and electronic health record data, March 2020-May 2021

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BACKGROUND AND AIM: We used SARS-CoV-2 whole-genome sequencing (WGS) and electronic health record (EHR) data to investigate the associations between viral genomes and clinical characteristics and severe outcomes among hospitalized COVID-19 patients.

METHODS: We conducted a case-control study of severe COVID-19 infection among patients hospitalized at a large academic referral hospital between March 2020 and May 2021. SARS-CoV-2 WGS was performed, and demographic and clinical characteristics were obtained from the EHR. Severe COVID-19 (case patients) was defined as having one or more of the following: requirement for supplemental oxygen, mechanical ventilation, or death during hospital admission. Controls were hospitalized patients diagnosed with COVID-19 who did not meet the criteria for severe infection. We constructed predictive models incorporating clinical and demographic variables as well as WGS data including lineage, clade, and SARS-CoV-2 SNP/GWAS data for severe COVID-19 using multiple logistic regression.

RESULTS: of 1,802 hospitalized SARS-CoV-2-positive patients, we performed WGS on samples collected from 590 patients, of whom 396 were case patients and 194 were controls. Age (p=0.001), BMI (p=0.032), test positive time period (p=0.001), Charlson comorbidity index (p=0.001), history of chronic heart failure (p=0.003), atrial fibrillation (p=0.002), or diabetes (p=0.007) were significantly associated with case-control status. SARS-CoV-2 WGS data did not appreciably change the results of the above risk factor analysis, though infection with clade 20A was associated with a higher risk of severe disease, after adjusting for confounder variables (p=0.024, OR=3.25; 95%CI: 1.31-8.06).

CONCLUSIONS: Among people hospitalized with COVID-19, older age, higher BMI, earlier test positive period, history of chronic heart failure, atrial fibrillation, or diabetes, and infection with clade 20A SARS-CoV-2 strains can predict severe COVID-19.

KEYWORDS: SARS-CoV-2, COVID-19, whole-genome sequencing, electronic health record, hospitalization, severe infection

P-0649 SARS-CoV-2 infection is associated with functional changes in resting-state neural mechanisms among Italian adolescents and young adults: a longitudinal case control study

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BACKGROUND: There is strong evidence for brain-related abnormalities COVID-19. Neurologic, cognitive, and olfactory deficits demonstrate the potential neurotoxic impact of the virus. Recent studies of covid-related brain changes focus on severe infection or older populations. To our knowledge, no studies have focused on brain changes in adolescents and young adults impacted mildly by COVID-19. We took a data-driven approach to identify functional brain changes in COVID-19 cases and controls from Lombardy, Italy, a global hotspot of COVID-19.

METHODS: From our ongoing longitudinal neuroimaging study of adolescents in Northern Italy (the Public Health Impact of Metals Exposure (PHIME) study), we selected 10 participants (age 16-25y) who tested positive for SARS-CoV-2 infection (confirmed via real-time reverse transcription polymerase chain reaction (RT-PCR) tests) and 11 age- and sex-matched non-infected controls (RT-PCR negative; no close-contact or self-reported symptoms). None of the 10 positive subjects were hospitalized or suffered from pneumonia. All participants completed resting state functional magnetic resonance imaging (rs-fMRI) studies prior to and after infection. Using graph theory metrics, we computed eigenvector centrality (EC) in 111 brain areas (Harvard Oxford Atlas) and computed ECdelta (i.e., the difference in EC values pre- and post-COVID-19). We used family wise error (FWE) corrected permutation statistics to quantify ECdelta differences between cases and controls.

RESULTS: ECdelta in four brain regions (right posterior temporal gyrus; right planum temporale; left insular cortex and left central opercular cortex; p= 0.034, 0.047, 0.016, 0.038, respectively) differed significantly between COVID-cases and matched controls.

CONCLUSIONS: To our knowledge, this is the first longitudinal imaging study of COVID-19 in adolescence where participants were scanned before and after SARS-CoV-2 infection. Our results show that key brain areas associated with the primary gustatory cortex (insula and opercular cortex) and the 'brain-fog' (temporal gyrus and planum temporale) have altered functional connectivity patterns in adolescents infected by SARS-CoV-2.

P-0651 Residential green space is associated with a buffering effect on stress responses during the COVID-19 pandemic in mothers of young children, a prospective study

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BACKGROUND AND AIM: Green spaces are associated with increased well-being and reduced risk of developing psychiatric disorders. In this study, we aimed to investigate how residential proximity to green spaces was associated with stress response buffering during the COVID-19 pandemic in a prospective cohort of young mothers.

METHODS: We collected information on stress in 766 mothers (mean age: 36.6 years) from the ENVIRONAGE birth cohort at baseline of the study (from 2010 onwards), and during the COVID-19 pandemic (from December 2020 until May 2021). Self-reported stress responses due to the COVID-19 pandemic were the outcome measure. Green space was quantified in several radiuses around the residence based on high-resolution (1 m2) data. Using ordinal logistic regression, we estimated the odds of better resistance to reported stress, while controlling for age, socio-economic status, stress related to care for children, urbanicity, and household change in income during the pandemic. In sensitivity analyses we corrected for pre-pandemic stress levels, BMI, physical activity, and changes in health-related habits during the pandemic.

RESULTS: We found that for an inter-quartile range contrast in residential green space 300 m and 500 m around the residence, participants were respectively 24% (OR = 1.24, 95%CI: 1.03 to 1.51) and 29% (OR = 1.29, 95%CI: 1.04 to 1.60) more likely to be in a more resistant category, independent of the aforementioned factors. These results remained robust after additionally controlling for pre-pandemic stress levels, BMI, physical activity, smoking status, urbanicity, psychological disorders, and changes in health-related habits during the pandemic.

CONCLUSION

This prospective study in young mothers highlights the importance of proximity to green spaces, especially during challenging times.

P-0656 Mental health dynamics during the national quarantine in China

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BACKGROUND AND AIM: The COVID-19 pandemic and accompanying lockdown, pandemic fear, and economic collapse are widely believed to harm mental health. However, the spatio-temporal dynamics of public mental health status during national or regional quarantine have not been systematically examined due to data availability issues. This leaves a gap in evidence required to estimate socio-psychological risks for facilitating post-pandemic recovery in the population.

METHODS: By leveraging Baidu Index (index.baidu.com), a numeric rating score reflecting netizens' concerns for a specific issue, we characterized the magnitude of three mental health issues during the first wave of COVID-19-caused national quarantine in China, including anxiety, depression, and insomnia. The weekly variations of mental health issues are measured at national, provincial, and city levels by comparing the indexes across years. Bayesian regression models examined the relationships between COVID-19-related factors and mental health problems.

RESULTS: Compared to the same period in 2019, we observed that mental health issues became more severe around the 5th -9th week after the start of China's national quarantine, with a nearly 18% increase in well-being-related topic search terms. In particular, anxiety became more severe in 274 of the 289 selected major cities, depression in 235 cities, and insomnia in 257 cities during this period. Provinces including Hubei, Shangdong, and Hebei are the regions that have the most extended duration of heightened mental health issues. In addition, factors like cumulative confirmed cases, new deaths, and emergency response levels are found to have significant positive effects on the increase of mental health issues.

CONCLUSIONS: The COVID-19 pandemic has a pervasive negative impact on people's mental health, exhibiting significant spatio-temporal heterogeneity. A timely and accurate assessment of mental health dynamics is beneficial for effective interventions during major health events.

KEYWORDS: COVID-19; lockdown policy; anxiety; depression; insomnia

P-0684 Social environment, inequality, and COVID 19 in Nicaragua: did we underreport COVID-19 impact on those most highly vulnerable socioeconomic population groups?

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BACKGROUND AND AIM: In Nicaragua, COVID-19 official figures are very limited for vulnerable socio-economic population groups. Therefore, we conducted a multiapproach study to investigate the health impact of the pandemic in such groups and to estimate underreporting of COVID-19 cases.
METHOD: We implemented both a web-based survey (n=8,200 respondents) and a face-to-face interview-based survey (n=321 respondents) to explore self-reports of suspected and confirmed cases of COVID-19. The health impact was assessed by calculating the COVID-19 years of life lost (YLLs) and the COVID-19 Disability-Adjusted Life Years. We also performed a national-level registry study of public official data, then by combining that information we created an underreporting index (UI) by region, age, and gender since official data are reported only according to those variables. We explored factors associated with underreporting and health impact through nonlinear multi regression analysis.

RESULTS: National level estimated percentage of underreporting varied between 60 to 90% of cases during the COVID-19 pandemic. The UI was higher among young females, people with disability, older adults living alone, older workers with no access to social security or limited ace to public health care, Afro-Caribbean ethnic groups, people living in rural areas, and belonging to low and very low socioeconomic strata. Also, the municipality with the highest national poverty index had the highest UI. Our data strongly suggest that the relative burdens of both the YLDs and DALYs were also higher among those groups with a higher UI.
CONCLUSION: The COVID-19 greatly impacts highly vulnerable population groups, however, this situation is not being reflected in the official figures. To make visible the true impact of the pandemic and establish effective measures to assist the most vulnerable groups, we need to start by making the situation of such groups visible to society.

KEYWORDS: COVID 19, underreporting, vulnerable groups, Nicaragua.

THEMATIC 16: Neurobehavioral changes in children/adults

P-1010 Prenatal metals exposure and pre-adolescents' emotional and behavioral problems

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BACKGROUND AND AIM: Humans are regularly exposed to metals and most of them can cross the placental barrier which can lead to adverse effects on the developing foetus. Our aim was to study the association between maternal metals and trace elements exposure during gestation and preadolescent's emotional and behavioural problems at 9 years of age. Socio-demographic, environmental and dietary variables, as well as single nucleotide polymorphisms (SNPs) in brain- and metabolism-related genes, were considered.

METHODS: The study sample comprised Spanish mother-child pairs in the INMA (Environment and Childhood) cohort study recruited in the regions Valencia, Sabadell and Gipuzkoa (n=1027). Metals (Cd, Co, Cu, Mo, Ni, Pb, Sb, Se, Tl and Zn) were measured in urine samples collected during first and third trimesters of pregnancy. Arsenic (As) metabolites (monomethylarsenic acid, [MMA], dimethylarsenic acid, and inorganic As) were determined in a subsample (n=729). Behaviour was assessed at 9 years of age using the Child Behaviour Checklist (CBCL) composed of three scales: internalizing, externalizing and total problems. Sociodemographic, dietary and environmental variables were obtained through questionnaires. SNPs in APOE, BDNF, GSTP1, and PON1 were genotyped in cord blood DNA. Multivariate negative binomial models were built. The interaction with sex and genotypes was evaluated including interaction terms.

RESULTS: Increasing maternal urinary concentrations of Cu, MMA and Pb were associated with an increased incidence ratio risk (IRR 4.6-7.5%) in pre-adolescents for all three CBCL scales. Increasing Mo, Ni and Co concentrations were associated with higher IRR for internalizing problems (up to 8%), and Cd for the externalizing scale (6.7%). Modifications of sex and genotypes were found for several associations.

CONCLUSIONS: In our population, prenatal exposure to several metals was associated with worse scores on behavioral tests in pre-adolescents. Sex and genetic background may play a role in metals toxicity.

KEYWORDS: Metals, behavioral problems, prenatal exposure

P-1013 Intergenerational Transmission of Stress: Multi-domain Stressors from Maternal Childhood and Pregnancy Predict Children's Mental Health in a Racially and Socioeconomically Diverse, Multi-site Cohort

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BACKGROUND AND AIM: Despite growing recognition that unfortunately common stress exposures during women's childhood and pregnancy may have intergenerational impacts, studies of children's mental health rarely take an intergenerational lifecourse approach. To identify modifiable risk factors, we examined associations of maternal exposure to adversity in childhood and pregnancy with children's mental health problems in a sociodemographically diverse, multi-site, sample.

METHODS: Participants were mother-child dyads in the ECHO-PATHWAYS consortium with harmonized data across three U.S. pregnancy cohorts drawn from 7 regions. Women reported on their own exposure to childhood traumatic events (CTE) and pregnancy stressful life events (PSLE), and their 4-6 year-old child's mental health problems using the Child Behavior Checklist (CBCL). Regression analyses estimated associations between maternal stressors and child Total Behavior Problems, adjusting for a wide range of confounders.

RESULTS: Among 1948 dyads (child age M=5.13 (SD=1.02) years; 38% Black, 44% White; 8.5% Hispanic), maternal history of CTE and PSLE were independently positively associated with children's Total Problems ([ßCTE=0.11, 95%CI [.06, .15]; ßSLE=0.22, 95%CI [.17, .27]) and also with greater odds of Clinical Levels of Problems (ORCTE=1.39; 95%CI [1.11, 1.76]; ORPSLE=1.37; 95%CI [1.24, 1.53]). Patterns of association were consistent across pooled analyses and within cohorts. Results held after adjustment for both confounders and variables on the mechanistic pathway (e.g., postnatal depression, birth outcomes).

CONCLUSIONS: Findings show consistent effects of maternal history of adversity during sensitive periods of her development on children's mental health, across region and cohort, within a large, socioeconomically and racially diverse sample, increasing confidence that mental health has intergenerational developmental underpinnings across populations. This is the first study to demonstrate independent contributions of maternal CTE and PSLE to children's mental health. Prevention and intervention programs that reduce childhood trauma and stress during pregnancy will likely positively impact women's and their children's health.

P-1015 Annoyance and sleep disturbance due to traffic noise: a comparison with WHO exposure-response functions

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BACKGROUND AND AIM: Traffic noise is omnipresent. Annoyance and sleep disturbance due to road, rail, and aircraft noise in Leipzig, Germany were investigated.

METHODS: Traffic noise-related annoyance and sleep disturbance were collected in the LIFE cohort study (2018-2021) and linked to address-specific traffic noise data (LDEN/LNight). Information on noise-related disturbances to falling asleep, sleeping at night, and staying asleep, as well as annoyance from each traffic noise source, were obtained using ISO/TS-15666 standards. Answers ranged from "not at all" to "extremely disturbed". "Highly" and "extremely disturbed" individuals were defined as "highly annoyed" and "highly sleep disturbed".
Logistic regressions were used for the association between high annoyance/sleep disturbance and traffic noise. The percentage of highly annoyed and sleep disturbed for all three traffic noise sources were modelled. Results were compared to WHO reviews for annoyance (Guski et al. 2017) and sleep disturbance (Basner & McGuire 2018).

RESULTS: The increase in risk (per 10 dB) was most pronounced for aircraft noise (annoyance (LDEN): ORair=12.65; 95% CI 9.37-17.10; sleep disturbance (LNight): ORair=19.66; 95%CI 11.47-33.71). Risk estimates for road and rail noise were increased for annoyance (ORroad=3.55; 95%CI 2.78-4.53; ORrail=3.31; 95%CI 2.77-3.97) and sleep disturbance (ORroad=2.86; 95%CI 1.92-4.28; ORrail=2.68; 95% CI 1.92-4.28).
Exposure-response curves for annoyance due to road and rail noise were lower than the corresponding curves in the WHO review, and were higher for aircraft noise. The curves for high sleep disturbance due to road noise were comparable, but the proportion of highly sleep-disturbed persons was lower for rail noise and higher for aircraft noise compared to the WHO review.

CONCLUSIONS: The higher proportion of highly annoyed and sleep disturbed at given aircraft noise levels compared with the WHO reviews may indicate changing noise effects over time. Our results underscore the need for improved noise control.

KEYWORDS: Annoyance, sleep disturbance, traffic noise

P-1021 Antenatal depression and environmental pollutants

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Mental health influences the experience of pregnancy. Antenatal Depression is a risk factor for mother-baby bond. Many factors can cause depression, including genetic, psychological and environmental factors.
The aim of this study is investigating associations between Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) and Metals exposure with depression in pregnancy.

METHODS: This study used data from Projeto Infância e Poluentes Ambientais (PIPA UFRJ) pilot study. That was accomplished at Federal University of Rio de Janeiro from 2017 to 2018. 131 pregnant women participated at this research. They answered questionnaires to collect sociodemographic, environmental pollutants exposure and mental health information. Maternal blood and urine sample were collected at third trimester of pregnancy to detect environmental pollutants.

RESULTS: The mean age of research participants was 27. All participants were in urban areas. The mean per capita income was R$ 891,80. All metals investigated by this study (4 metals) were detected in all participants. Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA) were detected in 73%. 6% of participants reported having depression. Higher mean PFOS exposure was detected in pregnant women with depression (With Depression= 1,1 ng/mL; CI 95% 0,74-1,56. No Depression= 0,79 ng/mL; CI 95% 0,76-0,84). The same was found in analysis of PFOA (WD= 0,82 ng/mL; CI 95% 0,55-1,48. ND= 0,59 ng/mL; CI 95% 0,55-0,63). Analyzing Metals exposure, higher mean Arsenic exposure was detected in participants with depression (WD= 10.3423 ng/mL; CI 95% 7,47-12,7). (ND= 9.805 ng/ mL; CI 95% 8,96-10,5).

CONCLUSIONS: These results suggest higher concentration in pregnant women with depression. However there is no statistical significance. The PIPA Project cohort is currently being developed. It will cooperate with greater statistical power in this discussion.

KEYWORDS: Environmental pollutants; Antenatal Depression; Perfluoroalkyl and Polyfluoroalkyl Substances; Metals

THEMATIC 20: Respiratory disorders in children/adults

P-1229 Long-term exposure to ambient air pollution from multiple sources and associations with asthma incidence in children born in Denmark 1998-2016

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BACKGROUND AND AIM Asthma has been associated with ambient air pollution exposure, mainly in the urban environment. We examined the nationwide associations between early-life exposure and childhood asthma incidence.

METHODS: Asthma incidence was defined as the first record of a ICD-code for asthma collected from hospital admission, emergency room or outpatient contact among all liveborn singletons born in Denmark between 1998 and 2016. We linked registry data with monthly mean concentrations of particulate matter (PM2.5 and PM10), nitrogen dioxide (NO2), nitrogen oxides (NOX), elemental carbon (EC) and organic carbon (OC), sulphur dioxide (SO2), ozone (O3), sulphate (SO42-), nitrate (NO3-), ammonium (NH4+), secondary organic aerosols (SOA) and sea salt modelled at the home addresses. Associations were estimated with Cox proportional hazard models adjusted for potential confounders using fixed prenatal and time-varying postnatal exposure means.

RESULTS: Out of the 1,060,154 children included, 6.1% had asthma during the mean follow-up of 8.8 years. The risk of asthma increased with increasing prenatal exposure to all pollutants in adjusted models except for O3 and sea salt. Increased risks were also evident for postnatal exposure to most pollutants and for asthma after age 4. The hazard ratio associated with an interquartile range increase of 2.4 and 8.7 µg/m3 in prenatal exposure was 1.06 (95% CI 1.04-1.08) for PM2.5 and 1.04 (95% CI 1.02-1.05) for NO2. This association with PM2.5 was stable after adjustment for NO2, while it attenuated for NO2 to 1.01 (95% CI 0.99-1.03) after adjustment for PM2.5. OC, for which biomass burning is an important source, appeared to increase risk beyond its contribution to total PM2.5. for a 0.5-µg/m3 increase in the HR was 1.08 (95% CI 1.06-1.10) irrespective of adjustment for PM2.5.

CONCLUSIONS:The findings strengthen the evidence that early-life exposure to ambient air pollution from multiple sources contributes to asthma development.

P-1231 Maternal stressful life events during pregnancy and child asthma: an investigation of effect modification by postnatal neighborhood opportunity

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BACKGROUND AND AIM: Studies have linked prenatal maternal psychosocial stress and childhood wheeze/asthma, but have rarely investigated modifiable factors that may mitigate risks such as the postnatal environment. We investigated associations between prenatal stress and childhood wheeze/asthma, examining effect modification by postnatal neighborhood-level opportunity as a potential buffer of stress.

METHODS: Participants included 2056 mother-child dyads from ECHO PATHWAYS, a consortium of three prospective pregnancy cohorts (CANDLE, TIDES, GAPPS) from six U.S. cities. The number of maternal stressful life events (SLEs) experienced during pregnancy was reported retrospectively using the 14-item Pregnancy Risk Assessment Monitoring System SLE questionnaire (including traumatic, financial, emotional and relationship stressors). Parents reported child wheeze/asthma outcomes at age 4-6 (mean: 4.7 +/-0.7) years using a validated questionnaire: ever asthma, current wheeze (previous 12 months), current asthma (any two: ever asthma, current wheeze, or asthma-specific medication use), and strict asthma (ever asthma and either current wheeze or asthma-specific medications). We used modified Poisson regression to estimate risk ratios and 95% confidence intervals (95%CI), adjusting for confounders. We examined effect modification between SLEs and postnatal Child Opportunity Index (COI), a measure of neighborhood-level resources and conditions based on residence up to age 4, using interaction terms.

RESULTS: Median of maternally-reported SLEs was 1 event (interquartile range: 0-2). Per one-unit increase in SLE, adjusted risk ratios (95%CI) were 1.06 (0.99, 1.13) for ever asthma (prevalence: 11%); 1.09 (1.03, 1.14) for current wheeze (prevalence: 15%); 1.05 (0.98, 1.12) for current asthma (prevalence: 12%); and 1.05 (0.98, 1.13) for strict asthma (prevalence: 9%). We found no evidence of effect modification by COI (all p-interaction >0.20).

CONCLUSIONS: Childhood wheeze/asthma risk, particularly current wheeze, increases with increasing stress events experienced by women prenatally. In this study of women with few SLEs, these associations were not mitigated by postnatal neighborhood opportunity.

KEYWORDS: Maternal Stress; Asthma; Wheeze; Neighborhood

P-1238 PM2.5 and NO2 as Potential Modifiers of Clinical Trial Results on Asthma Exacerbation and Control

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BACKGROUND: Despite well-established associations between ambient air pollution and asthma exacerbations, few RCTs have considered variation in clinical outcomes or treatment efficacy by pollutant concentrations. Common clinical treatment for asthma includes inhaled corticosteroids (ICS) and long-acting beta-agonists (LABA), although treatment response is heterogeneous. Many patients are nonresponsive to this combination, despite treatment compliance. Here, we re-analyzed data from NIH AsthmaNet Best African American Response to Asthma Drugs (BARD) trial, to investigate the role of PM2.5 and NO2 in asthma exacerbation (AE) and annual asthma control days (AACD), across varying doses of ICS and LABA combination therapy.

METHODS: We reexamined data from 247 children sequentially randomized to: a double-ICS dose (2xICS), double-ICS with LABA (2xICS+1xLABA), quintuple-ICS (5xICS) and quintuple-ICS with LABA (5xICS+1xLAB A). Treatment preference was determined by AE and AACD during each treatment. We geocoded participants' residences, estimated treatment-period-specific PM2.5 and NO2 mean exposures, using validated national spatiotemporal models, and estimated associations for PM2.5 and NO2 with AACD and AE, using mixed models adjusted for treatment and trial site.

RESULTS: The original RCT findings showed that half the children responded better to increased ICS, and half responded better to the LABA addition, with no clear preference. We found that PM2.5 and NO2 exposures varied substantially across periods (2.28 - 15.3 µg/m3, 2.6 - 23.7 ppb, respectively), and that, among children, both PM2.5 and NO2 conferred more exacerbations [0.25 events (95% CI: 0.078 - 0.41), 0.15 events (95% CI: -0.03 - 0.33), respectively], though neither significantly altered treatment preference in these data.

CONCLUSIONS: We found that, among children, ambient PM2.5 and NO2 had a stronger association with asthma outcomes than did treatment, but neither significantly altered treatment preference or efficacy. Richer considerations of environmental context may help improve the design and interpretation of RCTs.

KEYWORDS: Asthma, PM2.5, NO2, ICS, RCT, LABA.

Tuesday, September 20

POSTER DISCUSSION SESSION 04: Aging and Environment | Non-communicable diseases including cancer, cardio-metabolic and neurological

THEMATIC 02: Aging and Environment

P-0044 The association between long-term PM2.5 exposure and late-life amyloid burden in the Atherosclerosis Risk in Communities (ARIC) study cohort

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BACKGROUND AND AIM: Mechanistic models suggest that particulate matter ≤ 2.5 um (PM2.5) may promote Alzheimer's disease, which is characterized by brain amyloid accumulation. This hypothesis has rarely been explored in epidemiologic studies, despite studies showing associations between long-term PM2.5 exposure and late-life cognitive impairment. We estimated the association between long-term PM2.5 exposure and late-life brain amyloid deposition in the Atherosclerosis Risk in Communities (ARIC) study cohort.

METHODS: We used a chemical transport model with data fusion to estimate PM2.5 concentrations (ug/m3) in 36-, 12-, 4-, and 1-km grid cells in ARIC study areas. We linked concentrations to geocoded participant addresses and calculated mean PM2.5 exposures from 2000 to 2007. We estimated amyloid deposition using florbetapir amyloid positron emission tomography (PET) scans in 346 participants with normal cognition or mild cognitive impairment in 2011-2014. We defined amyloid positivity as a global cortical standardized uptake value ratio (SUVR) ≥ the sample median of 1.2. We used logistic regression models to quantify the association between amyloid positivity and PM2.5 exposure after adjusting for potential confounders. We explored effect measure modification by APOE e4 allele status and tested whether effect estimates were consistent using alternate PM2.5 exposure methods.

RESULTS: Our analytic sample included 279 participants. at the time of amyloid-PET scans, their mean age was 78 years, 56% were female, 42% were Black, and 26% had mild cognitive impairment. After adjusting for age, sex, education, and race-study center, we found no significant association between brain amyloid positivity and long-term mean PM2.5 exposure. There was no evidence of effect measure modification by APOE e4 allele status. Results were consistent when we used alternate PM2.5 estimation methods.

CONCLUSIONS: PM2.5 may induce neurotoxic effects through non-amyloid, potentially vascular pathways, though we note the small sample size may have made us underpowered to detect a significant association.

P-0052 Newborn ribosomal DNA content as a potential early marker of genomic instability and longevity in association with prenatal air pollution exposure

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BACKGROUND AND AIM: Repetitive regions in the genome, including ribosomal DNA repeats, have essential functions in genome stability. Alterations in ribosomal DNA copy numbers (rDNAcn) associates with genome-wide methylation and gene-expression, and links with longevity, as proposed in the rDNA theory of aging. Prenatal air pollution exposures affect molecular markers of aging that may underly later life health effects. We studied the association between prenatal air pollution exposure and this novel potential aging marker (rDNAc) in newborns.

METHODS: Cord blood rDNAcn (45S rDNA) was measured in 177 newborns from the ENVIRONAGE birth cohort using ddPCR. Maternal residential exposure to PM10, PM2.5, NO2, and BC during pregnancy was estimated using a high-resolution spatial-temporal interpolation method. Using multivariable-adjusted distributed lag models, newborn rDNAcn was associated with average weekly air pollution exposures.

RESULTS: The mean cord blood rDNAcn was 245 (SD: 64). Higher prenatal exposure to PM10, PM2.5, and NO2 in early to mid-pregnancy (weeks 9-18) was associated with an increase in rDNAcn. Each SD increment in air pollutants was associated with an average increase of 22.5 (95%CI: 5.9 to 35.0) copy numbers. Higher exposure to PM10, PM2.5, NO2, and BC late in pregnancy (weeks 25-35) was strongly associated with a decrease in rDNAcn. Each SD increment in air pollutants was associated with an average decrease of –29.6 (95%CI: –49.9 to –9.4) copy numbers.

CONCLUSIONS: We studied for the first time rDNAcn in newborns and show that prenatal air pollution exposure is associated with rDNA repeats at birth. These results add evidence to the impact of air pollution on genome stability and early aging mechanisms. Evaluating the rDNA concept of aging in relation to diseases may further show the link between prenatal air, molecular alterations, and health later in life.

KEYWORDS: genome instability, aging, ribosomal DNA copy number, prenatal air pollution

P-0056 Ambient Air Pollution and Clinical Dementia: Systematic Review and Meta-analysis

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BACKGROUND AND AIM: Air pollution exposure is a possible modifiable risk factor for dementia and epidemiologic evaluation of this relation has grown rapidly. We synthesize the existing literature, considering differences by study factors that could influence findings.

METHODS: Studies describing associations between EPA criteria air pollutants and proxies of traffic pollution were identified from Embase and PubMed through August 2021. Information on study characteristics and key findings were extracted for each study and results were meta-analyzed where at least three studies used comparable approaches. Differences in data source, study type, and variability in exposure reported were also explored.

RESULTS: Thirty-seven studies were identified and 11 could be meta-analyzed for PM2.5. Results were expressed per standard deviation or interquartile range. The overall HR for PM2.5 was 1.07 (95% CI: 1.04-1.10). The HR among 4 cohort studies was 1.20 (95% CI: 1.09-1.32) and among 6 studies using administrative data was 1.04 (95% CI: 1.00-1.07). Wider confidence intervals were observed for associations with NO2 (HR=1.04; 95% CI: 0.99-1.10; n=5 studies) and NOx (HR=1.08; 95% CI: 0.99-1.16; n=4 studies), and there was no clear association with O3 (HR=0.98; 95% CI: 0.93-1.04; n=3 studies).
CONCLUSION: The evidence suggests that PM2.5 is a risk factor for dementia. However, the meta-analyzed HRs are subject to limitations that require interpretation with great caution. Outcome ascertainment approaches differ across studies and each exposure assessment approach likely is only a proxy for etiologically relevant exposure as it relates to clinical dementia outcomes. Studies that evaluate critical periods of exposure, pollutants other than PM2.5, and that actively assess all participants for outcomes, are needed.

KEYWORDS: Air pollution; dementia; meta-analysis; systematic review.

P-0068 Greater residential greenness is associated with reduced epigenetic aging in a population survey in North Carolina

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BACKGROUND AND AIM. Epigenetic age acceleration (EAA) or the difference between DNA methylation-predicted age and chronological age is affected by environmental and social factors, and predictive of systemic diseases. This study assessed associations between residential greenness and EAA, and between EAA and systemic inflammation.

METHODS: This analysis applied three alternative EAA formulas proposed by Horvath (2013), Hannum et al. (2013), and Li et al. (2018) to Illumina EPIC DNA methylation data on 116 blood samples from adult participants of a cross-sectional survey in North Carolina. Inflammation score was based on a sum of 17 biomarkers including multiple cytokines, which were dichotomized at the 90th percentile of sample distribution. ELISA tests were applied to determine Helicobacter pylori, Toxoplasma gondii and cytomegalovirus IgG seropositivity, and calculate the number of chronic infections. Proportion of vegetated land cover (trees, shrubs, and grass) was calculated within 500 m of each residence using high resolution landcover data.

RESULTS: Li's epigenetic age formula [Li et al. 2018. Exposure to polycyclic aromatic hydrocarbons and accelerated DNA methylation aging; EHP 126] produced the strongest correlation between DNA methylation age and chronological age. Using this formula, an interquartile increase (23%) in vegetated land cover was associated with 2.3 (95% CI 1.2; 3.4) years reduction in predicted EAA in generalized additive regression analysis adjusting for obesity, sex, race, chronic infections, daily screen time and two-dimensional spline function of geographic coordinates. Individuals with three chronic infections had 10.3 (5.9; 14.7) years greater adjusted EAA than those with no infections. One extra year of EAA was predictive of 6.2% (2.5%; 10.2%) greater mean adjusted inflammation score in Poisson regression.
Conclusion. This study demonstrated that greater residential greenness is associated with reduced epigenetic aging.

KEYWORDS: Epigenetic age, DNA methylation, inflammation, greenness, green space.
This abstract does not represent EPA policy.

THEMATIC 17: Non-communicable diseases including cancer, cardio-metabolic and neurological

P-1058 Long-term exposure to transportation noise and risk of type 2 diabetes: a cohort study

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BACKGROUND AND AIM: A few studies have reported associations between transportation noise and diabetes. This includes studies based on millions of participants, relying entirely on register-based confounder adjustment, which raises concern about residual confounding from lifestyle. We aimed to investigate associations between road and railway noise and risk of type 2 diabetes (T2D), including investigation of effects of increasing adjustment for register-based and lifestyle covariates.

METHODS: In a population-based cohort of 324,988 participants randomly selected across Denmark in 2010–2013 and followed up until December 2017, we identified 7,574 incident T2D cases using hospital and prescription registries. Based on historical address-information, we calculated 10-year time-weighted exposure to road noise at the most (LdenMax) and least (LdenMin) exposed façades and exposure to air pollution (PM2.5). We used Cox proportional hazards models to calculate hazard ratios (HR) with increasing adjustment for individual- and area-level register-based sociodemographic covariates (e.g. education and income) and lifestyle covariates assessed through questionnaires, including smoking, physical activity and alcohol.

RESULTS: We found that a 10 dB increase in road LdenMin was associated with HRs (95% CI) of 1.06 (1.02–1.10) in the crude model, 1.08 (1.04–1.13) after adjustment for register-based sociodemographic covariates and 1.07 (1.03–1.12) after further adjustment for lifestyle. for road LdenMax, the corresponding HRs were 1.07 (1.04–1.10), 1.05 (1.02–1.08) and 1.04 (1.01–1.07). After further adjustment for PM2.5, HRs were 1.06 (1.01–1.10) for LdenMin and 1.03 (1.00–1.07) for LdenMax. Railway noise was associated with HRs of 1.05 (0.98–1.11) for LdenMax and 1.04 (0.94–1.14) for LdenMin in fully adjusted models.

CONCLUSIONS: Long-term exposure to road and potentially railway noise was associated with T2D. Our results indicated that administrative cohort studies can produce reliable results if a broad register-based adjustment strategy is applied.

KEYWORDS: Road noise; railway noise; type 2 diabetes; lifestyle

P-1060 Multidimensional sleep clusters and cardiometabolic risk factors in adolescents: Results from the GINIplus and LISA studies

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BACKGROUND AND AIM: Evidence of an association between sleep duration and body mass index is vast, but other sleep characteristics might also be relevant for cardiometabolic health. We aimed to identify sleep clusters based on multidimensional sleep characteristics, and to determine their associations with cardiometabolic risk markers in adolescents.

METHODS: A total of 1096 participants of the GINIplus and LISA birth cohorts, wearing accelerometers for one week during the 15-year follow-up, were included. K-means cluster analysis was performed based on twelve sleep characteristics including daily average and day-to-day variability, respectively, of total sleep time (TST), sleep efficiency, sleep-onset latency, sleep onset timing, time awake per hour after sleep onset, number of awakenings per hour. Cardiometabolic markers were dichotomized based on established cut-offs or sex-specific percentiles, including high fat mass index, prehypertension, high triglycerides, low high-density lipoprotein cholesterol, high C-reactive protein, and high homeostatic model assessment of insulin resistance (HOMA-IR). Cross-sectional, logistic regression models were run adjusting for potential confounders.

RESULTS: Five sleep clusters were identified: good sleep (n=391; average TST 7.7 hours), late but high-efficient sleep (n=224; 6.9 hours), irregular sleep (n=101; 6.9 hours), difficulty staying asleep (n=298; 6.8 hours), and difficulty falling asleep (n=82; 6.9 hours). Compared with "good sleep", the "irregular sleep" cluster was associated with higher odds of high triglycerides (odds ratio (OR) = 2.43, 95% confidence interval (CI) =1.29-4.60). Moreover, the "difficulty falling asleep" cluster was associated with increased odds of high HOMA-IR (OR=3.09, 95%CI=1.25-7.65). The "late but high-efficient sleep" and "difficulty staying asleep" clusters were not significantly associated with cardiometabolic markers.

CONCLUSIONS: Clusters describing "difficulty falling asleep" and "irregular sleep" patterns were associated with high insulin resistance and high triglycerides, respectively, in adolescents. Improving sleep quality and quantity in different sleep dimensions might benefit adolescents' cardiometabolic health.

KEYWORDS: Sleep, cardiometabolic markers, adolescents, cluster analysis, accelerometry

P-1061 Earthquake exposure and development of ischemic heart disease

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BACKGROUND AND AIM: The Kyungju earthquake of Korea (moment magnitude of 5.8) occurred on 12 September 2016 and over 600 aftershocks continued for a year. The association between the series of earthquake experience and the development of ischemic heart disease is evaluated.

METHODS: The 10 years (2010-2019) of medical history of 540,858 residents living in Kyungju and control cities (Pohang, Gimpo, and Jeonju) was gathered from the national health insurance database. The difference-in-difference analysis adjusting for time trend and age structure was used to evaluate the risk of ischemic heart disease development before (reference: 2014.09-2015.08; period 1: 2015.09-2016.08) and after the earthquake (period 2: 2016.09-2017.08; period 3: 2017.09-2018.08; period 4: 2018.09-2019.08). The difference-in-difference estimate comparing Kyungju and each control city was meta-analyzed using a fixed effect model. Stratification analysis by sex, age (25-44, 45-64, and 65-), and income groups were conducted.

RESULTS: The monthly average incidences of ischemic heart disease were 39.5 (reference) and 38.4 (period 1) persons before the earthquake but increased to 58.5 (period 2) and 49.8 (period 3) persons after the earthquake. There was an increase in the risk of ischemic heart disease development after the earthquake when compared to control cities and period before the earthquake [relative risk (95% confidence intervals): period 1, 0.97 (0.88, 1.06); period 2, 1.58 (1.43, 1.73); period 3, 1.33 (1.21, 1.46); period 4, 1.15 (1.04, 1.27)]. The risk increase was greater in women, young adults (age 25-44), and low-income groups.

CONCLUSIONS: The 2016 Kyungju earthquake was associated with an increased risk of ischemic heart disease development in local residents. It is necessary to manage the long-term cardiovascular health of people who experienced a series of earthquakes.

KEYWORDS: ischemic heart disease; earthquake; difference-in-difference; seismic activity

P-1064 Association between Food Insecurity and Cardiometabolic Outcomes in the U.S. Adult Population

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BACKGROUND AND AIM: To make progress toward the Sustainable Development Goals in the United States (U.S.), it is imperative to provide evidence to policymakers of the importance of achieving food security. The aim of this study was to examine the association between food insecurity and cardiometabolic outcomes among a representative sample of U.S. adults ages ≥20 years.

METHODS: Data were obtained from seven cycles of the National Health and Nutrition Examination Survey (NHANES), which spanned 14 years from 2005-2018. Multivariable logistic regression was utilized to investigate the association between food insecurity and laboratory-confirmed diabetes as well as self-reported measures of physician-diagnosed angina, heart attack, and stroke. Statistical models were adjusted for age, sex, and race. Stratified analyses were conducted by education level and body mass index. Survey weightings were applied to account for the complex design of NHANES.

RESULTS: The study population included 38,935 interview participants of whom 52% were female and 67% were Non-Hispanic White. Most interview participants (95%) underwent body measures analysis in a mobile examination center and 70% of those participants were classified as overweight or obese. When compared to participants with full and marginal food security, participants with low/very food security were 1.80 (95% CI: 1.62-2.02) times more likely to have laboratory-confirmed diabetes and were more likely to report a history of physician-diagnosed cardiometabolic outcomes including angina (adjusted OR [aOR]=2.48; 95% CI=1.92-3.20), heart attack (aOR=2.50; 95% CI=2.04-3.07), and stroke (aOR=2.71; 95% CI=2.22-3.31). Each of these associations was robust across all educational levels and significant among participants classified as normal weight, overweight, or obese.

CONCLUSIONS: Food insecurity is associated with multiple cardiometabolic health outcomes. Structural and environmental changes are needed to increase food security among the general U.S. adult population. Targeted clinical interventions should be implemented early for those who are food insecure.

KEYWORDS: Food insecurity; Cardiometabolic

P-1068 Association of multiple environmental risk factors with prevalent diabetes mellitus and obesity - Results from the population-based KORA FIT cohort in Augsburg, Germany

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BACKGROUND AND AIM
Although a number of studies suggest an association of surrounding greenness, air pollution and temperature with metabolic diseases, potential joint effects of these environmental factors were not adequately taken into account. In this study, we aim to investigate the associations and interplay of multiple environmental exposures with diabetes mellitus and obesity using single- and multi-exposure models.

METHODS: We analyzed data of 3,034 participants from the German population-based KORA Fit survey (2018-2019). Residential exposures included annual mean air temperature, air pollutants (nitrogen dioxide (NO_2), particulate matter with diameters ≤10 µm (PM_{10}), ≤2.5 µm ($PM_{2.5}$), and between 2.5 and 10 µm (PMcoarse), absorbance of $PM_{2.5}$ ($PM_{2.5}$abs), particle number concentration (PNC), ozone (O_3)) and surrounding greenness represented by normalized difference vegetation index within a 1000m buffer ($NDVI_{1000}$). We performed linear and logistic regression models with multiple covariate-adjustment to assess associations of long-term environmental exposures with prevalent diabetes and obesity (defined as Body-Mass-Index (BMI) ≥30 kg/m²).

RESULTS: In KORA Fit, 244 (8%) participants reported a diabetes mellitus diagnosis and 909 (30%) were obese. After adjusting for age, sex, lifestyle factors and individual socioeconomic status, an interquartile range increase of annual mean air temperature was associated with diabetes (Odds Ratio (OR): 1.20, 95% confidence interval (CI): 1.00, 1.44). Associations with air pollutants were suggestive (e.g. $PM_{2.5}$: OR: 1.20; 95% CI: 0.99, 1.46) and there was no association with greenness. Moreover, there was no association of environmental factors with obesity or any continuous obesity measure, except for $NDVI_{1000}$ and BMI (ß: 0.25 kg/m2, 95% CI: 0.04, 0.54 kg/m²).

CONCLUSIONS: These preliminary findings indicate that mean air temperature and air pollution were associated with prevalent diabetes in middle to older-aged adults in single-pollutant models. The analysis gave no indication that these associations were mediated by BMI.

KEYWORDS: Metabolic diseases, Air pollution, Greenness, Temperature

P-1070 Wireless phones and brain tumour risk in young people: results of the multi-national MOBI-Kids study

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BACKGROUND AND AIM. The possibility that wireless (mobile and cordless) phone use might increase brain tumour (BT) risk, has long been a concern, particularly in young people. We studied the association between

wireless phone use and subsquently radiofrequency (RF) and extremely low frequency (ELF) electromagnetic fields (EMF) exposure) in childhood/adolescence with BT risk.

METHODS: MOBI-Kids, a 14-country case-control study, recruited 899 BT cases and 1910 hospital controls aged 10-24 years. Each participant answered a questionnaire on history of mobile communication devices use. Analyses were conducted both in relation to the history of use of wireless phones and to estimated RF and ELF dose from use of wireless phones (based on algorithms developed in the project), adjusting for parental education. Numerous substudies and sensitivity analyses were conducted to address potential biases.

RESULTS: Mean ages of cases and controls were 16.5 and 16.6 years, respectively. The vast majority of participants were wireless phones users, with substantial numbers of long-term (>10 years) users. Most tumours were neuroepithelial (NBT; n=671). The adjusted odds ratios (OR) of NBT appeared to decrease with increasing time since start of use of wireless phones, cumulative number of calls and cumulative call time, particularly in the 15-19 years old age group. A decreasing trend in ORs was also observed with increasing estimated cumulative RF specific energy and ELF induced current density. These decreasing trends are attributable mainly to differential recall by proxies and prodromal symptoms affecting phone use before case diagnosis. Results remain unchanged despite the large number of sensitivity analyses we conducted.

CONCLUSIONS: Our study provides no evidence of a causal association between wireless phone use and brain tumours in young people. However, possible residual biases prevent us from ruling out a small increased risk.
KEYWORKS: brain tumours, young people, wireless phones

P-1082 Historical redlining and modern-day cardiovascular disease across New York City

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BACKGROUND AND AIM: In 1938, the Home Owners' Loan Corporation (HOLC), a federal program, graded neighborhoods in U.S. cities from A ("best") to D ("hazardous"), based on racial, ethnic, and immigrant composition. This policy, known as "redlining," limited access to mortgage financing, an essential tool for wealth generation. Redlining has been associated with long-term negative impacts including air pollution and violence, and lower greenness and life expectancy. Here, we analyzed associations between redlining and modern-day cardiovascular disease (CVD) events across New York City neighborhoods. We hypothesized that place-based associations (context) would persist, even after adjustment for sociodemographic composition.

METHODS: We used negative binomial models to examine incidence rates for acute CVD events, across 1727 census tracts, using complete emergency department and hospitals data for 2005-2011 (n=843,958) from NYS Department of Health Statewide Planning and Research Cooperative System. CVD event rates were predicted as a function of HOLC grade, which we assigned to 2010 census blocks using shapefiles from the Mapping Inequality Project. We fit incremental models, sequentially adjusted for modern-day confounders and potential mediators, including American Communities Survey (ACS) 2007-11 sociodemographic data, tract-level annual average violent crime (derived from NYPD point-level data on all reported offenses 2009-2012), and both tree canopy and overall greenness for 2010, from NYC OpenData.

RESULTS: Worse redlining grade was consistently associated with higher CVD incidence rate ratios (IRR), even after adjusting for sociodemographics and other mediators. Fully-adjusted model IRRs (compared to A-grade) were: B-grade: IRR = 1.11 (95% CI: 0.98 - 1.24), C-grade: IRR = 1.16 (95% CI: 1.02 - 1.29), and D-grade IRR = 1.23 (95% CI: 1.08 - 1.37).

CONCLUSIONS: Historical redlining continues to impact specific neighborhoods, with stronger effects on CVD than would be predicted by sociodemographics alone. The precise mechanisms through which redlining influences modern neighborhood health need be further explored.

P-1084 Association between Air Pollution and Prostate Cancer in the US-based Health Professionals Follow-Up Study

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BACKGROUND AND AIM: Prostate cancer, the most diagnosed cancer and the second leading cause of cancer death in U.S. men, is a hormonally driven malignancy. Air pollution could impact prostate carcinogenesis via its role in endocrine disruption and inflammation. There is limited epidemiologic research on the association between air pollution and prostate cancer. We prospectively evaluated whether PM2.5 and NO2 exposure increases prostate cancer risk, particularly more aggressive forms of the disease.

METHODS: We followed 48,879 participants in the Health Professionals Follow-up Study from 1990 through 2016 through biennial questionnaires. We used spatiotemporal models to estimate PM2.5 and NO2 at all mailing addresses. Fatal prostate cancer is defined as death from prostate cancer and total as diagnosis of prostate cancer. Multivariable Cox models were used to estimate hazard ratios and 95% confidence intervals in single and multipollutant models, adjusting for prostate cancer risk factors, neighborhood SES (nSES), and population density.

RESULTS: Over 26 years of follow-up, we identified 5,418 total and 779 fatal prostate cancer cases. We found no association with PM2.5 in single or multipollutant models for either outcome. Each interquartile (9.62 ppb) increase in cumulative NO2 was associated with fatal prostate cancer, in single (HR: 1.06, 95% CI: 0.96, 1.17) and more strongly in multipollutant models (HR: 1.12, 95% CI: 1.01, 1.26). There was no association between NO2 and total prostate cancer in single (HR: 1.01, 95% CI: 0.97, 1.04) or multipollutant models (HR: 1.02, 95% CI: 0.98, 1.07).
CONCLUSION
Exposure to higher levels of NO2 is associated with increased risk of fatal prostate cancer. Future analyses will explore how this association varies by nSES, population density, and region.

P-1087 Long-term effects of air pollutant exposures on site-specific cancer incidence in elders

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BACKGROUND AND AIM: As the second leading cause of death in the US, cancer has received much less attention in air pollution epidemiology. Currently, only lung cancer is well-studied. Evidence on other types of cancer is extremely limited. We aim to examine causal effects of long-term exposures to fine particulate matter (PM2.5), ozone, and nitrogen dioxide (NO2) on the incidence of common and understudied cancers in elders.

METHODS: We constructed an open cohort of all individuals aged ≥ 65 years with continuous enrollment in fee-for-service Medicare in the contiguous US during 2000–2016, with 146 million person-years of follow-up. We linked ambient pollutant predictions developed from high-resolution, well-validated models to each individual's residential ZIP Codes as proxy exposure measures. We used inverse probability weighting to adjust for confounders, with gradient boosting machine to account for nonlinearity and interactions and kernel density to relax the contentious assumption of the distribution of generalized propensity score. for each pollutant, we estimated independent effects of the moving average exposures over lag 0-2 year (current year and previous two years), lag 3-5 year, and lag 6-10 year on the hazard ratio (HR) for the incidence of breast, colorectal, endometrial, and prostate cancers.

RESULTS: The critical exposure window differed by pollutant and cancer site. Specifically, long-term PM2.5 exposure increased colorectal cancer incidence, with lag 0-2 exposure associated with the highest HR (1.040, 95% CI: 1.039, 1.042); long-term ozone exposure increased prostate cancer incidence, with lag 0-2 exposure associated with the highest HR (1.005, 95% CI: 1.004, 1.005); long-term NO2 exposure increased incidence of all cancer types, with the most susceptible window being mixed.

CONCLUSIONS: Long-term PM2.5, ozone, and NO2 exposures may initiate breast, colorectal, endometrial, and prostate cancer in a window of up to 10 years before diagnosis.

KEYWORDS: air pollution, common cancer incidence, causal modeling

P-1096 Metal exposures and risk of Parkinson's disease: a European prospective cohort (NeuroEPIC4PD)

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BACKGROUND AND AIM: Metals are environmental concerns in the etiology of Parkinson's disease (PD). Existing studies might be subject to reverse causality due to retrospective assessment of metal exposure. We aimed to investigate the association between metal levels in prospectively collected blood samples and risk of PD.

METHODS: A nested case-control study was conducted within NeuroEPIC4PD, part of the prospective European EPIC population-based cohort. 362 incident PD cases were ascertained through clinical records confirmed by neurologists. One control per case was selected, matched by age at recruitment, sex and study center. Concentrations of metals (arsenic, cadmium, calcium, copper, iron, lead, magnesium, manganese, mercury, selenium, zinc) in erythrocytes, collected at recruitment, were measured by inductively coupled plasma-mass spectrometry. Odds ratios (ORs) were estimated for quartiles (Qs) of metal levels and PD risk by logistic regression.

RESULTS: Cadmium was suggested to be associated with a decreased risk of PD (OR (95% confidence interval (CI): Q2 0.59 (0.38-0.90), Q3 0.75 (0.48-1.15), Q4 0.70 (0.42-1.17), compared to Q1), which remained after excluding current smokers. for current smokers, we found a strong inverse association between lead levels and PD risk: Q2 OR=0.08 (0.01-0.45), Q3 OR=0.06 (0.01-0.35), and Q4 OR=0.06 (0.01-0.35), with p-value=0.007 for linear trend. Zinc showed an increased risk of PD, which became most pronounced among females (Q2 OR=1.56 (0.80-3.04), Q3 OR=2.32 (1.16-4.63), Q4 OR=1.52 (0.68-3.38)). for other metals, we did not observe any indication of associations with PD risk.

CONCLUSIONS: This is the largest study assessing blood metal levels prior to disease onset. Cadmium, lead and zinc might play a role in PD development. The effects of cadmium and lead are possibly confounded by smoking.

KEYWORDS: Parkinson's disease, metals, prospective exposure assessment, cohort study

P-1104 Residential exposure to airborne polychlorinated biphenyls and risk of cardiovascular diseases: A register-based cohort study

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BACKGROUND AND AIM Polychlorinated biphenyls (PCBs) are biopersistent chemicals ubiquitously present in our environment. Although exposure to lower-chlorinated PCBs (LC-PCBs) evaporating from building materials to indoor air is relatively common, the long-term cardiovascular effects remain unknown. We aimed to examine the risk of cardiovascular disease (CVD) following residential exposure to PCBs in indoor air.

METHODS: The study builds on the register-based Health Effects of PCBs in Indoor Air (HESPAIR) cohort of 51,921 residents of two residential areas near Copenhagen: Farum Midtpunkt and Brøndby Strand Parkerne. Here, indoor air was contaminated with PCB in one third of the apartments. Indoor air measurements in subsets of apartments have documented large differences in PCB-concentrations between contaminated and uncontaminated apartments, dominated by LC-PCBs. Individual PCB-exposure was based on relocation dates from nation-wide registers and indoor air PCB-measurements and calculated as PCByear. CVD Information was retrieved from the Danish National Patient Register for the follow-up period 1977–2018. We estimated hazard ratios using Cox regression analyses with time-varying exposure adjusting for a priori identified potential confounders.

RESULTS: Residential exposure to airborne PCB was not associated with a higher overall risk for CVD (HR for highly exposed: 1.02, 95% CI 0.95-1.11). The same was the case for most of the specific cardiovascular diseases apart from acute myocardial infarction where a 17% higher risk was observed for residents exposed to ≥3300 ng/m3*year compared to the reference group (HR 1.17, 95% CI 1.01-1.36).

CONCLUSIONS:In this first study to examine CVD risk following residential exposure to PCBs in indoor air, we observed only limited support for cardiovascular effects of living in PCB-contaminated air. Considering the prevalence of exposure to airborne PCBs and lack of knowledge on their potential health effects, these findings need to be corroborated in future studies.

KEYWORDS: lower-chlorinated PCBs; cardiovascular toxicity; environmental epidemiology; environmental pollutants

POSTER DISCUSSION SESSION 05:
Air pollution (ambient & indoor) and Sources

THEMATIC 03: Air pollution (ambient & indoor) and Sources

P-0098 Combined Deep Learning and Land Use Regression Models for Ultrafine Particles and Black Carbon in Montreal and Toronto, Canada

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BACKGROUND: Ambient ultrafine particles (UFP; <100nm) and black carbon (BC) have been associated with adverse health outcomes including cardiovascular disease and brain tumour incidence. Estimating population exposures for these pollutants is a challenge since both exhibit high within-city spatial variability. In this study, our aim was to develop new models for annual average outdoor UFP particle number concentrations (PNC), UFP size, and BC concentrations in Montreal and Toronto, Canada using several approaches.

METHODS: We conducted large-scale mobile monitoring campaigns across both cities throughout 2020-2021 including all days of the week, most times of day, and all four seasons. Land use regression (LUR) models were developed using geographic information systems and Convolutional Neural Network (CNN) models were developed using Google Maps satellite and street view images. Final models were developed by combining predictions from LUR and CNN models. Historical land use/traffic data were used to project estimates back in time.

RESULTS: Our monitoring campaign included 700 hours of monitoring along 2,700 kilometers of roadways. Median observed UFP PNC and BC concentrations were 15,191 particles/cm3 (IQR = 13,614) and 1104 µg/m3 (IQR = 1015) respectively. Final models explained the majority of spatial variations in UFP PNC, UFP size, and BC across both cities. Model performance in independent test sets was: Montreal UFP PNC R2 = 0.64, Toronto UFP PNC R2 = 0.73, Montreal UFP size R2 = 0.52, Toronto UFP size R2 = 0.60, Montreal BC concentration R2 = 0.67, and Toronto BC concentration R2 = 0.70.

CONCLUSIONS: New models are available for ambient UFP PNC, UFP size, and BC concentrations in Montreal and Toronto, Canada. These models explain the majority of spatial variations in these pollutants and will be applied in new epidemiological studies examining associations between ambient UFPs and BC and nonaccidental and cause-specific mortality in Canada's two largest cities.
Research described in this article was conducted under contract to the Health Effects Institute (HEI), an organization jointly funded by the United States Environmental Protection Agency (EPA) (Assistance Award No. CR-83998101) and certain motor vehicle and engine manufacturers. The contents of this article do not necessarily reflect the views of HEI, or its sponsors, nor do they necessarily reflect the views and policies of the EPA or motor vehicle and engine manufacturers.

P-0100 Expression of aflatoxin genes in fungal isolates from vehicle air filters

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BACKGROUND AND AIM: In car air conditioning systems (filters, hoses and fittings), there are favorable conditions for the growth of fungi with infectious and toxic properties. The present study was conducted to detect aflD, aflO, aflS and aflR as four important genes contributing to aflatoxin B1 production cycle in Aspergillus species isolated from the automotive filter nonwovens.

METHODS: Sampling of used filter from the truck cab air conditioning system were carried out in “winter” and “summer” measurement seasons. The presence of gene fragments responsible for the production of selected aflatoxins in the obtained isolates from fungal cultures was confirmed using the polymerase chain reaction (PCR). The reaction utilized the pairs of primers complementary to fragments of structural (aflD and aflO) and regulatory (aflS and aflR) genes involved in the biosynthesis of aflatoxin B1. Detection of the amplification products was performed on 1.5% agarose gels.

RESULTS: The PCR amplification of selected genes for the detection of aflatoxigenic Aspergillus species showed the presence of specific PCR products of aflS, aflD and aflO genes in 6 out of 20 filter samples (30%). The regulatory gene aflR was not detected in any of the tested filter samples. Statistical analysis showed that the type of air-conditioning system and the measurement season had no effect on the amplification of the genes in the tested filter samples.

CONCLUSIONS: The molecular detection of aflatoxin biosynthesis genes (i.e. aflS, aflD, aflR and aflO) could be considered as a quick method for the detection of aflatoxigenic Aspergillus. The presence of these genes in the studied material indicates the presence of toxic fungi in the automobile AC system.

KEYWORDS: Aflatoxin, Aspergillus, PCR, automobile AC system, filters

P-0112 Effects of vitamin D on association between air pollution and mental health in Korean adults: Results from the Korea National Health and Nutrition Examination Survey (KNHANES)

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BACKGROUND AND AIM: Evidence suggests that low individual vitamin D levels enhance adverse effects associated with air pollution on mental health conditions. However, these associations remain unclear. The aim of this study was to identify associations between ambient air pollution exposure, mental health, and serum vitamin D status in the general population of South Korea.

METHODS: We included national representative data for 29,373 adults in the final analysis. We measured serum 25-hydroxyvitamin D concentrations to assess vitamin D status for each participant. We assessed mental health factors (e.g., perceived stress, depressive symptoms, and suicidal ideation), and analyzed associations between these factors and individuals' annual average exposures to air pollutants, including particulate matter with an aerodynamic diameter ≤10 μm (PM10), nitrogen dioxide, sulfur dioxide, and carbon monoxide.

RESULTS: Using an adjusted model, we found PM10 affected major mental health outcomes, such as perceived stress (odds ratio [OR]=1.04; 95% confidence interval [CI]=1.00–1.09), depression symptoms (OR=1.12; 95% CI=1.06–1.18), and suicidal ideation (OR=1.11; 95% CI=1.05–1.17). Effects of the pollutants NO2 and CO were significant only in the group with perceived stress and depressive symptoms. PM10 and NO2 exposures were significantly associated with increased odds of adverse mental health outcomes in participants with vitamin D deficiency.

CONCLUSIONS: The study results suggested that high levels of vitamin D attenuated associations between air pollution and adverse mental health outcomes in adults, including perceived stress, suicidal ideation, and depression symptoms.

KEYWORDS: air pollution; vitamin D status; perceived stress, depressive symptoms, suicidal ideation

P-0120 Europe-wide air pollution modelling from 2000 to 2019 using geographically weighted regression

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BACKGROUND AND AIM: Land-use regression (LUR) empirically relates air pollution concentrations to predictors such as traffic data, population, and land use data. Previously used regression methods in Europe wide models assumed spatially-fixed linear relationships between predictors and air pollution concentrations. Thus, to include spatial heterogeneity in relationships, we used geographically weighted regression (GWR) and the machine learning method Random Forest (RF), with the aim to further improve the accuracy of air pollution exposure estimates.

METHODS: We built separate LUR models for each year from 2000 to 2019 for NO2, O3, PM2.5 and PM10 using annual average concentrations from routine monitoring stations across Europe. The potential predictors included satellite retrievals, chemical transport model estimates and land-use variables. Supervised linear regression (SLR) was first used to select predictors, and then GWR estimated the potentially spatially-varying regression coefficients. We evaluated the model performance using five-fold cross-validation (CV) for each year and compared GWR with SLR and RF.

RESULTS: GWR explained measured concentrations generally well, with annual CV-R2 values of 0.62-0.67, 0.43-0.66, 0.48-0.71, 0.69-0.82, for NO2, O3, PM10, and PM2.5 respectively. GWR improved the R2 values compared to SLR by 4-7%, 7-15%, 7-14%, 0-6% and compared to RF by 1-4%, 0-10%, 0-11%, 7-19%, for NO2, O3, PM10, and PM2.5 respectively. Predictors selected and the spatially-varying coefficient values varied between years.

CONCLUSIONS: Including spatial heterogeneity using geographically weighted regression improved European air pollution LUR models. These models allow time-varying exposure-risk models.

KEYWORDS: Geographically weighted regression, spatial heterogeneity, land-use regression, air pollution, supervised linear regression, random forests

P-0137 Association of PM 2.5 components with the incidence of end-stage kidney disease in two large European cohorts

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BACKGROUND AND AIM: End-stage kidney disease (ESKD) poses a high burden on patients and the health system. The very few studies on air pollution and ESKD have shown associations with $PM_{2.5}$, but no study so far has investigated which of the components may be most relevant. We investigate the association of long-term exposure to $PM_{2.5}$ elements with ESKD incidence in two large population-based European cohorts.

METHODS: Individuals in the Rome Longitudinal Study (RoLS) and the Vorarlberg Health Monitoring and Prevention Program (VHM&PP) were followed up with Dialysis and Transplant Registries from 1985 to 2019 and 2011 to 2019, respectively.
Long-term exposures to eight $PM_{2.5}$ components (copper, iron, potassium, nickel, sulfur, silicon, vanadium, and zinc) at residence were estimated with Europe-wide hybrid land use regression models at 100x100m scale.
Hazard ratios (HR) were determined from Cox-proportional hazard models with age as time axis and adjusted for individual and neighbourhood confounders.
RESULTS: RoLS contributed 3,231 cases from 1,939,461 individuals (mean age 52.4 years; crude incidence rate (CIR) 0.22 per 1000 person years) and VHM&PP 501 cases from 136,823 individuals (mean age 42.1years; CIR 0.14).
In RoLS, elements associated with ESKD were potassium (HR 1.25 [1.05,1.48]) and sulphur (HR 1.10 [0.97,1.25]) for an increase of 50 and 200 ng/m³, respectively, whereas in VHM&PP, risk of ESKD was associated with copper (HR 1.20 [0.97, 1.47]) and iron (1.30 [0.98, 1.74]) for 5 and 100 ng/m³, respectively .
CONCLUSION: Air pollution indicative for biomass burning (potassium) and long-range transport (sulphur) in Rome, and indicators of traffic-related air pollution (iron and copper) in Vorarlberg were associated with an increased risk of ESKD.

P-0138 Association between ambient air pollutants and influenza – A systematic review and meta-analysis

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BACKGROUND AND AIM: There is emerging evidence that ambient air pollution exposure is not linked solely to chronic diseases but might also impact incidence and mortality of infectious diseases. The aim of this systematic review and meta-analysis was to examine the association between exposure to ambient air pollutants and risk of influenza/influenza like illness (ILI) and associated infection, morbidity and mortality.

METHODS: We conducted a systematic literature search and subsequently performed a random-effects meta-analysis using the Knapp-Hartung method with a restricted maximum likelihood (REML) estimator if at least four studies with similar outcome and exposure were available. We converted the estimates for each outcome into standardized increments for a 10 µg/m³ increase in air pollutant. Heterogeneity was assessed using I^2 and Cochranes Q. The study was registered at PROSPERO (CRD42020199906). An update including literature up to February 2022 is currently being prepared.

RESULTS: The literature search from 01.01.1980 to 27.10.2020 yielded 233 studies from PubMed and Web of Science and one study from the preprint server MedRxiv. In total, 10 articles were reviewed in-depth and risk of bias assessed.
For short-term studies, small positive associations were seen for a 10 µg/m³ increase in $PM_{2.5}$ for influenza incidence [relative risk: 1.02, 95%confidence interval: 1.01; 1.03]. The search yielded only two studies for hospital admission and no long-term studies or studies on mortality.

CONCLUSIONS: Our analysis indicates that ambient air pollution can exacerbate influenza infections. Lowering the current EU standards for $PM_{2.5}$ will reduce the adverse effects of ambient air pollution for chronic as well as infectious diseases. The results for influenza might also give some implications of possible associations for ambient air pollution with other respiratory virus diseases including SARS-CoV-2.

KEYWORDS: Influenza, influenza-like illness, meta-analysis, ambient air pollution, $PM_{2.5}$

P-0148 Long-term exposure to air pollution and decreased renal function in older adults: A longitudinal cohort study

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BACKGROUND AND AIM: Epidemiological evidence suggests that ambient air pollution adversely affects renal health. However, previous studies on the association between air pollution and renal function impairment have reported mixed findings. Furthermore, most of the studies were cross-sectional. Therefore, we conducted a longitudinal study to investigate the relationship between long-term exposure to air pollution and changes in renal function in older adults.

METHODS: A total of 326 adults (aged ≥50 years) dwelling in four cities (Seoul, Incheon, and Wonju/Pyeongchang) in the Republic of Korea were included. They participated in baseline and follow-up surveys between 2014 and 2019. Long-term concentrations of particulate matter≤10μm in diameter (PM10), ≤2.5μm (PM2.5), and nitrogen dioxide (NO2) at each participant's residential address were estimated. The Modification of Diet in Renal Disease was employed to derive the estimated glomerular filtration rate (eGFR). We used linear mixed effect models to examine whether long-term exposure to air pollution were associated with changes in renal function markers, including eGFR, blood urea nitrogen (BUN), and uric acid (UA), while controlling for potential confounders.

RESULTS: The number of men was 155 (47.5%). The mean±standard deviation age was 65.2±4.4 years. A 10-ppb increment in NO2 significantly associated with decreased eGFR [β=−4.48mL/min/1.73m2, Standard error (SE)= 1.96, P=0.02] and increased BUN (β=1.15mg/dL, SE=0.53, P=0.03), but not with UA (β=0.14 mg/dL, SE=0.16, P=0.36). None of the association between PM10 or PM2.5 and all the renal function markers was statistically significant.

CONCLUSIONS: We found that long-term exposure to NO2 was associated with a decline in eGFR and a raised level of BUN among older adults. These findings suggest that NO2 exposure may contribute to renal function impairment.

KEYWORDS: Air pollution, Renal function, Estimated glomerular filtration rate (eGFR), Blood urea nitrogen (BUN), Korean

P-0157 Impact of Do-It-Yourself and Commercial Air Cleaner Usage on Health and Residential PM2.5

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BACKGROUND AND AIM: Wildfire smoke can threaten health, necessitating creating cleaner indoor air spaces. Commercially available portable air cleaners (PACs) mitigate smoke impacts indoors but can be expensive or inaccessible. Lower-cost Do-It-Yourself (DIY) PACs (furnace filter attached to box fan) offer an affordable alternative. However, evidence of their effectiveness in real-world settings is limited. This pilot study aimed to 1) evaluate the effect of DIY/commercial PAC usage on indoor PM2.5 and health outcomes during wildfire season among tribal community members in Hoopa, California and 2) assess barriers and facilitators to use of either intervention.

METHODS: During four one-to-two-week phases (baseline; DIY PAC usage ≥8 hours/day; commercial PAC usage ≥8 hours/day; and air sensor with visual display with optional PAC use), we monitored indoor and outdoor PM2.5 at participants' homes. We conducted phase-specific phone surveys about participants' health, behaviors, and perceptions. We analyzed indoor PM2.5 and health outcomes associated with PAC usage using mixed effects multivariate linear regression and tabulated behavioral responses.

RESULTS: DIY and commercial PAC usage was significantly associated with reduced infiltrated PM2.5 (n=6). High usage (≥30% of phase) of either PAC was significantly associated with improved health (measured as a composite score), relative to low usage (<10% of phase) (n=10). Noise was the primary barrier to DIY PAC use, while quiet operation and small size of commercial PACs facilitated use. Nonetheless, eight of nine participants who preferred commercial PACs said they would use DIY PACs if the air were very smoky.

CONCLUSIONS: DIY and commercial PACs were associated with improved indoor PM2.5 and health, but the loudness of DIY PACs hindered use. State, local, and tribal organizations should consider these conclusions in tailoring messaging and allocating resources in preparation for wildfire seasons. Disclaimer: Does not reflect EPA views or policy.

KEYWORDS: Indigenous, wildfire smoke, indoor air quality

P-0180 Short-term effects of carbonaceous particles on mortality: A time-series study in London

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BACKGROUND AND AIM: Exposure to ambient particulate matter (PM) has been identified as a major global health concern. Recent studies have suggested that it is the carbonaceous constituents of PM that pose the greatest health risks. Using time-series methods, we investigated the associations between short-term exposure to carbonaceous particles and mortality in London.

METHODS: Daily counts of natural, cardiovascular, and respiratory deaths were obtained for London between 2010 and 2019. for the same period, daily concentrations of various carbonaceous species [organic (OC), elemental (EC), black (BC), wood-burning (WC), and total carbon (TC)] were averaged across two centrally located monitoring sites: Marylebone Road (roadside) and North Kensington (background). Generalised additive models (GAM) were used to estimate percentage changes in risks of mortality associated with interquartile range (IQR) increases in particle concentrations, at different lags (single-day lag0 to lag6 and cumulative lag03, lag06). Stratified analyses were conducted by age (0-64, 65+), season and site type.

RESULTS: For natural deaths, we observed positive associations for all particle species at lag 1, with significant increases in mortality of 0.52% (95% Confidence interval (CI): 0.18% to 0.86%) and 0.44% (95% CI: 0.03% to 0.85%) for WC and OC, respectively. We also observed positive associations for respiratory deaths, with strongest effects at exposure lag03 for WC (1.73% (95% CI: 0.05% to 2.93%), TC (1.30% (95% CI: −0.46% to 3.08), and OC (1.28% (95% CI: −0.11% to 2.68). In contrast, associations with cardiovascular deaths were generally null. Results remained consistent after adjustment for PM mass.

CONCLUSIONS: Our preliminary results suggest that carbonaceous particles are associated with increased risks of both natural and respiratory mortality in London. These findings contribute to the growing understanding of the differential health effects of PM constituents that is crucial for the development of targeted polices.

KEYWORDS: Particulate matter, carbonaceous constituents, Time-series, Mortality.

P-0212 Partitioning personal measurements into personal exposure to pollution from indoor and outdoor sources in London inhabitants - An analysis within the MELONS* project

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BACKGROUND AND AIM. Air pollution, particularly particles, from indoor and outdoor sources originate from different activities, have different toxicities, may have different health effects and need to be addressed by separate interventions. for epidemiological studies, personal exposure to pollution from outdoor sources was proposed as true exposure often approximated by modelled estimates. This study aimed to derive partitioned personal exposure to pollution from indoor and outdoor sources from four diverse study populations gathering 13,871 participant-day personal measurements of exposure using wearables in London.

METHODS: A mixed approach, based on personal measurement frequency, fixed radius, clustering and reverse geocoding, was applied to tag one-minute personal measurements into personal microenvironments. Home addresses were paired with local ambient data to facilitate calculation of infiltration efficiencies. Then personal measurements were partitioned into personal exposure to pollution from indoor and outdoor sources at one-minute resolution for each participant.

RESULTS: COPD patients, compared to school children, had higher mean PM2.5 pollution from indoor sources (COPD: 6.9 ± 37.2, children: 4.1 ± 42.8 μg/m3), but similar pollution from outdoor sources (COPD: 5.1 ± 12.8, children: 5.3 ± 27.2 μg/m3). for black carbon, professional drivers, compared to healthy adults, had higher personal exposure to pollution from outdoor sources (drivers: 1.7 ± 4.3, healthy adults: 1.2 ± 2.5 μg/m3) and lower personal exposure to pollution from indoor sources (drivers: 0.3 ± 1.8, healthy adults: 0.8 ± 2.1 μg/m3).

CONCLUSIONS: By utilising GPS data, personal measurements from wearable monitors can be partitioned into personal exposure to pollution from indoor and outdoor sources to aid epidemiological studies and policy development. Our results, highlight that sources of pollution can be very different even though personal measurements of total exposure levels are similar. Further work is required to extrapolate results over longer time periods and larger populations.

KEYWORDS: Pollution partition, Personal exposure; Wearables

P-0230 Effects of a liquefied petroleum gas cookstove and fuel intervention on preterm birth and gestational duration: the multi-country Household Air Pollution Intervention Network (HAPIN) trial

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BACKGROUND: Cooking with solid fuels such as wood and charcoal contributes to household air pollution and is associated with adverse birth outcomes. Cleaner fuel interventions may reduce HAP exposure sufficiently to prevent preterm birth (PTB, <37 weeks gestation). We assessed the effects of a randomized liquefied petroleum gas (LPG) stove and free fuel intervention on PTB and gestational duration (secondary outcomes of the trial), as well as associations with fine particulate matter (PM2.5), black carbon (BC), and carbon monoxide (CO) in the HAPIN trial conducted in Guatemala, India, Peru, and Rwanda.

METHODS: Pregnant women (18-35 years of age; gestation confirmed by ultrasound at 9-20 weeks) were randomly assigned to intervention arm (n=1,593) or control arm (n=1,607). We measured 24-hour personal exposure to PM2.5, BC, and CO at baseline, 18-24 weeks, and 32-36 weeks gestation. We used intent-to-treat approach to evaluate the intervention effect. We also assessed associations between measured pollution concentrations with PTB and gestational duration using linear and log-binomial regression models.

RESULTS: Intervention adherence was nearly exclusive; PM2.5, BC, and CO exposures were 66-80% lower post-randomization compared to control. The proportion of livebirths (n=3060) that were preterm was 5.9% (intervention arm) and 5.4% (control arm). Compared to the control arm, the relative risk of PTB among women randomized to the intervention was 1.09 (95% CI 0.82-1.46, p=0.56). The mean gestational duration was 39.3 weeks in both the intervention and control arm (adjusted mean difference 0.03 weeks, 95% CI -0.08-0.15, p=0.55). PM2.5, BC, and CO levels during pregnancy were not associated with PTB or gestational duration.

CONCLUSIONS: An LPG stove and fuel intervention did not reduce PTB risk or increase gestational duration in this study population, nor was measured personal pollution associated with either outcome.

KEYWORDS: household air pollution; preterm birth; particulate matter; black carbon; carbon monoxide; exposure-response; HAPIN trial

P-0237 Air pollution impacts at very low levels: Shape of the concentration-mortality relationship in a large population-based Canadian cohort

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BACKGROUND
Mortality is associated with long-term exposure to fine particulate matter, although the form of these associations remain poorly understood at lower concentrations. We applied novel 1 km satellite-derived estimates of PM2.5 exposure to a population-based cohort of 7.1 million Canadians.

METHODS: Cox proportional hazard ratios (HRs) were estimated for nonaccidental and cause-specific mortality and 10-year moving average exposure in models adjusted for a wide array of individual and contextual covariates. The shape of the concentration–response function was investigated using restricted cubic splines, threshold models and an extension of the Shape Constrained Health Impact Function (eSCHIF). Analyses examined sensitivity to co-pollutants, concentration thresholds and regional variation.

RESULTS: Each 10-µg/m3 increase in PM2.5 corresponded with a nonaccidental mortality HR of 1.084 (1.073 - 1.096). PM2.5 was associated mortality from ischemic heart disease, pneumonia, COPD, diabetes, and cerebrovascular disease, but not with heart failure, lung cancer, or kidney failure mortality. HR predictions steeply increased from the minimum concentration of 2.5 µg/m3 to 4.5 µg/m3, flattened from 4.5 µg/m3 to 8.0 µg/m3, then increased for concentrations above 8.0 µg/m3, a pattern also reflected in threshold and eSCHIF results. When restricting to those with exposures <10 µg/m3 shapes indicated positive associations for concentrations >9 µg/m3 with indications of adverse effects on mortality at concentrations as low as 2.5 µg/m3. In sensitivity analyses, PM2.5 - mortality associations were only observed in the highest tertile of oxidant gases with shapes varying across airsheds. These differences, were not related to variation in cohort composition or its access to healthcare, suggesting a role of spatially varying pollutant mixtures not sufficiently characterized by PM2.5 mass concentrations.

CONCLUSIONS: In a large Canadian cohort, associations were observed between exposure to PM2.5 with mortality at concentrations as low as 2.5 µg/m3, with no clear evidence of a threshold.

P-0239 Application of geostationary satellite and high-resolution meteorology data in estimating hourly PM2.5 levels during the Camp Fire episode in California

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BACKGROUND: Wildland fire smoke contains large amounts of PM2.5 that can traverse tens to hundreds of kilometers, resulting in significant deterioration of air quality and excess mortality and morbidity in downwind regions. Estimating PM2.5 levels while considering the impact of wildfire smoke has been challenging due to the lack of ground monitoring coverage near the smoke plumes.
AIM: We aim to estimate total PM2.5 concentration during the Camp Fire episode, the deadliest wildland fire in California history.

METHODS: Our random forest (RF) model combines calibrated low-cost sensor data (PurpleAir) with regulatory monitor measurements (Air Quality System, AQS) to bolster ground observations, Geostationary Operational Environmental Satellite-16 (GOES-16)'s high temporal resolution to achieve hourly predictions, and oversampling techniques (Synthetic Minority Oversampling Technique, SMOTE) to reduce model underestimation at high PM2.5 levels. In addition, meteorological fields at 3 km resolution from the High-Resolution Rapid Refresh model and land use variables were also included in the model.

RESULTS: Our AQS-only model achieved an out of bag (OOB) R2 (RMSE) of 0.84 (12.00 μg/m3) and spatial and temporal cross-validation (CV) R2 (RMSE) of 0.74 (16.28 μg/m3) and 0.73 (16.58 μg/m3), respectively. Our AQS + Weighted PurpleAir Model achieved OOB R2 (RMSE) of 0.86 (9.52 μg/m3) and spatial and temporal CV R2 (RMSE) of 0.75 (14.93 μg/m3) and 0.79 (11.89 μg/m3), respectively. Our AQS + Weighted PurpleAir + SMOTE Model achieved OOB R2 (RMSE) of 0.92 (10.44 μg/m3) and spatial and temporal CV R2 (RMSE) of 0.84 (12.36 μg/m3) and 0.85 (14.88 μg/m3), respectively.

CONCLUSIONS: Hourly predictions from our model may aid in epidemiological investigations of intense and acute exposure to PM2.5 during the Camp Fire episode.

KEYWORDS: PM2.5, GOES16, Wildland fire, Remote sensing, AOD, SMOTE, Weighted Random Forest

P-0240 Transportation-Related Emissions Surrogates Support Modeling of Oxides of Nitrogen Exposure

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BACKGROUND: Mobile sources such as traffic and airports contribute significantly to concentrations of nitrogen oxides (NOx) and nitrogen dioxide (NO2). Exposure to these pollutants in turn are associated with a range of negative health outcomes. Accurate, high resolution spatiotemporal models of NOx /NO2 are needed to support further epidemiological research. Traffic tailpipe emissions are especially elevated under high engine load (acceleration), and our earlier work shows accounting for airport emissions may decrease measurement error in our spatiotemporal NOx models. The goal of this work is to showcase improvements in accounting for these mobile sources more accurately and these features' importance in our spatiotemporal NOx models.

METHODS: We calculated airport-related NOx emissions by allocating airport-related NOx emissions from CARB's CEPAM emission inventory tool to each airport in California from 2004 through 2019. for 2020 and 2021, emissions were further scaled on a weekly basis to account for decreased flight volume during the COVID period. To account for on-road vehicle tailpipe emissions due to acceleration at intersections, we developed a dataset representing intersection density, broken into class by intersection type based on road class type and supported by GPS activity data. These variables were incorporated into spatiotemporal modeling of outdoor NOx/NO2 concentrations in California.

RESULTS: Airport emissions and intersection density were ranked highly by variable importance within the model. The transportation-related emissions surrogates improved the spatial representation of NOx/NO2 at fine scales, supporting accurate air quality exposure estimates.

CONCLUSIONS: Our findings demonstrate how improved measures of mobile source emissions (beyond distance to airports or roads) that capture gradients in emission patterns across spatial features (e.g. road class) can enhance spatiotemporal prediction performance of high resolution exposure models.

KEYWORDS: Air pollution, NOx, transportation, mobile sources

P-0242 Application of an ultra-low-cost passive sampler for light-absorbing carbon in India and Mongolia

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BACKGROUND: We previously developed and tested Washington Passive Samplers (WPS), an ultra-low-cost passive sampling method for long-term average level of light-absorbing carbon (LAC) air pollution. Briefly, we passively expose filter-paper in the WPS, and measure the before/after change in reflectance via analyzing filter images. Tests in a laboratory in Seattle and in polluted homes in Bangalore, India, (Clark et al., 2020) indicated robust reproducibility (duplicate samplers R2 = 0.98) but did not test accuracy.
AIM: to evaluate the WPS accuracy by co-locating the WPS with reference methods.

METHODS: We deployed three methods to each of 10 households in Ulaanbaatar, Mongolia, for multiple periods of 4 weeks each: one PurpleAir (PA; real-time PM2.5); two quartz filters using an ultrasonic personal aerosol sampler (UPAS; analysis: elemental carbon [EC]); and two WPS samplers (time-integrated LAC). Unadjusted LAC measurements are the change in pixel intensity [PI] per month (PI=65,535 would represent complete change from lightest (whitest) to darkest (blackest) colors).

RESULTS: Average indoor measurements were 180 µg/m3 PM2.5 (PA; uncalibrated), 14.1 µg /m3 BC (UPAS, EC), and 975 PI/month (WPS, LAC deposition rate). Calibrations the WPS to the UPAS results indicates that 1 µg of BC /m3 corresponds to 62 PI /month PM2.5, on average; if we predict BC concentrations from the passive LAC measurements, then the root-mean-square-error is 3.1 µg /m3 BC, or ~21% of the average BC concentration.
DISCUSSION: Prior research indicated high precision for the WPS; results here indicate reasonable accuracy (RMSE=21%). Compared to a conventional filter-and-pump, the WPS is substantially less expensive, easier to deploy, and offers time-integrated measurement.

KEYWORDS: Black carbon, Low cost sensor, Passive sensor, Indoor air pollution

POSTER DISCUSSION SESSION 06:
Chemical Exposures

THEMATIC 05: Chemical Exposures

P-0318 Relationship between cadmium exposure, triglyceride-glucose index and carotid artery atherosclerosis

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INTRODUCTION: Cadmium exposure is suggested to be associated with cardiovascular and metabolic diseases. We investigated the association between cadmium and carotid artery atherosclerosis and the mediating effect of serum triglyceride and glucose level represented by triglyceride-glucose index (TyG index).

METHODS: Among Cardiovascular and Metabolic disease Etiology Research Center (CMERC) Cohort participants, participants who received serum heavy metal screening tests were selected (N=200). Patients with more than 3 standard deviation level of serum cadmium were excluded (N=1). TyG index was calculated as formula: ln [{fasting blood glucose (mg/dL) × triglyceride (mg/dL)}/2]. Carotid artery ultrasonography was conducted to test carotid artery atherosclerosis. Carotid artery plaque was considered present if the thickness is greater by 50% or more than the surrounding intima-media thickness or if its size was 1.5mm or more. We used linear regression to test the association between serum cadmium level and TyG index, and Poisson regression to test the association between serum cadmium level, TyG index and number of plaques. Mediation analyses was conducted to detect the mediating effect of TyG index.

RESULTS: Serum cadmium level was associated with TyG index (β=0.155, p-value=0.042). Both serum cadmium level(β=0.753, p-value=0.039) and TyG index(β=1.049, p=0.010) were associated with number of carotid artery plaques. Mediation analyses showed that TyG index significantly mediated the association between serum cadmium level and carotid artery plaque (direct effect: β=0.733, p-value=0.042; indirect effect: β=0.165, p-value=0.048).
CONCLUSION: Cadmium exposure increases the risk of carotid artery atherosclerosis. The assocaition is mediated by disturbance in serum triglyceride and glucose level.

P-0324 Prenatal Perfluorooctanoic Acid (PFOA) Exposure Significantly Decreases in utero Fetal Head Circumference and Biparietal Diameter Growth Among Women Reporting Higher Levels of Perceived Stress

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BACKGROUND AND AIM: Perfluoroalkyl Substances (PFAS) are ubiquitous synthetic chemicals with long half-lives and are known to cross the placenta during pregnancy. We examined the influence of maternal PFAS levels on in utero fetal growth trajectories and assessed whether maternal stress modified these associations.

METHODS: Blood serum concentrations of five PFAS (PFOS, PFHxS, PFNA, PFOA, PFDA) were measured in 335 prenatal specimens (mean gestational age (GA): 21±9 weeks) in the MADRES cohort. Fetal growth outcomes were abstracted from ultrasound medical records and head circumference (HC), abdominal circumference (AC), biparietal diameter (BPD), and femur length (FL) were also measured at the 3rd trimester study visit (N=833 scans, GA range 10-42 weeks, mean 2.4 scans/participant). Adjusted linear mixed models with a GA quadratic growth curve were used for each PFAS exposure and growth outcome. PFOS and PFHxS were modeled continuously (100% sample detection), while PFOA, PFNA, and PFDA were modeled categorically (57%-70% sample detection). Scores on the Perceived Stress Scale (PSS) measured in pregnancy were dichotomized at the median (<13 vs. ≥ 13) in stratified models.

RESULTS: Participants were on average 29±6 years old and predominately Hispanic (76%). Median serum concentrations of PFOS, PFHxS, PFNA, PFOA and PFDA were 1.34, 1.10, 0.07, 0.12, and 0.04 ng/mL, respectively. Participants with detected PFOA concentrations had fetuses with –2.5 mm (95% CI -4.2, -0.8) smaller HC and –0.7 mm (95% CI -1.3, -0.2) smaller BPD on average than those without detected PFOA concentrations. In models stratified by PSS level, the effects of PFOA on fetal growth parameters were stronger and only significant in participants with higher stress levels (HC: β= -3.5, 95% CI -5.8, -1.4; BPD: β = -0.8, 95% CI -1.6, -1.1).

CONCLUSIONS: Prenatal PFOA exposure adversely impacted fetal head biometric parameters in participants experiencing higher stress during pregnancy.

KEYWORDS: PFAS; Fetal Growth; Stress

P-0329 Organophosphate Flame Retardant Exposures and Maternal Depression During Pregnancy in the Maternal and Developmental Risks from Environmental and Social Stressors (MADRES) Pregnancy Cohort

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BACKGROUND AND AIM: Depression is a major contributor to pregnancy-related morbidity, and pregnancy is increasingly recognized as a vulnerable window for maternal health effects from environmental exposures. Organophosphate flame retardants (OPFRs) are a class of organic chemicals applied to various industrial and consumer products with hypothesized mental health impacts but limited epidemiological research. We evaluated the association between prenatal OPFR exposures and maternal depression during pregnancy in a predominantly low-income, Hispanic cohort.

METHODS: Third trimester bis(1,3-dichloro-2-propyl) phosphate (BDCIPP) and diphenyl phosphate (DPHP) urinary metabolite concentrations were measured in 422 participants (collection mean gestational age= 31.5±2.0 weeks) in the MADRES cohort. Detection frequencies were 94.6% for BDCIPP and 99.8% for DPHP. OPFR metabolites ≤LOD were imputed as LOD/√2, and concentrations were specific-gravity-adjusted and categorized into tertiles. Depression was assessed using the Center for Epidemiologic Studies-Depression (CES-D) scale administered at each trimester and participants were classified as depressed (N=137) or not depressed (N=285) if one or more CES-D scores met the suggested cutoff score for clinically significant depressive symptoms (≥16). We used Modified Log-Poisson regression to model the association between tertiles of prenatal BDCIPP and DPHP exposures and prenatal depression risk, adjusting for maternal age, pre-pregnancy BMI, season, gestational age at urine collection, race/ethnicity, income, and education.

RESULTS: Participants were 28.8±6.1 years old and predominately Hispanic (78.0%). BDCIPP and DPHP geometric means (ng/mL) for depressed versus not depressed participants were 1.26 and 1.04 versus 0.99 and 0.81. Relative to the lowest tertiles, participants with the highest tertile of BDCIPP exposure had 50% increased risk of maternal depression during pregnancy (95% CI:5%-115%) and 63% increased risk for the highest tertile of DPHP exposure (95% CI:17%-126%).

CONCLUSIONS: Higher OPFR metabolite levels were associated with increased prenatal maternal depression risk, stressing the importance of considering chemical exposure impacts on maternal depression.

KEYWORDS: Depression; OPFRs

P-0352 Exposure to Per- and polyfluoroalkyl substances is associated with altered pancreatic β-cell function

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BACKGROUND AND AIM: Epidemiological and experimental evidence suggests that exposure to per- and polyfluoroalkyl substances (PFAS) increases risk of type 2 diabetes (T2D). However, the mechanisms linking PFAS exposure and T2D risk remain unclear. We examined whether PFAS exposure alters insulin secretion in adolescents.

METHODS: Overweight/obese adolescents (n=124 female, n=167 males; baseline age: 11.3±1.7 years) from the Study of Latinos at Risk (SOLAR) underwent annual clinical visits. Acute insulin response to glucose (AIRg; indicates β-cell function) and disposition index (DI; indicates β-cell function relative to insulin sensitivity) were assessed via intravenous glucose tolerance tests (IVGTT). Associations of baseline PFAS and IVGTT outcomes were assessed using linear mixed models accounting for repeated measures across pubertal stages. To illustrate a functional relationship between PFAS exposure and insulin secretion in β-cells, results were compared to an in vitro model which examined the effects of physiologically-relevant (based on NHANES) PFAS exposure on glucose stimulated insulin secretion (GSIS) in rat insulinoma cells (INS-1).

RESULTS: In early puberty, high perfluorohexanesulfonic acid (PFHxS) levels (>50th percentile; >1.37 µg/L) was associated with 26% higher AIRg (p=0.01). Between early puberty and late puberty, girls with high PFHxS levels exhibited a 31% decrease in AIRg (p=0.004), but no change was observed in girls with low PFHxS (p=0.43). Changes in AIRg across puberty were not different between boys with high versus low PFHxS. No other associations between PFAS and AIRg or DI were observed. In the in vitro model, exposure to high PFHxS concentrations (10.8µg/L) resulted in 33% higher GSIS compared to low PFHxS concentrations (1.08µg/L; p=0.01). PFOS was not associated with altered GSIS.

CONCLUSIONS: PFHxS exposure in early puberty is associated with increased insulin secretion. Over time, this may lead to reduced β-cell function, especially in females, which could increase the risk of youth onset T2D.

KEYWORDS: Diabetes, PFAS, Insulin

P-0354 Associations of urinary metabolite concentrations of legacy phthalates and their replacements with body composition from mid-childhood to early adolescence

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BACKGROUND AND AIM: Phthalates may adversely influence body composition by lowering anabolic hormones and activating peroxisome-proliferator activated receptor gamma. However, data are limited in adolescence when body mass distributions are rapidly changing and bone accrual is peaking. Also, the health impact of legacy phthalate replacements [e.g., di-2-ethylhexyl terephthalate (DEHTP)] has not been well studied.

METHODS: Among 578 children in the Project Viva cohort, we used linear regression to evaluate associations between urinary concentrations of 19 phthalate/replacement metabolites from mid-childhood (median: 7.6 years; 2007-2010) and change in dual-energy X-ray absorptiometry (DXA) measures of body composition between mid-childhood and early adolescence (median: 12.8 years). We used the two DXA measures to calculate longitudinal change in areal bone mineral density (aBMD) Z-score (i.e., bone accrual), lean mass, total fat mass, and truncal fat mass. To assess associations with the overall chemical mixture, we used quantile g-computation and Bayesian kernel machine regression. We adjusted for sociodemographics and tested for effect modification by sex.

RESULTS: Urinary concentrations were highest for mono-2-ethyl-5-carboxypentyl phthalate [median (IQR): 46.7 (69.1) ng/mL]. Metabolites of most replacement phthalates were detectable in a relatively small number of participants [e.g., 28% for mono-2-ethyl-5-hydrohexyl terephthalate (MEHHTP; metabolite of DEHTP)]. Detectable (versus non-detectable) MEHHTP was associated with less bone accrual in boys and marginally greater bone accrual in girls [change in aBMD Z-score (95% CI): -0.22 (-0.39, -0.05) in boys versus 0.17 (-0.005, 0.35) in girls; interaction p-value=0.01]. Other phthalate and replacement metabolites, and their mixtures, were not associated with longitudinal changes in body composition.

CONCLUSIONS: Boys with higher MEHHTP concentrations may have less bone accrual. Otherwise, there was limited evidence for adverse effects of mid-childhood phthalate/replacement exposure on body composition through early adolescence. As production of phthalate replacements such as DEHTP becomes more widespread, further investigation is warranted on the impact of early-life exposures.

P-0390 Associations between per- and polyfluoroalkyl substances and liver fibrosis and steatosis in U.S. adolescents and adults

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are associated with liver damage in experimental animals. This study aimed to examine associations between serum PFAS concentrations and liver fibrosis and steatosis in adolescents and adults from the general U.S. population.

METHODS: We included 288 adolescents (12-19 years) and 1391 adults (at or above 20 years) from the National Health and Nutrition Examination Survey (NHANES) 2017-2018 cycle. Serum concentrations of five prevalent PFAS compounds were examined, including perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexanesulphonic acid (PFHxS), perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDeA). Liver fibrosis and hepatic steatosis were determined by ultrasound transient elastography. We used logistic regression and quantile g-computation to examine covariate-adjusted odds ratios (ORs) for cirrhosis and severe steatosis in relation to changes in individual PFAS concentrations and PFAS mixtures.

RESULTS: The prevalence of cirrhosis and severe steatosis were 1.4% and 16% in adolescents, and 2.6% and 35% in adults. Serum PFOS (OR: 3.91, 95% CI: 1.59, 9.63) and PFNA (OR: 5.28, 95% CI: 2.88, 9.67) were positively associated with cirrhosis in adolescents, though confidence intervals were wide due to the limited number of cases. All examined PFAS compounds showed imprecise positive relationships with severe steatosis in adolescents. Per quartile increase in the total PFAS mixture was associated with a 2.17 (95% CI: 0.92, 5.11) fold increase in the odds for severe steatosis in adolescents. No associations for PFAS and cirrhosis or severe steatosis were found in adults.

CONCLUSION

In this U.S. representative study, we found positive associations between some PFAS compounds as well as PFAS mixtures with cirrhosis and severe steatosis in adolescents. Findings support the potential liver toxicity of PFAS, especially in younger age groups. Larger prospective studies are needed to confirm these results.

KEYWORDS: PFAS, liver toxicity, steatosis, liver cirrhosis, U.S., general population

P-0400 Control of prenatal exposures to mercury in Europe: harmonized communication of fish-consumption advice to pregnant women combined with human biomonitoring

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BACKGROUND AND AIM: Mercury is a substance of high concern globally. It is biotransformed to methylmercury (MeHg), a potent developmental neurotoxicant bioaccumulating in aquatic food chains. Fish consumption during pregnancy can expose the fetus to mercury, but at the same time provides essential nutrients for optimal brain and eye development. The benefits can outweigh the risks if suitable dietary advice is followed. The harmonized European intervention study 'HBM4EU-MOM' combined fish consumption advice to pregnant women with human biomonitoring (HBM), to assess and control prenatal exposures to methylmercury.

METHODS: Harmonized tools for HBM and communication of dietary advice were developed and applied in five countries (Cyprus, Greece, Portugal, Spain, Iceland). 654 women, recruited during early pregnancy in 2021, provided hair samples for mercury biomonitoring and extensive information about their fish consumption practices and preferences. Targeted fish consumption advice was communicated to randomized 'intervention participants' of each national cohort and exposures were reassessed after ≥12 weeks.

RESULTS: at baseline, the cumulative geometric mean exposure (GM) was 0.59 µg/g, varied across countries from 1.56 µg/g to 0.31 µg/g and correlated with fish-consumption patterns. Around 12% of participants exceeded EFSA's health-based guidance value (HB-GV = 1.8 µg/g). at reassessment, the mean exposures in the highest exposed countries decreased significantly and the overall number of participants exceeding EFSA's HB-GV dropped to 7.5%.

CONCLUSIONS: European pregnant women may exceed current health-based guidance values for mercury exposure because of inappropriate fish consumption, which can be maintained below HB-GV through suitable consumption. HBM provides a way to evaluate the effectiveness of fish-consumption advice. Harmonized European mercury biomonitoring informs policies to protect human health in vulnerable populations.
HBM4EU-MOM was funded by the European Union's Horizon 2020 research and innovation programme (Grant No.733032).

KEYWORDS: mercury, hair, fish, exposure assessment, human biomonitoring, nutrition, pregnancy, dietary advice

P-0402 Allostatic Load as a Modifier of Associations Between Metals and Blood Pressure

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BACKGROUND AND AIM: Disadvantaged populations are often co-exposed to high levels of metals and psychological stressors. While limited research suggests that stress may increase susceptibility to lead cardiotoxicity, the influence of stress on other metals remains unexplored. We examined whether allostatic load (AL), a measure of chronic stress, modifies associations between metals (cadmium, mercury, arsenic, antimony, cesium, cobalt, molybdenum, thallium, tungsten, uranium, or lead) and blood pressure (BP).

METHODS: We analyzed cross-sectional data on 11 blood and urinary metal biomarkers and systolic and diastolic BP in 5,022 adults (20+ years) participating in NHANES 2003-2010 using linear regression models. We assessed whether associations were modified by AL using interaction terms and stratified analyses. Because there is no scientific consensus on how to measure AL, we compared four different approaches to dichotomize participants into high and low AL based on seven stress biomarkers. Final models for each metal were adjusted for age, sex, race/ethnicity, BMI, education level, serum cotinine, urinary creatinine (to account for urinary dilution), and other confounding metals (e.g., lead).

RESULTS: for diastolic BP, we observed no significant interactions between any metals and AL, but stratified analyses indicated that blood lead and urinary cobalt were significantly associated with higher BP in the high AL group only. These results were robust to the method used to define AL. for systolic BP, we observed the opposite trend: blood lead and urinary cobalt were associated with higher BP in the low AL group but not the high AL group, though results varied by AL definition.

CONCLUSIONS: AL may modify the association between certain metals and BP in adults. As results may differ by method used to define AL, future research should use multiple approaches to operationalize AL until consensus is reached on the most appropriate definition.

KEYWORDS: Metals, Stress, Blood Pressure, Allostatic Load

THEMATIC 18: Occupational Exposures and Health

P-1115 Cancer risks in the employees working at the Air Transportation Industries in the Republic of Korea

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OBJECTIVES: In this study the risk of cancer in the air transportation industries by their occupations considering known personal and lifestyle risk factors affecting the cancer risk using the air transportation industry cohort data and the National Health Insurance claims data.

METHODS: Standardized incidence ratios (SIRs) and Hazard ratios (HRs) for 24 cancers were calculated using the National Cancer Center's National Cancer Registration Statistics (1988-2017), Statistics Korea Cause of Death (1995-2017), and National Health Insurance Medical Examinations and Medical Examinations (2002-2017). The incidence rates were compared with the total workers enrolled in employment insurance during the same period. In the case of the air transport industries, the time when employment insurance started to be applied for the air transport business group after 1995 was considered as the start point of the tracking, and the final tracking ended on December 31, 2017.

RESULTS: The number of included workers was 72,045 in the air transportation industry group, and 8,094,552 in the control group. After adjusting lifestyles and economic factors, the HR for skin cancer in the female workers in the air transport industry was high as 1.94 (95% CI 1.09-3.44). In spite that the alcohol drinking was adjusted, the highest proportionate risks were still found in both male and female workers for oral cancer and nasopharyngeal cancer in the air transportation group. The HR of oral cancer and nasopharyngeal cancer was 1.47 (95% CI 1.10-1.96) in men and 2.10 (95% CI 1.12-3.94) in women, which was statistically significantly higher than that of the control group.

CONCLUSIONS: Further studies are required to assess the assessing whether the increased risks of cancers were due to work or other factors in a group of air transport industry workers.

KEYWORDS: Hazard ratio, Air transportation industries, Occupational cancer

P-1143 Environmental pollution from nephrite jade mines and lung cancer risk in a nearby community: An age-period-cohort analysis and joinpoint regression analysis in Fengtian, Taiwan

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BACKGROUND AND AIM: Nephrite is a nonasbestiform asbestos mineral comprised of microcrystalline tremolite and/or actinolite. Fengtian is a small village in Taiwan located near asbestos and nephrite mines. The objective of this study was to investigate the effects of age, period, and birth cohort on lung cancer incidence in the surrounding communities.

METHODS: We tracked the incidence rate of lung cancer (ICD-9 code 162: cancers of the trachea, bronchus, or lung) from 1980 to 2019, with data from the Taiwan Cancer Registry. We then calculated age-standardized incidence rates (ASIRs) for lung cancer based on the world standard population in 2000. Joinpoint regression was used to evaluate the trend change, and age-period-cohort models were used to investigate the effects of age, period, and birth cohort on lung cancer incidence.

RESULTS: From 1980 to 2019, there were 278 newly reported lung cancer cases, for a crude incidence rate of 60.7 cases per 100,000 person-years. The ASIR of lung cancer exhibited a significant increase from 1980 to 2010 (APC = 6.8%, 95% CI: 4.0–9.7%, $P < 0.01$) and then declined. The risk of lung cancer in the population peaked 40 years after nephrite mining commenced. The population born between during the mass production of asbestos and nephrite had an increased risk of developing lung cancer. The lung cancer risk in the community decreased 30 years after the cessation of nephrite mining.

CONCLUSIONS: Nephrite mining may increase the risk of lung cancer in nearby communities. Appropriate medical monitoring is warranted for individuals with similar exposures.

P-1165 Lung cancer and radon: Pooled analysis of uranium miners hired in 1960 or later

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BACKGROUND

Despite reductions in exposure for workers and the general public, radon remains a leading cause of lung cancer. Prior studies of underground miners depended heavily upon information on deaths among miners employed in the early years of mine operations when exposures were high and tended to be poorly estimated. To strengthen the basis for radiation protection, we report on follow-up of workers employed in later periods of mine operations for whom we have more accurate exposure information and for whom exposures tended to be accrued at intensities that are more comparable to contemporary settings.

METHODS: We conducted a pooled analysis of cohort studies of lung cancer mortality among 57,873 male uranium miners in Canada, Czech Republic, France, Germany, and the United States, who were first employed in 1960 or later (thereby excluding miners employed during the periods of highest exposure and focusing on miners who tend to have higher quality assessments of radon progeny exposures). We derived estimates of excess relative rate per 100 working level months (ERR/100 WLM) for mortality from lung cancer.

RESULTS: The analysis included 1.9 million person-years of observation and 1217 deaths due to lung cancer. The relative rate of lung cancer increased in a linear fashion with cumulative exposure to radon progeny (ERR/100 WLM=1.33; 95% CI: 0.89, 1.88). The association was modified by attained age, age at exposure, and annual exposure rate; for attained ages <55 years, the ERR/100 WLM was 8.38 (95% CI: 3.30, 18.99) among miners who were exposed at ages >=35 years and at annual exposure rates <0.5 working levels. This association decreased with older attained ages, younger ages at exposure, and higher exposure rates.

CONCLUSIONS: Estimates of association between radon progeny exposure and lung cancer mortality among relatively contemporary miners are coherent with estimates used to inform current protection guidelines.

P-1175 Establishing heat stress indicators for work in a warming world: multi-country field evaluation and consensus recommendations

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BACKGROUND AND AIM: One third of the world labour force is frequently exposed to high heat stress at work, leading to significant health and labour implications. In a series of studies, we identified and validated the available thermal stress indicators (TSIs) for their capacity to protect individuals who work in the heat.

METHODS: We conducted a systematic review to identify all TSIs and provide reliable information regarding their use. Then, we identified the criteria to consider when adopting a TSI and we weighed their relative importance using a Delphi exercise with 20 experts from 12 countries. Finally, we conducted field experiments across nine countries (372 workers during 893 full work shifts) to evaluate the efficacy of the meteorology-based TSIs for protecting individuals working in the heat.

RESULTS: Our search identified 340 instruments and indicators developed between 200 BC and 2019 AD. of these, 187 can be mathematically calculated utilizing only meteorological data. of these meteorology-based TSIs, 127 were developed for people who are physically active, and 61 of those are eligible for use in occupational settings. Two Delphi iterations were adequate to reach consensus within the expert panel (Cronbach's α=0.86) for 17 criteria with varying weights to be considered when adopting a TSI. These criteria considered physiological parameters such as core/skin/mean body temperature, heart rate, and hydration status, as well as practicality, cost effectiveness, and health guidance issues. In the third study, when evaluated against the 17 Delphi criteria, the 61 meteorology-based TSIs for occupational settings scored from 4.7 to 55.4%. The indoor (55.4%) and outdoor (55.1%) Wet-Bulb Globe Temperature and the Universal Thermal Climate Index (51.7%) scored higher compared to other TSIs (4.7-42.0%).

CONCLUSIONS: We found that three TSIs are more efficacious and should be adopted to support evidence-based decision making and protect individuals who work in the heat.

THEMATIC 21: Water Quality

P-1245 Seasonal Changes in Physicochemical, Chemical and Bacteriological Parameters of Gomti River in Bangladesh

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BACKGROUND AND AIM: This study was undertaken to investigate the current pollution status of the Gomti river in Bangladesh by collecting water samples from twenty sites along the 120 km stretch of the Gomti river in the rainy season (June 2019) and dry season (January 2020).

METHODS: The collected samples were examined for their physicochemical parameters (pH, electrical conductivity (EC), total dissolved solids (TDS), total organic carbon (TOC), and
turbidity), chemical parameters (the concentrations of six heavy metals, namely chromium (Cr), copper (Cu), iron (Fe), nickel (Ni), lead (Pb), and zinc (Zn)), and bacteriological parameters (aerobic heterotrophic bacteria and total coliforms) in order to assess the suitability of the river water for various purposes.

RESULTS: The heavy metal concentrations of the Gomti river were compared with that of other national and international rivers and it was apparent that Fe, Ni, and Zn may potentially pose adverse effects on the aquatic ecosystems of the Gomti river. A significant ($p<0.05$) positive correlation was found between Cu and Zn indicating that water pollution by these two metals may have originated from common anthropogenic sources. The present study revealed for the first time that the river Gomti was considerably polluted with bacterial populations. The presence of Shigella spp., Salmonella spp., and Escherichia coli in the bacterial isolates is certainly a major water quality concern. Aerobic heterotrophic bacteria and total coliform counts were found to be 0.45×10^2 to 1.84×10^4 CFU/mL and 0.05×10^2 to 7.32×10^3 CFU/mL, respectively, which were above the permissible limits of WHO and are deemed unfit for drinking and domestic purposes, and for fish culture.

CONCLUSIONS: From this study, the priority pollutants of concern in the Gomti river water are Fe, Ni, Zn, aerobic heterotrophic bacteria, and total coliforms.

KEYWORDS: Water pollution, Heavy metals, Total coliform, Gomti river

P-1246 Polymers of micro- and nanoplastics in household tap water of Barcelona

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BACKGROUND AND AIM. Microplastics are emerging persistent pollutants present in drinking water. Previous studies evaluate 100-5 m particles, although smaller sizes are more biologically relevant and evidence suggest higher occurrence levels at the lowest range. However, analytical challenges to determine smaller particles result in limited population-based studies. We describe the concentrations of microplastics in the public drinking water network of Barcelona, Spain, through a novel workflow to quantify polymers of micro-and nanoplastics(MNPLs) in 0.7-20 m range.

METHODS: We conducted a cross-sectional study including 42 households(one per postal code), with home visits to collect tap water samples(5L). We conducted water fractionated filtration followed by toluene ultrasonic-assisted extraction and size-exclusion chromatography, using an advanced polymer chromatography column coupled to high-resolution mass spectrometry with atmospheric pressure photoionization source with negative and positive ionization conditions (HPLC(APC)-APPI(±)-HRMS) and normal phase chromatography HILIC LUNA® column and electrospray ionisation source in positive and negative mode (HPLC(HILIC)-ESI(±)-HRMS). Polymers were identified based on monomer characterisation through Kendrick Mass Defect analysis, plus confirmation and quantification using standards. A principal component analysis(PCA) was conducted to assess differences between the two areas supplied by different drinking water treatment plants. Analysis of bottled water samples are ongoing.

RESULTS: Polyethylene (PE), polypropylene (PP), polyisoprene (PI), polybutadiene (PBD), polystyrene (PS), polyamide (PA), and polydimethylsiloxanes (PDMS) were identified. PE, PP, and PA were the most highly detected polymers, and PI and PBD were found at the highest concentrations (9 and 1.9 µg/L, respectively). PCA showed no significant differences between the drinking water suppliers.

CONCLUSIONS: Citizens in Barcelona are exposed to MNPLs through drinking water, at variable concentrations depending on the polymer. The analytical method allows to analyse a smaller fraction compared to previous studies. Epidemiological research is needed to evaluate associated health risks

KEYWORDS: Drinking water, microplastics, nanoplastics, exposure, tap water, laboratory analysis, high-resolution mass spectrometry

P-1256 Abundance, Types, and Polymer Composition of Microplastics Present in a Coastal Region of Cox's Bazar, Bangladesh

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BACKGROUND AND AIM: In Bangladesh, microplastics (MPs) in different forms (e.g., microbeads) are being released continually into the encompassing water bodies and wastelands in and around Dhaka, Chittagong, and Sylhet. These microplastics eventually find their way to the Bay of Bengal and affect the marine lives there. To date, data pertaining to microplastic pollution in the terrestrial and aquatic systems is still limited in Bangladesh. Therefore, the study was undertaken to determine microplastic abundance, types, and polymer composition in seawater and beach sediment.

METHODS: Eighteen surficial sediment samples and twelve seawater samples were collected from three beach points (Laboni, Sugandha, and Kolatoli) of the world's longest sea beach, Cox's Bazar, Bangladesh. The samples were processed and then examined under a stereomicroscope and scanning electron microscope. The microplastic was further analyzed for the identification of polymers using the attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR).

RESULTS: This study provided the first quantification and characterization of MPs in the sediments and water of the world's longest sea beach. The study revealed a moderate abundance (368.68 ± 10.65 items/kg) and (210.12 ± 6.23 items/m3) of MPs in beach sediment and seawater, respectively. The identified MPs were mostly colorful (57%), and polyethylene (PE) (41%) and polyvinyl chloride (PVC) (29%) polymers were found to dominate the collected samples. The observed MPs were classified into three size ranges. The majority of the MPs (59%) measured were 1–5 mm in size, followed by 0.5–1 mm (27%) and <0.5 mm (14%).

CONCLUSIONS: This study gives insights into beach MPs pollution on the Bangladesh coast. This data can be used as baseline data for the management of this beach. Further research on the more precise identification of smaller microplastics present in marine biota using the Micro-FTIR Spectroscopy is warranted.

KEYWORDS: Microplastics, Marine Pollution, ATR-FTIR, Polyethylene, Polyvinyl chloride

POSTER DISCUSSION SESSION 07: Built and Physical Environment exposures | Climate change and Health

THEMATIC 04: Built and Physical Environment exposures

P-0247 Long-term Exposure to Walkable Residential Neighborhoods Reduces the Risk of Obesity-related Cancer in Women

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BACKGROUND AND AIM: Living in neighborhoods with higher levels of walkability has been associated with a reduced risk of obesity and higher levels of physical activity. Obesity has been linked to increased risk of 13 cancers in women. However, long-term prospective studies of neighborhood walkability (NW) and risk for obesity-related cancer are scarce. In this prospective study, we evaluated the association between average NW and risk of cancer.

METHODS: In the New York University Women's Health Study (NYUWHS), a prospective cohort with 14,274 women recruited between 1985 and 1991 in New York City and followed over nearly three decades, we geocoded residential addresses for each participant throughout follow-up. We calculated an average annual measure of neighborhood walkability across years of follow-up using data on population density and accessibility to destinations associated with geocoded residential addresses. We employed Cox proportional hazards models to assess the association between average NW and risk of overall and site-specific obesity-related cancers over a period of nearly three decades.

RESULTS: Residing in neighborhoods with a higher walkability level was associated with a reduced risk of overall and site-specific obesity-related cancers. The hazards ratio (95% CIs) associated with a standard deviation increase in average annual neighborhood walkability was 0.88 (0.85-0.93) for overall obesity-related cancer, 0.89 (0.84-0.95) for postmenopausal breast cancer, 0.82 (0.68-0.99) for ovarian cancer, 0.87 (0.76-0.99) for endometrial cancer, and 0.68 (0.49-0.94) for multiple myeloma, adjusting for potential confounders at both the individual and neighborhood level. The association between NW and risk of overall obesity-related cancer was stronger among women living in neighborhoods with higher levels of poverty compared to women living in areas with lower poverty levels (p-value, interaction=0.006).

CONCLUSIONS: Our study highlights a potential protective role of NW in preventing obesity-related cancers in women.

KEYWORDS: Neighborhood walkability, urban health, women's health, obesity-related cancer.

P-0268 Association between woodsmoke and respiratory health: A Dutch panel study

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BACKGROUND AND AIM: In the Netherlands household fireplaces are responsible for burning about 1 billion kilograms of wood per year, emitting a significant amount of woodsmoke. Little is known about the respiratory health effects associated with the level of woodsmoke exposure present in the Netherlands. Thus, our aim was to investigate the short-term changes in lung function, respiratory symptoms and medication use associated with short-term changes in woodsmoke exposures in citizens with and without COPD/asthma. The study was co-created with citizens.

METHODS: We conducted a panel study with repeated observations in 46 adults (11 asthma/COPD) between February and May 2021 in four Dutch cities. Participants were asked to document symptoms and medication use in a daily diary and conduct daily home spirometry measurements in the morning and evening. Woodsmoke exposure was characterized by measuring various exposures at central sites in each study location set-up specifically for the study, and individual woodsmoke perception (smell) recorded in the daily diaries. The association between woodsmoke and health was analyzed using linear and logistic regression, adjusting for time-varying confounders and repeated observations.

RESULTS: We found significant positive associations between the specific wood smoke marker levoglucosan and shortness of breath during rest (OR 1.15 (95%CI 1.01, 1.32) per IQR increment for previous day exposure) and extra medication use (OR 1.19 (95%CI 1.07, 1.33) per IQR increment for current day exposure). We found weak associations between woodsmoke and nasal symptoms, and no consistent association with either morning or evening lung function measurements. The associations with levoglucosan remained after the inclusion of generic PM2.5 as a co-pollutant in the statistical models.
CONCLUSION: People experienced more shortness of breath at rest, nasal symptoms and used more medication on days with higher levels of outdoor woodsmoke exposure.

KEYWORDS: Woodsmoke, Levoglucosan, Respiratory health, Panel study.

P-0282 The relation of residential greenness with fetal growth and the role of air pollution in Eastern Massachusetts, USA

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BACKGROUND AND AIM: There is growing evidence that green spaces may be beneficial for health. However, the effects on pregnant individuals and fetuses, including the underlying mechanisms, have been underexplored. We examined the association between neighborhood greenness and fetal growth, and the role of air pollution in these relationships (interaction and mediation) in a Massachusetts-based cohort.

METHODS: Our study consisted of 9,446 pregnancies that delivered at Beth Israel Deaconess Medical Center, Massachusetts in 2011-2016. Neighborhood greenness was estimated using normalized difference vegetation index (NDVI) with 270 m resolution. Fetal growth parameters included birth weight (BW), and ultrasound measures of biparietal diameter (BPD), head circumference (HC), femur length, and abdominal circumference (AC). Ultrasound parameters were classified into three distinct gestational periods: 16-23 weeks, 24-31 weeks, and 32+ weeks. We used distributed lag models to estimate the time-varying association between monthly NDVI and fetal growth. All models were adjusted for sociodemographic characteristics, and time trends. for models in which we identified an association, we tested for potential interaction with particulate matter ≤2.5 µm (PM2.5) and nitrogen dioxide (NO2) —predicted from well-validated ensemble models— and assessed for mediation by these pollutants.

RESULTS: We found that higher NDVI was positively associated with BPD, HC, AC, and BW. for example, a 0.1 NDVI increase sustained up until week 32 was associated with a higher mean AC z-score of 0.03 (95% CI: 0.01, 0.06), and a higher mean BW z-score of 0.02 (95% CI: 0.01, 0.03). We found no evidence for interaction or mediation by air pollution.

CONCLUSIONS: Residential greenness was associated with larger fetal growth measures. Our effect decomposition suggests that the association of greenness with fetal growth is independent from associations with local air pollution.

KEYWORDS: greenness, air pollution, fetal growth, ultrasound, pregnancy, interaction, mediation

P-0295 Road traffic noise and incidence of primary hypertension: a prospective analysis in UK Biobank

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BACKGROUND AND AIM The quality of evidence regarding the associations between road traffic noise and hypertension is low due to the limitations of cross-sectional study design, with the role of air pollution remains to be further clarified. To evaluate associations of long-term road traffic noise and air pollution exposure with incident primary hypertension, we conducted a prospective population-based analysis in UK Biobank.

METHODS: Road traffic noise was estimated at baseline residential address using the Common Noise Assessment Method model. Incident primary hypertension (ICD 10: I10) was ascertained through linkage with medical records for ~250 000 participants. Cox proportional hazard models were used to estimate hazard ratios (HRs) for association between road traffic noise and incident primary hypertension, adjusting for covariates determined via directed acyclic graph.

RESULTS: During a median of 8.1 years follow up, 21 185 incident primary hypertension cases were ascertained. The HR for a 10 dB[A] increase in mean weighted average 24-h road traffic noise level (Lden) exposure was 1.08 [95% confidence interval (CI) 1.02, 1.14]. A dose-response relationship was found, with HRs of 1.14 (95% CI: 1.04, 1.26) for Lden > 65dB[A] vs. ≤ 55dB[A] (P trend <0.05), and HRs of 1.15 (95% CI: 1.04, 1.26) for night-time road traffic noise (Lnight)>55 dB[A] vs. ≤ 45dB[A] (P trend <0.05). The associations were all robust to adjustment for fine particulate matter (PM2.5) and nitrogen dioxide (NO2). Furthermore, the highest incident hypertension risk was seen in the group who were exposed to the highest level of both road traffic noise and air pollution.

CONCLUSIONS:Long-term exposure to road traffic noise was associated with increased incidence of primary hypertension, and the effect estimates were greater in those with higher air pollution exposure.

KEYWORDS: road traffic noise; air pollution; primary hypertension; prospective analysis

P-0298 Association between greenspace exposure and different domains of cognitive function in the French CONSTANCES cohort

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BACKGROUND AND AIM: Greenspace has been suggested to be associated with better cognitive function in adults. We assessed the association between residential surrounding greenspace and different domains of cognition in the French CONSTANCES cohort.

METHODS: We included 76,482 participants aged 45 and older, who performed tests at enrollment (2012-2019) on three cognitive domains: episodic memory (fast free and cued recall), language skills (semantic and lexical fluency), and executive functions (digit-symbol substitution, trail making test part A and B [TMT-A and TMT-B]), and a global cognitive score (a composite of these six tests). Residential surrounding greenspace was quantified using satellite-based Normalized Difference Vegetation Index (NDVI) at 300m buffer around the participant's home in the enrollment year. We modeled the cross-sectional associations for urban, suburban, isolated cities, rural, and Paris separately, using multiple linear regressions on standardized outcomes (TMT-A and TMT-B were log-transformed) adjusted for age, sex, education, recruitment center, neighborhood deprivation, and air pollution.

RESULTS: The participants were 57.6±7.2 years old, 54.9% women, and 49.7% with university education. Average NDVI at 300m buffer (IQR: 0.26) was 0.58±0.14, 0.67±0.12, 0.71±0.11, 0.81±0.08, and 0.35±0.09 for urban, suburban, isolated cities, rural, and Paris respectively. We found significant beneficial association between residential surrounding greenspace and semantic fluency at urban, suburban, isolated cities, and rural areas (ß=0.048 [95% CI: 0.018, 0.079], 0.068 [0.037, 0.098], 0.105 [0.033, 0.177], 0.096 [0.033, 0.158] respectively). We also observed similar beneficial associations for executive functions in urban and suburban areas. No associations with greenspace were found for episodic memory, lexical fluency, and global cognitive score in most communes of residence.

CONCLUSION

Exposure to greenspace could be beneficial for cognition, especially semantic and executive functions, in adults. Urban and suburban residents probably gain more cognitive benefits from greenspace.

KEYWORDS: Natural environment; Cognitive function; Alzheimer's disease; Environmental epidemiology

P-0301 Validation and Improvement of the Dutch Obesogenic Built Environment Characteristics Index

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BACKGROUND AND AIM

Neighbourhood characteristics can influence physical activity and dietary behaviours, and therefore impact body weight. Characterizing neighbourhoods in terms of their 'obesogenicity' has useful applications in research and policymaking. Our study aimed to (1) develop a basic Obesogenic Built environment CharacterisTics (OBCT) index quantifying obesogenicity of all neighbourhoods in the Netherlands and (2) examine the associations between the index and overweight in a large population survey.

METHODS: The basic OBCT index consists of 20 equally-weighted components from both the food (densities of five food outlet types and an overall healthiness score) and physical activity environments (walkability, drivability, bikeability and sports facilities). We linked the index to residential addresses of 258,552 adult participants (>18 years old) of the Dutch Health Monitor, a nationwide cross-sectional survey in 2016; and analyzed the index by logistic regression against odds of overweight (BMI>25.0kg/m²), adjusting for individual demographic characteristics. Effect modification by age, sex and urbanicity was examined.

RESULTS: The OBCT index ranged from 0 (leptogenic) to 100 (obesogenic) across all Dutch neighbourhoods (mean=55.7, SD=10.5 for surveyed individuals). Mean BMI was 26.0 (SD=4.26) kg/m² with an oversampling of older adults >65 years old (n=131,296). The odds ratio (OR) of overweight per 10% increase in obesogenicity was 1.01 (95%CI:1.00-1.01) in a fully adjusted model, which was significantly higher for older adults (OR: 1.02, 95%CI:1.01-1.03) compared to those <65 years old (OR:1.00, 95%CI:0.99 -1.01). Associations were also significantly stronger for rural (OR:1.04, 95%CI:1.02-1.05) compared to urban residents (OR:1.00, 95%CI:0.98-1.01) but not for sex.

CONCLUSION

The basic OBCT index had limited association with BMI outcomes. As improvement, individual components of the index will be reweighted using four data-driven

METHODS: logistic regression, supervised principle component, random forest, and data envelopment analysis. Results of these modified weights in terms of predictive power for the resulting indices will be presented.

P-0304 Modeling MODIS LST at European scale

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BACKGROUND
To harmonize exposure assessment of temperature in multi-cohort studies, models require to cover large temporal and geographical extends at high resolution. The daily 1km Land Surface Temperature (LST) product from MODIS instrument is an important satellite predictor in ambient temperature models. However, LST products present an uneven data distribution due to cloud and snow cover. Interpolating LST "gaps" can become computationally expensive and require performance indicators to evaluate spatial and temporal stability and overfitting. Traditional (global) performance indicators might not be sensitive to changes in performance resulting from local data density and autocorrelation structures.
This study aims (1) to evaluate different model configurations to understand how LST spatial and temporal data density patterns affect model performance at global and local levels, and (2) to identify the most stable models.

METHODS: We aggregated observations into 100km² spatial blocks, trained random forest models and evaluated performance through 5-fold block cross-validation. We tested different model configurations based on the number of predictor variables (latitude, longitude, elevation, date, NDVI & climatic variables), the model's temporal extent and the number of sampled instances per block for Europe.
RESULTS: Adding predictor variables and increasing the temporal extent dramatically increased time, but not performance. Sampling 25% of the maximum amount of observations per block show the largest drops in RMSE, while keeping the computational times low. We showed some evidence of overfitting when training large extents and sample sizes due to limited representativeness at blocks with less instances. Our best model showed a CV-RMSE of 2.4 Kelvin with 90% of mean RMSE at the block level below 0.93 Kelvin.
CONCLUSIONS: Using a block sampling approach can balance sample size, thus limiting overfitting and computational time.

KEYWORDS: Europe wide, temperature modelling, block cross-validation, Land surface temperature

P-0316 Improved Hyperlocal Air Quality Mapping: Can Traditional Deterministic Modelling Leverage Mobile Monitoring via Hybrid Modelling Approaches?

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BACKGROUND AND AIM: Recent advances in mobile monitoring offer excellent opportunities to explore the hyperlocal variation of ambient air pollution. One example is Google Street View (GSV) car equipped with high-quality instruments. Here, some challenges are translating on-road pollution levels to the building façades and the scalability of such mapping at large spatial scales, e.g. national scale. Since "traditional" deterministic modelling has been a reliable method for pollution assessment and mapping, this talk aims to explore whether deterministic modelling, via hybrid modelling, can help address the challenges mentioned above and leverage mobile monitoring for improved pollution mapping.

METHODS: Three GSV cars measured hyperlocal levels of nitrogen dioxide (NO2), black carbon (BC) and Ultrafine particles (UFP) on all streets of Amsterdam (N = 46664) and Copenhagen (N = 28499) from October 2018 to March 2020. The measurements were corrected and, among others, compared with pollution estimates from national prediction models, the Danish DEHM-UBM-AirGIS, and the Dutch NSL (National Collaborative Air Quality Programme). Further, model estimates are incorporated with GSV measurements to test and apply hybrid modelling approaches using statistical (e.g. kriging) and machine learning techniques.

RESULTS: Overall, Amsterdam's measured pollution levels were relatively higher (e.g. median NO2 = 24 µg/m3) than in Copenhagen (median NO2 = 13 µg/m3). In addition, GSV NO2 measurements correlated moderately (Spearman's r = 0.50) (N = 7004) with the NSL estimates in Amsterdam, whereas in Copenhagen, the Spearman's correlation (r) was in the range 0.45 – 0.67 (N = 97 and 58234).

CONCLUSIONS: High-quality mobile monitoring offers a great way to study the hyperlocal variation of air pollution. Since the modelled vs measured correlation was moderate to slightly high, combining both datasets may better predict external data. The presentation will reflect on hybrid model development.

KEYWORDS: Mobile measurements, Google Street View, deterministic modelling, AirGIS, hybrid model

THEMATIC 07: Climate change and Health

P-0554 The prospective effects of Climate change on Neglected Tropical Diseases in the Eastern Mediterranean region: A review

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BACKGROUND AND AIM: An increase in the annual daily temperature is documented and predicted to occur in the coming decades. Climate change has a direct effect and adverse impact on human health, as well as on multiple ecosystems and their species. The purpose of this paper is to review the effect of climate change on neglected tropical diseases including leishmaniasis, schistosomiasis, and lymphatic filariasis in the Eastern Mediterranean Region (EMR).

METHODS: A list of engine web searches was done; 280 full-text records were assessed for eligibility. Only 48 original records were included within the final selection for the review study.

RESULTS: Most research results show an alteration of neglected diseases related to climate change influencing specifically the Eastern Mediterranean Region, in addition to the expectation of more effects at the level of vectors and reservoir whether its vector transmission route or its egg hatching and replication or even the survival of adult worms in the coming years. at the same time, not all articles related to the region interpret the direct or indirect effect of climate variations on these specific diseases.
CONCLUSION: Although few studies were found describing some of climate change effects on neglected tropical diseases in the region, still, the region lacks research funding, technical, and mathematical model expertise regarding the direct effect of climate change on the ecosystems of these neglected tropical diseases

KEYWORDS: climate change, neglected tropical diseases, Eastern Mediterranean region

P-0577 Short-term effects of air temperature on mortality in the Norwegian CONOR cohort – results of the EXHAUSTION project

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BACKGROUND AND AIM: Short-term health effects of air temperature have been extensively investigated at the population level. However, such effects have rarely been assessed using individual-level data. This time-stratified case-crossover study examined short-term associations of air temperature with cause-specific mortality and potential effect modification by individual characteristics in the Cohort of Norway (CONOR) cohort.

METHODS: CONOR recruited ~173,000 participants from 1994 to 2003. Participants' vital status and cause of death were collected from the Cause of Death Registry of Norway. Daily mean air temperatures estimated by a spatial-temporal model were assigned to participants' residences. We applied conditional logistic regression models with the distributed lag non-linear model approach to assess cold and heat effects on cause-specific mortality up to a lag of 10 days. Effect modification was examined by an interaction term between air temperature and potential modifiers.

RESULTS: We identified 40,040 cases of natural-cause deaths through December 31, 2018, including 14,457 deaths from cardiovascular diseases and 3,699 deaths from respiratory diseases. The mean air temperature during the study period was 5.0 °C (SD: 7.5 °C). We observed an increased risk of natural-cause mortality (OR: 1.12, 95% CI: 0.99, 1.27) for a decrease in temperature from the 25th (0 °C) to the 1st (-13.3 °C) percentile. This was accompanied by a trend for increased risks of cardiopulmonary, cardiovascular, ischemic heart disease, and cerebrovascular mortality associated with decreasing air temperature. The cold effect on natural-cause mortality was more pronounced among participants who were female, had lower socioeconomic status, lived in sparsely populated areas, and had no history of CVD. We did not find adverse heat effects on mortality.

CONCLUSIONS: We find evidence for adverse short-term cold effects on mortality at the individual level in Norway and identify the sub-populations that are potentially most vulnerable.

KEYWORDS: Air temperature, mortality, cardiovascular, respiratory, susceptibility

P-0580 Ambient heat and emergency department visits for mental health in Canada: assessing temporal variations by greenspace, urbanicity and socioeconomic status

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BACKGROUND AND AIM: Although previous research has suggested that greenspace might attenuate health risks associated with ambient heat, there is limited research on mental health disorders. Thus, we evaluated the effect modification of greenspace on heat-related mental health emergency department (ED) visits and whether these effects changed over time.

METHODS: We conducted a case-crossover study for mental health-related ED visits in Canada between 2004 and 2021 during warm-season months (May to August). ED visits for all Canadians living in 111 health regions were included. Daily average temperature as well as greenspace exposure, estimated by the Normalized Difference Vegetation Index (NDVI), were assigned to individuals at their residential location. Extreme heat was defined as the 95th percentile of the health region-specific warm-season temperature distribution. Conditional logistic regression was used to estimate associations between heat and mental health-related ED visits.

RESULTS: A total of 10,638,372 ED visits for any mental health condition were included. Days of extreme heat were associated with an increased risk of ED visits for any mental health condition (OR = 1.07; 95% CI: 1.05-1.09). In the earlier part of the study period (2004–2009), the associations between ambient heat and mental health ED visits were stronger among individuals exposed to the lowest quartile of NDVI exposure (OR = 1.20; 95% CI: 1.15-1.25), compared to individuals in the highest quartile of NDVI (OR = 1.01; 95% CI: 0.96-1.07). This difference, however, accentuated in the later part of the study (2016-2021) with the ORs for regions in the lowest quartile of NDVI increasing to 1.29 (95% CI: 1.25-1.34) and remaining stable for regions in the highest quartile. Effects appeared strongest in the most deprived socioeconomic areas.

CONCLUSIONS: Potential health benefits of greenspaces should be considered in mitigation strategies regarding the impacts of climate change on mental health ED visits.

P-0590 Association between high temperature and hospital admissions for kidney diseases: a nationwide study

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BACKGROUND AND AIM: High temperatures have a known impact on human morbidity and mortality.
Few small time series studies have documented associations between acute kidney injury (AKI) and temperature. Studies conducted on agricultural workers found an association between AKI and chronic kidney disease (CKD) of unknown origin. The association between temperature and kidney diseases was less investigated on the general population and on a large scale. The aim of this study is to evaluate the effect of temperature on kidney diseases hospital admissions in Spain.

METHODS: Data on daily hospital admission for AKI and CKD were retrospectively collected from 2004 to 2019 in Spain. A Conditional Poisson regression combined with Distributed Lag Non-Linear Models was applied to evaluate the overall cumulative effect of maximum temperature among the 7 days preceding the admission. Models were adjusted for humidity and national holidays, and analyses were also stratified by age and sex.

RESULTS: Overall, 244,348 and 39,448 admissions for AKI and CKD were registered, respectively. We observed a J-shaped curve for the association between AKI and temperature with a minimum morbidity temperature of 7°C. The overall cumulative relative risk (RR) at the 99th percentile versus the minimum morbidity temperature percentile was 1.46(95%CI:1.37-1.55). The impact of high temperature remained strong also in the analyses stratified by age and sex with the highest risk observed in the young (<65years) population (RR:1.59; 95%CI:1.43-1.75). Concerning CKD, results were not clear and varied by age and sex. An increased risk of being admitted for CKD in association with high temperature was observed among young males.

CONCLUSIONS: High temperatures increased the risk of AKI hospital admissions in the general population, whereas less evidences were found for CKD. Dehydration and hyperthermia caused by high temperatures may stress renal function leading to kidney injury.

KEYWORDS: Acute kidney injuries; Chronic kidney diseases; Temperature;

P-0599 Describing cumulative exposure related to heat stress in France to support adaptation

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BACKGROUND AND AIM: Differential exposure to multiple environmental factors and social deprivation can enhance health vulnerabilities and thus limit the exposed population's capacity to adapt to climate change. We aimed to identify hotspots of cumulative exposure to urban heat island, air pollution, deficit of green spaces and social deprivation in continental France and to describe their evolution between 2000 and 2018.

METHODS: Daily gridded exposure to minimum, mean and maximum temperature and mean PM2.5, PM10 and NO2, were estimated based on validated exposure models with high spatial resolution (200m to 1km). Winter and summer mean NDVI (Normalized Difference Vegetation Index) was estimated using Landsat satellite images with a 30m spatial resolution. Over-exposure to temperature, air pollution and deficit of green spaces was assessed by defining thresholds for each indicator that are based on potential underlying health risks. WHO air quality guidelines were used to define over-exposure to air pollution. for temperature and green spaces, reference values were defined for each department by type of climate and urbanization rate. The frequencies of exceedance days for mean temperatures, PM10, PM2.5 and NO2 concentrations over a year were calculated and combined altogether with a deficit of green spaces indicator. The differential exposure to environmental hotspots related to social deprivation, assessed through European Deprivation Index (EDI) and French Deprivation Index (FDep), was studied by using distributions comparison methods.
CONCLUSION
This study will provide the first picture of fine scale exposure to heat stress and its co-exposures at a national scale. This work could be used to study the combined effect of temperature, air pollution, greenspace and social deprivation on health outcomes.

KEYWORDS: Social deprivation; environmental burden; spatial inequality; cumulative environmental exposures

P-0604 Extreme temperatures and cause-specific mortality in a temperate climate zone: a case-crossover study in Central Mexico

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BACKGROUND AND AIM. The association between exposure to extreme temperatures with non-external mortality has been well documented in high-income regions. However, fewer studies have investigated this association with cause-specific mortality, especially in temperate climate zones. Understanding the link between extreme temperature and cause-specific mortality can inform targeted mitigation strategies.

METHODS: We conducted a time-stratified case-crossover study, including ~1.5 million ICD-10 coded deaths, to estimate the risk of cause-specific mortality associated with daily mean temperature (Tmean), in the Mexico City Metropolitan Area, 2004-2019. Tmean and $PM_{2.5}$ predictions came from our 1x1km satellite-based models for the region. We fit conditional logistic regressions with distributed lag non-linear Tmean terms exploring up to 21 days of lagged effects of Tmean on mortality. We estimate mortality risks for extreme-heat (99th Tmean-percentile), and extreme-cold (1st Tmean percentile) compared to the minimum mortality temperatures (MMT) stratified for age group, sex, or cause-specific mortality.

RESULTS: MMTs varied by age group, sex, and cause of death [MMT=11.2°C (3rd Tmean percentile) for suicides to MMT=21.3°C (98th Tmean percentile) for renal failure]. Overall, single-lag effects from extreme-heat peaked at lags 0-2, and remained positive one week after exposure. for extreme-cold, the strongest positive single-lag effects started at lag 2. Extreme-heat (cumulative $lag_{0\text{-}6}$) exhibited the strongest associations with suicides (OR=1.46, 95%CI: 1.16-1.90), ischemic stroke (OR=1.40, 95%CI: 1.14-1.71), chronic respiratory disease (OR=1.12, 95%CI: 1.03-1.22), pulmonary heart disease (OR=1.12, 95%CI: 0.86-1.44) and ischemic heart disease (OR=1.08, 95%CI: 1.04-1.12). Extreme-cold related mortality (cumulative $lags_{0\text{-}21}$) was stronger for extrapyramidal disorders, hypertensive disease, chronic respiratory disease, ischemic and hemorrhagic stroke.
CONCLUSION. Our results suggest that preventing temperature-related mortality in moderate climate zones should consider varying susceptibility for underlying health conditions.

KEYWORDS: Case-crossover, minimum mortality temperature; distributed lag nonlinear models, extreme temperature

P-0611 Climate change and cardiovascular disease mortality: exploring the association in Puducherry, India

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BACKGROUND AND AIM: Climate change has far reaching consequences on all aspects of life, including health. Cardiovascular diseases (CVDs), the global leading cause of death, have also been found to be climate sensitive, mainly to temperature. However, the associations between CVDs and temperature are region-specific with relatively few studies on the topic from low-and-middle-income countries (LMICs). This study explores these associations in Puducherry, a coastal district in Eastern India.

METHODS: We analyzed the association between apparent temperature (Tapp) and CVD mortalities to estimate the burden of in-hospital CVD mortalities attributable to non-optimal temperatures between 2010-2020. We used a binomial regression model to analyze the temperature-mortality association along with a distributed lag non-linear model to capture the delayed and non-linear trends.

RESULTS: We found that the optimal temperature range for Puducherry is between 33^{o}C and 35^{o}C with respect to CVDs. Temperatures both above and below the optimal temperature range were associated with an increased risk of overall in-hospital CVD mortalities, resulting in a U-shaped association curve. Up to 20% of the CVD deaths could be attributable to non-optimal temperatures, with a slightly higher burden attributable to cold (11.2%) than heat (9.12%). We also found that males below 50 years of age were more vulnerable to colder temperatures while females above 50 years were more vulnerable to the heat. Mortality with cerebrovascular accidents was associated more with heat compared to cold, while ischemic heart diseases did not seem to be affected by temperature.

CONCLUSIONS: This study analyses the temperature-CVD mortality association for the first time in the Puducherry district. It also identified the age and gender differences in temperature attributable CVD mortalities, which can be socio-cultural. Further studies from India could identify the regional associations and enhance the development of regional and contextual climate-health action plans.

KEYWORDS:
climate-change, cardiovascular diseases,temperature, health, LMIC

THEMATIC 09: Environment and health in low and medium income areas

P-0698 Determinants of clean cooking fuels utilization in three peri-urban communities in Ghana: key lessons to inform national policy

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Use of polluting fuels has negative effect on human health and the environment. Use of clean cooking fuels (liquefied petroleum gas (LPG) can address this burden but in Ghana adoption is low with accessibility, convenience and safety concerns being potential barriers to LPG use. In order to address these issues, the Ghanaian government launched a new LPG distribution model through cylinder recirculation in 2019 on a pilot basis

As part of the CLEAN-Air (Africa) project, we collaborated with National Petroleum Authority implementing the CRM to conduct face-to-face surveys of randomly selected households on household cooking fuels preferences and use in three peri-urban CRM pilot communities in Ghana. To analyse determinants of adoption and sustained use of LPG for cooking, individual, household and wider community characteristics were entered as covariates into logistic regression models as potential predictors.

A total of 5,008 respondents completed the questionnaires across the three communities (Obuasi; 1,987 (40.0%), Kwaebibirem; 1,731 (34.9%) and Hohoe; 1,248 (25.1%)). A total of 48.6% (Obuasi (50.1%); Kwaebibirem (44.4%); Hohoe (52.2%)) households reported currently using LPG as the main cooking fuel. Being head of the household, increased household size, home ownership, an indoor cooking area, increased educational status and an increased number of LPG burners were associated with household's choice of using LPG as a primary fuel. Households using an LPG stove with three or more-burners, were 68% [OR:1.68 (95%CI: 1.32, 2.14), 001] more likely to use LPG as a primary fuel than those using a single burner on top of the cylinder.

Given the importance of the CRM, understanding household level characteristics for adoption are important. Better education and awareness raising of benefits will be important in scaling adoption of LPG as a clean fuel for cooking at the household level.

KEYWORDS: clean cooking fuels, LPG, Cylinder Recirculation Model, primary fuel use

Wednesday, September 21

POSTER DISCUSSION SESSION 08: Environment and health in low and medium income areas | Environmental Equity | Ethics

THEMATIC 09: Environment and health in low and medium income areas

P-0687 Long-term exposure to PM2.5 and avoidable mortality in Colombia 2014-2019

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OBJECTIVE: To compare estimates of surface PM2.5 concentrations in Colombia from 2014-2019 at municipality level derived from two global air quality models, as well as to quantify the avoidable deaths attributable to the long-term exposure to concentrations above the current PM2.5 annual mean national standard of 25 µg/m3 and projected standard of 15 µg/m3.

METHODS: We retrieved PM2.5 concentrations at the surface level from the ACAG and CAMSRA global air quality models for all 1,122 municipalities, and compare 28 of them with available concentrations from monitor stations. Annual mortality data 2014-2019 by municipality of residence and pooled effect measures for total, natural and specific causes of mortality were used to calculate the number of annual avoidable deaths and years of potential life lost.

RESULTS: Compared to surface data from 28 municipalities with monitoring stations in 2019, ACAG and CAMSRA models under or overestimated annual mean PM2.5 concentrations. Estimations from ACAG model had a mean bias 1,7 µg/m3 compared to a mean bias of 4,7 µg/m3 from CAMSRA model. Using ACAG model, estimations of total nationally attributable deaths to PM2.5 exposure over 25 and 15 µg/m3 were 142 and 34,341, respectively. Cardiopulmonary diseases accounted for most of the attributable deaths due to PM2.5 excess of exposure (38%). Estimates of YPLL due to all-cause mortality for exceeding the national standard of 25 µg/m3 were 2,381 years.

CONCLUSIONS: Comparison of two global air quality models for estimating surface PM2.5 concentrations during 2014-2019 at municipality scale in Colombia showed important differences. Avoidable deaths estimations represent the total number of deaths that could be avoided if the current and projected national standard for PM2.5 annual mean have been met, and show the health-benefit of the implementation of more restrictive air quality standards.

KEYWORDS: Air quality standards, Particulate Matter, Satellite data, Mortality

P-0694 Long-term ambient air pollution exposure and tuberculosis notification rates during 2005–2017 in Ningxia Hui Autonomous Region, China

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BACKGROUND AND AIM: Pulmonary tuberculosis (TB) is a persistent public health concern, with 1.3 million attributable deaths and 10 million new cases recorded annually worldwide. Low- and middle-income countries account for the greatest proportion of TB cases globally (>95%), where some of the highest levels of air pollution occur. Epidemiological studies of an association, however, have been limited in number. We conducted a small-area study in Ningxia, a low socioeconomic and high TB-burden area in rural China, using TB-registry data (2005 – 2017).

METHODS: We used TB registry data to determine if annual average concentrations of remote-sensing based estimates of ambient air pollution (particulate matter <2.5 µm; [PM2.5], nitrogen dioxide [NO2] ozone [O3]) were associated with township-level (n=358) TB notification rates. Pollutant effects on age-standardised TB-notification rates (as Incidence Rate Ratios [IRR]) at township-level were estimated using Generalised Estimating Equations.

RESULTS: Median concentrations of PM2.5, NO2, and O3 were 42 µg/m3 (IQR: 10 µg/m3), 15 ppb (IQR: 4 ppb) and 56 ppb (IQR: 1 ppb), respectively. In single pollutant models adjusted for socio-economic covariates, an interquartile range (IQR) increase (10 µg/m3) in PM2.5 was significantly associated with an increase in TB notification incidence rates (IRR: 1.35; 95% CI: 1.27–1.41). Comparable effects were observed per IQR (4 ppb) increase in NO2 (IRR: 1.23; 95% CI: 1.19–1.28). Ground-level ozone was not associated with TB-notification rate in any models. The observed effects remained consistent in multi-pollutant models, and when adjusted for indicators of household crowding, solid fuel use and remoteness.

CONCLUSIONS: These findings may suggest that improving air quality may have population-level health benefits in socio-economically disadvantaged, TB-endemic settings.

KEYWORDS: Tuberculosis, TB, respiratory disease, China, outdoor air pollution

P-0697 Effects of Environmental Pollution from Illegal Mining Activities on Community Health: A community-based study in Kenyasi, Ahafo Region

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BACKGROUND AND AIM: Mining is the backbone of many economies in developing countries, however, its activities, no matter the scale, are disruptive to community health as a result of environmental pollution. The extent of environment pollution caused by mining activities is mainly due to illegal mining practices. The study aimed to determine perceived effects of environmental pollution from illegal mining activities on community health in Kenyasi, Ahafo Region.

METHODS: A community-based cross-sectional study was conducted between September to November, 2021. A multi-stage sampling technique was used to sample 410 community member resident in Kenyasi and data collected using a questionnaire. Data was analyzed using SPSS version 25. Frequencies, percentages, correlation and multiple linear regression tools were utilized at 0.05 confidence level.

RESULTS: Out of the 410 participants recruited for the study, 62.7% were males and a mean age of 34 years. Results from the study indicated that most of the participants (81.7%) think illegal mining causes environment pollution which has bad effect on community health. Correlation analysis indicated a positive relationship between environmental pollution from illegal mining and community health. Consequently, land pollution from illegal mining contributed the highest with coefficient of determination R2 = 0.35. The linear regression analysis showed that illegal mining activities were good predictors of the environmental conditions [F (3, 117) = 12.390 and p = 0.000], with surface mining being the best predictor. About 53.9% of the residents in the Kenyasi recommended building health facility was the best way of improving community health conditions in Kenyasi.
CONCLUSION
Illegal mining is a resource to every community; however, its activities are conducted with total disregard to community health. Therefore, government should strengthen the enforcement of environmental and safety laws to mitigate against harmful effect of environmental pollution.

KEYWORDS: Illegal mining, environmental pollution, community health, Kenyasi

P-0700 Main and added effects of heatwaves on hospitalizations for Mental and Behavioral Disorders in a tropical megacity of Vietnam

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BACKGROUND AND AIM: Vietnam is highly vulnerable to climate change-related extreme weather events such as heatwaves. This study assesses the association between heatwaves and hospitalizations due to mental and behavioral disorders (MBDs) in Ho Chi Minh City (HCMC).

METHODS: We collected daily MBD hospital admissions data at the HCMC Mental Health Hospital from 2017 to 2019. Heatwaves effects were characterized into the main effect (i.e., the intensity of temperature during heatwaves) and the added effect (i.e, the duration of heatwaves). Time series Poisson regression coupled with a distributed lag linear model (DLM) was used to quantify the 14-day lags effect of heatwaves. Confounders including long-term trend, seasonality, days of the week, holidays, relative humidity were included in the model.

RESULTS: Heatwaves increased all-cause MBD hospitalization by 62% (95%Cl, 36%–93%) for the main effect, and by 8% (95% Cl, -3%–19%) for the added effect. Noticeably, the group aged 18 to 60 years old was affected by the main effect of the heatwave, while the group aged 61 years and older was affected by the added effect of the heatwave. The effects of heatwaves differed among groups of MBD hospitalizations. The mental and behavioral disorder group due to psychoactive substance use was significantly affected by the main effect of heatwaves (RR:2.21; 95%Cl:1.55–3.15). The group of schizophrenia, schizotypal and delusional disorders were highly vulnerable towards both the main and the added effect of heatwaves with RR=1.50 (95%CI, 1.20–1.86) and RR = 1.14 (95%CI, 1.01–1.30), respectively.

CONCLUSIONS: These results aroused the need for adequate heat warning and adaptation programs when temperatures are not too high but prolonged, particularly with the elderly

P-0704 Geospatial modelling of road-traffic noise levels and frequency and the attributable burden of annoyance and sleep disturbance in Accra, Ghana

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BACKGROUND AND AIM: Limited city-wide data on environmental noise and sources in rapidly growing sub-Saharan African (SSA) cities constitutes a major barrier for investigating health impacts as well as environmental policy making. In a first of its kind study in SSA, we modelled and predicted noise levels and road-traffic-specific sounds in Accra, Ghana, and estimated the attributable burden of being highly annoyed and sleep disturbed in high-spatial resolution.

METHODS: From 2019-2020, we collected measurements of sound levels and audio recordings along the roadside in a large-scale campaign. The audio was processed with a deep learning acoustic classifier to identify the frequency of road-traffic sounds. We combined the acoustic data with geospatial predictors in land use regression models (mixed models/random forest) to predict noise levels (Lden, Lnight) and the frequency of road-traffic-specific sounds across the city. Finally, by combining population exposures to predicted Lden and Lnight with literature informed exposure-response relationships and disability weights, we estimated the attributable burden of being highly annoyed and sleep disturbed in aggregate and by census enumeration area (median size: 0.03km2).

RESULTS: Predicted road-traffic sounds were prevalent throughout the day (median: 81% of the time present) and nighttime (median: 62%) in Accra. Furthermore, 99% of the population in lived in census enumeration areas where average Lden and Lnight surpassed WHO guidelines for road-traffic noise (Lden <53; Lnight <45). Noise exposures in Accra translated into 21% and 7% of the population highly annoyed and sleep disturbed, with significant variation across areas, and a combined 10,761 Disability Adjusted Life Years lost.

CONCLUSIONS: In an area of the world where noise research is severely lacking, this work can support epidemiological studies, burden of disease assessments, and the development of policies and interventions that address noise exposure within Accra.

KEYWORDS: Noise, Africa, health burden, land-use-regression, audio processing, road-traffic noise

P-0729 Use of insecticide-treated nets and other household insecticides for preventing malaria in six-year-old children in Benin, sub-Saharan Africa

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BACKGROUND AND AIM: In addition to early diagnosis and treatment of malaria, the cornerstone of malaria control lies in the use of insecticides such as long-lasting insecticidal treated nets (LLITNs), household spraying, mosquito coils or sprays. However, the quantification of other household insecticides use, including coils and sprays, was less assessed so far. The main insecticide used for LLITN, coils and sprays is pyrethroid. The objectives of the study were to describe the LLITN and other household insecticides used for preventing malaria and to determine factors associated with these different uses.

METHODS: Data were collected on 567 mothers from a birth cohort in the district of Allada, a semi-urban area in Benin. Mothers were interviewed using a standardized questionnaire when their offspring were 6 years of age. Associations between LLITNs, other household insecticide use, sociodemographic and environmental factors, were assessed using multiple logistic regression.

RESULTS: Eighty percent of mothers declared that their six-year-old child slept under a LLITN the night before the visit. Approximatively 23% and 7% of households used coils and sprays at home, respectively. When using coils, 62% of families were using them at least once a week. Being a girl, living with the father, having a high number of siblings at home, rainy season and non-use of coils at home were significantly associated with LLITN use. Use of coils was associated with non-LLITN use, having moved since child's birth and absence of stove in the house.

CONCLUSION

Children at six years of age were frequently sleeping under LLITN. However, a considerable proportion of them was sleeping in proximity to coils, but not under LLITN. These coils have no proven efficacy in the reduction of malaria vectors so far and may potentially expose children to pyrethroids.

THEMATIC 10: Environmental Equity

P-0755 Investigation on sociodemographic and health inequity of greenspace using different greenspace indicators in 3 US urban communities

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BACKGROUND AND AIM: Study results are inconclusive regarding how greenspace exposure differs by sociodemographic status potentially due to lack of consideration of varying dimensions of greenspace. We investigated the inequity of greenspace and its health effects by sociodemographic status comparing various greenspace metrics.

METHODS: We used five metrics: vegetation levels measured by Enhanced Vegetation Index (EVI), percent greenspace, percent tree cover, percent tree cover along walkable roads, and percent people living <500m of a park entrance (park accessibility). We used data for 2008–2013 in Census block groups in 3 US regions: New Haven, Connecticut; Baltimore, Maryland; Durham, North Carolina. We examined associations between each greenspace metric and indicators of income, education, linguistic isolation, race/ethnicity, and age. Logistic regressions examined associations between these greenspace metrics and age-standardized mortality controlling for sociodemographic indicators.

RESULTS: The region with the highest greenspace differed across metrics. Average percent greenspace was highest in Durham and lowest in Baltimore. Average percent people living <500m of a park entrance and percent tree cover along walkable roads were highest in New Haven. An interquartile range (64.7%) increase in people of color was associated with a 6.2% (95%CI: 3.1–9.3) increase in park accessibility, whereas it was associated with 0.03–7.3% decreases in other greenspace metrics. A 15.5% increase in the lower-education population was associated with a 2.1% increase (95%CI: -0.3%–4.6%) in park accessibility but decreases with other greenspace metrics (0.02–5.0%). The odds ratios of having an all-cause standardized mortality rate ≥75th percentile were inversely associated with all greenspace metrics except for park accessibility (OR=1.40, 95% CI: 0.52–3.75).

CONCLUSIONS: Environmental justice concerns and health benefits of greenspace can differ by form of greenspace and socioeconomic status within communities. Comparisons of greenspace between different greenspace metrics should be incorporated in decision-making.

KEYWORDS:
Environmental justice, greenspace, health inequity.

P-0758 Temperature and cardiovascular hospitalization in persons with and without disabilities: Invisible population in climate change discourse

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BACKGROUND AND AIM: The adverse health effects of non-optimal temperatures are disproportionately distributed in the population due to differential susceptibility and adaptive capacity to heat and cold. Although persons with disabilities (PwD) can be one of the susceptible populations, they have been neglected in the climate change discourse. This study aimed to investigate the association of ambient temperature with cardiovascular hospitalization in persons with and without disabilities.

METHODS: This study used the National Health Insurance Service-National Sample Cohort established by South Korea. Using nationwide data from 2003 to 2013, we conducted a space-time-stratified case-crossover study using a conditional Poisson regression with a distributed lag nonlinear model to investigate the association between daily mean temperature and cardiovascular hospitalization. The extreme and moderate heat (99th and 95th temperature percentile, respectively) and cold (1st and 5th temperature percentile, respectively) effects on hospitalization over ten days were estimated using the minimum hospitalization temperature (MHT) as a reference. All analyses were conducted separately by the existence of a disability.

RESULTS: A J-shaped association between temperature and cardiovascular hospitalization was found with the MHT at 22.2°C and 15.9°C in persons with and without disabilities, respectively. In persons without disabilities, the effects of hot temperatures were acute and lasted several days, while the effects of cold temperatures appeared after 2-3 days. In PwD, the effects of hot temperatures lasted up to 10 days, while the effects of cold temperatures appeared immediately with the following deficit in hospitalizations. The cumulative cold effects over ten days were higher in PwD than their non-disabled counterparts, although the cumulative heat effects did not show a significant difference.

CONCLUSIONS: PwD were more susceptible to cold-related hospitalizations compared to their non-disabled counterpart. Precision adaptation strategies to heat and cold that considers susceptibility in PwD are needed.

KEYWORDS: Temperature; Climate change; Health equity; Disability

P-0760 Historic redlining and the siting of oil and gas wells in the United States

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BACKGROUND AND AIM. The presence of active or inactive (i.e., postproduction) oil and gas wells in neighborhoods contributes to ongoing pollution. Racially discriminatory neighborhood security maps developed by the U.S. federal Home Owners Loan Corporation (HOLC) in the 1930s may contribute to environmental exposure disparities. Our aim was to determine whether receiving worse HOLC grades was associated with exposure to more oil and gas wells.

METHODS: We assessed exposure to oil and gas wells among HOLC-graded neighborhoods in 33 U.S. cities from 13 states where urban oil and gas wells were drilled and operated. Among the 17 cities for which 1940 census data were available, we used propensity score restriction and matching to compare well exposure neighborhoods that were similar on observed 1940 sociodemographic characteristics but that received different grades.

RESULTS: Across all included cities, redlined D-graded neighborhoods had 12.2 ± 27.2 wells km-2, nearly twice the density in neighborhoods graded A (6.8 ± 8.9 wells km-2). In propensity score restricted and matched analyses, redlined neighborhoods had 2.0 (1.3, 2.7) more wells than comparable neighborhoods with a better grade.

CONCLUSIONS: Our study adds to the evidence that structural racism in U.S. federal policy is associated with the disproportionate siting of oil and gas wells in marginalized neighborhoods.

KEYWORDS: Oil and gas, environmental justice, structural racism, health disparities

P-0766 Environmental Exposures in a Cohort of Swedish Women – Are there Inequalities by Socioeconomic Status?

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BACKGROUND AND AIM: Recent reviews provide evidence for inequalities in environmental exposures between and within European populations. The aim of this study is to explore differences in exposure to air pollution, road-traffic noise, and greenness by multiple socio-economic determinants in a female cohort in Sweden.

METHODS: 20,407 women born in 1914-48 residing in Uppsala County, Sweden, were followed from 1997 until migration, death, or end of follow-up in 2017. We combined survey data, time-varying register data, and spatial-temporal modelled air pollutants ($PM_{2.5}$, PM_{10}, NO_2), road-traffic noise (Lden), and greenness (NDVI) at the residences. We descriptively assessed exposures over time and by categories of socio-economic variables, including age, civil status, employment status, education, individual, household, and area-based income, and municipality type. We applied linear regressions estimated with generalized estimating equations to assess differences in environmental exposures by socio-economic levels.

RESULTS: at baseline (1997), the average age of 19,953 women with complete data was 61.9 years, 50% were still employed and 56% lived in urban areas. Compared with the baseline population, 67.8% (n=12,682) remained at the end of follow-up (2017). Over the 20-y follow-up, the average exposure to $PM_{2.5}$, PM_{10}, and NO_2 declined significantly, however, levels of road-traffic noise and greenness were stable. Small but statistically significant differences in exposures were found across socio-economic levels. Suggested predictors of high exposure to air pollution, noise, and low greenness (only PM_{10} changes compared to references and 95%-CI in $\mu g/m^3$ shown) include high age (0.09 [0.05; 0.13]), being unmarried (0.09 [0.01; 0.17]), divorced/widowed (0.09 [0.05; 0.12]), or retired (0.03 [0.01; 0.05]), having high education (0.07 [0.004; 0.14]), high individual income (0.03 [0.003; 0.05]), but low area-based income (0.26 [0.20; 0.31]).
CONCLUSION: This study provides evidence of a complex interplay between environmental exposure and levels of socio-economic determinants.

KEYWORDS: Air pollution, road-traffic noise, greenness, socio-economy, inequality

P-0767 Sociodemographic Determinants of PFAS Contamination in United States Community Water Supplies: An Analysis of Sampling Data from 11 States

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BACKGROUND AND AIM: Many studies show marginalized communities are disproportionately exposed to air pollution. However, relatively few studies have considered water quality disparities, including exposures to per- and polyfluoroalkyl substances (PFAS). We evaluated whether Community Water Systems (CWS) serving greater proportions of minority and low-income individuals had higher likelihoods of detecting PFAS and exceeding Maximum Contaminant Levels (MCL) using recent statewide drinking water monitoring data.

METHODS: We compiled drinking water PFAS concentration data from 11 states with statewide monitoring data and ancillary data on sociodemographics, CWS characteristics, active PFAS treatment, and PFAS sources. We examined associations between PFAS concentrations in drinking water and sociodemographics at various spatial units for 4,698 CWS (serving 62.2 million people) using multivariate logistic regressions.

RESULTS: CWS serving 20.8 million people (33%) had detectable concentrations (>5 ng/L) of at least one of five PFAS and those serving 16 million people (26%) exceeded the lowest state-level MCL for several PFAS. CWS with detectable PFAS levels and MCL exceedances served greater proportions of Hispanic and Black residents than those with PFAS levels below detection and without exceedances. at the county-level, a percentage point increase in the proportion of Hispanic residents served by a CWS was associated with a 4-6% increase in the odds of detecting PFAS. Results for state-level relationships were more mixed, although CWS in five of the 11 states had increased odds of detecting several PFAS for CWS serving counties with greater proportions of Hispanic residents.

CONCLUSIONS: Our findings suggest that CWS serving some communities with greater proportions of Hispanic and non-Hispanic Black residents have increased likelihood of detecting PFAS, including detection at levels above regulatory thresholds. These disparities are concerning and warrant consideration when planning remediation strategies and treatment for sites contaminated with PFAS.

KEYWORDS: Community water systems, Environmental justice, Drinking water, Anthropogenic compounds, Disparities

P-0777 Fine particulate matter component air pollution in American Indian vs. Non-American Indian communities

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BACKGROUND AND AIM: Exposure to fine particulate matter ($PM_{2.5}$) increases risk of numerous adverse health outcomes, with varying component-specific estimated effects. Prior work examining total $PM_{2.5}$ in primarily American Indian- (AI-) populated areas shows disparate trends over time compared to the rest of the US, with higher concentrations in more recent years. We compared trends in concentrations of six $PM_{2.5}$ components in American Indian (AI-) vs. non-AI-populated counties over time (2000 – 2017) in the contiguous US.

METHODS: Using a multi-criteria approach to classify counties as AI- or non-AI-populated, we ran component-specific linear mixed models to estimate differences in county-wide annual concentrations of sulfate, ammonium, nitrate, organic matter, black carbon, and soil from well-validated prediction models in AI- vs. non-AI-populated counties, adjusting for population density and median household income. We estimated whether trends in AI- vs. non-AI-populated counties varied over time using interaction terms with calendar year.

RESULTS: Our final analysis included 3,109 counties, of which 199 were classified as AI-populated (6.4%). On average, there was no difference in BC concentrations by AI-populated county type. Adjusted concentrations of all five other $PM_{2.5}$ components in AI-populated counties were significantly lower than in non-AI-populated counties. However, component-specific trends varied over time; sulfate and ammonium levels were significantly lower in AI- vs. non-AI-populated counties in 2000 but higher after 2011, nitrate levels were consistently lower in AI- counties, and black carbon, organic matter and soil levels showed inconsistent differences in AI- vs. non-AI-populated counties.

CONCLUSIONS: This study highlights how differences in time trends of certain components by AI-populated county type, namely sulfate and ammonium, are driving steeper declines in total $PM_{2.5}$ in non-AI vs. AI-populated counties, providing potential directives for air pollution regulations of key emissions sources on tribal and AI-populated lands.

KEYWORDS: particulate matter, air pollution, environmental disparities, environmental justice

P-0785 Modification by Multiple Social Stressors in Air Pollution-CVD Associations

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BACKGROUND AND AIM: Susceptibility to urban air pollution is shown to vary by chronic psychosocial stressors (e.g., poverty, violence), though it remains unclear whether a confluence of multiple stressors may compound susceptibility, or confound observed modification by any one stressor.

METHODS: We examined modification by multiple community stressors on relationships between spatio-temporal pollutant exposures and risk of cardiovascular (CVD) event in New York City, using conditional logistic regression in a case-crossover design. We used exhaustive data on all inpatient (admitted) CVD events presenting at NYC emergency departments from 2005-2011 (n = 837,523), fine-scale spatial maps for PM2.5, NO2, SO2, and O3 from NYC Community Air Survey, and daily EPA pollution and NOAA weather data.
A range of stressor indicators were drawn from Census and administrative databases, examined against focus group and survey data to confirm relevance to residents' stress experience. Due to concern about stressors clustering by race and ethnicity (i.e., non-random assignment into tracts), we adjusted year-round models (NO2 and PM2.5) for modification by tract composition.

RESULTS: Testing stressors individually, we found significant associations between NO2 and CVD risk only in the highest quintile for violent crime, felony assault, poverty, or socioeconomic deprivation (SDI). Associations in all other quintiles were non-significant, as were associations for all other pollutants.
In models including separate interaction terms for violent crime and SDI, NO2 was associated with significant increases in CVD risk in all quintiles. Associations for NO2 modestly increased across quintiles of increasing violence, but not SDI.

CONCLUSIONS: Observed patterns of modification differed substantially when including multiple stressor modifiers, increasing observed NO2-CVD associations overall. These results suggest a need to capture community stress experience more holistically, to reduce confounding across stressors which may dampen observed pollutant-health associations and modification.

KEYWORDS: Social susceptibility, chronic stress, urban health, air pollution, cardiovascular disease

THEMATIC 11: Ethics

P-0796 Management of the Afghan Refugee Resettlement Crisis and Integration Challenges to Public Health

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BACKGROUND
After the peak of conflict in Afghanistan in 2021, 2.2 million Afghan refugees were left seeking asylum. The US welcomed 76,000 Afghan refugees and this brings challenges including resettlement issues, integration and access to public benefits to alleviate personal and mental health concerns. This article aims to study the benefits and challenges that refugees present when resettling into the US.

METHODS: The authors reviewed published health studies on Afghan refugees. They have engaged with non-profit organizations like the International Rescue Committee that are leading efforts to alleviate the challenges of US refugees. The authors communicated directly with refugees to understand their challenges. The primary issues include resettlement during a housing crisis in the US, access to healthcare, language barriers, job opportunities, and focusing on the integration challenges that come with moving to a foreign land.

RESULTS: The refugee crisis has collided with US housing shortage making it difficult and expensive to provide housing for unemployed refugees, leaving many in hotels for long periods of time. Refugee access to healthcare is difficult because of lack of coverage coupled with the fear of reaching out layered on concerns over costs, communication and cultural barriers, and transportation. Although the US provides a system to gain permanent legal residency and citizenship through the Special Immigrant Visa (SIV), the process is backlogged, and thus Afghan social integration is hampered.
CONCLUSION
There is a lack of federal involvement in the Afghan refugee crisis which has placed an overwhelming burden on local governments and non-profit organizations. We suggest forming a taskforce to study refugee challenges and how to overcome those hurdles. These challenges will have a lasting impact on these refugees, and if they are not resolved there will be serious consequences impacting them from a health and wellness standpoint.

KEYWORDS: Afghan refugees, health integration challenges

POSTER DISCUSSION SESSION 09: Exposome | Health Impact Assessment, Risk communication and Participatory Epidemiology | Mechanisms and Molecular Biomarkers

THEMATIC 12: Exposome

P-0797 Per− and polyfluoroalkyl substances and psychosocial stressors have a joint effect on adverse pregnancy outcomes in the Atlanta African American Maternal-Child cohort

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BACKGROUND: African Americans (AAs) consistently experience high rates of adverse pregnancy outcomes relative to whites. Differential in utero exposure to environmental chemicals and psychosocial stressors may explain some of the observed health disparities, as exposures to per− and polyfluoroalkyl substances (PFAS) and experiences of discrimination have been linked to adverse birth outcomes, including preterm birth and fetal growth restriction. Few studies have examined chemicals and non-chemical stressors together as an exposure mixture, which may better reflect real-life exposure patterns. We adapted methods designed for the analysis of exposure mixtures to examine joint effects of PFAS and psychosocial stress on birth outcomes among AAs.

METHODS: Participants were a subset of the Atlanta African American Maternal-Child cohort for whom first trimester serum and questionnaire measures were available. Four PFAS (PFOA, PFOS, PFNA, PFHxS) were measured in 1st trimester serum samples and were natural log transformed for analysis. Validated questionnaires were administered during the first trimester and were used to assess psychosocial stress (perceived stress, depression, anxiety, gendered racial stress). Quantile g-computation and Bayesian kernel machine regression (BKMR) were used to estimate the joint effects between PFAS and psychosocial stressors on gestational age at delivery and birthweight for gestational age z-scores (N=348).

RESULTS: In quantile g-computation models, a simultaneous one quartile increase in all PFAS, perceived stress, depression, anxiety, and gendered racial stress was associated with a reduction in birthweight z-scores (mean change per quartile increase = -0.24, 95% confidence interval= -0.43, -0.06). BKMR similarly showed that increasing all exposures in the mixture was associated with a modest decrease in birthweight z-scores, but not a reduced length of gestation.

CONCLUSIONS: Using methods designed for analyzing exposure mixtures, we found that a simultaneous increase in in utero PFAS and psychosocial stressors was associated with reduced fetal growth.

KEYWORDS: stress, pregnancy, mixture, PFAS

P-0804 Exposomic Analysis of Organic Pollutants in Seminal Plasma and Male Reproductive Parameters

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Previous studies of environmental exposures and male reproductive health have typically examined limited sets of exposures in the urine, which may not accurately capture the chemical burden in relevant tissues and do not consider a large range of concurrent exposures. Here, we used a combined targeted and untargeted exposome approach to identify novel associations of environmental pollutants found in seminal plasma, as individual metabolites and co-exposure patterns, with male reproductive parameters.

Semen samples were collected from male partners from 100 heterosexual couples undergoing assisted reproductive treatment in Tel Aviv after 2-7 day abstinence. Semen parameters were assessed for sperm concentration, percent motility, and total motile sperm. Using a novel QuEChERS (quick, easy, cheap, efficient, rugged, and safe) extraction method, 118 targeted and 2005 untargeted organic pollutant exposures were measured from seminal plasma using gas chromatography. We used linear regression, principal component pursuit (PCP), and Bayesian Kernel Machine Regression (BKMR) to estimate the associations of organic pollutants with semen parameters.

Using an exposome-wide association approach, we found that etriadizole, a common pesticide, was negatively associated with total motile sperm ($p<0.001$), concentration ($p=0.002$), and percent motility ($p=0.04$). Using PCP, a machine learning pattern recognition approach, we derived a low-rank matrix with one major principal component. This principal component was primarily loaded by one phthalate (diethyl phthalate) and three PAHs (anthracene, pyrene, phenanthrene) and was associated with lower total sperm ($p=0.03$) and percent motility ($p=0.05$). BKMR results confirmed that as an overall mixture, these four pollutants were negatively associated with percent motility, although anthracene was not important to the mixture effect.

Seminal plasma levels of etridiazole, diethyl phthalate, and polycyclic aromatic hydrocarbons (PAHs) are negatively associated with semen parameters. Future exposomic investigations using seminal plasma are warranted.

KEYWORDS: exposomics; exposome; seminal plasma; reproduction; reproductive health; semen; sperm; pesticide, etridiazole, phthalates, PAH

P-0813 A multi-environmental media approach to explore the association between metal exposure and the ability to identify smells among school-age children residing in Northern Italy

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BACKGROUND AND AIM: Inhalation of airborne particles can lead to olfactory dysfunction. We aimed to test the association between the exposure to a mixture of 12 metals measured in three environmental media and olfactory function among children and adolescents residing at different distances from ferromanganese alloy plants in the province of Brescia, Italy.

METHODS: We enrolled 130 children between 6 and 13 years old (51.5% females) residing in Valcamonica and Bagnolo Mella, respectively. The Burghart “Sniffin` Sticks” test was used to investigate olfactory performance in identifying smells. Metal concentrations in soil, indoor, and outdoor deposited dust samples from the subjects’ households were analyzed with a portable X-ray fluorescence instrument. A Multi Environmental Media (MEM) Weighted Quantile Sum (WQS) regression for count data was applied to test for the association between the exposure to metals and child olfactory function. All models were adjusted by age, sex, socio-economic status, area of residence, intelligence quotient, BMI and passive smoking.

RESULTS: The metal mixture was negatively associated with the identification score (□=-0.229; 95%CI -0.439, -0.018). Cadmium (17.0%), iron (13.0%), lead (11.5%) and arsenic (8.5%) provided the strongest contribution to the association. Indoor dust resulted as the environmental media with the strongest contribution to the association with olfactory function for most of the elements considered in the mixture.

CONCLUSIONS: We identified metal concentrations in indoor dust as a risk factor for olfactory dysfunction in children and adolescents residing close to ferroalloy plants. Indoor pollution can be improved through public health interventions; moreover, the identification of the factors that can deteriorate olfactory functions can also prevent neurodegenerative disease.

KEYWORDS: Environmental exposure; olfactory function; metal exposure; soil; outdoor dust; indoor dust.

THEMATIC 14: Health Impact Assessment, Risk communication and Participatory Epidemiology

P-0904 Seasonal and spatial patterns of mortality and socio-economic characteristics associated with exposure to air pollution and a lack of green areas

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BACKGROUND AND AIM. Air pollution and lack of green spaces can be important burdens to health, contributing to considerable levels of mortality and morbidity. The objective of this study was to quantify – at a high spatial resolution (the statistical sector level in Belgium)- associated mortality estimates and socio-economic inequalities.

METHODS: We combined high-resolution (10x10 metre) annual and seasonal modelled data on air pollution (NO2, PM2.5, BC, O3) and NDVI-data (as a proxy for green space availability) with relative risk estimates from published meta-reviews on the relation between total mortality, cause-specific mortality and exposure to those environmental stressors. We calculated annual and seasonal population attributable fraction (PAF), being the percentage of the total mortality that can be explained by exposure to air pollution and lack of green space.

RESULTS: More than 10% of all annual deaths are associated with air pollution in Belgium with strong spatial and seasonal variations. for nitrogen dioxide, double the amount of deaths occurring in the winter compared to summer and in terms of spatial patterns, the population attributable fraction ranges from < 5% in some statistical sectors to >20% in other statistical sectors. for green spaces, we examined that, in some areas with very limited presence of green spaces, up to 20% of mortality could be prevented if those areas were as green as the greenest areas in Belgium. Socio-economic inequalities are significantly associated with the seasonal and spatial patterns of mortality related to air pollution and a lack of green areas.

CONCLUSIONS: A lack of green spaces and air pollution are causing considerable amounts of mortality. There are strong spatial and temporal variations in the amount of attributable mortality. at the same time, socio-economic inequalities are strongly associated with increased attributable mortality.

KEYWORDS: Health impact assessment, air pollution, green spaces, socio-economic characteristics, environmental equity.

P-0925 Lanthanum, cerium and praseodymium in urban topsoils, an emerging health concern?

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BACKGROUND AND AIM: Rare earth elements (REEs) are contaminants of emerging concern. Lanthanum (La), cerium (Ce) and praseodymium (Pr) were monitored in the environment of Alcalá de Henares, one of the biggest cities in the Community of Madrid (Spain), to characterise their risks for the population.

METHODS: Ninety-four topsoil samples were collected in July 2017: urban (66), industrial (24) and city centre public garden (4). REEs were analysed by ICP-MS after acid digestion in a microwave system.

RESULTS: REEs were detected in all samples and presented identical distribution, i.e. higher and significantly higher concentrations in the garden and industrial areas, respectively, compared to the urban area. This distribution would be logical due to their anthropic uses in fertilisers (e.g., higher concentrations of REEs has been detected in fertilisers used in Spain), as additives in ceramics/glass (Alcalá had important ceramic fabrication) and electronic/industrial uses (e.g. in alloys, catalytic converters, phosphors). Our results might suggest a low anthropic input in urban topsoils in Alcalá, as the ranges (mg/kg) of La (2.13-36.01 vs. 1.10-143), Ce (4.03-72.87 vs. 2.45-267) and Pr (0.55-8.84 vs. 0.29-31.6) found were lower than their baseline concentrations reported in topsoils in Europe. Levels were also lower than the averages reported in Spanish soils as reference (17.92 vs. 33; 36.57 vs. 63; 4.51 vs. 7.7; respectively), suggesting low contamination. Provisional reference doses for La and Pr were used to characterise non-carcinogenic risks for ingestion/dermal contact, which were lower than the threshold.

CONCLUSIONS: There is no potential risk of toxic pathology resulting from the ingestion/dermal contact of La and Pr in soils and resuspended soils for the different areas monitored in Alcalá. However, efforts should be initiated to determine the toxic effects of REEs, especially Ce owing to its high presence, for a better characterisation of the risks to these emerging contaminants.

P-0929 Dwelling mouldy area size and current asthma in adults from the French CONSTANCES cohort

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BACKGROUND AND AIM: Mould presence is a key determinant of poor indoor air quality. Data on mouldy contamination and its effects on respiratory health from nationwide population-based studies are scarce. We studied the associations between visible mould, including for the first time their area size, and current asthma in adults from the population-based cohort Constances.

METHODS: Participants responded to 2019 self-questionnaire on mould exposure. Reports of visible mould (yes/no), and of mouldy area, i.e., maximum area size in bathroom, kitchen, or main living quarter (living room, bedroom), expressed as: 0m², spots, <0.2m², [0.2m²-1m²[, [1m²-3m²] or >3m²) were studied. Between 2019-2021, participants had one medical exam including a self-questionnaire on respiratory health. Current asthma was defined among ever-asthmatics by self-report of asthma attacks, symptoms or treatments in the last 12 months. Logistic models adjusted for age, sex, smoking and occupant-surface ratio were performed.

RESULTS: Visible moulds were reported by 21.2% of the 21,390 adults included in the analyses (mean age: 48 years, 51.4% women, 31.8% living in flats, 7.7% current asthma). Mouldy area of spots, <0.2m², [0.2m²-1m²[, [1m²-3m²] or >3m² were reported by 12.9%, 6.0%, 1.4% 0.6%, and 0.3% of the participants, respectively. Report of visible moulds was associated with current asthma (adjusted(a)OR[95%CI]=1.25[1.11-1.41], this association being more marked 1) when restricting to the main living quarter: aOR=1.43[1.20-1.69], or 2) for those living in flats as compared to those living in houses: aOR=1.44[1.19-1.75]. The likelihood of current asthma increased with increasing mouldy area (from spots to >3m², 0m² as reference): aOR=1.21[1.05-1.39], 1.36[1.12-1.65], 1.09[0.73-1.63], 1.60[0.93-2.74], 1.42[0.62-3.25] (pTrend=0.0004).

CONCLUSIONS: More than 20% of participants reported visible mould in a population-based cohort in France in 2019. Visible mould and mouldy area size were associated with an increased risk of current asthma in adults, highlighting the need for prevention measures.

KEYWORDS: Asthma, mould exposure, indoor air

P-0945 Occupational exposure to benzene and risk of non-Hodgkin lymphoma in Shanghai: an extended follow-up of two population-based prospective cohorts of Chinese women and men

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BACKGROUND AND AIM: The carcinogenicity of benzene, a ubiquitous environmental chemical causally associated with acute myeloid leukemia, was reevaluated by the International Agency for Research on Cancer in 2017, with the Working Group reaffirming positive yet still inconclusive associations with non-Hodgkin lymphoma (NHL). To extend our previous observation of a significant exposure-response for cumulative occupational benzene exposure and NHL risk among Chinese women in a population-based prospective cohort in Shanghai, we conducted additional follow-up of this cohort and pooled the data with a similarly designed population-based cohort of men in Shanghai.

METHODS: Benzene exposure status and cumulative exposure estimates were derived for 134,449 participants in the pooled analysis using a previously developed exposure assessment framework that combined ordinal job-exposure matrix intensity ratings with quantitative benzene exposure measurements from an inspection database of Shanghai factories. Associations between benzene exposure metrics and total NHL (n = 363 cases including multiple myeloma (MM)) were assessed using Cox proportional hazard models.

RESULTS: Ever occupational exposure to benzene in the pooled population was significantly associated with increased NHL risk (HR=1.5, 95%CI=1.2-2.0), and significant exposure-response relationships were observed for increasing duration (ptrend=0.003) and cumulative exposure (ptrend=0.003). The associations with ever exposure, duration, and cumulative exposure were similar for NHL with and without MM in the case definition, including lifetime cumulative exposures in the highest quartile (HR=1.6, 95%CI=1.1-2-4 with MM included; HR=1.7, 95%CI=1.1-2.7 with MM excluded). No significant heterogeneity in the associations by study/sex was observed. An elevated risk of chronic lymphocytic leukemia was also suggested in the pooled analyses (HR for ever vs. never exposure=2.3, 95%CI=0.9-5.6).

CONCLUSIONS: These observations provide additional data to support and extend the most recent IARC reevaluation of benzene carcinogenicity and suggest that benzene is a lymphomagen and are consistent with substantial mechanistic data.

KEYWORDS: Benzene, non-Hodgkin lymphoma, NHL

P-0948 Estimating the health burden of ambient fine particulate matter in Korea

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Korea has been making efforts to reduce the PM2.5 concentration through policy intervention but the PM2.5 level still belongs to a lower group among OECD countries. The aim of this study is to thus to evaluate the cases of premature deaths due to PM2.5 levels in Korea using AirQ+ model. We also examined the effect of reducing the burden of disease according to the current level of PM2.5 and future reduction targets in Korea.

The burden of disease analysis of PM2.5 was based on cases of premature death of chronic obstructive pulmonary disease (COPD), stroke, ischemic heart disease (IHD), acute lower respiratory disease (ALRI), and lung cancer (LC). for the scenario, the current PM2.5 conc. of 25 $\mu g/m^3$, and the future reduction targets of 17 $\mu g/m^3$ and 15 $\mu g/m^3$ were applied. Also, Statistics Korea's population and baseline mortality data by disease were used.

The premature deaths of the five diseases due to the current and future PM2.5 scenarios in Korea were calculated as 12826, 12808, and 13223, respectively. The increase of premature deaths cases due to aging in the future population offset the effect of improving PM2.5, and thus the actual number of deaths did not decrease. However, the contribution rates of PM2.5 to the premature death cases decreased to 15.8%, 12.2%, and 11% as the concentration improved. In particular, the concentration rate of PM2.5 in ALRI, COPD, and LC decreased by more than 5%.

In conclusion, it could be more effective to estimate the contribution rate rather than the absolute death case for the health improvement effect due to the reduction of PM2.5 in the case of countries where aging is expected in the future. In addition, this study showed that the reduction of PM2.5 in Korea was slightly more effective in reducing premature death of respiratory disease than cardiovascular disease.

THEMATIC 15: Mechanisms and Molecular Biomarkers

P-0966 DNA methylation and aeroallergen sensitization – The chicken or the egg?

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BACKGROUND AND AIM: DNA methylation (DNAm) is considered a plausible pathway through which genetic and environmental factors may influence the development of allergies. However, causality has to be determined as it is unknown whether DNAm is rather the cause or consequence of allergic sensitization.
Here, we investigated the direction of the observed associations between well-known environmental and genetic determinants of allergy, DNAm, and aeroallergen sensitization using a combination of high-dimensional and causal mediation analyses.

METHODS: Using prospectively collected data from the German LISA birth cohort from two time windows (6&10 years: N=234; 10&15 years: N=167), we tested whether DNAm is the cause or the consequence of aeroallergen sensitization (specific immunoglobulin E>0.35kU/l) by conducting mediation analyses for both directions of effect using prenatal smoking, family history of allergies, and a polygenic risk score (PRS) for any allergic disease as exposure variables. We evaluated individual CpG sites (EPIC BeadChip) and allergy-related methylation risk scores (MRS) as potential mediators in the mediation analyses. We applied various high-dimensional mediation approaches (HIMA, DACT, gHMA) and validated results using causal mediation analysis.

RESULTS: We identified five CpGs using HIMA and DACT as mediators of sensitization with significant ($p<0.05$) indirect effects in the causal mediation analysis (smoking: 2 CpGs, family history: 1, PRS: 2). The effect of family history on allergy-related MRS was significantly mediated by aeroallergen sensitization (proportions mediated: 36% to 51%), suggesting changes in DNAm occurred prior sensitization.

CONCLUSIONS: The results indicate that DNAm may be a cause or consequence of aeroallergen sensitization depending on genomic location. Allergy-related MRS, identified as a potential cause of sensitization, can be used as a cross-sectional biomarker of disease. Differential DNAm in individual CpGs, identified as mediators of the development of sensitization, could be used as clinical predictors of disease development.

KEYWORDS: High-dimensional mediation analysis, allergies, Methylation risk scores

P-0967 Contribution of gut bacteria to arsenic metabolism in the first year of life in a prospective birth cohort

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BACKGROUND AND AIM: Gut bacteria are at the interface of environmental exposures and human systems, and may aid host metabolism and excretion of toxic chemicals. We investigated whether arsenic metabolism by gut bacteria is related to arsenic exposure and metabolism.

METHODS: In the New Hampshire Birth Cohort Study, urine and stool samples were obtained at six weeks (n=186) and one year (n=190) of age. Inorganic arsenic (iAs), monomethylarsonic acid (MMA), dimethylarsinic acid (DMA), and arsenobetaine (AsB) were quantified in infant urine samples using high-performance liquid chromatography with inductively coupled plasma mass spectrometry. Total arsenic exposure (tAs) was summarized as Σ(iAs, MMA, DMA) and log10-transformed. Fecal DNA underwent metagenomic sequencing and the relative abundance of bacterial gene pathways were grouped as KEGG Orthologies (KOs) using BioBakery algorithms. In the first set of models, arsenic-related KOs with >80% detection were log10-transformed and modeled continuously using linear regression, those with <10% were not evaluated and those with 10-80% detection were analyzed dichotomously (detect/non-detect) using logistic regression. Models adjusted for age at sample collection and child's sex. Effect modification by delivery mode was assessed in stratified models. In the second set of models, the association between the relative abundance/detection of the KOs and arsenic speciation (%iAs, %MMA, %DMA) was assessed with linear regression.

RESULTS: tAs was associated with the increased relative abundance/detection odds of several arsenic-related KOs, including K16509, an arsenate reductase transcriptional regulator, with stronger associations among six-week-olds than one-year-olds. K16509 was also associated with increased %MMA and %DMA at six weeks and one year, suggesting it contributes to host metabolism. Notably, many associations were stronger among Caesarean-delivered than vaginally-delivered infants, suggesting vertical transfer of arsenic-related genes.

CONCLUSIONS: Our findings suggest that the infant gut microbiome may be responsive to arsenic exposure and may aid host metabolism and excretion.

KEYWORDS: arsenic, microbiome

P-0976 Prenatal polycyclic aromatic hydrocarbon (PAH) exposure in relation to placental corticotropin releasing hormone (pCRH) in a sociodemographically diverse U.S. cohort

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BACKGROUND AND AIM: Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous endocrine-disrupting combustion by-products that have been linked to preterm birth. One possible mechanism underlying this association is disruption of placental corticotropin releasing hormone (pCRH), a key hormone implicated in parturition. Extending prior research identifying pCRH as a potential target of endocrine disruption, here we examine maternal urinary PAHs in relation to pCRH in the sociodemographically diverse CANDLE cohort, part of the ECHO-PATHWAYS Consortium.

METHODS: In a subset of 810 pregnant CANDLE participants, we measured urinary mono-hydroxylated PAH metabolites in Trimester 2 (T2) and serum pCRH in T2 and Trimester 3 (T3). Associations between individual log-transformed PAHs and log(pCRH) (at each timepoint as well as the change over time) were estimated using linear regression models. Minimally adjusted models included gestational age and specific gravity, while fully adjusted models also included sociodemographic characteristics. We additionally evaluated effect modification by factors including pregnancy complications and fetal sex.

RESULTS: Participants were 62% Black, 32% White, and mean age 26.8±5.6 years. In minimally adjusted models, most PAH metabolites were inversely associated with pCRH concentrations. for instance, 1-hydroxypyrene was associated with lower T2 (β=-0.10, 95%CI: -0.16, -0.03) and T3 (β=-0.08, 95%CI: -0.15, -0.003) log(pCRH). After adjustment for sociodemographic factors, however, results were attenuated for all PAHs, including associations between 1-hydroxypyrene and log(pCRH) at T2 (β=-0.01, 95%CI: -0.07, 0.06) and T3 (β=0.01, 95%CI: -0.07, 0.08). There was no evidence of effect modification by any factors considered.

CONCLUSIONS: In the only epidemiological study of PAHs and pCRH to date, we observed little evidence of association after adjustment for covariates. PAHs may nevertheless affect timing of birth through other mechanisms, such as inflammatory or oxidative stress pathways.

P-0995 Maternal DNA Methylation Signatures of Arsenic Exposure is Associated with Adult Offspring Insulin Resistance in the Strong Heart Study

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BACKGROUND AND AIM: Exposure to low-to-moderate arsenic levels has been associated with type 2 diabetes (T2D) and other chronic diseases in American Indian communities. Prenatal exposure to arsenic may increase the risk for T2D in adulthood, however, detection of long-term disease risk due to arsenic exposure has yet to be realized. We hypothesized that a molecular biosignature of arsenic exposure in mothers can be used to evaluate risk for T2D-related outcomes in offspring into adulthood.

METHODS: We evaluated the association of maternal DNA methylation with incident T2D and T2D-related variables (fasting glucose, homeostatic model assessment of insulin resistance (HOMA2-IR)) in adult offspring. for DNA methylation, we used 20 differentially methylated cytosine-guanine dinucleotides (CpG) associated with urinary total arsenic in the Strong Heart Study.

RESULTS: 6 CpGs were associated with HOMA2-IR in a fully adjusted model that included offspring adiposity measurements; a similar model that included maternal adiposity measurements showed 3 CpGs associated with HOMA2-IR, 2 that overlapped the offspring adiposity model. Using the 6 HOMA2-IR-associated CpGs, 3 associated with offspring fasting glucose in unadjusted models, although none remained significantly associated in adjusted models. Finally, the adjusted odds ratio of incident T2D was positively associated with maternal DNA methylation at one HOMA2-IR associated CpG, cg12116137. Our results indicated offspring adiposity had the largest effect on effect estimates between unadjusted and fully models, suggesting offspring adiposity as potentially mediating the relationship between maternal DNA methylation and offspring metabolic health.

CONCLUSIONS: We identified several arsenic exposure-associated CpGs in mothers that were associated with HOMA2-IR, and one CpG of which also associated with incident T2D, in offspring. Our findings support a role for epigenetic biosignatures of maternal arsenic exposure as a potential biomarker for evaluating risk of T2D-related outcomes in offspring later in life.

KEYWORDS:
American Indians, arsenic, diabetes, epigenetics, insulin resistance, DNA methylation

P-0996 Establishing a method to isolate blood-borne extracellular vesicles derived from microglia: a critical biomarker source for environmental exposure-linked neurotoxicity

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BACKGROUND AND AIM: Extracellular vesicles (EVs) are membrane-bound nanostructures, whose contents are increasingly recognized for their potential as biomarkers and mediators of environmental exposures. The function of EVs as intercellular communicators further suggests their involvement in disease mechanisms. Microglial cells, critical for brain homeostasis, appear to be instrumental in the neurotoxic effects of aerosolized pollutants. Particulate matter (PM) exposure was shown to activate microglial cells and stimulate EV release in experimental models. To better elucidate potential mechanisms underlying air pollution-induced brain pathophysiology, we aimed to develop the first method to isolate microglial-derived EVs from human plasma samples. We compared the efficiency of two microglial-specific cell surface markers and evaluated protein enrichment to determine microglial origin.

METHODS: We isolated microglial-EVs using a direct immunoprecipitation (IP) protocol, which we previously optimized for astroglial-EVs, with antibodies against homeostatic, microglia-specific markers for the purinergic receptor P2Y12 and cell-surface protein TMEM119. Starting with 0.5mL of plasma, we incubated samples in different concentrations of primary antibody solution. We utilized nanotracking particle analysis (NTA) and transmission electron microscopy (TEM) to characterize EVs, and enzyme-linked immunoassays (ELISAs) to evaluate concentrations of different neuronal, glial, microglial, as well as EV and non-EV associated protein markers.

RESULTS: Preliminary ELISA results showed greater concentrations of the pan-EV marker syntenin-1 in microglial EVs isolated using P2Y12 compared to TMEM119. Additional ELISA data for P2Y12 microglial-derived EVs showed little enrichment of neuronal and astrocytic protein markers for neurofilament light chain (NEFL), glial fibrillary acidic protein (GFAP), and glutamine synthetase (GLUL), compared to microglial protein markers of P2Y12. NTA results of EVs isolated using P2Y12 showed 1.73x107 particles/mL, with an approximate size of 187.45nm (SD: 20.16nm).

CONCLUSIONS: Preliminary results suggest that an IP using microglial antibodies specific to P2Y12 may be a feasible, lower-cost technique for isolating microglial derived EVs.

P-0997 Epigenetic Modulations with BPA and PFOA Exposure Prior to Pubertal Onset in Growing Up Female

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BACKGROUND AND AIM: Changes in the degree of DNA methylation in peripheral blood may occur with exposure to an environmental chemical. Examining the differential methylation status by exposure to BPA or PFOA will begin to address the interaction between the epigenome and environmental exposures. Our aim was to identify CpG sites of increased or decreased DNA methylation, which may provide clues to the mechanism whereby the exposure causes a change in pubertal development.

METHODS: 108 girls of the Cincinnati BCERP puberty study cohort with banked blood samples obtained prior to thelarche (when the girl was observed to be in Tanner breast stage 2 (-18 or -24 months) were selected for this discovery study. Eligibility requirements included consistent breast staging (no regression to breast stage 1 after being observed in breast stage 2) and the thelarche-first pubertal maturation pathway. Genome-wide methylation was measured using the Illumina 850K methylation bead chip assay. Serum perfluorooctanoic acid and urinary bisphenol-A were measured at CDC. Association analyses, without the Y chromosome probes and using a paired t-test with a false discovery rate (FDR) control at 0.05 were conducted on the methylation array data.

RESULTS: Median urinary BPA and serum PFOA were 1.7ng/ml and 7.55 ng/mL Linear regression models were used to test the main effect of BPA or PFOA on percent methylation adjusting for race. After adjusting for multiple testing, no significant association existed between urinary BPA and degree of methylation at any site. for serum PFOA, we identified 20 CpG sites with FDR<0.05. The CpG site with smallest P-value was cg18323749.
CONCLUSION: PFOA exposure prior to puberty may result in changes in the degree of DNA methylation at certain CpG sites, which may result in changes in gene expression and consequently changes in pubertal development.

KEYWORDS: PFOA, BPA, DNA methylation, puberty

POSTERS DISPLAYED ONSITE

DAY 1 (Monday, September 19)

THEMATIC 01: Advances in Epidemiology and Statistical

P-0001 A Machine Learning Exposure Response Analysis of the effect of PM2.5 on Myocardial Infarctions Using Regression Adjustment Causal Modeling

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BACKGROUND AND AIM: The association of short-term exposure to PM2.5 with myocardial infarctions is well established and recent studies provide evidence for long-term exposure as well. Few have used causal modeling approaches to examine the concentration-response association.
METHOD: Using the U.S. Medicare cohort between 2000 and 2016 we stratified PM2.5 exposure into deciles. Within each decile, we fit a gradient boosting algorithm predicting the risk of MI based on multiple SES variables, smoking rate, mean BMI, access to care variables, race/ethnicity and exposure to NO2 and O3, and calendar year. We then applied those 10 models to the entire cohort, to predict the counterfactual risk of MI had everyone been exposed to each decile. We bootstrapped the process 200 times to obtain confidence intervals.

RESULTS: We find a significant association with no evidence of a threshold down to 5 μg/m3. Each 1 μg/m3 increase in PM2.5 increased the MI rate by 0.148 cases per 1000 per year (95% CI 0.139, 0.156).

CONCLUSIONS: Annual PM2.5 exposure increases the risk of Myocardial Infarctions in the Elderly.

KEYWORDS: Causal, Machine Learning, PM2.5, Heart Attacks

P-0002 Effect of pesticides exposure on oxidative stress and epigenetic changes biomarkers in Czech adults and children from the CELSPAC-SPECIMEn cohort

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BACKGROUND AND AIM: Pesticides exposure occurs through diet and environmental application readily in both agricultural and urban settings. While pesticides exposure has been associated with many health effects, the question of the adverse outcome pathways is still not clearly answered. Among various molecular mechanisms linked to pesticide-induced chronic diseases, DNA damage due to oxidative stress and their role in epigenetics seems to be of great importance. Thus, we have explored the associations between pesticide metabolites and biomarkers of oxidative stress and epigenetic changes in urine samples from Czech adults and children population during two seasons.

METHODS: A total of 440 adult-child pairs urine samples were collected during winter and summer season of 2019-2020. Twelve current-use pesticides or their metabolites were measured in urine as well as 8-hydroxydeoxyguanosine and five methylated DNA bases as biomarkers of oxidative stress and epigenetic changes, respectively. To examine the associations, linear mixed effect models accounting for intraindividual and intrahousehold correlations were utilized. We have applied false discovery rate procedure (FDR) to account for multiplicity and have adjusted for several potential confounding variables.

RESULTS: In fully adjusted single exposure models, pyrethroids, chlorpyrifos and tebuconazole metabolites were associated with changes in both oxidative stress and epigenetic biomarkers. In the final fully adjusted multiple exposure model, the greatest effect estimate was observed for chlorpyrifos metabolite which interquartile range change was associated with 15.1 % increase (FDR adjusted 95% confidence interval = 1.16, 31.0) in 5-methyl cytosine biomarker concentration.

CONCLUSIONS: Our findings showed some significant associations between urinary metabolites of current-use pesticides and oxidative stress biomarker and methylated DNA bases measured in human urine of general population. These findings suggest potential use of oxidative stress and epigenetic changes biomarkers in future epidemiological studies linking exposure to pesticides and health outcomes.

KEYWORDS: pesticides exposure, chlorpyrifos, oxidative stress, epigenetic, DNA methylation

P-0004 Adjustment for Unmeasured Spatial Confounding in Settings of Continuous Exposure Conditional on the Binary Exposure Status: Conditional Generalized Propensity Score-Based Spatial Matching

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BACKGROUND AND AIM: Generalized propensity score (GPS) is used to estimate causal effects of continuous treatments/exposures. The valid estimation relies on the assumption of no unmeasured confounding. Many environmental, demographic, built-environmental, behavioral, and health data can exhibit spatial patterns, raising concerns of unmeasured spatial confounding. Furthermore, researchers are often confronted with settings where continuous exposure is conditional on binary exposure status (e.g., level of a contaminant (continuous) within a specified radius from residence (binary)). Both binary and continuous exposures can commonly exhibit spatial patterns, such that unmeasured spatial confounding in both dimensions may be concerning. We developed a novel GPS matching method for such settings, called conditional GPS (CGPS)-based spatial matching (CGPSsm).

METHODS: CGPSsm estimates the average treatment effect in the treated. CGPSsm matches exposed observational units (e.g., exposed participants) to unexposed units by their spatial proximity and GPS integrated with spatial information. GPS is estimated by separately estimating PS for the binary status (exposed vs. unexposed) and CGPS on the binary status. Spatial regression and machine learning can be leveraged to estimate GPS. A motivating example is to investigate the association between refineries with high petroleum production and refining (PPR) and stroke prevalence in the southeastern USA.

RESULTS: CGPSsm maintains the salient benefits of propensity score matching and spatial analysis: straightforward assessments of covariate balance and adjustment for unmeasured spatial confounding. Statistical simulations showed that CGPSsm can adjust for unmeasured spatial confounding. Using our example, we found positive association between PPR and stroke prevalence.

CONCLUSIONS: CGPSsm has potential in epidemiological studies where exposure has both binary and continuous attributes and unmeasured spatial confounding may be of concern (e.g., accessibility to emergency services, exposure to nearby environmental factors, and surrounding built environments). Our R package, CGPSspatialmatch, is publicly available.

KEYWORDS: Causal inference; Generalized propensity score; Spatial confounding; Machine learning

P-0005 Counternull sets in randomized experiments

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Consider a statistical analysis for a randomized experiment that draws inferences based on hypothesis testing. In such settings, the plausibility of a null hypothesis is often examined using a p-value associated with a test statistic. In controlled experiments such as the ones that Bob conducts, Fisher-exact p-values are available and should be used to help evaluate results rather than the more commonly reported asymptotic p-values associated with common statistical tests (e.g., t-tests). Low p-value typically indicates some evidence against the null hypothesis, and when p-values are large, no definite statistical conclusions should be drawn! To avoid misinterpretations when testing a null hypothesis, we will present the “counternull value”, which was first defined by Rosenthal and Rubin (1994) and illustrate these concepts using some of Bob's chamber experiments.

P-0008 Performance of Competing Methods for Quantile Regression with Count Data: A Simulation Study with Applications for Environmental Epidemiology

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BACKGROUND AND AIM: Quantile regression is a useful tool in health research, but count data, which are common in environmental epidemiology, are incompatible with frequentist quantile regression. Using Bayesian methods and applying dithering (also known as jittering) to frequentist methods are possible workarounds, but the optimal strategy is unclear. We compared the performance of all available methods for quantile regression on count data, including 11 dithered frequentist methods and two undithered Bayesian methods. We also assessed whether dithering was associated with a loss of performance.

METHODS: We conducted Monte Carlo simulation studies to estimate the empirical coverage probabilities, bias, variability of point estimates, and interval widths of all methods. We simulated various scenarios (smaller sample sizes, heteroscedasticity, lognormal covariates, skewed error distributions) that might occur in the field of environmental epidemiology.

RESULTS: Point estimates from Bayesian quantile regression were the slightly less variable, and may be slightly less biased in certain circumstances. The adjusted Bayesian ("bnid") method had good empirical coverage probabilities, while the xy-bootstrap and rank-based methods had nearly perfect coverage. In contrast, the unadjusted Bayesian ("biid") method had poor coverage. Finally, the adjusted Bayesian ("bnid") and rank-based methods had the most variable interval widths. Dithering did not diminish performance.
CONCLUSION: We recommend the xy-bootstrap with dithering for conducting quantile regression with count data; xy-boostrapping had the best performance and it is easily implemented. We also found that dithering is a valid technique and endorse its use for count data, although it is unnecessary for continuous data.

KEYWORDS: Quantile regression, simulation study, count data, epidemiological methods, Bayesian statistics

P-0009 Time series clustering using self-organizing maps to identify longitudinal pollutant exposure profiles

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BACKGROUND AND AIM: Metrics for assessment of air pollutant exposures are often reduced to summaries of time-series data. These overlook detailed patterns of high-resolution diurnal data, possibly obscuring important features of exposure for health response. We use a novel methodology featuring self-organizing maps (SOMs) to perform time-series classification to identify distinct diurnal patterns of air ambient pollution in Southern California.

METHODS: SOMs are an unsupervised learning process for multi-dimensional data reduction with the ability to discern distinct temporal patterns, particularly at high temporal resolution. We implemented a two-stage approach using: 1) SOM with dynamic time warping to perform dimensionality reduction and feature extraction, and 2) partitioning around medoids (PAM), a time-series clustering method, to identify clusters of characteristic diurnal profiles. PAM is advantageous because expository cluster time-series come from existing data rather than generating new time-series that may average cluster members and be sensitive to outliers. Hourly monitoring data for particulate matter <2.5µm and <10µm, nitrogen dioxide, and ozone were obtained from the USEPA's Air Data website for 2006 through 2010 in 6 coastal and 2 populous inland counties of Southern California.

RESULTS: Using SOMs, we identified 100 diurnal patterns characteristic of Southern California for each air pollutant that emphasized peaks and plateaus of different magnitude, length, and time of occurrence. for each pollutant, the 100 patterns were partitioned into 8 clusters. Using chi-squared tests, the 8 diurnal patterns were found to statistically significantly vary by season ($p<0.001$) and day of week ($p<0.001$) for all pollutants. We also observed differences in diurnal patterns by geography, including coastal versus inland.

CONCLUSIONS: Temporally resolved exposure profiles of potential health significance determined through SOMs (with PAM) demonstrate utility as a novel alternative to prevailing pollutant exposure summaries. This methodology is being extended to a multipollutant framework.

KEYWORDS: time-series, exposure, methods, clustering, air pollution

P-0010 Estimating high-dimensional heterogeneous treatment effects in the context of climate and health: a case study exploring the role of effect modification in the relationship between precipitation shocks and diarrheal illness

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Identifying heterogeneity of treatment or exposure effects among subgroups of a study population is important in public health to identify subgroups to target with priority. Previous approaches have relied on the estimation of the conditional average treatment effect, which requires effect modifiers to be specified a priori and for a limited number of potential effect modifiers. More recently, machine learning (ML) algorithms have been proposed for estimation of effect heterogeneity in observational studies, which allow for greater flexibility and accuracy in the identification of heterogeneous subgroups in high-dimensional settings. One advancement in this area is the Causal Rule Ensemble (CRE) method which identifies heterogeneous population subgroups with high statistical precision while also offering improved interpretability of results. In this study, we apply the CRE estimator to study modification in the effect of precipitation shocks on diarrheal illness among children under three years of age by a set of demographic and socio-economic covariates. for this purpose, we use a large dataset of 807,073 children from 56 low- to middle-income countries (LMICs) via the Demographic and Health Surveys in combination with high resolution precipitation data via the Climate Hazards Group InfraRed Precipitation with Station dataset. Precipitation shocks (both droughts and floods) have been linked to outbreaks of water-borne diseases, including diarrheal illnesses that are among the leading causes of child death in LMICs. Better understanding is needed of the factors that increase disease susceptibility of populations exposed to such climatic shocks. Our results show high degree of heterogeneity in the effect of droughts on infectious illness among multiple population subgroups. We demonstrate how innovative ML algorithms can be leveraged in climate and health research to optimize the benefits of public health policies.

KEYWORDS: machine learning, effect modification, public health; climate and health

P-0011 Bridging differences across cohorts in the relationship between prenatal secondhand smoke exposure and birth weight: Transportability of effect estimates in the ECHO consortium

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BACKGROUND AND AIM: Transportability of effect estimates in epidemiology can potentially help investigators explain the differences in effect estimates for the same exposure-outcome relationships observed across different cohorts. In this study we aim to explain potential differences in the relationship between prenatal secondhand smoke exposure (SHS) and birth weight across different cohorts of the Environmental influences on Child Health Outcomes (ECHO) consortium that may be due to population differences in sociodemographic characteristics.

METHODS: We assessed transportability of effect estimates across 5 different cohorts in the ECHO consortium consisting of 6582 mother-offspring dyads. We first estimated individual cohort effects using Targeted Maximum Likelihood Estimation adjusting for several sociodemographic covariates. We then proceeded to estimate transported effects from one cohort to each of the remaining cohorts using a robust non-parametric estimation approach. We compared the transported effect estimates to the original effect estimates for these cohorts with any decrease in differences between cohort-specific estimates potentially attributable to different sociodemographic variable distributions.

RESULTS: Individual cohort effects associated with SHS exposure varied across the 5 cohorts with a range of strongly suggestive results for harmful effects of exposure (149.0 gram decrease in birthweight (95% confidence interval (CI): -254.4, -43.5), to results on the protective side of the null albeit with very wide confidence intervals. Transported effect estimates partially explained differences in 3 out of the 4 cohort pairs, explaining 7% to 97% of the differences in the effect point estimates.
CONCLUSION: Differences in sociodemographic characteristics across different populations may partially explain differences observed in the relationship between prenatal SHS exposure and birth weight across cohorts in the ECHO consortium. This framework could have broader implications in in multi-cohort consortiums by aiding in the comparability of cross-cohort results.

KEYWORDS: transportability, causal inference, machine learning, secondhand smoke, birth outcomes

P-0012 Does trajectory of ambient air pollutant (PM2.5, NO2) exposure influence cognitive function? A co-pollutant examination using sequence analysis

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Historical pattern of longitudinal changes in air pollution exposure may be relevant to cognitive risk in older adulthood. We used sequence analysis to characterize 10-year trajectories of PM2.5 and NO2 exposure and evaluate their association with cognition in a US-representative sample of 8,245 adults 65+ years old.

The CACES database provided census tract mean annual PM2.5 and NO2 (trichotomized at 2010 25th and 75th percentiles [7.9 µg/m3; 10.8µg/m3 and 4.8 ppb; 10.8 ppb respectively]) from 2000-2010. Sequences of PM2.5 and NO2 were evaluated using the Halpin optimal matching algorithm. We linked exposure trajectory group to residential census tract (N=3,559) of each participant of NHATS. Participants underwent cognitive assessments annually; their episodic memory score in a given year was the mean of their immediate and delayed word recall scores, standardized to NHATS 2011 baseline mean and sd. We used linear mixed models to estimate the association of air pollution trajectory with memory, adjusted for age, gender, education, race/ethnicity, smoking status, neighborhood SES, and census division.

Over 10 years, we observed 1,208 unique air pollution trajectories, which were clustered into 7 groups based on similarity. In general, participants occupying the higher exposure clusters had lower memory scores (e.g. high NO2 and PM2.5 until 2008, followed by medium level exposure by 2010 = -0.19; 95%CI: -0.29, -0.09).
Through this novel application of sequence analysis, we identified 7 distinct air pollution trajectories. We found that participants' historical pattern of air pollution exposure differentially predicted memory level such that, despite more recent lower exposures, higher exposures in the more distant past were associated with the greatest memory deficit . Our findings provide further support that use of more expansive air pollution exposure histories may offer more comprehensive discovery of air pollution's adverse cognitive effects in older adulthood.

KEYWORDS: sequence analysis, air pollution trajectories, longitudinal exposure assessment

P-0013 Is cadmium a risk factor for breast cancer – results from a Mendelian randomization analysis

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BACKGROUND AND AIM: Previous research have indicated cadmium as a possible risk factor for breast cancer, as cadmium has estrogen-like properties. Using observational data for environmental risk assessment, however, there is always risk for confounding, due to e.g. unbalanced data. The aim of this study is to use previously identified single nucleotide polymorphisms (SNP:s) as instrumental variables for cadmium exposure, to investigate the association with breast cancer risk using data from a Swedish cohort study.

METHODS: A previous genome-wide association study, performed in the Swedish Malmo Diet and Cancer cardiovascular sub cohort, showed a significant association between erythrocyte cadmium and two SNP:s among never-smoking women (Borné, Hum Mol Genet 2016). A breast cancer case-control study nested in the same Malmo cohort, showed an increased risk at high blood cadmium levels (Andersson, Can Epi Biom Prev 2021). A single sample mendelian randomization was performed using the inverse-variance weighting method with robust regression in the MendelianRandomization package in R.

RESULTS: The mean age at baseline among 1332 women (current, former and never smokers) was 57.0 (range 45-73) and the median blood cadmium level was 0.28 µg/L (p5=0.11, p95=1.72). for the rs12681420 SNP, the allele distribution was 29, 50 and 21 % (AA, GA, GG) and for rs17574271 it was 82, 17 and 1% (TT, CT, CC). Preliminary results, using an additive allele model, indicated an odds ratio, for breast cancer, of 1.21 per each doubling of blood cadmium levels (95% CI 0.59-2.49).

CONCLUSIONS: Preliminary results suggested a possible risk increase in breast cancer associated with cadmium, although the estimate was not precise. for never smokers in Sweden, the exposure is mainly through food (e.g. cereals, potatoes, vegetables) and preventive measures against cadmium pollution are warranted.

KEYWORDS: Mendelian randomization; Breast cancer; Cadmium

P-0014 Using triangulation to assess confounding by co-exposures to multiple per- and polyfluoroalkyl substances (PFAS)

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BACKGROUND AND AIM: Evaluation of health effects of highly correlated chemicals like per- and polyfluoroalkyl substances (PFAS) is complicated by the potential for confounding. We used a triangulation approach to determine the likelihood that observed associations could be explained by confounding across PFAS.

METHODS: As part of a systematic review of the hepatic effects of perfluorooctanoic acid (PFOA), we considered the sources and direction of bias in studies with varying exposure scenarios. In addition, we examined PFAS correlations and multipollutant modeling results within and across studies.

RESULTS: Twenty-five studies reported on the association between PFOA exposure and hepatic effects. Fourteen were in the general population using biomarkers in blood, in which individuals are exposed to a mixture of PFAS and it can be challenging to disentangle individual effects. Eight studies were in workers exposed to PFOA via inhalation and two were in communities with significant PFOA drinking water contamination. In these studies, PFOA exposure is predominant so there is less confounding by other PFAS but there may be potential for selection bias (e.g., healthy worker effect in occupational studies and heightened awareness of PFAS exposure and toxicity in contamination communities) and other confounding (occupational). for all exposure scenarios, the majority of studies reported associations between PFOA exposure and increased alanine aminotransferase in blood.

CONCLUSIONS: Consistency in the direction of association combined with differences in the sources of bias across studies with different exposure sources reduces the likelihood that the observed effects can be fully explained by confounding across PFAS.

KEYWORDS:
Per- and polyfluoroalkyl substances, systematic review, evidence synthesis
Disclaimer: The views expressed in this abstract are those of the author and do not necessarily represent the views or the policies of the U.S. Environmental Protection Agency.

P-0015 Measurement error and Regression Calibration method for multiple exposures: a Simulation study within the EXPANSE project

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BACKGROUND AND AIM: Exposure Measurement error (ME) in air pollution leads to imprecise and biased health effects estimates, while its impact when multiple exposures are considered presents additional challenges. Within the EXPANSE project where multiple exposures are investigated we assessed the application of regression calibration (RC) as an approach to correct effect estimates in multi-exposure Cox models.

METHODS: We simulated data informed by the Cardiovascular Effects of Air Pollution and Noise in Stockholm cohort in order to investigate multiple exposures effects on cardiovascular mortality applying Cox regression models. PM2.5, NO2 and road traffic noise were considered as ME-prone exposures. We simulated the “true” exposure levels for each exposure by subtracting ME from surrogate measures under two different scenarios derived from the exposure assessment methods. The observed correlations between the three exposures ranged from 0.3 to 0.7. We simulated survival data for cardiovascular mortality based on the “true” effect estimates of the multi adjusted exposures under two scenarios. The average surrogate and RC-corrected effect estimates across 1000 repetitions were assessed. Estimates are reported as Hazard Ratios (HR) for 1-unit increase in respective exposures.

RESULTS: Prevailing classical-type error was defined for noise, while Berkson-type error for PM2.5 and NO2. Under the scenario with average performing exposure assessment (R2: 0.39-0.66), the surrogate estimates underestimated all associations and the RC correction slightly reduced the bias, except for PM2.5. Under the scenario of better exposure assessment (R2:0.68-0.77), the surrogate exposures underestimated the PM2.5 and noise effect while the RC correction reduced bias for all exposures (HR PM2.5: True 1.000 vs. RC 1.000; HR NO2: True 0.998 vs. RC 1.000; HR Noise: True 1.004 vs. RC 1.004).

CONCLUSIONS: RC performed well in both scenarios and reduced the bias of most effect estimates in multi-exposure Cox models.

KEYWORDS: Environmental Exposures, Measurement Error, Regression Calibration

P-0016 Exploiting dose-response trends in registry-based studies for regulatory risk assessment: arsenic in drinking water and congenital heart disease

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BACKGROUND AND AIM: Regulatory risk assessment of toxic compounds is commonly based on dose-response data that are obtained from planned, small-scale dose-response toxicity experiments involving test organisms, which can range from cellular material to higher order plants and animals (e.g., common duckweed and daphnia). Subsequently, results are translated to a human health setting through appropriate scaling factors. Recently, a large-scale registry-based study provided evidence that the risk of congenital heart disease in offspring was associated with maternal exposure to arsenic in drinking water through an increasing concentration-response relationship. The aim is to adapt risk assessment concepts from standard toxicity experiments to registry-based studies.

METHODS: Benchmark concentration/dose analysis involves fitting a regression model to the intake-outcome data. Based on the model fit, inverse regression allows deriving intake concentrations corresponding to specified levels of excess risk above the background level in a unexposed scenario. These estimates are called benchmark concentrations (BMC's). Often the lower limits of the corresponding confidence interval (BMCL's) are used as the point of departure for subsequent risk assessment. The concentration-response trend previously seen in the incidence in congenital heart disease as arsenic concentrations increased was re-visited to estimate benchmark concentrations corresponding to an excess risk in incidence of 1 and 2 per 1000 births. A log-logistic concentration-response Poisson model was fitted and BMCL's obtained through inverting the estimated s-shaped curve.

RESULTS: for an excess risk of 1 and 2 more cases of congenital heart disease per 1000 births, the estimated BMCL's were found to be 0.95 and 1.13 µg/L, respectively. These thresholds are smaller than several recommended maximum intake levels.

CONCLUSIONS: The window of harmless exposure to arsenic is seemingly very narrow. Moreover, it has been demonstrated that registry-based studies may also be used for regulatory risk assessment.

KEYWORDS: arsenic, dose-response, drinking water, maternal exposure, offspring, risk assessment

P-0017 Bias amplification and variance inflation in distributed lag models using low spatial resolution data

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BACKGROUND AND AIM: Distributed lag models (DLMs) are often used to estimate lagged associations and identify critical exposure windows. Here, we focus on two perils that can occur when fitting DLMs to low-spatial-resolution exposure data: 1) bias amplification in the presence of residual confounding by time trends, and 2) variance inflation that arises from concurvity between a distributed lag function and a secular function of time.

METHODS: We demonstrate these issues using the example of NO2 and birth weight through a simulation study and in a real-data analysis. We first estimate the NO2–birth weight lag-response function using DLMs in a Massachusetts-based cohort. Then, using the lag–response relationships estimated from the real data, we illustrate using simulations that bias amplification and variance inflation can manifest under certain combinations of spatial resolution, DLM estimation approach, and time trend adjustment method.

RESULTS: Our simulations showed that when using high-spatial-resolution exposure (1-km resolution), any time trend adjustment method produced low bias and nominal coverage for the distributed lag estimator. When using low-spatial-resolution exposures (county-level or no resolution), bias due to time trends was amplified for all adjustment methods. Variance inflation was higher in low-spatial-resolution DLMs when using a long-term spline to adjust for time trends due to concurvity between a distributed lag function and secular function of time. NO2-birth weight analyses in the Massachusetts-based cohort showed that associations were negative for exposures experienced in gestational weeks 15-30 when using 1-km-resolution DLMs; however, associations were null and positive for DLMs with county-level and no-spatial-resolution exposures, respectively, which is likely due to bias amplification.

CONCLUSIONS: DLM analyses should jointly consider the spatial resolution of exposure data and the parameterizations of the time trend adjustment and lag constraints.

KEYWORDS: distributed lag models, spatial resolution, bias amplification, variance inflation, concurvity, air pollution, birth weight

P-0018 Bayesian Linear Regression with Multivariate Prior for the Coefficients and Practical Imputation of Exposure variables Below the Limit of Detection: An Application to Multiple Metal Exposure and Blood Pressure Throughout Childhood

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BACKGROUND AND AIM: Multi-pollutant studies based on linear regression with independent priors for metal effects can lead to identifiability problems due to correlated metals. In addition, metal exposures may be lower than limit of detection (LOD) of the measurement technique, forcing those observations to be discarded or imputed, often by partial fixed values. The aim of this talk is to propose a Bayesian model that makes practical imputations of metal exposures below the LOD and mitigates collinearity, by applying it to longitudinally assess the association between multiple metals exposure and blood pressure (BP).

METHODS: Metal exposures below LOD are predicted by a multivariate normal with a Gaussian process-based mean function, and the LOD is set as the upper bound of prediction. Furthermore, a multivariate prior distribution is defined for metal regression coefficients. This methodology is implemented in a multi-output longitudinal model based on mixed-effects linear regression to assess associations between multiple metals (18 metals measured in urine) and BP among 617 children from the Spanish INMA cohort measured at 4, 7 and 9 years of age.

RESULTS: Complete predictive posterior distributions upper bounded by the LOD are obtained for each one of the observations below LOD. By defining a multivariate prior for regression coefficients improves inference on the posterior with nearly collinear predictor metals. Regarding the application, the most significant single metal effects on BP are: Mg and As, associated with higher BP, and Cu and Mo, associated with lower BP, in both systolic and diastolic BP.

CONCLUSIONS: Full posterior distributions of metals below the LOD are used for inference, as opposed to point estimates or fixed imputations that can have excessive influence on the model. The use of linear effects is more effective to capture subtle associations as those between metals and BP.

KEYWORDS: Probabilistic Programming; Multi-pollutant; Imputation; Collinearity

P-0025 The Long-term Effect of Fine Dust Concentration on Exacerbation of Environmental Diseases for Vulnerable and Susceptible Individuals in South Korea : The Necessity of Personalized Standards on Air Quality Index

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Indoor and outdoor air pollutants have been known to effect health through many studies. WHO has identified the levels of air quality necessary to protect public health worldwide. Many countries also announce standards suitable for each country. In Korea, the appropriate concentration standard of PM10 is less than 50 $\mu g/m^3$ per year. However, there are still few studies confirming whether these air quality standards are valid for vulnerable and susceptible individuals.

This study aimed to investigate the association between the occurrence of worsening environmental diseases according to PM10 concentration.

The study used nationwide population data from the Korea National Health Insurance Service and AirKorea data, which summarized the concentration of air pollutants. From 2015 to 2019, subjects newly diagnosed with environmental disease were followed up for period of 1 month and 12 months before acute exacerbation of environmental diseases occurred. Hazard ratios(HRs) was estimated through cox proportional-hazard model.

For 1 month, compared with the lowest level of PM10 (Quartile 1), the risk of exacerbation of most environmental diseases significantly increased in the highest quartile level (Quartile 4) (COPD: HR 1.85, 95% Confidence Interval (CI) 1.57-2.18/ Asthma: HR 1.79, 95% CI 1.62-1.97/ Arrhythmias: HR 1.20, 95% CI 0.83-1.75/ Stroke: HR 1.42, 95% CI 1.20-1.68). Exposure for 12 months was not statistically significant. When a stratified analysis of 12 months exposure was performed by age group, the cut-off value of the pm10 concentration, which is likely to COPD be exacerbated upon exposure, was 49 in children (HR 0.947, 95%CI 0.847-1.058) and 45 in the elderly (HR 1.045, 95%CI 1.031-1.058).

In Korea, fine dust concentration standards were valid not only for the general public but also for vulnerable and sensitive individuals. However, the cut-off value of PM10 was different depending on their characteristics. These results suggest the necessity for concentration standards reflecting individual characteristics.

P-0027 Spatially Stratified Controls: A simulation study of pre-term births

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BACKGROUND AND AIM: A simple random sample (SRS) of non-cases often selects the majority of controls from metropolitan areas and may not be an ideal approach for a spatial study. Unmatched spatially stratified random selection (SSRS) may be a useful alternative to sample a geographically balanced selection of controls from the population, facilitated by the MapGAM package.

METHODS: We divided the study area into non-overlapping spatial strata and then randomly selected controls from among the non-cases within each stratum. Inverse-probability weights were calculated to account for non-random sampling. To illustrate this approach in a spatial case-control study, we conducted simulations using generalized additive models to analyze the association between location and preterm birth in Massachusetts, and compared results for models with SSRS or SRS controls to the model with all non-cases. We selected 1-3 controls per stratum to observe if efficiency increased, and compared mean squared error (MSE), bias, relative efficiency, and map areas with significantly different risks across models.

RESULTS: We analyzed 4389 preterm births in models with approximately 8778 controls using SSRS and SRS to select from among 64,785 non-cases. Adjusted SSRS models had lower average MSE (range: 0.0042-0.0047) and higher relative efficiency (range: 76-79%) across simulations compared to SRS models (MSE/ relative efficiency ranges: 0.0067-0.0073; 71%). In addition, SSRS provided better estimates along the map edge. All SRS and SSRS models detected areas of high risk, but SSRS model results were more consistent across simulations and some were able to identify areas of statistically significant low risk SRS models did not.

CONCLUSIONS: The SSRS approach improved study efficiency by selecting controls geographically distributed across the study area, particularly in low population density areas and map edges, compared to the SRS approach. This method should be considered when sampling controls for spatial studies.

KEYWORDS: spatial analysis, stratified controls

P-0032 Exploring the role of humidity on heat-health impacts using a risk assessment framework

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While physiological models showed that high humidity leads to stronger heat-stress, findings from epidemiological studies remain inconclusive. We aim to explore the role of humidity on heat-health impacts with a new analytical framework combining epidemiological modelling techniques with existing methods in hazard-risk assessments. This approach characterises events based on the severity of health impacts and allows assessing the role that humidity played in extreme events.

For illustrative purposes, we used temperature-mortality series in Zurich (Switzerland, May-September, 1989-2018). Using the state-of-the-art epidemiological models, we derived the temperature-mortality association and corresponding daily heat-related deaths using (1) daily mean temperature as exposure (adjusted for partial pressure humidity, PPH), and (2) daily wet-bulb temperature (combining temperature and humidity), in separate models. Events (four-day windows) were ordered based on the cumulative heat deaths and then characterized by the return period (i.e., inverse of the probability of occurrence of events equal to or severe than corresponding event in terms of impact). We then compared the impact estimates and return-periods across models and assessed whether high-impact events are also high-humid events (PPH > 95thpercentile).

Using mean-temperature as exposure, 3 out of the 11 events of high impact severity (i.e., with a return period above once-in-100 events) were also high-humid events. for wet-bulb, this ratio was 6 out of 11. Estimates from wet-bulb temperature in extremes returned higher heat-mortality for events with same return period compared to mean-temperature based estimates.

Based on our preliminary findings, high humidity seems to exacerbate heat-health impacts, but it may not be the only factor driving elevated heat stress. Further analyses will be conducted across other locations with different heat,humidity conditions. This framework could provide valuable insights into the role of humidity in heat-stress mortality, and other complex research questions in environmental epidemiology.

KEYWORDS: Heat-stress, Humidity, Risk-assessment framework, Climate and Health

P-0033 How well can we estimate causal effects with exposome data in the absence of strong a-prior hypotheses?

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BACKGROUND AND AIM: Linking multi-exposure data to exposome-related disease risks is one of the major goals of environmental epidemiology and, when successful, may lead to improved disease prediction and prevention, thereby reducing morbidity, mortality, and healthcare costs. However, epidemiological and statistical analysis of exposome data is extremely challenging due to its high-dimensionality, often skewed exposure and outcome distributions, strong correlations between (subsets of)exposures, and complex causal structures including possible non-linear exposure-response relations and age/time-varying interactions. We aim to build an efficient high-dimensional causal inference framework, to evaluate environmental mixture effects and the contribution of individual components to disease-risks.

METHODS: State-of-art methods of causal inference and data integration will be applied to a large prospective cohort of UK-Biobank with high-dimensional exposure and OMICs data to identify causal factors related to cardiometabolic and pulmonary health. Environmental exposures, social and behavioral factors affect the complex set of biomarkers at the internal exposome level, inferring the development of the health outcome. Thus, OMICs features are considered as potential mediators in causal pathways relating exposures to health outcomes, which may result in the identification of potential intervention targets.

RESULTS: We present a critical review of existing methods with illustrative examples and argue their strengths/limitations, especially regarding the peculiarities of multi-layered exposome data. We discuss the separate challenges of identifying important exposures and obtaining unbiased, precise causal effect estimates in the absence of strong a-priori hypotheses and the presence of strong (multi)collinearity.

CONCLUSIONS: Highly challenging causal effect estimation for exposome data is unlikely to succeed with current approaches and limited data from single studies. To achieve a comprehensive causal inference framework, it will be necessary for exposome researchers to collaborate even more intensively and for existing statistical methods to be developed further to tackle the complexity of real-world applications.

KEYWORDS: Causal inference, Exposome, Big data, Statistical methods

P-0034 Principal Component Pursuit for Source Apportionment from Block Missing Data: An Application to NYC PM2.5 Data

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BACKGROUND AND AIM: It is often of interest to identify sources of environmental exposures from imperfect data that suffer from block missingness, in which observations for multiple pollutants are missing across large portions of the study period.

METHODS: We adapted Principal Component Pursuit (PCP), a robust dimensionality reduction algorithm, to identify air pollution sources from incomplete data. PCP decomposes the pollutant matrix into consistent patterns while separately isolating unique or outlying pollution events. PCP handles structural missingness by reconstructing missing blocks using the information from observed blocks of the exposure matrix. We applied PCP to apportion 26 PM2.5 constituents to their sources in New York City, using data from three monitors (2001 – 2020). Two constituents, elemental (EC) and organic carbon (OC), were missing all measurements from 2001 to 2007, comprising 2.6% of the overall pollution matrix.

RESULTS: PCP reconstructed six years of EC and OC data consistent with existing literature, and identified five sources of PM2.5 pollution: crustal dust, road dust, salt, secondary/regional sulfate, and traffic, as well as three single-constituent components: arsenic, barium, and chromium. Traffic contributed most to total PM2.5 concentrations (20.2%) across the study period, peaking during the winter months and on weekdays. PCP also identified interpretable outlying pollution events, most notably spikes in potassium ion concentrations around each fourth of July.

CONCLUSIONS: PCP can serve as a useful and robust technique capable of handling data suffering from block missingness to identify exposure patterns and sparse events amenable to public health messaging and research.

KEYWORDS: Mixtures, Air Pollution, Source Apportionment, Missing Data, Fine Particles

P-0037 Generating daily high-resolution gridded meteorological datasets for New York State from 2017-2018 using two-stage downscaling model

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BACKGROUND AND AIM: Exposure misclassification in weather-related epidemiological studies is always a concern because there are a limited number of weather monitoring sites. This study aimed to build a high-resolution meteorological dataset using two-stage downscaling model and simulate exposures with a highly dense monitor system, New York State (NYS) Mesonet.

METHODS: High-resolution covariates for terrestrial characteristics, meteorological conditions, and temporal features were linked with NYS Mesonet data from 2017-2018, which contains 126 weather monitor stations (around 27 km x 27 km). These 126 weather stations were split into training set (116 stations) and testing set (10 stations). Machine learning models were used to generate initial meteorological simulations at the first stage. In the second stage, Bayesian spatial-temporal model was used to correct the spatial-correlation residuals from the first stage to get the final high-resolution gridded meteorological datasets (1 km x 1 km).

RESULTS: From 2017-2018, the optimal two-stage downscaling model on testing set had R2 = 0.992, RMSE = 0.996 °C, and MAE = 0.703 °C for temperature; R2 = 0.876, RMSE = 4.698 %, and MAE = 3.580 % for RH; R2 = 0.952, RMSE = 1.743 MJ/m2, and MAE = 1.261 MJ/m2 for SR; and R2 = 0.774, RMSE = 3.895 mm, and MAE = 1.603 mm for rainfall. The overall performance of the optimal two-stage downscaling model across training set and testing set had R2 = 0.999 for temperature, R2 = 0.978 for RH, R2 = 0.996 for SR, and R2 = 0.980 for rainfall.

CONCLUSIONS: This study proposed a two-stage downscaling model by combining machine learning models and Bayesian spatial-temporal models. We generated high-resolution gridded meteorological datasets (1 km x 1 km) which can be used by other researchers in environmental epidemiological studies to reduce exposure misclassification.

KEYWORDS: Meteorological exposure, exposure assessment, downscaling model, high resolution

THEMATIC 06: Children's environment and health

P-0411 Association of lifestyle factors with per- and polyfluoroalkyl substance (PFAS) concentrations in breast milk of Korean mothers

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BACKGROUND: Per- and polyfluoroalkyl substances (PFAS) is a group of synthetic chemicals used frequently in our daily life and has high stability in the environment and human body. The aim of our study is to measure the concentrations of per- and polyfluoroalkyl substance (PFAS) in breast milk of Korean mothers and find out the associations with the life-style factors.
Objective: The study population was made up of 207 primipara mothers who had one infant and enrolled in nationwide breastfeeding clinic from July 2 to September 9, 2018 in Korea.

METHODS: We analysed 14 PFAS and it includes 4 Perfluoroalkyl sulfonic acids (PFBA, PFHxS, PFOS and PFDS) and 10 Perfluoroalkyl carboxylic acids (PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFTeDA). A questionnaire covering demographic features, obstetrical, life-style, and neonatal information was given to mothers.

RESULTS: PFOS and PFOA were detected 100% of breast milk samples followed by PFHxS (87.4%), PFNA (87%), and PFHxA (72.9%). The median concentrations were 0.05 ng/mL, 0.1 ng/mL, 0.031 ng/mL, 0.007 ng/mL, 0.033 ng/mL for PFOS, PFOA, PFHxS, PFNA, PFHxA respectively. There was 178% of increase of PFOA concentrations between 2007 and 2018. We also found that PFAS levels in Korean mothers' breast milk were higher than those in other countries. In the bivariate association test, the factors associated with the PFAS concentrations were body mass index, area, neonatal age, fish consumption, frequency of Ice-cream and canned food intake. In the multiple regression model, fish consumption had significant effect on the PFOS levels in breast milk (B=0.88 p=0.033).

CONCLUSIONS: As the PFAS has a high stability in the environment and hard to break down naturally, it is important to pay attention how it enters in our body and how can we reduce it to protect our family.

P-0413 Building Characteristics and Bioaerosols' Size Distribution as Predictors of Respiratory morbidities among Elementary School Pupils in Nigeria

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BACKGROUND AND AIM: Bioaerosols are among pollutants that impair indoor air quality in schools where children spend long hours daily. Knowledge of bioaerosols' sizes is essential for the identification of associated risks in Nigeria. This study investigated school building characteristics, bioaerosols' size distribution and associated respiratory morbidities among elementary school pupils.

METHODS: In nine randomly selected schools, indoor air sampling was conducted in occupied and unoccupied classrooms. Airborne Bacterial Respirable Fraction (BRF) and Fungal Respirable Fraction (FRF) of aerodynamic diameter of 1.1–4.7 µm which corresponds to regions between the human primary bronchus and the alveolar duct were sampled using a six-stage cascade impactor. Building risk score was estimated and categorised as high (0-39) and low (40-56) using a validated walk-through checklist. A standardised questionnaire was adapted to elicit information from 554 randomly selected pupils on respiratory morbidities. Data were analysed using Mann-Whitney U, Spearman's rank correlation and multivariate logistic regression model at α0.05.

RESULTS: Median BRF and FRF were significantly higher when classrooms were occupied (3906 and 230 cfu/m3) than unoccupied (2800 and 214 cfu/m3), respectively. About 67.5% of the total bacterial and 77.8% fungal aerosols were respirable fractions. Building risk score was inversely correlated with BRF ($p<0.001$) and FRF ($p<0.001$). Exposure to high BRF and FRF was significantly associated with current rhinitis (aOR = 1.78, 95%CI: 1.11–2.85 and aOR = 1.83, 95%CI: 1.14–2.93) and current wheeze (aOR = 2.77, 95%CI: 1.73–4.43 and aOR = 1.88, 95%CI: 1.18–3.00), respectively.

CONCLUSIONS: Exposure to high levels of BRF and FRF was associated with respiratory health outcomes. Provision of new sustainable buildings is key to dipping the levels of indoor bioaerosols fractions and consequently, reduction in the prevalence of associated respiratory morbidities.

KEYWORDS: Indoor air quality, Microbial aerosols, Aerosol size distribution

P-0416 Environmental noise effect on 11 year old children sleep quality: a DAG model

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BACKGROUND AND AIM: Environmental noise is considered the second environmental risk factor in Europe. Most of the noise effects in the adult population are associated with sleep quality, but there is little evidence about how environmental noise can affect children´s health and sleep and literature is inconclusive. It is thought that noise effects in health derives from the same mechanism as in adults; noise exposure creates a stress response, stimulating endocrine system and autonomic nervous system. Therefore, the goals of the study are: the description of environmental noise exposition in 11-year-old children from a cohort from northern Spain and the creation of a DAG model to test the unbiased effect of noise exposition on children´s sleep quality

METHODS: Data from 377 children participating in the Gipuzkoa cohort from the INMA project in the 11 year follow-up phase was used. Environmental noise exposition at children´s home, and both subjective and objective sleep quality were measured. Other variables were also assessed. Analyse was based on DAG model, that allows to identify a minimal sufficient adjustment set of variables to test the unbiased direct and total effect of environmental noise on sleep quality.

RESULTS: Children are exposed in media an exposition of 53,7dB during the evening and 46,73dB during the night. 60% of children are exposed to a day-evening-night environmental noise exposure above 55dB Lden. Clear sociodemographic differences were not observed. A suitable causal model to explain the unbiased effect of environmental noise on sleep quality has been created. No evidence was found that environmental noise has a significant effect on any sleep outcome.

CONCLUSIONS: Our study observed environmental noise exposition is very high. However, no effect on sleep quality was observed. for better understanding, further research is needed including a bigger sample and other sleep quality markers.

KEYWORDS: Environmental Noise, Sleep quality, stress

P-0417 Birth Cohort of Environmental Exposure and Childhood Development - PIPA Project – Rio de Janeiro, Brazil

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BACKGROUND AND AIM: As a developing country, Brazil presents a wide range of environmental risks that may constitute hazards to child health. Currently, the Brazilian population faces environmental risks concerning both domiciliary and community scenarios. According to the Brazilian Institute of Geography and Statistics, over 80% of the Brazilian population lives in urban areas. The industrial development process in the country was accelerated and disorganized, comprising human migratory movements to large metropolitan areas, leading to urban clusters near industrial areas.

METHODS: The "PIPA project" is a prospective maternal-infant health study hosted in the city of Rio de Janeiro and designed to investigate childhood development alterations associated with multiple exposures to urban environmental pollutants from pregnancy until the age of 4. The project was initiated in June 2021, and the study population comprises all children born at the UFRJ Maternity University until June 2022 (12 months).

RESULTS: To date, 734 pregnant women have enrolled in the project, with 605 births. Maternal blood (n = 639) and urine (n = 595) were collected between the 32nd and 38th weeks of pregnancy. Newborn umbilical cord blood (n = 564) samples were collected at birth. Prematurity was observed in 14% and low weight in 6% of births. Returned for follow-up 214 3-month babies with 210 newborn urine samples and 169 maternal milk samples collected. Lead, mercury and arsenic concentrations were detected in 99,7%, 92,5% and 60,4% of 361 umbilical cord blood samples, respectively, with geometric means of 0,92 µdL (Pb), 0,75 µL (Hg) and 0,27 µL (As). In the 3-months babies following, 8,7% presented high and 1,7% low weight gain, according to the IMC Z score.

CONCLUSIONS: These results indicate the need to monitor maternal-child environmental pollutant exposure and correspondent investigation of its toxic effects on child health.

KEYWORDS: environmental pollutants; maternal-child health.

P-0418 Child Health Cohort Study. “Bruminha project”

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BACKGROUND AND AIM: In Brazil, mining activities are one of the economic pillars of the country and the hundreds of municipalities. Mining disasters, their socio-environmental and health effects are part of the externalized environment, and their social costs are left to local territories and their inhabitants. In many situations, the exposed population has a low income and precarious access to drinking water and basic sanitation services, also suffering from any infectious or chronic diseases and nutritional deficits. Concerning child populations, exposure to any pollutant may lead to additional risk factors, worsening their vulnerability.

METHODS: The Bruminha project is a prospective cohort study established after the breakdown of a mining tailings dam in the city of Brumadinho, Brazil, in January 2019. This project investigates metal concentrations and their effects on the growth and immunological, neurodevelopmental, and respiratory health of children aged 0 to 4 years old living in the surrounding area of the disaster.

RESULTS: The cohort had begun in July 2021. Were examined 217 children, and 186 urine samples were collected. Arsenic and lead in urine samples were above the reference limits in 43% (80) and 13% (24) of the evaluated children. Underground water consumption was observed in 40% (83) of the study population. Fail in neuropsicomotor development was observed in 38% (82) of children after Denver Developmental Screening Test II (DDST-II) application. Fail in the DDST-II test was not associated with metal exposure but 66% (54) of children in the fail group lived in the communities directly affected by the impact of the mud of metals residue. Around 10% of children presented overweight.

CONCLUSIONS: The examined children live in a social-environmental vulnerability condition. These first results indicate the need to monitor pollutants exposure and investigate their toxic effects on these children´s health.

KEYWORDS: mining disasters; metals exposure; child health.

P-0419 Prenatal Exposure to Metals and Neurodevelopment in Infants at Six Months: Rio Birth Cohort Study of Environmental Exposure and Childhood Development (PIPA Project)

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Intrauterine and early childhood metal exposure can affect neurodevelopment. Metal exposure in urban areas can occur through the air, water, and food routes. The literature reports an association between metal exposure during pregnancy and early childhood and impaired cognitive function in children. The city of Rio de Janeiro is the second more populous of Brazil and the sixth most populous in the American continent. The Rio Birth Cohort Study of Environmental Exposure and Childhood Development (PIPA Project) is the first cohort in Rio de Janeiro to assess pollutants in umbilical cord blood and investigate the relationship with childhood neurodevelopment, among other outcomes. The PIPA Project is a prospective birth cohort study based in Rio de Janeiro, Brazil, whose pilot study was carried out between October 2017 and August 2018. Arsenic, cadmium, lead, and mercury concentrations were determined in maternal (n = 49) and umbilical cord blood (n = 46). The Denver Developmental Screening Test II (DDST-II) was applied in 50 six-month-old infants. Metals were detected in 100% of the mother and newborn samples above the limits of detection. Maternal blood lead concentrations were higher in premature newborns (GM: 5.72 µg/dL; p = 0.05). One-third of the infants (n = 17–35.4%) exhibited at least one fail in the neurodevelopment evaluation (fail group). Maternal blood arsenic concentrations were significantly (p = 0.03) higher in the “fail group” (GM: 11.85 µg/L) compared to infants who did not fail (not fail group) (GM: 8.47 µg/L). Maternal and umbilical cord blood arsenic concentrations were higher in all DDST-II domains in the “fail group”, albeit non-statistically significant, showing a tendency for the gross motor domain and maternal blood (p = 0.07). These findings indicate the need to further investigate the toxic effects of prenatal exposure to metals on infant neurodevelopment.

KEYWORDS: prenatal exposures; metals; neurodevelopment.

P-0420 Identifying critical windows of perinatal lead exposure for serum antibody levels following childhood vaccination

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BACKGROUND AND AIM: Many aspects of child health depend on the proper development of the immune system during pre- and early post-natal periods. Mounting evidence suggests that early-life lead exposure may alter aspects of the immune response, including T-cell dependent antibody responses to childhood immunizations. However, no studies have identified critical windows of susceptibility to lead exposure.
We aim to identify critical time windows of lead exposure—measured weekly from 16 weeks before birth to 14 weeks after birth—that are associated with antibody responses to MMR (measles, mumps, and rubella) and DTP (diphtheria, tetanus, and pertussis) vaccinations measured at 5-years of age.

METHODS: Weekly pre- and post-natal dentine lead concentrations were measured in 302 children enrolled in the PROGRESS (Programming Research in Obesity, GRowth, Environment, and Social Stress) study in Mexico City. at age 5 years, serum anti-MMR and anti-DTP antibody levels were determined by a Luminex multiplexed-microbead array immunoassay. Time-varying associations between log2–transformed antibody levels and log2–transformed dentine lead concentrations were estimated by fitting distributive lag models. Models were adjusted for maternal age, education, parity, child sex, and child age. Sensitivity models also included maternal smoking, time since vaccination, and a lead exposure-sex interaction.

RESULTS: Higher lead levels in the first month postpartum were associated with lower anti-tetanus antibody levels at 5-years of age. Weekly coefficients indicated that, on average, a two-fold higher dentine lead concentration was associated with a 4% decrease in anti-tetanus antibody levels. A critical window of lead exposure was identified as one week before to one week after birth for anti-diphtheria antibody levels, although these associations were borderline significant. Sensitivity analyses indicated a lack of sex-specific differences, and observed associations were robust to alternative model specifications.

CONCLUSIONS: Early-life lead exposure may program immune dysregulation that manifests in later childhood.

KEYWORDS: child immune system, dentine lead levels

P-0421 Effects of air pollution exposure predicting sleep efficiency in children modified by exposure to violence, 4-7 years, in the PROGRESS birth cohort

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BACKGROUND: Studies suggest that expose to both air pollution and violence may alter development trajectory, as it may disrupt the HPA-axis which plays an important role in how the human body reacts to environmental stressors affecting sleep. We propose that prenatal air pollution exposure may interact with violence to affect the efficiency of sleep, therefore, modified by exposure to violence.

METHODS: We studied 412 children enrolled in Programming Research in Obesity, GRowth, Environment and Social Stressors (PROGRESS), a birth cohort study in Mexico City. We used a spatio-temporal model to estimate individual daily prenatal PM2.5 exposure at each participant's residential address. We assessed the sleep efficiency (defined with time awake divided by time in bed) of all kids at age 4-7 years with assigned accelerometer worn during sleep, and recorded sleep patterns for a week to examine the association between PM2.5 exposure and sleep efficiency.

RESULTS: Participants are mostly low SES families (54.6%) with slightly lower proportion of low maternal education (42.1%) and are racial/ethnicity uniformed. Sleep efficiencies are normally distributed and ranging from 63.5 to 91.8. at age 4, children who were exposed to low-to-mid violence are more likely to have their sleep efficiency disrupted by prenatal PM2.5 exposure (ETV at 10%tile, β=-0.26, CI:-1.19,0.68; However, at age 6, we found that PM2.5 reduced sleep efficiency at even lower levels, (ETV at 10%tile, β=-0.26, CI:-1.05,0.54; peak PM effect at ETV at 36%tile, β=-0.71, CI:-1.5,0.09; ETV at 90%tile, β=0.28, CI:-1,1.55;).
CONCLUSION: As the literature expands on sleep and sleep disparities, the sparseness of studies on children's sleep highlights a research void that if addressed could mitigate the adverse impact of child sleep disparities on long term health.

KEYWORDS: environmental stressors, violence, sleep health, disparities, exposure

P-0423 Pre and postnatal exposure to mercury and sexual development in 9-year-old children in Spain: The role of brain-derived neurotrophic factor

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BACKGROUND: Early exposure to the mercury has been related to endocrine disruption. Steroid hormones play a crucial role in neural cell migration, differentiation, as well as protecting against several neurotoxic compounds. Some studies have reported interactions between steroid hormones and the brain-derived neurotrophic factor (BDNF), a polypeptide known to play an important role in the survival, differentiation and outgrowth of neurons. We investigate the relation between mercury exposure and children's sexual development, and we evaluate the possible influence of different BDNF polymorphisms on this relation.

METHODS: Our study sample comprised 412 9-year-old children (49.5% of females) participating in the INMA (Environment and Childhood) Valencia cohort (2004–2015, East of Spain). Total mercury (THg) concentrations were measured at birth (cord blood) and at 4 and 9 years of age (hair). Sexual development was assessed by levels of sex steroid hormones (estradiol and testosterone) in saliva and the Tanner Stages of development (categorized as 1: pre-puberty and >1: puberty). Covariates were collected through questionnaires during pregnancy and childhood. Polymorphisms in the BDNF gene were genotyped in cord blood DNA. Multivariate linear and logistic regression analyses were performed between mercury levels and children's sexual development by sex and including the effect modifier variables of genetic polymorphisms.

RESULTS: We found some evidence of inverse associations between 9 year-old THg (geometric mean=0.8 and 1.0 µg/g for boys and girls, respectively) and testosterone levels (β[95%CI]=-0.16[-0.33,0.001], and -0.20[-0.42,0.03], for boys and girls, respectively). Additionally, we found that prenatal THg was negatively associated with puberty onset in boys. Finally, we found significant genetic interactions for some single nucleotide polymorphisms in the BDNF gene.
In conclusion, pre and postnatal exposure to THg seems to affect children's sexual development and BDNF may play a role in this association, but further research would be needed.

KEYWORDS: mercury, sexual development, birth cohort

P-0424 Short-term nitrogen dioxide exposure and asthma emergency hospital admissions in children: a case-crossover study in England

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BACKGROUND AND AIM: Most studies on the acute health effects of air pollution rely on temporally resolved exposure information, potentially ignoring the high spatial variability of pollutants such as nitrogen dioxide (NO_2). Our study aims to examine associations of short-term NO_2 exposure with the risk of asthma-related emergency hospital admission in children in England, using spatio-temporal (ST) highly resolved air pollution data.

METHODS: We conducted a time-stratified case-crossover study including 111,766 asthma emergency hospital admissions in children (aged 0-14 years) during 2011-2015. Daily NO_2 levels were predicted at the patients' place of residence using ST models by combining land use data and chemical transport model estimates. Conditional logistic regression models were used to obtain odds ratios (OR) and confidence intervals (CI), adjusting for temperature, relative humidity, bank holidays and influenzas. Effect modification of risk by age, sex, season, income deprivation index and region were explored.

RESULTS: for a 10 $\mu g/m^3$ increase of NO_2 exposure, a positive association was observed in children aged 0-14 years, between emergency admission for asthma and NO_2 concentrations with a 5-day moving average (mean lag0-4) (OR 1.082, 95% CI 1.064-1.100). The associations were higher for males (OR 1.095, 95% CI 1.072-1.119) than females (OR 1.059, 95% CI 1.030-1.089), but results were similar for different age groups. We found evidence of effect modification by season with the strongest effect for the cold season (OR 1.101, 95% CI 1.079-1.123). Small differences in estimates were found by income deprivation and region, most of these were statistically significant.

CONCLUSIONS: Our study provides evidence that some sub-populations are more susceptible to the effects of ambient NO_2 and are of higher risk of asthma-related hospital admissions, which has implications for air quality regulatory standards and policymaking.

KEYWORDS: nitrogen dioxide, asthma, children, emergency hospital admissions, case-crossover, effect modifiers

P-0425 Pediatric Anxiety and Daily Fine Particulate Matter: A Longitudinal Study

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BACKGROUND & AIM: Ambient fine particulate matter with an aerodynamic diameter of less than 2.5 μm (PM2.5) is a potential contributor to the morbidity of anxiety disorders in children and adolescents. Recent PM2.5 has been associated with increased anxiety symptom severity and frequency in cohort studies, but daily PM2.5 has not been studied outside of emergency department utilization data, nor in a longitudinal study design. We sought to determine the association between daily ambient PM2.5 concentrations and repeated measures of anxiety symptom severity in a cohort of adolescents with untreated, moderate to severe anxiety.

METHODS: Anxiety symptom severity was measured weekly for up to 8 weeks in 23 non-medicated adolescents with moderate to severe generalized anxiety disorder by using a clinician-administered instrument (Pediatric Anxiety Rating Scale, PARS). PM2.5 was assessed based on the date and residential address using a previously validated spatiotemporal exposure prediction model. We used a distributed lag nonlinear model with fixed effects for study participant and controlled for confounding by air temperature, relative humidity, and day of the year.

RESULTS: An increase in PM2.5 concentration from the 25th percentile to the median (5.93 μg/m3 versus 7.96 μg/m3) was significantly associated with increased PARS scores two (0.57, 95% CI: 0.06, 1.07), three (0.82, 95% CI: 0.18, 1.45), and four (0.62, 95% CI: 0.11, 1.14) days later. We found evidence of a supralinear dose-response curve, with increases at lower concentrations being associated with larger changes in PARS scores compared to similar increases at higher concentrations.
CONCLUSION: Fine particulate matter may be a novel, modifiable exposure that could inform population level interventions to decrease psychiatric morbidity.

KEYWORDS: Particulate matter 2.5, General Anxiety Disorder, Pediatric Anxiety Rating Scale, distributed lag nonlinear model, environmental exposure, pediatrics

P-0429 Early-Life Stages Human Health Risk Assessment of toxic and essential metals in Rice and Rice-Based Baby Foods

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BACKGROUND AND AIM: Dietary exposure to heavy metals in Rice and Rice Based foods can have deleterious effects including lung and kidney cancer, Keratosis and Diabetes. Early-life exposure to these toxicants from consuming these foods is a growing area of research that requires further study. This research utilizes a probabilistic analysis to examine the likelihood of adverse health effects from early life consumption of rice and rice-based foods.

METHODS: Thirty-three rice and rice-based foods for infants and toddlers were purchased via an online market based survey. These samples were subsequently acid digested and underwent Inductively Coupled Plasma Mass Spectrometry Analysis. The elements of interests were Arsenic (As), Cadmium (Cd), Lead (Pb) and Selenium (Se). These metals were then used to conduct a probabilistic risk analysis including a Hazard quotient (HQ), margin of exposure (MOE) and lifetime cancer risk (LCR) calculation, principal component analysis (PCA). Also, we generated descriptive and inferential statistics.

RESULTS: As and Se had the highest mean concentrations 111 + 67.1, 72 + 58.5 respectively. Significant differences were found between Cd and Hg metal concentrations for samples cultivated in USA versus Internationally $p < 0.05$. for PCA, three pc scores were selected for a total variance of 59.8%. As was highly negatively correlated with PC3, meanwhile Se and Cd were negatively correlated with PC2 and PC1. HQ calculations were indicative of a negligible risk. Both MOE and LCR analysis indicate risk of genotoxic and carcinogenic outcomes.

CONCLUSIONS: Overall, findings indicated that mean exposure to As above the FDA's recommended safe level. PCA also showed that these metals likely came from varying anthropogenic sources. Risk analysis highlighted increased risks of genotoxicity and carcinogenicity.

KEYWORDS: Arsenic, Cadmium, Lead, Baby food

P-0430 Educational intervention in rural schoolchildren exposed to pesticides: a qualitative analysis of their experiences and testimonies

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BACKGROUND: Organophosphate pesticides (OP) are frequently used in agriculture and are toxic to humans. In Chile, OP metabolites were detected in the urine of rural schoolchildren. Although there are studies examining the effect of educational interventions on risk perception and urine metabolites in students exposed to pesticides, there are no qualitative data available.
OBJECTIVE: The aim of this study was to conduct a qualitative analysis of the pictorial and narrative experiences of two Chilean rural educational communities that participated in a pesticide exposure intervention.

METHODS: The intervention lasted four weeks and involved 48 schoolchildren and their parents over a two-year period (2016-2017). The experience's systematization was investigated qualitatively using pictorial compositions and oral testimonies from participants during and after the intervention.

RESULTS: Both parents and children show an increased knowledge of the environmental concerns associated with pesticide exposure and its consequences on health, occupational conflicts, and cohabitation with neighbors who use these agrochemicals. Certain individuals experience cognitive dissonance when they apply pesticides due to their toxicity. Children have a discourse that is risk-averse, concerned with the common good, and prioritizes the pursuit of justice, solidarity, and accountability; nonetheless, they are dependent on the actions of adults. The parents believe the children's demands are reasonable, but they express frustration over the lack of monitoring and the difficulties in filing complaints due to a lack of knowledge about the procedures, a lack of connectivity, or fear of disagreement with those who use pesticides.

CONCLUSIONS: It is critical that interventions are centered on the direct experiences of rural schoolchildren and their families, while remaining true to scientific content and grounded in local knowledge and culture, and that they contribute significantly to the community's search for solutions and actions in the face of environmental conflict.

KEYWORDS: Pesticides, schoolchildren, qualitative analysis.

P-0431 Exploring blue spaces' effects on childhood leukaemia inci-dence: A population-based case-control study in Spain

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BACKGROUND AND AIM: Blue spaces have been a key part of human evolution, providing resources and helping economies develop. To date, no studies have been carried out to explore how they may be linked to paediatric oncological diseases. The aim of this study was to explore the possible relationship of residential proximity to natural and urban blue spaces on childhood leukaemia.

METHODS: A population-based case control study were conducted in four regions of Spain across the period 2000-2018. 936 incident cases and 5,616 controls were included, individually matched by sex, year-of-birth and place-of-residence. An exposure proxy with four distances (250m, 500m, 750m and 1 km) to blue spaces was built using the geographical coordinates of the participants' home residences. Odds ratios (ORs) and 95% confidence intervals (95%CIs), blue space exposure were calculated for overall childhood leukaemia, and the acute lymphoblastic (ALL) and acute myeloblastic leukaemia (AML) subtypes, with adjustment for socio-demographic and environmental covariates.

RESULTS: A decrease in overall childhood leukaemia and ALL-subtype incidence was found as we came nearer to children's places of residence, showing, for the study as a whole, a reduced incidence at 250m (odds ratio (OR)=0.77; 95%CI=0.60-0.97), 500m (OR=0.78; 95%CI=0.65-0.93), 750m (OR=0.80; 95%CI=0.69-0.93) and 1000m (OR=0.84; 95%CI=0.72-0.97). AML model results showed an increasing incidence at closest to subjects' homes (OR at 250m = 1.06; 95%CI=0.63-1.71).

CONCLUSIONS: Our results suggest a possible association between lower childhood-leukaemia incidence and blue-space proximity. This study is a first approach to blue spaces' possible effects on childhood leukaemia incidence; consequently, it is necessary to continue studying these spaces – while taking into account more individualized data and other possible environmental risk factors.

KEYWORDS: urban blue spaces; environmental factors; childhood cancer; childhood leukaemia; incidence; spatial epidemiology.

P-0432 Prenatal exposure effects to environmental pollutants on birth weight and weight gain during the first six months of life

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The intrauterine period and first months after birth are critical concerning pollutant exposure, as the fetus and infant are especially vulnerable to developmental disrupting pollutants during these timeframes. Environmental pollutants can cross the placental barrier and affect intrauterine growth and development, which can lead to birth weight effects, as well as changes that may only manifest in adulthood. Birth weight and growth and development assessments are important child health indicators. This study evaluated the relationship between biological sample pollutant concentrations and birth weight and weight gain in the first six months of life.

Data from the PIPA-UFRJ Project pilot study were used, evaluating metal (lead, mercury, cadmium, arsenic), organochlorine (4'4DDE), and perfluoroalkyl substances (PFOS) concentrations in umbilical cord blood and pyrethroids (3BPA) in the urine of pregnant women, as well as birth weight and weight gain at 6 months in 125 and 58 children, respectively, born at the UFRJ Maternity School from October/2017 to August/2018.

Prenatal DDE exposure was associated with weight gain (Z score >2) at six months of age OR= 6,0 (CI 95% 1,03 – 34,90). Mean arsenic concentrations were also significantly higher in children with high weight gain at six months of age (p=0,046). Mean birth weight was lower in female newborns exposed to 3BPA (p=0,081), and weight gain at six months of age was moderately and inversely correlated with 3BPA (p=0,096), although not significant.

The PIPA-UFRJ Project pilot study was the first in Brazil to evaluate umbilical cord blood environmental pollutants in relation to birth weight and weight gain at 6 months. These results are in agreement with other findings in the literature and indicate the need for further studies to investigate the relationship between prenatal environmental pollutant exposure and weight gain in the Brazilian child population.

KEYWORDS: Prenatal Exposure; Environmental Pollutants; Birth Weight; Weight gain

P-0433 Exposure to ambient ultrafine particles and allergic sensitization in children up to 16 years

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BACKGROUND AND AIM: Few epidemiological studies so far have investigated the role of long-term exposure to ultrafine particles (UFP) in allergy development. The purpose of this study was to assess the association between UFP exposure and allergic sensitization to inhalant and food allergens in children up to 16 years old in the Netherlands.

METHODS: 2295 participants of the prospective PIAMA birth cohort with specific IgE measurements to common inhalant and food allergens at ages 4, 8 or 12 or to common inhalant allergens at age 16 were included in the study. Annual average UFP concentrations were estimated for the home addresses at birth and at the time of the IgE measurements using land-use regression models. Generalized estimating equations were used for the assessment of overall and age-specific associations between UFP exposure and allergic sensitization. Additionally, single- and two-pollutant models with NO2, PM2.5, PM2.5 absorbance and PM10 were assessed.

RESULTS: We found no significant associations between UFP exposure and allergic sensitization to inhalant and food allergens (OR (95% CI) ranging from 1.02 (0.95 – 1.10) to 1.05 (0.98 – 1.12), per IQR increment). In contrast, NO2, PM2.5, PM2.5 absorbance and PM10 showed significant associations with sensitization to food allergens (OR (95% CI) ranging from 1.09 (1.00–1.20) to 1.23 (1.06–1.43) per IQR increment) but not with sensitization to inhalant allergens (OR (95% CI) ranging from 0.98 (0.90-1.07) to 1.08 (0.93-1.25) per IQR increment). for NO2, PM2.5 and PM2.5 absorbance, the associations with sensitization to food allergens persisted in two-pollutant models with UFP.
CONCLUSION: This study found no association between annual average exposure to UFP and allergic sensitization in children up to 16 years of age. NO2, PM2.5, PM2.5 absorbance and PM10 were associated with sensitization to food allergens.

KEYWORDS: ultrafine particles, IgE sensitization, inhalant and food allergens, children, air pollution, allergy

P-0434 Exposure to endocrine-disrupting chemical mixture and IQ at 4-6 years of age: in Mother and Children's Environmental Health study (MOCEH study)

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BACKGROUND AND AIM: Early childhood is important for neurodevelopment and exposure to endocrine disruptors such as bisphenol-A and phthalate in this period may cause neurodevelopmental disorders such as autism spectrum disorder, attention deficit hyperactivity disorder and developmental delay. The present study aimed to examine the association between exposure to endocrine-disrupting chemical mixture in early childhood and IQ at 4-6 years of age.

METHODS: Mother and Children's Environmental Health study (MOCEH study) is a prospective Korean birth cohort study. We used the urinary concentrations of metabolites of endocrine-disrupting chemicals (Bisphenol-A, Mono-(2-ethyl-5-oxohexyl) phthalate, Mono-(2-ethyl-5-hydroxyhxyl) phthalate, Mono-(2-ethyl-5-buyl) phthalate) measured at the age of 24 and 36 months. We measured the children's IQ with Korean Wechsler Intelligence Test at the age between 4 through 6 years. After adjusting for the potential confounders, multivariate linear regression was conducted to examine the association between the endocrine-disrupting metabolic substances eack and the IQ of the children. Bayesian kernel machine regression analysis was used to assess the association between exposure to endocrine-disrupting chemical mixtures and IQ(n = 164).

RESULTS: All endocrine-disrupting chemicals measured at both 24 and 36 months were significantly associated with decreased IQ. Mono-(2-ethyl-5-buyl) phthalate measured at 36 months showed the greatest magnitude of association (β = -0.026, 95% confidence interval: -0.049, -0.003). The exposure to mixture of all chemicals was associated with lower IQ. Among the four chemicals and two periods, Mono-(2-ethyl-5-buyl) phthalate exposure at 36 months was identified as the most critical factor associated with IQ scores.

CONCLUSIONS: We observed that exposure to endocrine-disrupting chemical mixture was negatively associated with children's IQ.

KEYWORDS: Bayesian kernel machine regression, Chemical mixtures, Endocrine-disrupting chemical, Neurodevelopment, Intelligence Quotient

P-0435 Exposure to greenspace and bluespace in relation to cognitive functioning in children and adolescents - A systematic review

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BACKGROUND AND AIM: The field of green- and bluespace research including studies in relation to cognitive functioning is rapidly growing. Thus, there is a strong need to systematically review the existing studies. Several systematic reviews have been already published on this topic but none of them is specific to cognitive outcomes in children of the entire age range. Moreover, only few of them examined the effects of bluespace in addition to greenspace. Also, previous reviews were focused either only on observational studies or on experimental studies. Our systematic review focuses on cognition in relation to green- and bluespace in children and adolescents between birth and 18 years old and captures both observational and experimental studies.
METHODS: We followed the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines. Searches were conducted in two databases – PubMed and PsychInfo. Free-text terms related to outcome, exposure, and population as well as MeSH terms for outcome and population were used. Further, the reference lists of publications identified as eligible for full-text review were "snowball" searched to detect additional studies.
RESULTS: Records identified from PubMed (n=2030) and PsycINFO (n=1168) were deduplicated and screened. 22 publications were selected. 13 additional publications were identified through „snowball" search. The extration of data revealed heterogeneity among studies. Methodological flaws and differences between studies should be considered. First, various methods of exposure and outcome assessment were used. Second, risk of bias assessment revealed inappriopriate use of statistical methods including the confounding and modifying variables, and mediating methods, exclusion data from analysis and selective reporting of outcomes, and inappriopriate assessment of cognition.
CONCLUSIONS: Improvement regading the methodological quality of future studies is required: expertise from several domains such as environmental epidemiology, statistics, and psychology should be involved in conducting future studies.

KEYWORDS: green space, blue space, cognitive development

P-0436 Unconventional oil and gas exposure and risk of childhood leukemia in Pennsylvania

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BACKGROUND/AIM: Unconventional oil and gas development (UOGD), commonly known as "fracking," is a rapidly expanding industry that releases chemicals that have been linked to cancer and childhood leukemia. Despite high community concern, studies of childhood cancer are sparse. We evaluated potential associations between residential proximity to UOGD and risk of acute lymphoblastic leukemia (ALL), the most common form of childhood leukemia, in a large regional sample using UOGD-specific metrics, including a novel metric representing the water pathway.

METHODS: We conducted a registry-based case-control study of 405 children aged 2-7 years diagnosed with ALL in Pennsylvania between 2009-2017, and 2,080 controls matched on birth year. We used adjusted logistic regression to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the association between residential proximity to UOGD (including a new water-specific proximity metric) and ALL in two exposure windows: a primary window (three months pre-conception to one year prior to diagnosis/reference date) and a perinatal window (three months pre-conception–birth).

RESULTS: Children with at least one UOG well within 2 km of their birth residence during the primary window had 1.98 times the odds of developing ALL versus those with no UOG wells (95% CI: 1.06-3.69). Children with at least one versus no UOG wells within 2 km during the perinatal window had 2.80 times the odds of developing ALL (95% CI: 1.11-7.05). These relationships were slightly attenuated after adjusting for maternal race and socio-economic status (OR: 1.74 [95% CI: 0.93-3.27], OR: 2.35 [95% CI: 0.93-5.95], respectively). Analyses based on the water-specific metric yielded similar findings.

CONCLUSIONS: Our large regional study including a novel water-specific metric found UOGD to be a risk factor for childhood ALL. This work adds to mounting evidence of UOGD's impacts on children's health, supporting the need to limit UOGD near residences.

KEYWORDS: Childhood leukemia, unconventional oil/gas

P-0437 Early-life exposure to per- and polyfluoroalkyl substances and gut microbial composition

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BACKGROUND AND AIM: Human milk is an under-appreciated source of toxic exposures, including immunomodulatory per- and polyfluoroalkyl substances (PFAS), for breastfed infants. The immune-related effects of PFAS may, in part, be due to alterations of the microbiome. We aimed to identify changes in the infant gut microbiome related to milk PFAS exposure.

METHODS: In the New Hampshire Birth Cohort Study, PFAS were quantified in human milk samples from ~six weeks postpartum using solid-phase extraction coupled to high-performance liquid chromatography-isotope dilution tandem mass spectrometry. A molar sum (ΣPFAS) was calculated. Caregivers collected infant stool samples at six weeks (n=116) and/or one year postpartum (n=119). Stool DNA was extracted and underwent metagenomic sequencing. We profiled bacterial species and KEGG Orthologies (KOs) using BioBakery pipelines. Diversity was quantified with the Shannon Index. We estimated the association of PFAS with alpha diversity and relative abundances of species and KOs with linear regression. Single- and multi-pollutant models adjusted for confounders and predictors of the microbiome, with missing covariate data imputed. Each outcome timepoint was considered separately and analyses at six weeks were restricted to infants who were exclusively fed human milk (n=90).

RESULTS: Perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) were detected in 94% and 83% of milk samples, respectively. PFOS was associated with increased Shannon Index at six weeks [β=0.24 per PFOS doubling, (95%CI: 0.03, 0.45), p=0.03]. Estimates were stronger in multi-pollutant than single-pollutant models, and among complete cases. ΣPFAS was associated with one-year-old Bacteroides vulgatus relative abundance [(β=-2.48 % per doubling (-3.77, -1.18), FDR q=0.05]. No other associations were observed.

CONCLUSIONS: PFAS may increase diversity of the infant gut microbiome and alter the relative abundance of cardiometabolically-active bacteria. Additional analyses may highlight susceptible populations and identify related health outcomes.

KEYWORDS: per- and polyfluoroalkyl substances, microbiome, human milk

P-0438 Investigation of the relationship between multiple environmental exposures and pediatric obesity in a national cross-sectional study of Canadian children

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BACKGROUND AND AIM: Pediatric obesity rates in Canada have nearly tripled in the last 30 years, leading to increased rates of morbidity. While environmental exposures are suspected to be obesogenic, data are lacking and mostly employ a single-exposure approach. We aimed to evaluate the potential associations between multiple environmental factors and pediatric obesity.

METHODS: We used nationally-representative biomonitoring and health data for children aged 3-11 from the cross-sectional Canadian Health Measures Survey. Chemicals of interest, monitored in blood or urine, were polyaromatic hydrocarbons (PAH), bisphenol A (BPA), parabens, perfluorinated compounds, phthalates and metals. Obesity was characterized by WHO sex-specific body mass index (BMI) for age z-scores. Central obesity was defined using international waist circumference percentile cutoffs. Using generalized additive models, we examined the impact of multiple environmental characteristics, including proximity to greenspace, fine particulate matter (PM 2.5), nighttime light brightness and walkability (active living environment), on associations between single-chemical exposures and obesity. Using quantile-based G computational analysis, we quantified the combined effects of chemicals captured in all cycles, where feasible. Models were adjusted for confounders identified in a directed acyclic graph. Results are adjusted odd ratios with 95% confidence intervals (95% CI).

RESULTS: Overall, 9,147 children were included. In single-exposure models, several PAH compounds, BPA, cadmium and total phthalates were linked to increased obesity and central obesity. Per interquartile range increase in total PAHs, risks of obesity and central obesity were elevated to 1.09 (95%CI 1.01, 1.18) and 1.14 (95%CI 1.01, 1.30), respectively. In combined-effects models for PAHs and BPA, risks of obesity and central obesity were strengthened to 1.46 (95%CI 1.20, 1.78) and 1.29 (95%CI 1.10, 1.56), respectively.

CONCLUSIONS: Our findings support the role of early chemical exposure in pediatric obesity, particularly PAHs. The combined effects of chemicals strengthened the observed associations.

KEYWORDS: Pediatric; Chemicals; Obesity; Public Health; Environment

P-0446 Associations between prenatal and early-life air pollution exposure and lung function in young children: exploring influential windows of exposure on lung development

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BACKGROUND AND AIM: Evidence in the literature suggests that air pollution exposures experienced prenatally and early in life can be detrimental to normal lung development, however potentially more influential windows during development are not fully understood. We evaluate air pollution exposures during the prenatal and early-life period in association with lung function at ages 7-9, in an effort to identify potentially influential windows of exposure for lung development.

METHODS: Our study population consisted of 222 children aged 7-9, from the Fresno-Clovis metro area in California with spirometry data collected between May 2015 and May 2017. We used distributed-lag non-linear models to flexibly model the exposure-lag-response for monthly average exposure to fine particulate matter (PM2.5) and ozone (O3) during the prenatal months and first three years of life in association with forced vital capacity (FVC), and forced expiratory volume in the first second (FEV1), adjusted for covariates.

RESULTS: PM2.5 exposure during the period spanning pregnancy and the first 3-years of life was associated with lower FVC and FEV-1. Specifically, an increase from the 5th percentile of the observed monthly average exposure (7.55 µg/m3) to the median observed exposure (12.69 µg/m3) was associated with 0.42 L lower FVC (95% confidence interval (CI): -0.81, -0.03) and 0.38 L lower FEV1 (95% CI: -0.74, -0.01). The shape of the lag-response indicated that the second half of pregnancy may be a more influential window of exposure. Associations for ozone were not as strong and typically CIs included the null.

CONCLUSION: Our findings indicate that prenatal and early-life exposures to PM2.5 are associated with decreased lung function later in childhood. Exposures during the latter months of pregnancy may be especially influential.

KEYWORDS: air pollution, lung development, distributed-lag models, exposure windows

P-0447 Seasonal attack patterns in childhood atopic dermatitis are related to different environmental factors

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BACKGROUND AND AIM: Atopic dermatitis (AD) is a prevalent childhood condition involving many people. The attack pattern has been quite diverse. Few studies have classified AD children into subgroups according to seasonal attack pattern. This study explores the methods to group AD children into seasonal attack patterns, and examines hereditary and environmental factors on each subgroup in children with AD.
METHODS: In Taiwanese children from one elementary and one middle schools in each of the 22 cities/counties, allergic status, hereditary and living environmental factors were surveyed in 2016, as well as air pollutants by air monitoring stations. Among those with current AD, principal component analyses on weighted moving average of monthly attack score was applied to categorize AD attack subtypes. Generalized Estimating Equation was used to study the effects of environmental exposure on each AD attack subgroups.
RESULTS: A total of 11,585 children were surveyed, and 17.6% of children reportedly had AD attack in the past 1 year. Among them, four attack patterns were identified: spring, summer/fall, winter and perennial. Parental atopic diseases and higher education, and molds in residence are important factors for AD. Among seasonal attack patterns, lower temperature, higher humidity, and PM2.5 were related to spring-attack; higher temperature to summer-fall-attack; lower humidity to winter-attack; and traffic-related air pollutants to perennial-attack AD.
CONCLUSIONS: Distinguished attack patterns are identified in children with current AD. Depending on individual attack subtypes, environmental factors can be different.

KEYWORDS: seasonal attack pattern; atopic dermatitis; environmental factors; GEE

P-0453 Prenatal exposure to persistent organic pollutants and early child growth: a pooled analysis in two Belgian birth campaigns

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BACKGROUND AND AIM: Children are born with a burden of persistent organic pollutants (POPs) which have endocrine-disrupting properties and may contribute to the rise in childhood obesity. The current evidence is equivocal, partly because many studies are cross-sectional or prospective studies addressing the effects at one time point during childhood. We aimed to assess the associations between prenatal POP exposures and growth during infancy and across early childhood.

METHODS: We used data from two campaigns of a Belgian cohort with five organochlorine [(dichlorodiphenyldichloroethylene (p,p'-DDE), hexachlorobenzene (HCB), polychlorinated biphenyls (PCB138, -150, -180)] (n=1397) and two perfluoroalkyl substances [perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS)] (n=343) measured in cord blood. We assessed infant growth, defined as body mass index (BMI) z-score change between birth and 2 years, and early childhood growth, characterized as BMI trajectory from birth to 8 years. In addition to a single-pollutant approach (linear regression), we applied a multi-pollutant approach (penalized elastic net regression with stability selection) to evaluate the associations with 2-year infant growth, controlling for covariates and co-exposures. Associations with 8-year early childhood growth were evaluated by assessing alterations in growth trajectories using single-pollutant covariate-adjusted linear mixed models with natural cubic splines.

RESULTS: Prenatal exposure to PCB-153 and -180 was significantly associated with increased infant growth in single-pollutant models (β=0.002, 95%CI: 0.000-0.005 per ng/g lipid and β=0.004, 95%CI: 0.001-0.008 per ng/g lipid, respectively). Both were also selected in elastic net models, although with modest precision. We found no clear associations between any of the exposures and growth trajectories (p-value>0.05 for the interaction of single exposure and child age).

CONCLUSIONS: These results suggest that prenatal exposure to two PCB congeners may be associated with increased infant growth in the first two years, with little evidence of more persistent effects.

KEYWORDS: Prenatal exposures, POPs, Early childhood, Growth

P-0455 Ambient ozone exposure and bone turnover markers in children: Results from the GINIplus and LISA birth cohorts

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BACKGROUND: Multiple environmental factors can regulate bone metabolism, and it is hypothesized that air pollution may be adversely involved in this regulation. However, only a few studies considered bone turnover markers (BTMs) - sensitive and specific markers of bone metabolism - as outcomes, and no study explored the exposure to ambient ozone. We aimed to analyze associations between long-term exposure to ozone and concentrations of two BTMs, osteocalcin and β-isomer of C-terminal telopeptide of type I collagen (CTx), among 10-year-old children.

METHODS: Cross-sectional analyses were based on 1848 children from the Munich and Wesel centers of the GINIplus and LISA German birth cohorts. Serum osteocalcin and CTx concentrations were measured. We estimated ozone exposures by optimal interpolation and assigned them to home addresses. Nitrogen dioxide and particulate matter with an aerodynamic diameter < 10 µm were assessed by land use regression models. We adjusted linear regression models for covariates and co-pollutants, and the analyses were further stratified by area.

RESULTS: The mean concentrations were 93.09 ng/mL and 663.66 ng/L for osteocalcin and CTx, respectively. In general, higher levels of ambient ozone exposure were associated with lower concentrations of BTMs in both areas. The number of days per year with a maximum 8-hour average concentration exceeding 120 µg/m³ showed consistent results across different models. Specifically, models adjusted for co-pollutants illustrated that the beta estimates and 95% confidence intervals on osteocalcin and CTx were -2.51 (-3.78, -1.14) and -44.53 (-57.12, -31.93), respectively, for an increase of 10 days.

CONCLUSIONS: Long-term exposure to ambient ozone was associated with decreased concentrations of BTMs in German children. Unless other prospective studies confirm our results, the adverse effects of exposure to ozone on bone development in children should be interpreted with caution.

KEYWORDS: Air Pollutants, Bone Development, Bone Remodeling, Osteocalcin, Collagen Type I, Epidemiology

P-0457 Prenatal manganese and working memory in school-aged children in Mexico City: A multi-media biomarker approach

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BACKGROUND/AIM: Mn is a nutrient, and over/underexposure may be linked to poorer development, but little work has addressed executive functioning, including working memory (WM). We used the multi-media biomarker (MMB) approach to assess prenatal blood and urine levels as predictors of WM in children.

METHODS: Leveraging the PROGRESS birth cohort in Mexico City, children (N = 572) ages 6–8 completed the CANTAB Spatial Working Memory (SWM) task. We used between errors (incorrectly returning to a previously selected empty box) and strategy (whether children begin new searches randomly or in a pattern) as primary outcomes. Blood and urinary Mn levels were collected from mothers in the 2nd and 3rd trimesters. Multiple regression models estimated the association between Mn biomarkers at each trimester with SWM. We categorized Mn exposure as low (1st quintile of Mn concentrations), moderate (2nd–4th quintiles), and high (5th quintile) levels. We used weighted quantile sum regression to estimate the MMB integrated effect of combined Mn biomarkers on the SWM measures. Models were adjusted for maternal age, education, socioeconomic status, and child's gender and age at CANTAB assessment.

RESULTS: Low blood Mn in the 3rd trimester was associated with higher between error scores, indicating poorer WM (B = 3.24, 95% CI: 0.11, 6.36) using moderate blood Mn as the reference group, but was not with the strategy scores. The integrated Mn MMB was inversely associated with WM performance (B = -2.19, 95% CI: -3.51, -0.09). In the 2nd and 3rd trimesters, urinary Mn contributed the most prominent weight to the MMB effect (40.4% and 40.1% contributions, respectively).
CONCLUSION: Lower prenatal blood Mn and combined blood and urine Mn were associated with poorer WM performance in school-age children. Given that Mn is a nutrient, this analysis suggests that maternal Mn deficiency may affect WM.

KEYWORDS: Prenatal exposure, Manganese, Working memory,

P-0458 Maternal urinary phthalate metabolites during pregnancy and thyroid function: The MAKE Study

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BACKGROUND AND AIM: Phthalates, endocrine-disrupting chemicals that are commonly found in consumer products, may adversely affect thyroid hormones, but findings from prior epidemiologic studies have been inconsistent. In a prospective cohort study, we investigated whether maternal urinary phthalate metabolite concentrations and phthalate mixtures measured during pregnancy were associated with thyroid hormones among pregnant women.

METHODS: We measured five phthalate metabolites [monoethyl phthalate (MEP), mono-n-butyl phthalate, mono-isobutyl phthalate, monobenzyl phthalate (MBzP), and four monoesthers of di(2-ethylhexyl) phthalate] in urine collected at pregnant women in MAKE Study. Thyroid stimulating hormone (TSH) and free and total thyroxine and triiodothyronine were measured in maternal serum (n = 215). We used multivariable linear regression to assess associations between individual urinary phthalate metabolites and concentrations of maternal thyroid hormones. We used weighted quantile sum regression (WQS) to create a phthalate index describing combined concentrations of phthalate metabolites and to investigate associations of the phthalate index with individual thyroid hormones.

RESULTS: The geometric mean urinary concentrations of specific gravity adjusted MEPm MBzP and MECCP were 2.1, 0.2, and 0.1 μg/L, respectively. The phthalate index was had a significantly positive effect on the maternal serum TSH (WQS beta = 0.13; p = 0.02). However, no significant association was found with both maternal serum TT3 (WQS beta = -0.23; 0.89) or and TT4 (WQS beta = -0.02; p=0.83)

CONCLUSIONS: Our results suggest that co-exposure to multiple phthalates was positively associated with TSH in pregnant women in this birth cohort. These findings highlight the need to study chemical mixtures in environmental epidemiology.

KEYWORDS: Phthalates; Pregnancy; Thyroid hormones; Weighted quantile sum regression.

P-0459 Exposure to mixtures of phenols, phthalate metabolites, parabens, and pesticide and BMI and lipid profiles in adolescents age 12-18 po

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BACKGROUND AND AIM: Endocrine disrupting chemicals (EDCs) interfere endocrine system and lead to the imbalance in the regulation of lipid metabolism and body weight. Some recent studies suggest that EDCs may increase the risk for obesity or dyslipidemia, but most previous studies have evaluated the health effects of individual EDCs in isolation. We evaluated the association of combined exposure of EDCs with body mass index (BMI) and lipid profiles in a representative sample of a general population from Korea.

METHODS: Urinary concentrations of exposures including three phenols (bisphenol A, bisphenol F, bisphenol S), eight phthalate metabolites (mono- (2-ethyl-5-hydroxyhexyl) phthalate, mono-(2-ethyl-5-oxohexyl) phthalate, mono-n-butyl phthalate, monobenzyl phthalate, mono-(2-ethyl-5-carboxypentayl) phthalate, mono-(carboxyoctyl) phthalate, mono-(carboxynonyl) phthalate, mono(3-carboxylpropyl) phthalate), three parabens (methyl paraben, ethyl paraben, propyl paraben), and pyrethroid pesticides metabolite (3-phenoxybenzoic acid) and outcomes of interest including BMI, triglycerides (TG), total cholesterol, and high-density lipoprotein cholesterol (HDL-c) were measured in 891 adolescents. Age, sex, monthly household income, mother's education level, frequency of fast-food, physical activity, smoking status, and alcohol consumption were adjusted. The association was examined using Bayesian Kernel Machine Regression (BKMR), and the analyses were stratified by sex to assess the potential effect modification.

RESULTS: BMI, TG to HDL-c ratio (TG/HDL), and total cholesterol to HDL ratio (TC/HDL) showed significant increasing trends when all the chemicals were at different levels from 25th percentile to 75th percentile, although the confidence intervals were wide. and the overall effects were more significant among males compared to female. for BMI, parabens showed the highest group posterior inclusion probability (PIP). On the other hand, for TG/HDL and TC/HDL, phthalate metabolites showed the highest group PIP.

CONCLUSIONS: Our findings suggest that higher exposure to EDCs mixture is associated with higher BMI, TG/HDL, TC/HDL, particularly in male adolescents.

KEYWORDS:
endocrine disrupting chemicals, mixture, BKMR, BMI, TG, HDL, total cholesterol, adolescents

P-0460 The association between exposure to mixture of phenols, phthalate metabolites, and persistent organic pollutants with insulin resistance in children

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BACKGROUND AND AIM: Endocrine disrupting chemicals (EDCs) exposure has been suggested to play an important role in increasing insulin resistance. However, there has been limited epidemiologic evidence, particularly in children, and most previous studies focused on the effect of individual chemical. Given that we are exposed to various EDCs simultaneously, we aim to study the overall effects of EDCs mixture on insulin resistance.

METHODS: Children from the Ewha Birth and Growth Cohort Study who underwent follow-up examinations at 7-9 and 13-15 years of age was analyzed. We included chemicals with detection rates greater than 50%. Urinary bisphenol A (BPA), 9 urinary phthalate metabolites, and 14 serum persistent organic pollutants (POPs) measured at 7-9 years of age were included in the analysis. Fasting insulin was measured at 7-9 and 13-15 years of age. Homeostatic model assessment of insulin resistance (HOMA-IR) and homeostatic model assessment of beta-cell function (HOMA-β) were measured at 7-9 years of age. Age, sex, monthly household income, mother's education level, and frequency of soda consumption and fast-food consumption were adjusted. A total of 89 to 158 children, depending on outcome variables, with complete data were analyzed. We used Bayesian Kernel Machine Regression (BKMR) to evaluate the joint effects of multiple chemical exposures on insulin resistance.

RESULTS: We found significant positive associations between the chemical mixtures at 7-9 years of age with insulin, HOMA-IR, and HOMA- β at 7-9 years of age and insulin at 13-15 years of age. and the increasing trend was shown more significantly among females compared to male. Phthalates showed the highest group posterior inclusion probability for all outcomes.

CONCLUSIONS: Our results indicated that mixtures of BPA, phthalate metabolites, and POPs may increase the insulin resistance and the effects persist for years.

KEYWORDS: phenol, phthalate, POPs, mixture, BKMR, insulin resistance, children

P-0462 Maternal and child exposure to organophosphate ester mixtures and child neurobehavior

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Organophosphate esters (OPEs) are a class of chemicals used mainly as flame retardants and plasticizers, but growing experimental evidence of their neurotoxicity has raised concerns of potential effects in humans. We aim to study whether exposure to OPE mixtures in early life is associated with child behavior.

We quantified urinary concentrations of three OPE metabolites, bis-2-chloroethyl phosphate (BCEP), bis(1,3-dichloro-2-propyl) phosphate (BDCIPP), and diphenyl phosphate (DPHP), at prenatal (16 and 26 weeks of gestation and birth) and postnatal time points (ages 1, 2, 3, and 5 years) in the Health Outcomes and Measures of the Environment Study, a longitudinal pregnancy and birth cohort in Cincinnati, Ohio, USA. Using latent variable analysis and quantile g-computation, we investigated associations between mixtures of the three urinary OPE metabolites and child behaviors at ages 3 and 8 years, as measured by the Behavioral Assessment System for Children, Second Edition.

In the latent variable analysis, higher log-OPE exposure at 16 weeks was associated with fewer externalizing problem behaviors (ß = -5.74; 95% CI = -11.24, -0.24) and fewer overall behavioral problems at age 3 years (ß = -5.26; 95% CI = -10.33, -0.19), whereas higher exposure at birth was associated with poorer overall behavioral problems at age 3 years (ß = 2.87; 95% CI = 0.13, 5.61). OPE exposures at 16 weeks, 26 weeks, and birth were not associated with child behavior at age 8. Higher log-OPE exposure at age 3 was associated with fewer externalizing behaviors at age 8 years (ß = -2.62; 95% CI = -5.13, -0.12). The quantile g-computation estimates, albeit null, had directions largely consistent with the latent variable analysis results.

Pre- and postnatal urinary OPE metabolite mixtures were associated with child behaviors at 3 and 8 years, but we did not identify a consistent pattern.

KEYWORDS: Organophosphate esters; children; neurobehavior; cohort; mixtures

P-0463 Children's exposure and risks to the rare earth elements of gadolinium and yttrium in Alcalá de Henares (Spain).

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BACKGROUND AND AIM: Widespread applications of rare earth elements (REEs) has increased their environmental presence, facilitating accumulation in humans. The aim was to determine the environmental presence, exposure and risks of gadolinium (Gd) and yttrium (Y) in topsoils in children living in Alcalá de Henares (Spain).

METHODS: Scalp-hair was collected from 120 children (6 to 9-years-old; 70 girls) born and residing in Alcalá. Gd and Y were analysed by ICP-MS after appropriate removal of exogenous contamination using Triton X-100/bath sonication. Additionally, Gd was monitored in 66 topsoil samples randomly sampled from different urban parks across the city in 2017, meanwhile Y was analysed in 97 topsoil samples collected in a previous study in 2001 in the same parks. Data was processed using statistical methods applied to censored data available in the 'NADA' statistical package.

RESULTS: The limits of detection in hair (µg/g) and soils (mg/kg), respectively, were: Gd (0.000386; 0.0007), Y (0.0056; 0.033). Although both REEs were detected in all the topsoil samples, only Gd was detected in the hair samples, 80.5% of samples. Median and range for Gd in scalp hair in µg/g was 0.00067 (0.000388-0.002), which were lower to those found in Chinese children environmentally exposed to REEs. Concentrations in topsoils in mg/kg were: Gd 2.902 (0.348-4.951), Y 4.982 (1.294-12.526). Provisional reference dose for Y was used to characterise non-carcinogenic risks for ingestion/dermal contact, which were lower than the unit (threshold).

CONCLUSIONS: Our results suggest minimal environmental exposure to both REEs, as human hair has been proposed as an effective biomonitoring tissue to identify individuals who have been chronically exposed to Gd and Y. Further monitoring studies should be performed to rule out the risks from exposure to both REEs in topsoils, particularly for Y, due to the time differences in which samples were collected.

P-0464 Monitoring lanthanum and praseodymium in Spanish children's hair

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BACKGROUND AND AIM: Children may be threatened by emerging contaminants such as lanthanides. The aim was to identify whether children living in Alcalá de Henares (Madrid Region, Spain), are exposed to lanthanum (La) and praseodymium (Pr).

METHODS: Lanthanides were analysed in scalp-hair from 120 children (6 to 9-years-old; 70 girls) by ICP-MS. Data was processed in the 'NADA' statistical package.

RESULTS: Pr was detected in most of the samples (82.4%; LoD=0.0005 μg/g), meanwhile La was detected in 63.2% (LoD=0.0055 μg/g), which may suggest a general exposure for both elements, as they were poorly detected in scalp hair from other population groups from the Madrid Region. Alcalá had important industries dedicated to manufacturing glass and ceramics, important sources for both lanthanides that might explain our results. The concentrations found (median and interquartile range; μg/g): La 0.0071 (<0.0055, 0.0114) and Pr 0.0014 (0.0007, 0.0021), were lower than those reported in populations living in contaminated areas. Although both lanthanides did not show sex dependency, Pr showed statistical significance according to zones of residency (p=0.008), possibly due to its uses. Thus, mean Pr level was higher in children's hair living in the area close to the glass/ceramics fabrics than those living in areas with higher densities of green spaces (0.00203 vs. 0.00132 μg/g).

CONCLUSIONS: Exposure to La and Pr would not represent a risk for Alcalá's children, as their levels were within the same order of magnitude as those reported in hair from healthy French children. Although a general exposure was observed, more studies are needed as beryllium, an important element also linked with glass/ceramics industries, was not detected in these samples in a previous study. A better understanding of the exposure to these lanthanides is required, as recent reports have observed that exposure to Pr could contribute to pathogenesis of pediatric cancer.

P-0465 Associations of Maternal Urinary Arsenic Concentrations during Pregnancy with Infant and Child Mental, Psychomotor, and Cognitive Development: The HOME Study

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BACKGROUND AND AIM: Arsenic exposure during pregnancy may increase the risk for intellectual deficits in children, but limited data exists from prospective epidemiologic studies, particularly at low arsenic exposure levels. We investigated the association between prenatal urinary arsenic concentrations and childhood cognitive abilities in the Health Outcomes and Measures of the Environment (HOME) Study.

METHODS: We used anion exchange chromatography coupled with inductively coupled plasma mass spectrometry detection to measure arsenic species content in pregnant women's urine. The summation of inorganic arsenic (iAs), monomethylarsonic acid (MMA), and dimethylarsinic acid (DMA) refers to ∑As. We longitudinally assessed children's cognitive function (n = 260) longitudinally at 1, 2, and 3 years using Bayley Scales of Infant and Toddler Development, at 5 years using Wechsler Preschool and Primary Scale of Intelligence, and at 8 years using Wechsler Intelligence Scale for Children.

RESULTS: We observed a modest decrease in mental development index and full-scale intelligence quotient at ages 3 and 5 years with each doubling of ∑As (median and IQR of 3.63 and 2.40-5.86 µg/L) with estimated score (ß) differences and 95% confidence interval (CI) of -1.8 from -4.1 to 0.5 and -2.5 from -5.1 to 0.0, respectively. This trend was stronger among children whose mothers had lower iAs methylation capacity and low urinary arsebonetaine concentrations.

CONCLUSIONS: Our findings suggest that exposure levels relevant to the general US population may adversely affect children's cognitive abilities.

KEYWORDS: arsenic; neurodevelopment; cognitive; Bayley Scale of Infant Development; Wechsler Preschool and Primary Scale of Intelligence; in utero exposure; Mental development index; Full scale intelligence quotient.

P-0466 Ultraviolet radiation exposure in children, behavioral factors associated with measured doses and seasonality

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BACKGROUND AND AIM: Ultraviolet radiation (UVR) exposure is associated with both positive and adverse health, such as beneficial aspects of vitamin D and skin cancer, respectively. Childhood is a time of great variability for sun behaviours and increased sensitivity to UVR. However, the relationship between one's received exposure and the level of ambient UVR is modified by activities. There is a need to document UVR exposure in relation to concurrent activities and sun protection behaviour for children and adolescents. While several studies have measured UVR exposure in children there has been no study conducted in Switzerland, where skin cancer incidence is one of the highest in Europe.
METHODS: UVR was measured in children aged 4-17 years (n=120) over 5 consecutive days using dosimeters worn on the chest. The dosimeter included an acceleration sensor, to identify periods during which it was worn. During measurement of UVR parents recorded children's activities in activity diaries. Measurements were related to reported activities and mean exposure (and spread) was assessed by activity type and season.
RESULTS: 4'058 hours of exposure measurements was assessed. The measured mean cumulative daily exposure was 0.46 standard erythmal dose (SED) per participant. The largest contribution to the total cumulative dose came from activities that involved playing outdoors (83.4 SED), followed by walking (32.6 SED), and hiking (25.7 SED), which had the highest mean exposures. The mean exposures were higher during midday hours and at higher altitudes; however, did not evidently vary by season during the measurement period.

CONCLUSIONS: Children's UVR in Switzerland varies considerably by activity and whereabouts, and is highest during midday and early afternoon hours, with only modest variation between seasons. While measured UVR intensities are similar for different outdoor activities, the largest contribution to received doses comes from playing outdoors.

KEYWORDS:
Ultraviolet radiation exposure, children, exposure assessment

P-0467 Gestational exposure to phthalates and phthalate replacements in relation to neurodevelopmental delays in early childhood

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BACKGROUND AND AIM: Phthalates are endocrine-disrupting chemicals that have been linked to changes in child neurodevelopment. However, sex-specificity has been reported inconsistently, and little is known about the impact of recent phthalate replacement chemicals. We aimed to examine the associations between prenatal exposure to phthalates/phthalate replacements and neurodevelopment, and the sex-specificity of such relationships.

METHODS: Our analysis included mother-child pairs (N=274) from the PROTECT birth cohort in Puerto Rico. Phthalate metabolites were measured in maternal urine collected up to three times during pregnancy. Neurodevelopment was measured at 6, 12, and 24 months of age using the Battelle Developmental Inventory-2nd edition (BDI), which provides scores for adaptive, personal-social, communication, motor, and cognitive domains. Multivariable linear regression was used to examine associations between the geometric mean of individual phthalate metabolite concentrations across pregnancy and BDI scores, adjusting for maternal age, maternal education, child age, and specific gravity. Differences by sex were assessed with sex*exposure interaction terms and stratified models.

RESULTS: Cognitive domain scores were associated with mono-carboxy-isooctyl phthalate (MCOP) at all assessment ages, and all five domains were associated with mono-carboxy-isooctyl phthalate (MCOP), mono-3-carboxypropyl phthalate (MCPP), and mono-oxononyl phthalate (MONP) at age 24 months. Sex-specificity existed for all timepoints (p-interaction<0.2), in general, showing stronger associations among boys. for example, metabolites of a recent phthalate replacement, di-2-ethylhexyl terephthalate (DEHTP), were differentially associated with Adaptive scores (boys β=-6.38, 95%CI:-12.36,-0.41 vs. girls β=-0.72, 95%CI:-4.31,2.86), and Cognitive scores (boys β=-4.88, 95%CI:-8.78,-0.99 vs. girls β=-1.56, 95%CI:-3.34,0.22) at 6 months, and with Motor scores (boys β=-4.32, 95%CI:-7.24,-1.41 vs. girls β=0.71, 95%CI:-2.38,3.44) at 24 months.

CONCLUSIONS: Gestational exposure to phthalates and phthalate replacements was associated with neurodevelopmental delay across multiple domains, with differences by sex and child age. Further research pertaining to neurodevelopmental delay throughout childhood and sex dimorphism over time is needed.

KEYWORDS: phthalates, phthalate replacements, neurodevelopment, sex-specificity

P-0468 Associations of a metal mixture with neuromotor function in a cross-sectional study of Italian adolescents

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BACKGROUND AND AIM: Motor function is critical for children's overall well-being but remains an understudied neurodevelopmental domain. Evidence supports links between exposure to individual metals and motor function, but no epidemiological study has examined the joint effects of metals.

METHODS: We estimated associations between an industrial metal mixture and multiple measures of motor function among 612 adolescents (10-14 years old; 49% female) within a cross-sectional study. Concentrations of blood lead and hair manganese, copper, and chromium were quantified using inductively coupled plasma mass spectrometry. Neuropsychologists administered three motor assessments: Pursuit Aiming (PA), Finger tapping (FT), and subtests from the Luria Nebraska (LN) battery. We quantified associations with 95% confidence intervals (CI) between motor function and the metal mixture using quantile g-computation (qgComp) and multivariable linear regression (MLR), adjusting for child age, sex, and socioeconomic status. We explored sex-specific associations in stratified models.

RESULTS: All metals had high detection frequency (>99%). The metal mixture was associated with worse scores on tests of fine motor function: a quartile increase in the mixture was associated with 2.7 fewer correct responses on the PA test (95% CI: -5.8, 0.4). This association was stronger among girls (β= -4.5, 95% CI: -8.8, -0.2) than boys (β= -1.9, 95% CI: -6.2, 2.3). Joint associations were null for the FT and LN tests. In MLRs, a 1-SD increase in hair Cu was associated with fewer total responses (β= -2.07, 95% CI: -5.4, 1.2); this association was stronger among boys (β =-6.9, 95%CI -11.9, -2.0) than girls (β=1.20, 95% CI: -3.3, 5.7).

CONCLUSIONS: Although most associations between metal mixtures and motor function were null, our findings suggest adverse effects of the mixture on visual-motor abilities. This work begins to fill a gap in understanding effects of environmental metals on motor function in children.

KEYWORDS: metals, mixtures, motor function, neurodevelopment

P-0469 Fetal exposure to cannabis, neonatal adiposity, and postnatal growth trajectories: The Healthy Start study

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OBJECTIVE: Cannabis use during pregnancy is associated with lower birth weight and may influence postnatal growth. We estimated associations of fetal exposure to cannabis with neonatal adiposity and body mass index (BMI) z-score trajectories through age 3 years, as well as effect modification by breastfeeding.

METHODS: We leveraged a subsample of 130 mother-child pairs from a Colorado-based cohort. Twelve cannabinoids/metabolites (including delta 9-tetrahydrocannabinol [THC] and cannabidiol [CBD]) were measured in maternal urine collected at ~27 weeks gestation. Fetal exposure to cannabis was dichotomized as exposed (any cannabinoid≥limit of quantification) and not exposed (cannabinoids<limit of quantification). Generalized linear models estimated the associations between fetal exposure to cannabis with birth weight and neonatal adiposity (measured by air displacement plethysmography). A mixed-effects model estimated the association between fetal cannabis exposure and BMI z-score trajectories. Interaction by breastfeeding duration was assessed by including a product term (with fetal exposure to cannabis) in a mixed-effects model.

RESULTS: Fetal exposure to cannabis was associated with lower birth weight (-206g; 95% CI: -393, -18; p=0.03) and neonatal adiposity (-2.0%; 95% CI: -3.7, -0.02; p=0.03) followed by rapid postnatal growth through 3 years (0.37 increase in BMI z-score per square root year; 95% CI: 0.01, 0.60; p=0.02). Breastfeeding modified this association (p for interaction<0.01). Among cannabis-exposed offspring who were not breastfed, BMI z-scores were 0.42 lower at 6 months (95% CI: -1.15, 0.31) but 0.54 higher at 36 months (95% CI: -0.36, 1.44). Conversely, BMI z-scores were no different by fetal cannabis exposure among offspring who were breastfed for ~5 months.

CONCLUSIONS: Our data suggests that fetal exposure to cannabis alters fetal and postnatal growth, and that breastfeeding may stabilize over-compensatory growth among cannabis-exposed offspring. Although the impact of lactational exposure to cannabis requires further investigation, it remains important to caution against cannabis use during pregnancy and lactation.

P-0472 Association between Air Pollution, Stress, and Sleep Efficiency in 6 -7 year old Children living in East Harlem

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Environmental toxicants, broadly defined to encompass chemical and non-chemical risk factors, present in the built environment, can adversely impact children's growth and development. Children are particularly vulnerable to environmental exposures because of the sensitive nature of children's neurodevelopment, a prenatal life stage marked by cell differentiation. A recent study by Bose et al., found an association between prenatal PM2.5 exposure and poorer sleep outcomes (i.e., sleep quantity and quality) in childhood. Yet, little is known about the relationship between air quality and sleep efficiency among children, within the larger context of household and psychosocial conditions. To address this knowledge gap, this pilot research study will examine potential relationships between indoor air quality and its effects on sleep patterns among twenty-five Hispanic children, 6-7 years old living in East Harlem, NY. Specific research aims are: 1) Convene and engage with the Community Advisory Board (CAB) quarterly to elicit meaningful input on pilot study design, implementation and dissemination of how air quality impacts child sleep in 6–7 year-old children in East Harlem. 2) Together with East Harlem families and MPH student researchers, we will quantify a). PM2.5 exposure using indoor air monitors, b). children's time spent sleeping, quantity of awakenings, and c). children's 24-hour activities wearing continuous wrist-worn actigraph watches over 7 days, to examine potential associations between air quality and sleep, and 3) The research team and the CAB will collaborate on the design, and implementation of a bi-lingual study questionnaire, to assess child caregivers' understanding of air pollution, sleep, and household environmental risk factors. A diary along with instructions will be given to all caregivers to write down how they interpret sleepiness and sleep quality in their own words. This will provide important information that can guide meaningful study report back to study participants.

P-0473 Life after discharge from Pediatric Intensive Care Units: Long-term effects of air pollution on re-hospitalization rates in fragile children

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BACKGROUND AND AIM: Air pollution is a known risk factor for cardiovascular, respiratory and neurological hospitalizations in the general population. Several studies assessed the effect of air pollution on subjects with specific pathologies, but only few of them focused on subjects with a previous hospitalization in Intensive Care Unit (ICU). The aim of this study is to evaluate the risk of re-hospitalization in children that were previously hospitalized in the Pediatric ICU (PICU).

METHODS: Children hospitalized in the PICU of Padova hospital (Italy) between 2013 and 2019 were selected from hospital discharged records. All subsequent hospitalizations for cardiovascular, respiratory or neurological diagnosis have been tracked until 2020.
To account for time-varying air pollution levels, a Cox model with the Andersen-Gill counting process adjusted for exposure and subject-related confounders was applied to evaluate the association between NO2, PM10 and PM2.5 and the risk of re-hospitalization within one and five years from the discharge. A ridge penalty was applied to face the collinearity among covariates.

RESULTS: Overall, 1204 children were admitted to the PICU of which 425 for cardiovascular, respiratory or neurological issues. The 77% was re-hospitalized during the first year after the PICU discharge. NO2 shows a non-linear impact on the risk of re-hospitalization with higher hazards at higher concentrations (HR1.44; 95%CI:1.06-1.94 for an IQR increase in NO2) that remains significant when including children re-hospitalized within 5 years (HR1.37; 95%CI:1.04-1.82). Interestingly, PM10 and PM2.5 have no effect on the risk of re-hospitalization.

CONCLUSIONS: The exposure of fragile children (those with a previous PICU admission) to high levels of NO2 could lead to severe outcome as re-hospitalization for several diseases. It is crucial to assess the association between these two events in order to adopt public health policies aimed at safeguarding this particularly fragile population.

KEYWORDS: children; air pollution; nitrogen dioxide;

P-0474 Comprehensive exploration of interactions between persistent organic pollutants and nutritional biomarkers on birth weight

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BACKGROUND AND AIM: Pregnant women are exposed to complex chemical mixtures, either nutrients or environmental stressors, whose joint impacts on fetal growth has been scarcely explored. The main objective of this study was screening interactions between chemicals and nutrients to better characterize their joint associations with birth weight.

METHODS: We analysed data from the population-based INMA birth cohort, relying on blood biomarkers from the first trimester and weight at birth. The most representative biomarkers of organochlorine compounds (OCs) and perfluoroalkyl substances (PFAS) were included, as well as nutritional biomarkers for vitamins and carotenoids. A dataset with minimal imputation was established with complete data of OCs and PFAS, carotenoids and vitamins (n=810). The statistical framework included a screening phase to identify interactions using Gradient Boosting Regression and Glinternet. Identified interactions were further characterized using regression models.

RESULTS: The screening step revealed interactions between perfluorooctanesulfonic acid (PFOS) and carotenoids, but also with other chemicals like the pesticide dichlorodiphenyldichloroethylene (p,p'-DDE). The regression methods showed that at low levels of β-cryptoxanthin (tertile 1 and 2) the associations between PFOS and birth weight were clearly strengthened compared the flat slope of the highest tertile, yet the interaction was not statistically significant. Moreover, statistically significant interaction between PFOS and p,p'-DDE was confirmed: a log increase of PFOS, increased 131.0 g (95% confidence interval 18.4-243.6) of birth weight in the Tertile 1 of p,p'-DDE whereas a reduction of -59.6 g (95% confidence interval -155.9, 36.7) was found in the Tertile 3 of p,p'-DDE (p interaction= 0.01).

CONCLUSIONS: The results of this study support the presence of complex interactions between chemicals and nutrients during pregnancy and birth weight. These findings may help to better characterize the heterogeneous findings in the overall body of epidemiological evidence, yet further research is needed to confirm those findings.

P-0475 Early pregnancy phthalate and phthalate alternative metabolites in relation to fetal cardiac development

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BACKGROUND AND AIM: Environmental exposures can impact organogenesis, contributing to adverse fetal cardiac development. Phthalate exposure contributes to fetal cardiac malformations in mice, but human studies have not been conducted. We sought to examine associations between biomarkers of exposure to phthalates and new alternative phthalates in early pregnancy and fetal cardiac development.

METHODS: Analyses were conducted among 260 singleton pregnancies in a prospective cohort. Twenty metabolites of phthalates and alternatives were assessed in up to two spot urine samples collected at 12- and 14-weeks gestation. Metabolite concentrations were corrected for urine dilution and averaged to provide a stable exposure estimate. Fetal cardiac outcomes (cardiothoracic area ratio, annulus displacement, fractional shortening, myocardial performance index, and the ratio of peak velocities in early and late diastole [E/A]) were assessed using M-Mode and Doppler conducted at 12-, 20-, and 32-weeks' gestation. Single- and multi-pollutant associations between metabolites and longitudinal fetal cardiac development were estimated using generalized estimating equations and quantile g-computation models, respectively. Models adjusted for maternal sociodemographics, smoking, and fetal sex.

RESULTS: Phthalate and alternative metabolites were highly detected (>90%). In single-pollutant models, all metabolites were inversely associated with the cardiothoracic area ratio. MiBP and MEP were inversely associated with the mitral E/A ratio (β: -0.02 [95% confidence interval: -0.03, 0.00] and -0.02 [-0.03, -0.01], respectively). In multi-pollutant models, a one-quartile increase in the exposure mixture was inversely associated with the cardiothoracic ratio (-0.69 [-1.22, -0.17]) and the mitral E/A ratio (-0.02 [-0.03, 0.00]).

CONCLUSIONS: Confirming findings in animal models, prenatal phthalate and phthalate alternative exposure was inversely associated with fetal cardiothoracic area and E/A ratios, indicating cardiac malformations, ventricular stiffness, and worse diastolic function. These developmental modifications manifest structural and functional cardiac adaptations, contributing to an elevated risk of cardiovascular disease.

KEYWORDS: pregnancy; cardiovascular disease; endocrine disrupting chemicals

P-0476 Environmental Noise Exposure During Pregnancy and Childhood and Embryonic and Fetal Growth: the Generation R Study

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BACKGROUND AND AIM: Noise exposure is considered a risk factor for adverse health outcomes. Literature has studies the association between noise exposure during pregnancy and adverse birth outcomes intensively, suggesting moderate to high quality evidence for an absence of association. However, few studies have explored the association with embryonic and fetal growth during pregnancy.

METHODS: We studied 7946 pregnant women from the Dutch Generation R Study. Average 24h noise exposure at the home address during pregnancy were estimated using EU maps from road traffic and total noise (road, aircraft, railway, industry). Embryonic and fetal growth parameters (crown-rump length, head circumference, femur length, estimated fetal weight) were measured by ultrasound at several points in pregnancy. Information on neonatal anthropometrics at birth (head circumference, length, weight) and adverse birth outcomes (preterm birth, low birthweight, small for gestational age) were retrieved from medical records. Linear mixed models were conducted to analyze the association between noise exposure and repeatedly measured fetal growth. Linear and logistic regression models were used to analyze the association between noise exposure and embryonic growth in the first trimester and birth outcomes.

RESULTS: Median total noise exposure levels were 55.3dB. Total noise exposure during pregnancy was associated with larger crown-rump length (0.04 SDS, 95%CI 0.00; 0.07), but not with repeatedly measured head circumference, length, and weight. Total noise exposure during pregnancy was not associated with neonatal anthropometrics at birth or adverse birth outcomes. Similar results were observed with road traffic noise exposure.

CONCLUSIONS: Noise exposure during pregnancy was associated with larger embryonic growth. We did not observe evidence of an association between noise exposure during pregnancy and fetal growth nor with birth outcomes. Additional research is warranted to confirm and elucidate the potential effects of noise exposure during pregnancy on altered embryonic growth.

KEYWORDS: environmental pollution, development, cohort study, pregnancy

P-0477 As safe as houses; the risk of childhood lead exposure from housing in England

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BACKGROUND AND AIM: Exposure to lead can harm a child's health, including damage to the nervous system. Lead exposure in children is still a concern and cases require public health management to find the exposure source. Housing characteristics can indicate the presence of lead-contaminated paint and leaded water supply pipes. We aimed to explore the relationship between housing characteristics and elevated blood lead concentration (BLC) in children in England.

METHODS: We used a retrospective cohort design and included all cases of lead exposure in children reported to the UK Health Security Agency between 2014 and 2020 via surveillance. A case was a child aged under 16 years, resident in England, BLC of ≥0.48µmol/L and referred for public health management. We collected case demographic details and housing characteristics (age and type). We explored associations between elevated BLC and risk factors, using generalised linear mixed effects models and compared cases' housing type to that expected nationally.

RESULTS: 266 cases met the case definition. There was no difference in BLCs between genders, age groups, deprivation and housing type. After adjusting for reporting source, housing age and type, cases residing in housing built pre-1976 had a BLC of 0.32 (95%CI 0.02, 0.63) µmols/L higher than cases living in housing built after this time. Cases were 1.68 times more likely to be living in terraced housing than other children and less likely to live in apartments and detached properties.
CONCLUSION: This study suggests an association between housing characteristics and BLC in children. Housing age and type may act as a proxy for lead exposure risk through exposure to leaded paint, lead water pipes and lead contaminated dust from outdoor sources. Public health action should consider targeting families more at risk in older housing raising awareness of lead pipes and paint.

KEYWORDS: Lead, children, housing

P-0478 Description of childen's chemical exposome and possible determinants of exposure based on hair analysis

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BACKGROUND AND AIM: Chemical exposure at young ages is associated with various diseases, and 25% of all deaths of children younger than 5 y/o are caused by exposure to unhealthy environment. Moreover, the specific physiology and behaviour of children, which differ significantly from adults, make them particularly vulnerable to chemical exposure. As a result, children exposure cannot be extrapolated from data obtained in adults and specific studies must be conducted on children. In the present study, hair samples were collected from 264 children inhabitants of Luxembourg aged below 13 y/o to investigate their chemical exposome and possible determinants of exposure.

METHODS: Each sample was analysed with a multi-residue method targeting 153 biomarkers, including 140 pesticides (persistent and non-persistent), 4 PCBs, 7 BDEs, and 2 bisphenols. Moreover, anthropometric parameters, information on diet, residence area and presence of pets at home were collected through self-reported questionnaires.

RESULTS: The number of compounds detected per sample ranged from 29 to 88 (median = 61). Twenty-three biomarkers were detected in ≥95% of the samples, including 13 in all samples (11 pesticides, BPA and BPS). Results showed higher exposure in younger children, and higher exposure to non-persistent pesticides in boys. Moreover, the results showed that diet (organic vs conventional), residence area, and living with pets at home are determinants of exposure.

CONCLUSIONS: The present study demonstrates that children are exposed simultaneously to multiple pollutants from different chemical classes, and confirms that hair is well adapted to investigate children exposure. The presence of many persistent organic pollutants (POPs) in most children, despite their young age, strongly suggests that exposure to POPs is still ongoing. The results obtained here set the basis for further investigations to better understand the determinants of exposure to pollutants in children.

KEYWORDS: Chemical exposome; Determinants of exposure; Hair analysis; Biomonitoring; Children; Organic pollutants

P-0483 Indoor Air Quality in Classrooms Before and During the COVID-19 Pandemic: Lessons Learned from the Health Effects of Lebanese Schools Indoor Environment (HELSIE) Study Study

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BACKGROUND AND AIM: COVID-19 interrupted the education of millions of children in the Eastern Mediterranean Region (EMR), including Lebanon, and, as educational institutions began to partially, gradually, and cautiously return to in-person learning, safety guidelines have underscored the importance of proper ventilation in response to the pandemic. Indoor Air Quality is critical for student populations because it is associated with growth disturbance, reduced attention, and increased absenteeism as well as diseases such as influenza, asthma, and other respiratory diseases. The aim of this study is to evaluate the COVID-19 safety guidelines adopted by Lebanese schools and their effects on IAQ by comparing air quality and health indicators measured before and during the COVID-19 pandemic.

METHODOLOGY:

Launched in 2019, before the COVID-19 pandemic, the HELSIE study measured carbon dioxide (CO2), particulate matter (PM2.5), Volatile Organic Compounds (VOCs), Nitrogen Dioxide (NO2) in indoor and outdoor microenvironments in 6 Lebanese schools. Questionnaire data were also collected from students, parents, and school staff. Upon the re-opening of schools in Lebanon, the project resumed to collect post-COVID-19 measurements of indoor and outdoor air quality indicators and to assess the adopted safety guidelines followed by the same schools.

FOCUS AND IMPLICATIONS:

Improving IAQ and ventilation systems is not only instrumental for COVID-19 safety but also to address the schools' preparedness to reduce the risks and adverse outcomes of seasonable infections and respiratory diseases. This study aims to guide the development of national and/or regional guidelines for classroom IAQ for the COVID-19 era and beyond.

KEYWORDS: Indoor Air Quality; Environmental Health; School Settings; Health Effects; Respiratory Health

P-0484 Exposure to Green Spaces and Multiple Child Health Outcomes: a preliminary meta-analysis from 11 European Birth Cohorts

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Studies on the association between exposure to green spaces and child health have captured only a narrow range of outcomes. Here, we conducted an outcome-wide study on more than 90,000 mother-children's dyads from 11 European birth-cohort studies, to examine the association of residential availability (NDVI) and accessibility to green spaces (yes/no) in a 300 meters buffer during pregnancy and childhood with a range of outcomes. Fourteen outcomes in three areas of child health (respiratory health, obesity, neurodevelopment) will be included. The latest available measure of each outcome within the age band 3-12 years, was selected for each child. for postnatal period, green space exposures were calculated from birth up to the age before the outcome assessment. Using a federated-analysis tool (DataSHIELD), we fitted linear and logistic regression models in each cohort separately and then combined the results using random-effects meta-analysis. All the analyses were adjusted for child age (years) and sex, maternal education (low, medium, high), and area-level socioeconomic status (low/medium/high deprived). More than 70% of study participants lived close to green space during pregnancy and childhood period. Preliminary analyses on eight outcomes show no associations between availability of, or accessibility to, green spaces and respiratory (asthma diagnosis, forced expiration volume, and wheezing symptoms) and neurodevelopmental (gross and fine motor, internalization and externalization problems score tests, ADHD symptoms) outcomes. Further analyses will be presented on the full set of outcomes, including Body Mass Index, blood pressure, and general intelligence.

P-0485 Prenatal exposure to multiple persistent organic pollutants and adiposity markers and blood pressure in 12-year-old children

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BACKGROUND: Several studies reported that prenatal exposure to some persistent organic pollutants (POPs) is associated with greater adiposity in childhood. Few studies have assessed whether this finding persists into adolescence and have considered exposure to POPs as a mixture. This study aims to assess the association between prenatal exposure to multiple POPs and adiposity markers and blood pressure in 12-year-old children.

METHODS: This study included 1658 mother-child pairs enrolled in the PELAGIE (France) and the INMA (Spain) mother-child cohorts. Three polychlorobiphenyls (PCB 138, 153 and 180, treated as a sum of PCBs) and three organochlorine pesticides (Dichlorodiphenyldichloroethylene [DDE], β-hexachlorocyclohexane [β-HCH], and hexachlorobenzene [HCB]) were assessed by biomarkers. Body mass index z-score (zBMI), abdominal obesity (waist-to-height ratio>0.5), percentage of fat mass, and blood pressure were measured around 12 years old. Single-exposure associations were studied using linear and logistic regressions and the POP mixture effect was evaluated using Quantile G-computation (qgComp) and Bayesian Kernel Machine Regression (BKMR). All models were adjusted for potential confounders and were performed for boys and girls together and separately.

RESULTS: Prenatal exposure to the POP mixture was associated with higher zBMI (beta [95% CI] of the qgComp = 0.15 [0.07; 0.24]) and percentage of fat mass (0.80 [0.28; 1.32]) at 12 years old. These mixture effects were also statistically significant using BKMR, and after stratification by sex. In overall, these associations were mainly driven by exposure to HCB and, to a lower extent, to β-HCH. Additionally, the single-exposure models showed an association between β-HCH and DDE with higher systolic blood pressure, especially in girls (beta [95% CI] of DDE for girls = 0.91 [0.06; 1.76], p sex-interaction=0.08).
CONCLUSION: This study suggests that prenatal exposure to POPs, especially to organochlorine pesticides, remains associated with adiposity markers until age 12.

KEYWORDS: Chemicals; Body mass index; Mixture; Birth cohort

P-0486 In utero exposure to tobacco smoke and reproductive health related markers in children: Evidence from the Rhea mother-child cohort, Crete, Greece

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BACKGROUND AND AIM: Early fetal exposure to tobacco smoke has been associated with several adverse effects on offspring reproductive development possibly due to the suspected endocrine disrupting action of toxic compounds contained in cigarettes. We investigated the association of prenatal exposure to tobacco smoke with anogenital distance measures in young children and reproductive-related hormones in pre-adolescents from the Rhea birth cohort in Greece.

METHODS: Information regarding tobacco smoke exposure was obtained from maternal questionnaires throughout pregnancy. Anogenital distances - sexually dimorphic, longer in males than females- [(AGD; anus to upper penis), anoscrotal distance (ASD; anus to scrotum), anoclitoral (ACD; anus to clitoris) and anofourchetal distance (AFD; anus to fourchette)] were measured in 350 boys and 350 girls at the age of 2 years. at 10-11 years of age, we measured dehydroepiandrosterone sulfate (DHEA-S), luteinizing hormone (LH) and follicle-stimulating hormone (FSH) in 242 children (132 boys and 110 girls). Adjusted associations were obtained via multivariable regression analyses.

RESULTS: Maternal active smoking before and during pregnancy was associated with increased ACD in girls (adjusted β= 1.9 mm; 95% CI: 0.6, 3.3, β= 1.7 mm; 95% CI: 0.1, 3.3 respectively). Moreover, maternal exposure to passive smoking -via paternal active smoking- was associated with decreased LH in girls (adjusted β=-0.7 mUI/mL; 95% CI: -1.4, 0.0). In boys, maternal smoking in early pregnancy was associated with increased FSH (adjusted β= 0.5 mUI/mL; 95% CI: 0.1, 0.8) and the same association was observed for maternal smoking during any trimester of gestation(adjusted β= 0.4 mUI/mL; 95% CI: 0.1, 0.7).

CONCLUSIONS: In utero exposure to tobacco smoke was associated with increased anogenital distances in girls and altered hormonal levels in both sexes. Further research is needed to understand whether these findings may indicate long-term adverse effects on the reproductive health.

KEYWORDS: smoking during pregnancy, anogenital distance, reproductive hormones

P-0487 Prenatal air pollution exposure and childhood obesity: Effect modification by maternal fruits and vegetables intake

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BACKGROUND & AIMS: Prenatal exposure to air pollution is associated with fetal growth but the relationship with postnatal growth and childhood obesity remains unknown. We examined the association of prenatal exposure to air pollution with growth and childhood obesity and evaluated the possible protective effect of the diet.

METHODS: We included 637 mother-child pairs from the Rhea birth-cohort in Crete, Greece. Fine particles (PM2.5 and PM10) during pregnancy were estimated using land-use regression models. We measured weight, height, and waist circumference at 4 and 6 years of age and body composition analysis was performed at 6 years using bioimpedance. Adjusted associations were obtained via multivariable regression. Interactions and stratified analyses were performed to evaluate the potential protective effect of nutrition.

RESULTS: Exposure to PM2.5 in utero (median (IQR): 14.4 (13.0, 15.4) µg/m3) was not associated with childhood obesity or abdominal obesity at 4 years of age. at 6 years of age, an IQR increase in prenatal PM2.5 was associated with increased risk of abdominal obesity (waist circumference > 90th percentile; RR 1.55, 95% CI: 1.01, 2.38). Moreover, in children whose mothers reported less than 5 servings of fruits and vegetables per day, an IQR increase in PM2.5 during pregnancy was associated with increased risk of obesity (RR 3.54, 95% CI: 2.18, 5.77) and increased risk of abdominal obesity (RR 3.69, 95% CI: 1.67, 8.15) at 6 years of age. Similar associations were observed between PM2.5 and body fat at 6 years as well as between PM10 (median (IQR): 35.5 (35.1, 37.2) µg/m3) and BMI, risk for obesity and abdominal obesity at 6 years.

CONCLUSIONS: Exposure to fine particulate matter during pregnancy was associated with higher risk of childhood obesity, while mothers' diet during pregnancy may protect against air-pollution related adverse effects.

KEYWORDS: Childhood obesity, particulate matter, air pollution, diet, interaction

P-0488 Prenatal exposure to mixtures of non-persistent endocrine disrupting chemicals and respiratory health in children from the Rhea birth cohort study, Greece

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BACKGROUND AND AIM: Endocrine-disrupting chemicals (EDCs) are present in many consumer products and can affect the development and functions of the immune system. There is growing concern over the role of EDCs, including phthalates, bisphenol A (BPA) and parabens, on early life origins of respiratory diseases, however, results are inconsistent and most studies assessed one chemical at a time. We investigated whether prenatal phthalates, BPA and parabens are associated with childhood wheeze and asthma using a mixtures approach in the RHEA birth cohort in Greece.

METHODS: We quantified concentrations of seven phthalate metabolites, six parabens, and BPA in first trimester maternal urine. Information on wheezing and asthma up to 11 years was obtained from parent-completed questionnaires and lung function by spirometry. Multiple regression and quantile g-computation was used to assess the independent and joint associations between the EDCs and respiratory outcomes, respectively.

RESULTS: Prenatal exposure to monobenzyl-, mono(2-ethyl-5-hydroxyhexyl)-, and mono(2-ethyl-5-oxohexyl)-phthalates was associated with increased risk for early wheezing (≤4 years). Mono(2-ethyl-5-hydroxyhexyl) and mono-isobutyl phthalates were associated with higher FEV1 and FEV1/FVC ratio at 6 years, respectively. Methyl paraben was associated with increased risk for late wheezing (>4 years) and n-butyl paraben was associated with increased risk for current asthma at 6 years and ever asthma. Moreover, methyl and n-propyl parabens were associated with higher FEV1 at 6 years. We did not find any associations between prenatal BPA and any of the respiratory outcomes. In the mixture analysis, one quartile increase in phthalates was associated with higher FEV1 and in parabens with higher FEV1/FVC ratio at 6 years, respectively.

CONCLUSIONS: Our data indicate that prenatal exposures to phthalates, parabens and their mixtures may be associated with child respiratory health. Further research is needed to verify these findings and shed light on the molecular mechanisms.

KEYWORDS: prenatal, phthalates, parabens, mixtures

P-0489 Assessing the Effect of Heavy Metal Exposures on Pediatric Tuberculosis

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BACKGROUND AND AIM: Children are particularly vulnerable to environmental pollution due to their underdeveloped immune systems. Exposure to environmental pollutants such as heavy metals may alter the immune system, increasing human susceptibility to infectious diseases, particularly respiratory diseases including tuberculosis (TB). Our aims are a) test the hypothesis that exposure to heavy metals (e.g., As, Pb, Cd and Cr) is a risk factor for tuberculosis b) Quantify environmental sources.

METHODS: We hypothesize that children in urban Bangladesh are exposed to high concentrations of heavy metals, and these contribute to immune modulation and the occurrence of (precipitating) respiratory tract infections. Our ongoing study found Pb from recycling lead-acid batteries and the adulterated turmeric contribute to elevated blood lead levels; Cadmium (Cd) and Arsenic (As) also contributes to health disparities. This study will compare exposure to metals among children (1-15years) diagnosed with TB (cases) and matched healthy children (controls) in the Dhaka region. To measure exposure and infection status, we will analyze whole blood for metal level, immune assay and antibody markers. We will also conduct house dust sampling and questionnaire surveys to evaluate parental occupational exposures (including engagement in industrial and agricultural practices), household exposures (smoking and type of cooking fuel), and behaviors relevant to exposure. Based on the surveys and described samples, we will run a generalized /Bayesian additive model to estimate immune and antibody markers interlinked with the metal exposures.

RESULTS: Heavy metal pollution will be viewed as a sentinel indicator of predisposition, development, and severity of infectious disease outcomes. That are linked to TB are likely to also contribute to other infectious diseases such as pneumonia and bronchiolitis in children.

CONCLUSIONS: This research will uncover the interplay and potential causal pathway connecting environmental metals to tuberculosis and inform interventions to improve children's health.

KEYWORDS: Children's Environmental Health

P-0492 Prenatal and postnatal exposure to ambient air pollution and cognitive function in school-age children in France

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BACKGROUND AND AIM: There is growing evidence that early life exposure to ambient air pollution may affect child cognitive development. However, combined effects of both prenatal and early postnatal exposure has rarely been investigated and critical periods of sensitivity are unknown. This study explored the temporal relationship between pre- and postnatal exposure to ambient air pollution and child cognitive abilities.

METHODS: Using validated spatiotemporally resolved exposure models, pre- and postnatal daily PM2.5, PM10 and NO2 concentrations at the mother's residence were estimated for 789 mother–child pairs from the French EDEN and PELAGIE cohorts. Scores representative of children General, Verbal and Non-Verbal abilities at 5-6 years were constructed based on subscale scores from the WPPSI-III, WISC-IV, NEPSY-II batteries, using confirmatory factor analysis. Associations of both prenatal (first 35 gestational weeks) and postnatal (60 months after birth) exposure to air pollutants with child cognition were explored using Distributed Lag Non-linear Model (DLNM) adjusted for confounders.

RESULTS: Increased exposure to PM2.5 in the third trimester of pregnancy was associated with better General and Verbal abilities. Exposure to higher NO2 levels in the first month of pregnancy and third trimester of pregnancy was related to improved Verbal abilities. During the postnatal period, increased exposure to PM2.5, PM10 and NO2 between 2-4 years was positively associated with General and/or Verbal abilities. Contrariwise, exposure to high PM2.5 or NO2 concentrations during the first year of life was associated with decreased General and/or Verbal abilities. No sex-specific association was observed after stratification of the analyses.

CONCLUSIONS: These results suggest better or poorer cognitive development associated with higher exposure to ambient air pollution in early life, depending on the exposure window. Further analyses will be conducted to assess the robustness of these results.

KEYWORDS: Children; Cognition; DLNM; NO2; PM10; PM2.5; Prenatal/Postnatal exposure

P-0493 Ambient air pollution and body-mass index from infancy to later childhood in 10 European birth cohorts

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BACKGROUND AND AIM: Exposure to ambient air pollution may contribute to childhood obesity, but few large longitudinal studies have explored this. We aim to examine associations between exposure to pre-, early postnatal and childhood air pollution on offspring body-mass index (BMI) in key developmental periods using harmonized data from ten European birth cohorts.

METHODS: Ambient exposure to nitrogen dioxide (NO_2) and fine particulate matter ($PM_{2.5}$) was estimated at home addresses during pregnancy, the first year of life and the year before outcome measurement. We derived child age-and-sex standardized BMI in four age periods (infancy (0-2 years), early childhood (2-5 years), adiposity rebound (5-9 years), and later childhood (9-12 years)). Cohort specific estimates were calculated using confounder adjusted linear regressions, and meta-analysed afterward. The fraction of variance due to heterogeneity (I^2) was calculated. All analyses were conducted in DataSHIELD, a platform for non-disclosive federated analysis.

RESULTS: Meta-analysis results (N=29,535) showed no robust associations between air pollutants and BMI, and heterogeneity between cohorts was generally high (I^2>25). However, a tendency was observed for an association between higher prenatal $PM_{2.5}$ and NO_2 exposure and higher BMI at 0-2 years and 9-12 years respectively (e.g BMI_{0-2} beta for 10 µg/m³ increase in $PM_{2.5}$=0.03 (95%CI -0.02;0.09), I^2=0). Tendency for positive associations was also observed for some postnatal exposures, including $PM_{2.5}$ in the first year of life with BMI at 2-5 years (beta=0.06 (95%CI -0.03;0.14), I^2=0) and NO_2 in the year before outcome assessment with BMI at 5-9 years (beta=0.02 (95%CI -0.01;0.05), I^2=31).

CONCLUSIONS: In this large European meta-analysis there was little evidence for an association between prenatal or childhood exposure to ambient air pollution and childhood BMI, although considerable heterogeneity between study areas is noted.

KEYWORDS:
Ambient air pollution, childhood BMI, stratification by age

P-0494 Ambient air pollution and inflammation-related proteins during early childhood

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BACKGROUND AND AIM: Experimental studies show that short-term exposure to air pollution may alter cytokine concentrations. There is, however, a lack of epidemiological studies evaluating the association between long-term air pollution exposure and inflammation-related proteins in young children. Our objective was to examine whether air pollution exposure is associated with inflammation-related proteins during the first 2 years of life.

METHODS: In a pooled analysis of two birth cohorts from Stockholm County (n=158), plasma levels of 92 systemic inflammation-related proteins were measured by Olink Proseek Multiplex Inflammation panel at 6 months, 1 year and 2 years of age. Time-weighted average exposure to particles with an aerodynamic diameter of <10 µm (PM_{10}), <2.5 µm ($PM_{2.5}$), and nitrogen dioxide (NO_2) at residential addresses from birth and onwards was estimated via validated dispersion models. Mixed effect model was applied to estimate the overall effect of preceding air pollution exposure on combined protein levels, "proteome" at respective ages, followed by protein-specific bootstrapped quantile regression analysis.

RESULTS: We identified significant association between overall proteome profile at the age of 6 months and PM_{10} exposure during the first 6 months of life (p=0.03), particularly among girls (p interaction with sex=0.03), whereas no associations were observed with $PM_{2.5}$ or NO_2. Subsequent protein-specific analyses revealed significant associations of PM_{10} exposure with an increase in IFN-gamma and IL-12B in boys, and a decrease in IL-8 in girls at different percentiles of proteins levels. Several inflammation-related proteins were also significantly associated with preceding $PM_{2.5}$ and NO_2 exposures, at ages 1 and 2 years, in a sex-specific manner.

CONCLUSIONS: Ambient air pollution exposure may influence inflammation-related protein levels already during early childhood. Our results also suggest age- and sex-specific differences in the impact of air pollution on children's inflammatory profiles.

P-0496 Individual and joint associations between prenatal polycyclic aromatic hydrocarbon exposure and asthma at age 8-10 in a multi-site longitudinal study

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BACKGROUND AND AIM: A few studies suggest prenatal exposure to polycyclic aromatic hydrocarbons (PAHs) influences wheezing or asthma in preschool-aged children. The hypothesized mechanisms for these associations include disruption to endocrine and immune function, oxidative stress, and inflammation. However, the impact of prenatal PAH exposure on asthma in population-based middle childhood remain unclear. We investigated these associations in the diverse participants of the ECHO PATHWAYS multi-cohort consortium.

METHODS: We included 1,015 mother-child dyads in the CANDLE and TIDES cohorts across five U.S. cities. Maternal mid-pregnancy urinary mono-hydroxylated metabolite concentrations (OH-PAH) were measured. Asthma was defined at age 8-10 years by caregiver report of physician diagnosis as well as current asthma medication use and/or recent wheezing. We used modified Poisson regression with robust standard errors to estimate relative risk of current asthma associated with seven individual OH-PAHs, adjusting for urine specific gravity, maternal and child characteristics, study site, prenatal and postnatal smoke exposure, and birth year and season. We used multiplicative interactions to evaluate effect modification by child sex, and we explored PAH mixture effects through Weighted Quantile Sum regression.

RESULTS: The prevalence of asthma was 10.5% (65% male). Overall, 47% of women were Black and 45% were White; 58% had graduated from college or technical school at enrollment. We did not find evidence of associations between individual OH-PAH concentrations or mixtures of OH-PAHs and child asthma at age 8-10. In males, we found a suggestion of a protective association between 1- and 2- hydroxynaphthalene and asthma, but the interaction term between child sex and all OH-PAH concentrations was not statistically significant.

CONCLUSIONS: In a large, multi-region U.S. cohort, we did not find evidence of an association between prenatal exposure to PAHs and child asthma at age 8-10, an age when asthma is more readily diagnosed.

P-0497 Parental arsenic exposure and DNA methylation in Bangladeshi infants with spina bifida

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BACKGROUND AND AIM: Arsenic, a chemical naturally occurring in soil and drinking water, is a recognized human toxicant and has been linked to numerous adverse health outcomes. An emerging hypothesis linking arsenic to detrimental health involves the epigenome, the multitude of compounds that affect DNA transcription but do not alter the underlying DNA sequence. The objective of the current study was to investigate the relationship between parental arsenic exposure and DNA methylation in infants diagnosed with spina bifida in a case-control study in Bangladesh.

METHODS: We analyzed arsenic in maternal and paternal toenail samples using inductively coupled plasma mass spectrometry. Infant DNA methylation was measured in dural tissue, buccal swab, and whole blood samples using the Illumina Infinium MethylationEPIC BeadChip and we used M-values for analysis. A total of 28 children with spina bifida and their parents were included in the analysis.

RESULTS: After accounting for child sex, child age at sample collection, maternal serum folate levels, and surrogate variables, and after adjusting for multiple hypothesis testing, DNA methylation levels at cg24039697 (β=0.59, p=7.6E-9) were associated with paternal toenail arsenic levels (log_2-transformed) in the child dural tissue models. None of the sites in the maternal arsenic and child dural tissue analysis remained significant after accounting for multiple hypothesis testing. In the models including child whole blood or buccal swab DNA methylation, we did not observe any significantly differentially methylated CpG sites related to either paternal or maternal arsenic exposure following adjustment for multiple hypothesis testing.

CONCLUSIONS: The findings from this study provide novel insight into the role of environmental arsenic exposure in DNA methylation patterns in multiple tissues collected from children with neural tube defects. The study warrants replication in larger groups to validate findings and to inform targeted prevention strategies.

KEYWORDS: Arsenic, DNA methylation, Bangladesh, folate, spina bifida

P-0500 Associations of prenatal ambient air pollution exposures with asthma in middle childhood

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BACKGROUND AND AIM: Early life susceptibility to air pollutants may reflect unique vulnerabilities across the well-described phases of prenatal morphological lung development. We assessed associations between air pollution exposures in these periods and asthma among school-age children.

METHODS: Participants were drawn from full-term births in three prospective cohorts spanning six US metropolitan areas in the ECHO-PATHWAYS Consortium: CANDLE, TIDES, and GAPPS. Current asthma at age 8-10 was assessed by parent-report on the International Study of Allergies and Asthma survey and required asthma diagnosis and either asthma medication use or recent wheezing. Prenatal nitrogen dioxide (NO_2) and ozone (O_3) exposures were estimated using a national spatiotemporal model in the pseudoglandular (5-16 weeks), canalicular (16-24 weeks), saccular (24-36 weeks) and alveolar (36+ weeks) lung development phases. Modified Poisson regression models to estimate relative risk (RR) were adjusted for child, maternal, and socioeconomic factors. Effect modification was evaluated with interaction terms for maternal history of asthma and child sex.

RESULTS: In this sample (n=1214), 9.7% of children had current asthma. Among mothers, 18% reported a history of asthma. No statistically significant associations were observed between prenatal NO_2 or O_3 and child asthma. We found suggestive evidence of an adverse association with NO_2 in the saccular phase among those without maternal history of asthma (RR=1.31 per 5 ppb; 95% CI: 0.90-1.91) and possible reduced risk (RR=0.61; 95% CI: 0.35-1.07) among those with maternal history of asthma (p-interaction=0.02). No effect modification was observed by child sex.

CONCLUSIONS: We found a suggested adverse effect of maternal NO_2 exposure during mid to late pregnancy on asthma risk in middle childhood, but only for children without one marker of a familial predisposition (maternal asthma history). Further research to examine this potential critical window and discrepancies by genetic risk factors is needed.

KEYWORDS: air pollution, asthma, children's environmental health

P-0501 Association of maternal fluoride exposure during pregnancy with increased size at birth and the potential mediation effect by maternal thyroid hormones: the Swedish NICE birth cohort

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BACKGROUND AND AIM: Observational studies have indicated that maternal fluoride exposure during gestation may impair child neurodevelopment but a potential impact on birth outcomes is understudied. The aim of the study is to evaluate the impact of gestational fluoride exposure on birth outcomes and assess the potential mediating role of maternal thyroid hormones.

METHODS: We studied 583 mother-child pairs in the NICE cohort in northern Sweden, where drinking water fluoride varies considerably. Fluoride concentration was measured in urine at gestational week 29 using an ion selective electrode. Plasma levels of free and total thyroxine and triiodothyronine, and thyroid stimulating hormone at gestational week 29 were measured with electrochemiluminescence immunoassays. The infant's length, head circumference, weight, and gestational age at birth were extracted from hospital records.

RESULTS: Median maternal urinary fluoride concentration was 0.7 mg/L (5th-95th percentile 0.3-1.9 mg/L; specific gravity adjusted). In multivariable-adjusted regression models, every doubling of maternal urinary fluoride was associated with a mean increase in birth length by 0.4 cm (95%CI: 0.2, 0.6), head circumference by 0.18 cm (95%CI: 0.04, 0.31), and weight by 67 g (95%CI: 22, 112), as well as an increased odds of being born large for gestational age (OR=1.49, 95%CI: 1.11, 2.02). Every doubling of maternal urinary fluoride was also associated with a mean increase in the plasma tT3 level by 0.04 µmol/L (95%CI: 0.00, 0.09) but with no other marker of thyroid functioning. In mediation analysis, maternal tT3 levels explained only about 10% of the urinary fluoride-birth length/weight associations.

CONCLUSIONS: Gestational fluoride exposure was associated with increased size at birth and even increased odds of being born large for gestational age. The observed associations were not explained by maternal thyroid hormone levels.

KEYWORDS: urinary fluoride, pregnancy, birth length, head circumference at birth, birth weight, large for gestational age, thyroid hormones

P-0503 Association between short-term exposure to ambient air pollution and cognitive interference: evidence from the Environment and Development of Children cohort

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BACKGROUND AND AIM: Fine particulate matters with diameter < 2.5 and 10 μm (PM2.5 and PM10) have been linked to cognitive interference, but the evidence on gaseous pollutants, such as NO2, SO2, and CO is scarce. Besides, very few studies examined the short-term association between air pollution and cognitive interference. This study aimed to investigate the association of short-term air pollution exposure with cognitive interference.

METHODS: We conducted a repeated measurement study with 470 children in the Environment and Development of Children cohort. Cognitive interference was assessed when children were aged 6 and 8 years using the Stroop Color and Word Test. Air pollution levels (PM2.5, PM10, NO2, SO2, and CO) from the day to 2-week moving average prior to the test were linked to the children based on the residential district. We applied a mixed-effect linear model after controlling for maternal characteristics during the mid-pregnancy or at birth (maternal age, gestational age, parity, smoking before or during the pregnancy,) in addition to children's characteristics (sex, physical activities, and second-hand smoking) and spatial-temporal information (month of the test, residential region, temperature, and humidity).

RESULTS: An interquartile range increase in PM2.5 (11.4 μg/m3) on a week moving average was associated with 1.70 (95% confidence interval [CI]: 0.53, 2.87), 2.29 (95% CI: 1.12, 3.45) and 1.33 (95% CI: -0.05, 2.72) decreases in Stroop word, color, and color-word test scores, respectively. Similar associations were detected for PM10, NO2, SO2, and CO. The negative associations were greater for girls, preterm births, and children with vigorous physical activities.
CONCLUSION: Our study suggests that short-term air pollution exposure is associated with childhood cognitive interference. Further improvement in air quality may benefit the cognitive development of children.

P-0507 Adherence to Mediterranean diet and metal exposure during childhood in the INMA study

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BACKGROUND AND AIM: The Mediterranean diet (MD) has been shown to have beneficial effects in children. A greater adherence to this pattern has been associated with a lower risk of developing obesity, diabetes, and cardiovascular disease. Yet, the contribution of the MD to the ingestion of essential and non-essential elements during childhood is unknown. Here, it is investigated the association between children's adherence to the MD and exposure to essential and non-essential elements.
METHODS: Our study population of 714 children come from the INMA cohort study (INfancia y Medio Ambiente). Urinary concentrations of essential (Co, Cu, Zn, Se, and Mo) and non-essential (As, Pb and Cd) elements were measured as exposure biomarkers. Urinary arsenic speciation was also determined, and concentrations were adjusted for urine dilution. The MD dietary indexes rMED (relative Mediterranean Diet Score) and aMED (alternate Mediterranean Diet Score) were calculated based on the information gathered with a validated food frequency questionnaire (FFQ). The urine samples and data from FFQ were collected at 4 years of age.
RESULTS: The median urinary concentrations of Co, Cu, As, Se, Mo, Cd, Pb and Zn were 0.78, 7.64, 24.45, 23.07, 92.76, 0.08, 0.37 and 377.39 μg/L, respectively. Urinary arsenic species concentrations (median) included arsenobetaine (10.83 μg/L), monomethylarsonic acid (0.36 μg/L), dimethylarsinic acid (3.00 μg/L), and inorganic arsenic (1.17 μg/L). An increased adherence to MD was associated with higher Mo, As and lower Co concentrations. The non-toxic arsenobetaine was associated with fish consumption in both indexes, but vegetables consumption was related to the inorganic arsenic exposure only in aMED index.
CONCLUSIONS: These findings suggest that the level of adherence to the MD is associated with exposure to essential but also non-essential elements. Efforts should aim to reduce toxic dietary exposures while preserving beneficial nutrients in children's dietary patterns.

KEYWORDS:
Mediterranean Diet, Metals, Childhood

P-0508 Exposure to Pesticides and Respiratory Health Outcomes in Children Residing in Imperial Valley, CA

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BACKGROUND AND AIM: Exposure to pesticides have been linked with adverse respiratory health outcomes such as lower lung function and greater wheezing. Pesticide use registries (PURs) have been used to estimate geospatially-based pesticide exposures throughout the life-course, but their usage in epidemiological studies remains underutilized. We aim to link data from a pesticide use registry in California with parent-reported respiratory health symptoms in predominantly Latino children enrolled in a longitudinal cross-sectional study in Imperial Valley, CA.

METHODS: We leveraged the Children's Assessing Imperial Valley Respiratory Health and the Environment cohort located in the highly burdened rural agricultural community of Imperial Valley near the US-Mexico border. We calculated the pounds of total pesticides applied within 400 meters of children's residential addresses for the years 2016-2018 and created three exposure categories (none, low, high), with the low and high exposure groups split at the median (47 kg). We used logistic regression to examine associations of pesticide exposures with respiratory symptoms, including wheezing and asthma medication usage, and controlled for language of survey completion, age, doctor-diagnosed asthma, and sex. All health variables were derived from the validated ISAAC questionnaire.

RESULTS: A total of 746 children were included in this analysis. 62% of children lived within 400m of at least one pesticide application within 12 months prior to survey administration. Compared to children with no pesticide exposure in the past 12 months, those with the highest level of pesticide exposure reported greater wheezing (OR=1.86, 95%CI 1.01, 3.45), and medication usage (OR=2.43, 95%CI 1.14, 5.35). There were no associations with coughing or bronchitic symptoms.

CONCLUSIONS: We observed associations of living near pesticide applications during the 12-months prior to survey administration with wheezing and asthma medication usage outcomes among children living in a highly agricultural rural county along the US-Mexico border.

KEYWORDS: pesticides, wheezing, children

P-0510 Prenatal exposure to traffic-related air pollution and childhood acute leukaemia in France - GEOCAP Birth 2010-2015

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BACKGROUND AND AIM: Acute leukemia (AL) affect approximately 500 children under 15 each year in France. Living near major roads and being exposed to traffic-related air pollutants are increasingly suggested as risk factors for childhood AL.
The present GIS-based registry-based case-control study investigates the hypothesis that prenatal exposures to traffic-related pollutants increase the risk of AL, using exposure at the residence at birth as a proxy of prenatal exposure.

METHODS: the study included all the AL cases born and diagnosed in France during 2010-2015 (n=728) and 11,908 controls representative of the French births during the same period.
Addresses of residence at birth were geocoded. Exposure indicators were the length of major roads within 150 m of the address, and the concentrations of NO2, fine particulate matter (PM2.5) and black carbon (BC) estimated by land use regression models.
Odds-ratios were estimated for several exposure categories and under the hypothesis of a log-linear increase in childhood AL risk with increasing level of exposure, using unconditionnal logistic regression models (all AL) and polytomic logistic models (AL subtypes). The analyses were also stratified according to the degree of urbanization of the municipality.

RESULTS: childhood AL was not associated with major road length. Overall, PM2.5 and BC concentrations were associated with an increased risk of childhood AL (OR=1.3 [1.2-1.4] and OR=1.1 [1.0-1.2] per inter-quartile range increase, respectively). However, no positive association was observed for BC when the effect of BC was isolated from that of total PM2.5. Stratifying by urbanization status did not change the results for PM2.5 but the associations were weaker for BC especially in most urban areas. Non-significant positive associations were observed for NO2.

CONCLUSIONS: our findings suggest a role of prenatal exposure to traffic-related air pollution in childhood AL.

KEYWORDS: Childhood leukemia; road traffic; air pollution; prenatal exposure

P-0512 Residential green space improves cognitive performances in primary schoolchildren independent of traffic-related air pollution exposure

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BACKGROUND AND AIM: Cognitive performances of schoolchildren have been adversely associated with both recent and chronic exposure to ambient air pollution. In addition, growing evidence indicates that green space is associated with a wide range of health benefits. Therefore, we aimed to investigate if surrounding green space improves cognitive performance of children while taking into account air pollution exposure.

METHODS: Cognitive performance tests were administered repeatedly to a total of 307 primary schoolchildren aged 9-12y, living in Flanders, Belgium (2012-2014). These tests covered three cognitive domains: attention (Stroop, Continuous Performance Tests), short-term memory (Digit Span Forward and Backward Tests), and visual information processing speed (Digit-Symbol, Pattern Comparison Tests). High-resolution green space exposure was estimated within several radii around their current residence (50-2000 m). Furthermore, residential air pollution exposure (year before examination) was modelled using a spatial-temporal interpolation method.

RESULTS: An improvement of the children's attention was found with more residential green space exposure independent of traffic-related air pollution (NO_2 and distance to major roads). for an IQR increment (21%) of green space within 100 m of the residence, a significantly lower mean reaction time was observed for sustained (-9.21 msec, 95%CI: -16.0 to -2.4 msec, p=0.008) and selective attention (-62.55 msec, 95%CI: -112.6 to -12.5 msec, p=0.02). Moreover, residential green space exposure within a large radius (>1000 m) was significantly associated with a better performance in short-term memory and a higher visual information processing speed, taking into account traffic-related exposure. However, all associations were attenuated after taking into account long-term residential $PM_{2.5}$ exposure.

CONCLUSIONS: Our panel study showed that exposure to residential surrounding green space was associated with better cognitive performances. These findings support the necessity to build attractive green spaces in the residential environment to promote healthy cognitive development in children.

KEYWORDS: neurodevelopment, greenspace, natural environment, mental health

P-0513 Strengthening the global role of environmental epidemiology in the Respiratory Diseases Exploratory: Analysis of Age in the Diagnosis of Asthma in Brazil, 2019

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Asthma is a recurrent inflammatory lung disease in which certain stimuli (factors triggers) inflame the airways and cause them to narrow temporarily, resulting in breathing difficulties. Can be develop at any age, begins most often in childhood, especially in the first five years of life. It is a chronic disease and should be routinely monitored. Affects more than six million children in the USA, where more than 8.5% of children in the USA were diagnosed with asthma, indicating a 100% increase in recent decades. the rate goes up to 25% to 40% among some urban child populations. Asthma is one of the main causes of hospitalization of children and is the main chronic clinical condition school absenteeism. Important to know when the diagnosis of asthma is being made in Brazil, aiming at preventive measures.

OBJECTIVE: to identify the age group in which it was performed. Asthma diagnosis by regions of Brazil in 2019.Descriptive study. An open database analysis of the National Health Survey (PNS) and the Brazilian Institute of Geography and Statistics (IBGE).108,525 households were visited and 94,114 interviews were carried out. Analyzed: Regions of Brazil,sex, race, color, household characteristics and age at diagnosis asthma doctor.

RESULTS: The mean age in Brazil was 15.5 years (95% confidence), and by regions: North(N):10.8;Northeast (NE): 14.4; Southeast (SE):14.8; South (S): 16.1; Midwest (CO): 15.5. The coefficients of the variations found were: Brazil - 2.8; N-8.0; NE -14.4; SE - 4.9; S-5.2; CO-6.4. There is one important variation in the age of asthma diagnosis in Brazil that deserves to be known and addressed. Research with open data from the Ministry of Health and IBGE can contribute to the discussion of preventive health measures considering the early diagnosis, treatment of asthma and environmental discussion.

KEYWORDS: Asthma, Children, Age

P-0522 Factors effecting inflammatory-based diseases anxiety and atopy in Australian children

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BACKGROUND AND AIM: New evidence is emerging that some mental health disease is related to inflammation. This could see individuals with multiple inflammatory diseases sharing pathological pathways. A variety of environmental factors will influence these relationships.

METHODS: We used the Longitudinal Study of Australian Children, a population representative survey of Australian children which has been running since 2003 and consists of nine waves of data with. 10000 participants. We analysed the remaining 3127 adolescents and 3037 young adults. A range of questionnaire data on risks and health have been used to identify health status and risk factors/confounders. Relationships were adjusted for a range of know potential confounders, including sex, BMI, socio-economic indexes for areas, latitude, state of residence and remoteness of the area.

RESULTS: Of the 4-5 year old 1.6% (95% CI 1.3-2.0 had both anxiety and asthma, of the 16-17 year old 6.8% (95% CI 5.5-8.5). In two sub-cohorts, anxiety was associated with asthma diagnosis (aOR 1.6, 95%CI 1.2, 2.0) and (aOR 1.5, 95%CI 1.2, 1.9). Presence of anxiety increased the risk of other atopic-related diseases eczema and food allergy. There was a trend for more atopic disease in southern regions compare to the northern cities.

CONCLUSIONS: There is a relationship between anxiety and atopy in this Australian cohort, which may be bi-directional. A common pathological pathway for both diseases groups is possible. Solar exposure in more northerly states may be related to better immune health.

KEYWORDS: Inflammation, allergy, anxiety, vitamin D, children

P-0525 Associations of prenatal exposure to outdoor PM2.5 and NO2 with childhood respiratory symptoms

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BACKGROUND AND AIM: Prenatal and early life exposures to air pollution have been shown to play an important role in the development of childhood respiratory and allergic diseases. Nitrogen dioxide (NO2) has been associated with increased paediatric asthma incidence, while prenatal exposure to fine particulate matter (PM2.5) has chronic and adverse effects in lung development and respiratory health. The aim of the study was to assess the associations of prenatal exposure to air pollutants with the prevalence of respiratory symptoms, asthma, allergic rhinitis, and eczema in children.

METHODS: We selected 2150 children from the PELAGIE Cohort in Brittany, France, that were followed-up at 2, 6 and 12 years old. Parents reported children's respiratory health history, family lifestyle behaviours and children's immediate environment through standardized and validated questionnaires. Concentrations of PM2.5 and NO2 were modelled during the pregnancy at residential address. We used logistic regression models to assess the associations per one increase of an interquartile range (IQR), adjusted by sex, parents smoking during pregnancy, environmental tobacco smoke of children and children smoking (at 12).

RESULTS: Prenatal concentrations of NO2 were 20.04±6.33µg/m3 (IQR=2.48) and PM2.5 10.24±1.17µg/m3 (IQR=1.59). Prenatal exposure to higher NO2 concentrations was associated with increased odds of wheezing episodes at the age of 2 years [odds ratio (OR) = 1.26; 95% confidence interval (CI):1.00–2.61] and higher odds of suffering asthma at 12 years old [OR=1.33; 95%CI: 0.97–1.82]. Overall, higher exposure to NO2 and PM2.5 during the prenatal period showed associations with increased odds of sneezing, wheezing and asthma attacks during childhood; however, these associations were at the limit of statistical significance.
CONCLUSION:
Prenatal exposures to ambient PM2.5 and NO2 seem associated with higher risk of respiratory and allergic diseases in children even at relatively low levels of air pollution concentrations.

KEYWORDS: Air pollution, children health, allergic diseases, prenatal exposure.

P-0527 The NeuroTox study – Investigating in-utero exposures to environmental toxicants and neurodevelopment

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BACKGROUND AND AIM: Chemical pollution is an increasing threat to child health worldwide and the impact of environmental toxicant on early brain development could contribute to the origins of neurodevelopmental disorders and cognitive impairments. The NeuroTox study has investigated prenatal exposure to environmental chemicals and child neurodevelopmental outcomes in the Norwegian Mother, Father and Child Cohort study (MoBa). We evaluate the relations between population levels of common environmental toxicants in pregnant women and child neurodevelopment across NeuroTox findings.

METHODS: Toxic metals, essential elements, and per- and polyfluoroalkyl substances (PFAS) were measured in the mother's blood, while phthalates and organophosphate esters (OPEs) were measured in urine of 3,500 mother–child pairs from the MoBa study during gestation. Relationships between toxicant levels and neurodevelopmental outcomes (Attention-Deficit/Hyperactivity Disorder [ADHD], Autism-spectrum disorders [ASD], and cognitive impairment) in children were assessed using multivariable-adjusted quartile or quintile, logistic, restricted-cubic-spline, and quantile-based-g-computation models controlling for maternal age, education, parity, smoking, seafood intake, and child sex.

RESULTS: Published findings from NeuroTox show that elevated maternal levels of phthalates and PFAS (e.g. perfluorooctanoic acid [PFOA] and perfluorooctane-sulfonic acid [PFOS]) were associated with lower cognitive functions in the child. Elevated maternal cadmium, lead, arsenic, PFOA, PFOS, manganese, and cobalt were associated with increased risk of ADHD and/or ASD, while elevated OPEs and phthalates with increased risk of ADHD. With PFOA, lead and manganese, both low and high levels were associated with an adverse effect in non-linear dose-response relationships.

CONCLUSIONS: These results suggest that population levels of these toxicants in pregnancy even in a high-income country (Norway) may adversely impact brain development by contributing to the risk of neurodevelopmental disorders and cognitive impairments. Planned developments will investigate how socioeconomic status modulates both the exposures and their downstream effects on brain development and child mental health.

KEYWORDS: PFAS, Neurodevelopment, OPEs, metals, Prenatal exposure

P-0529 Adverse Birth Outcomes Related to NO2 and PM Exposure: European Systematic Review and Meta-Analysis

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There is a growing number of international studies on the association between ambient air pollution and adverse pregnancy outcomes, and this systematic review and meta-analysis have been conducted focusing on European countries, to assess the crucial public health issue of this suspected association in this geographical area. A systematic literature search (based PRISMA guidelines) has been performed on all European epidemiological studies published up until 1 April 2020, on the association between maternal exposure during pregnancy to nitrogen dioxide (NO2) or particular matter (PM) and the risk of adverse birth outcomes, including low birth weight (LBW) and preterm birth (PTB). Fourteen articles were included in the systematic review and nine of them were included in the meta-analysis. Our meta-analysis was conducted for 2 combinations of NO2 exposure related to birth weight and PTB. Our systematic review revealed that the risk of LBW increases with the increase of air pollution exposure (including PM10, PM2.5, and NO2) during the whole pregnancy. Our meta-analysis found that birth weight decreases with NO2 increase (pooled beta = −13.63, 95% confidence interval (CI) (−28.03, 0.77)) and the risk of PTB increase for 10 µg/m3 increase in NO2 (pooled odds ratio (OR) = 1.07, 95% CI (0.90, 1.28)). However, the results were not statistically significant. Our findings support the main international results, suggesting that increased air pollution exposure during pregnancy might contribute to adverse birth outcomes, especially LBW. This body of evidence has limitations that impede the formulation of firm conclusions. Further studies, well-focused on European countries, are called to resolve the limitations which could affect the strength of association such as the exposure assessment, the critical windows of exposure during pregnancy, and the definition of adverse birth outcomes.

KEYWORDS: systematic review; meta-analysis; birth weight; low birth weight; preterm birth; exposure; air pollution; PM; NO2

P-0530 A study protocol to explore the social effects of environmental exposure and lifestyle behaviours on adverse pregnancy outcome: an overview of pregnant women cohort study

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A growing number of international studies have highlighted the adverse consequences of lived experience in the first 1000 days of early life on the probability of stillbirth, child mortality and healthy development during both childhood and adulthood. The lived experience of the foetus inside the womb and at the birth is strongly related to maternal health during pregnancy and mother's exposure to various environmental factors known as 'exposome'. The aim of our project is to explore the relationships between exposome characteristics and the health status of pregnant women and their newborns. Specifically, we study the relationships between the social inequality of adverse pregnancy outcomes and short-term exposure to atmospheric pollution, and pregnancy lifestyle.

METHODS: and analysis This is a cohort study of pregnant women, involving on university hospital across two sites in the Eurometropolis of Strasbourg. The researchers collect data on outcomes and individual characteristics from registries, clinical records data and questionnaires. Participants are being recruited from first trimester antenatal ultrasound examinations conducted on weekdays at both sites; each woman meeting our inclusion criteria enters the cohort at the end of the first trimester. Study participants receive three online questionnaires covering socio-demographic characteristics, travel behaviour patterns, and lifestyle. The level of personal exposure to air pollution is characterized using a dynamic spatio-temporal trajectory model that describes the main daily movements of pregnant women and the time spent in each place frequented. Univariate, multilevel and baysian model will be used to investigate the relationships between exposome characteristics and the health status of pregnant women and their new-borns.
Ethics and dissemination Research approved by the Commission de Protection des Personnes Ile de France VI on 9 December 2020 and the Agence Nationale de Sécurité du Médicament was informed of it on 15 December 2020.

KEYWORDS: urban exposome, pregnancy, new-born, socio-environmental approach

P-0531 Effect of toenail metal concentrations on thyroid function in Bangladeshi children

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BACKGROUND AND AIM: The ubiquitous presence of toxic metal exposures in the environment is a global public health concern. Arsenic, cadmium, and mercury are commonly occurring toxic environmental metal exposures in the general population. These metal exposures appear among the top 20 of the Agency for Toxic Substances and Disease Registry Substance Priority List, prioritizing substances based on their frequency, toxicity, and potential for human exposure. The existing experimental literature supports the hypothesis that the disruption of hormone signaling by metals at key developmental time points might underlie health outcomes observed in childhood, adolescence, and adult life. While limited data exist in humans, experimental studies have observed correlations of metals with endocrine function. This study evaluates the associations between toenail metal concentrations and free thyroxine (T4) among 500 Bangladeshi children aged 5-7 years enrolled in the Bangladesh Environmental Research in Children's Health (BiRCH) cohort.

METHODS: We investigated the associations of toenail metal concentrations of arsenic, cadmium, and mercury with free T4 using linear regression models (single-metal and mutually-adjusted models), adjusted for a priori covariates. Additionally, Bayesian kernel machine regression (BKMR) was conducted as a secondary analysis to test the robustness of findings and potential exposure patterns.

RESULTS: Arsenic was positively associated with free T4 (Q4 versus Q1 b=0.10, 95% CI=0.03-0.17), and mercury was inversely associated with free T4 (Q4 versus Q1 b= -0.07, 95% CI=-0.14-0.002). No association was observed with cadmium. Secondary analyses examining metal mixtures yielded similar results.

CONCLUSIONS: Findings from linear regression modeling and secondary analyses using BKMR suggest thyroid function may serve as an important mechanism for arsenic and mercury toxicity. Future research is needed to evaluate the inter-related roles of metal exposures and thyroid function across the life course.

KEYWORDS: metals, thyroid, children's environmental health

P-0532 A 40-year follow-up study of liver cancer risk in Taiwan:An age-period-cohort analysis and joinpoint regression analysis

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OBJECTIVES:
Malignant neoplasm of liver and intrahepatic bile ducts is a leading cause of cancer-related mortality in Taiwan. The objective of this study was to investigate the effects of age, period, and birth cohort on liver and intrahepatic bile ducts cancer incidence in Taiwan.

METHODS: We tracked the incidence rate of malignant neoplasm of liver and intrahepatic bile ducts (ICD-10 code C22) from 1980 to 2019, with data from the Taiwan Cancer Registry. We then calculated age-standardized incidence rates (ASIRs) for liver and intrahepatic bile ducts cancer based on the world standard population in 2000. Joinpoint regression was used to evaluate the trend change, and age-period-cohort models were used to investigate the effects of age, period, and birth cohort on liver and intrahepatic bile ducts cancer incidence.

RESULTS: From 1980 to 2019, there were 278,363 newly reported cases of liver and intrahepatic bile ducts cancer, for a crude incidence rate of 32.17 cases per 100,000 person-years. The ASIR exhibited a significant increase from 1980 to 2000 (APC = 7.4%, 95% CI: 6.9–7.8%, P = <0.001), maintained at the plateau from 2000 to 2009, and then declined. The risk of liver and intrahepatic bile ducts cancer in the population peaked in 2005-2010. The population born between 1965 and 1975 had the highest risk of developing liver and intrahepatic bile ducts cancer compared to the other cohort. The cancer risk dropped after hepatitis B vaccination program since 1980s.

CONCLUSIONS: Hepatitis B vaccination program may decrease the risk of liver and intrahepatic bile ducts cancer in Taiwan. Appropriate vaccination program is advised for countries with similar exposures.

P-0535 Blood mercury levels of Brazilian preschool children and associated risk factors

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BACKGROUND AND AIM: Environmental exposure to mercury in preschool children can increase their blood total mercury levels (BML) and impact their health. This study aimed to determine BML in preschool children from the most populous city of Brazil and investigate associated risk factors.

METHODS: Blood samples were collected from 2,436 children (1-5-year-old) attending 50 daycare centers (DCC) located in São Paulo, Brazil, in 2013. Parents or guardians answered questionnaires about sociodemographic information and potential risk factors. BML was determined by Cold Vapor Atomic Absorption Spectrophotometry (CV-AAS). BLM was dichotomized at a cut-off point of 2.77 μg L^{-1}, which represents the 75th percentile. Summary data and multiple logistic regression were performed ($p<0.05$).

RESULTS: The geometric mean for BML was 1.65 μg L^{-1} (95%CI: 1.60-1.70), the arithmetic mean was 2.15 μg L^{-1} (95%CI: 2.09-2.22), the 75th percentile was 2.77 μg L^{-1} (95%CI: 2.67-2.91) and the 95th percentile was 5.51 μg L^{-1} (95%CI: 5.18-5.92). The regression model was adjusted for vehicle flow in the DCC location (high/low), DCC geographic zone (northwest/south/east), fish intake in the last two days (yes/no), recent home renovation (yes/no), and parents living together (yes/no). DCCs located in the Northwest and East zone ($p<0.001$) and fish consumption in the last two days ($p=0.04$) were associated with high BML.

CONCLUSIONS: The Brazilian geometric mean for BLM in preschoolers was higher than the U.S. 95th percentile, which is five times lower than the 95th percentile determined in this study. The mercury exposure in preschool children was related to multiple risk factors, highlighting the need to identify and control hot spots in Sao Paulo, Brazil, where children can be exposed to elevated mercury levels. Formulation of public health policies to understand and eliminate mercury sources is crucial. Funded: Fapesp (2011/13076-0, 2011/23272-0, 2012/21840-4, 2018/18391-0, 2017/25424-9) and Capes.

KEYWORDS: Children; Mercury; Blood; Exposure

P-0539 Changes of heavy metals in Korean pregnant women and cord blood from 2006 to 2018 in MOCEH and KoCHENS

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BACKGROUND AND AIM: Environmental pollutions affect the concentrations of heavy metals. Heavy metals affect the neurocognitive development of infants and children. Korean government and Koreans have tried to improve environmental pollutions. We investigated how much the concentration of heavy metals in maternal and umbilical cord blood changed over 10 years due to environmental pollution improvement.
METHODS: MOCEH (MOthers and Children Environmental Health) and KoCHENS (Korean Children Health and ENvironmental Study) are population-based birth cohort studies which was recruited in 2006 -2010 and 2015-2018, respectively. 1,696 and 4,299 mothers included in this study among 1,751 and 5,459 participants in MOCEH and KoCHENS. Lead (Pb), cadmium (Cd) and mercury (Hg) were measured in early and late pregnancy, and cord blood at birth. Food intakes, residential environments, and general characteristics were measured by questionnaire. All protocols were approved by the research ethics committee. SPSS 25.0 was used for statistical analyses.
RESULTS: Pb, Cd, and Hg concentrations were 52.3-55.5%, 33.8-45.1%, and 56.5-64.5% in KoCHENS compared to MOCEH. Pb decreased towards the end of pregnancy, Cd was highest in late pregnancy and lowest in cord blood, and Hg was highest in cord blood. The correlation coefficient was greater in KoCHENS than in MOCEH during pregnancy and delivery. Cd was not correlated with maternal and umbilical cord blood concentrations. Despite the approximately 37% decrease in Hg over 10 years, the ratio of Hg concentrations between cord blood and late gestation was greater in KoCHENS, with 1.65 and 1.83 in MOCEH and KoCHENS, respectively.

CONCLUSIONS: As the environment improved, maternal heavy metal concentrations decreased. However, the mother's heavy metals are still transmitted to the fetus, and the intensity is stronger, so continuous efforts are needed to reduce the level of heavy metal exposure.

KEYWORDS:
birth cohort study, heavy metals, lead, cadmium, mercury, environment pollution

P-0544 Tetrachloroethylene exposure and neurobehavioral performance among children living in a small community with multiple contamination sites

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BACKGROUND: Tetrachloroethylene (PCE) is a neurotoxicant based on evidence from high levels of occupational exposure among workers. Community PCE exposures potentially impact many people (often disadvantaged) living near contaminated sites, but have not been well studied.
AIM: To evaluate the association between PCE exposure and neurobehavioral performance among children living in a community that overlays multiple contamination sites with PCE being the primary contaminant.

METHODS: Participants are 6 - 11 years old children recruited in 2021–2022. PCE is measured in participants' exhaled breath. Past exposure is estimated based on residential history. Neurobehavioral performance is assessed using the Wide Range Achievement Test Fifth Edition (WRAT-5), the Behavior Assessment System for Children Third Edition (BASC-3), and NIH Toolbox cognitive measures. Children are classified as exposed or unexposed based on PCE concentration in their exhaled breath in this initial analysis. Multiple linear regression is used to examine the association of PCE exposure and outcome measures after adjusting for covariates.

RESULTS: Eighty-three participants have been recruited, with 64 and 39 having finished the outcome assessment and the first round of exhaled breath testing, respectively. The second round of breath testing will be conducted in May 2022. Twenty-seven percent of tested participants had detectable PCE concentrations in the exhaled breath (mean = 0.27 ppb, SD = 0.12 ppb). Exposed children have lower scores on crystalized composite and spelling compared to unexposed children. Several covariates have significant associations with outcome measure subtests and need to be adjusted in the full data analysis.

CONCLUSIONS: Our initial analysis suggests that PCE exposure might be associated with subtle changes to verbal reasoning and spelling. These observations need to be further examined in the full data analysis.

KEYWORDS: Tetrachloroethylene, Neurobehavioral performance, Children's health, Community exposure

P-0545 Gestational and Early Life Risk Factors for Childhood Food Allergies

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AIM(S):
The prevalence of food allergy among children has risen steadily over the past two decades, with 4 to 6% of children having at least one type of food allergy.[1,2] We investigated whether the occurrence of food allergies in childhood were related to factors known to influence the early microbiome and implicated in immune training (e.g., delivery mode, antibiotic use, proximity to a farm). We also assessed maternal consumption of foods during pregnancy for which children become allergic and maternal history of food allergies.

METHODS: Participants, enrolled in the New Hampshire Birth Cohort Study, included 2,011 women with a singleton pregnancy and their offspring. We used Cox Proportional Hazards models to estimate the risk of a medical diagnosis of food allergies during the first five years of life in relation to maternal-infant characteristics, adjusted for potentially confounding factors.

RESULTS: A greater risk of food allergies was associated with cesarean delivery (HR = 1.99; 95% CI: 1.06, 3.74) and prenatal antibiotic use (HR = 2.29; 95% CI: 1.15, 4.56). Daycare attendance (HR: 0.27; 95% CI: 0.15, 0.47) was inversely associated with risk. Children of mothers with a history of food allergies, consuming tree nuts or eggs during pregnancy and those living near a farm had a higher risk and those whose mothers ate peanuts prenatally had a lower risk, but these associations could have been due to chance.
CONCLUSION(S):
Prenatal factors related to the early acquisition of the microbiome, such as method of delivery, prenatal antibiotics, and day care correlated to risk of a food allergy diagnosis among children in the first 5 years of life. Developing a clearer understanding of allergy development and its risk factors is crucial to reducing the burden of food allergies.

KEYWORDS:
Food allergy, daycare attendance, prenatal factors, early childhood, prenatal antibiotics

P-0547 Characterization of the External Exposome and its Contribution to the Clinical Respiratory and Early Biological Effects in Children: PROMESA cohort in Colombia

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BACKGROUND AND AIM: Air pollution contains a mixture of different pollutants from multiple sources. However, the interaction of these pollutants with other environmental exposures, as well as their harmful effects on children under five in tropical countries, is not well known. This study aims to characterize the external exposome (ambient and indoor exposures) and its contribution to clinical respiratory and early biological effects in children.

METHODS: A cohort study is conducted on children under five in two cities in Colombia. Enrolled children are followed monthly (phone call) post-enrollment with upper and lower Acute Respiratory Infections (ARI) examinations and will be followed at months 6 and 12 (in person) to evaluate asthma development, asthma control, and genotoxic damage. The asthma diagnosis is pediatric pulmonologist-based and a standardized protocol is used. Exposure, effect, and susceptibility biomarkers are measured on buccal cells and blood samples. for environmental exposures, PM2.5 was sampled in two moments of the year to chemical characterization. Additionally, the standardized questionnaire developed for HELIX is used and geographic information, dispersion models, and Land Use Regression models for PM2.5 and NO2 will be used.

RESULTS: these are preliminary data. of 135 children 47.4% are female and 49.6% are 4 years old. Exposure to pets 45.9%, cockroaches 41.5%, mold 47.6%, parental tobacco smoke in pregnancy and early childhood 14.3%, parental electronic cigarettes 4.44%, noise 20.7%, and never eaten vegetables or fruits 9.6% have been found. Prevalence of asthma is 29.4% with TRACK<80 in 83.3% of children with previous asthma. Comet assay damage indicator median 55 (IQR: 29 – 90.5).

CONCLUSIONS: This is the first exposome study on the region. There is a high prevalence of asthma with high exposure to unfavorable environmental conditions.

KEYWORDS: Exposome, Air Pollution, Children, Asthma, Respiratory Infection Disease, Early Biological Effect, DNA Damage, Polycyclic Aromatic Hydrocarbons

THEMATIC 08: COVID-19 and the Environment

P-0637 Attitudes toward COIVID-19 vaccination: cross sectional study in Iraq

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BACKGROUND:
In March 2020, the WHO announced that COVID-19 has become pandemic. In Iraq since the start of applying the national covid-19 vaccines campaign, a lot of people refused to take the COVID-19 vaccine.

METHODS: A cross-sectional study was done and a total of 814 participants were involved in the survey. A convenient sample approach was introduced in this study from 11 different areas (Central, Southern, and Northern) at Anbar governorate including urban and rural regions. A questionnaire form was distributed to people involved in the study and a self-administered answer was applied by the principal researcher. Analysis of data was carried out using simple descriptive statistics. This included calculation of percentages, risk factors, reasons, tables, and charts all done.

RESULTS: A total of 814 participation included in this study. Male was 52.5% while female 47.5%.71.7% population understudy didn't take any type of Covid-19 vaccine. and among those who took the covid-19 vaccine, of them, 58.4 % took only one dose of vaccination. a high percentage of 72.1% was among people understudy who didn't take any type of vaccine because they don't trust it. 14.3% of them didn't take it because their friends and relatives didn't take it. While 8.6% were afraid of its side effects. Almost 10% of people prefer to be infected with covid-19 rather than take the vaccination. Gender, age, marital status, occupation, and educational level all variables were significant differences with having or refusing the covid-19 vaccine.
CONCLUSION:
In Iraq, people are still refusing to uptake the COVID-19 vaccine. A lot of rumors through social media are influencing public opinion and trust about the COVID-19 vaccine. More efforts should be done by the primary health centers, health workers, and doctors to educate public about the COVID-19 vaccine

KEYWORDS: Attitude, COVID-19 vaccine, Iraq

P-0640 Differences in Silicone Wristband Exposure Profiles by COVID School Restrictions in Washington State Children

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BACKGROUND AND AIM: The school closure restrictions following the COVID-19 pandemic likely increased the time spent at home for school-age children and therefore may have impacted overall environmental burden. Silicone wristbands have been used as personal passive samplers measuring exposure to semi-volatile organic compound (SVOC) contaminants. We hypothesized that SVOC exposure levels would differ by pandemic restriction status.

METHODS: We assessed SVOCs in a pilot study of 55 children (24 boys and 31 girls) at ages 5-9 years within the GAPPS PATHWAYS Study at two study sites: Seattle (n=38) and Yakima (n=17), Washington from 2020-2021. Pre-cleaned silicone wristbands were worn for 5 days. Wristbands were analyzed for 109 SVOC compounds using GC-MS. Washington school closures were used to identify 7 wristbands worn outside of pandemic restriction periods. Regressions associated analytes with pandemic restrictions, controlling for age, sex, and site. Coefficient p-values underwent false discovery rate (FDR) adjustment. Exposure profiles were summarized using self-organizing maps (SOMs).

RESULTS: 40 compounds with >60% detection were included in our analysis. School closure restrictions were associated with 92% (FDR q=0.006), 91% (q=0.04), 88% (q=0.008), 88% (q=0.04), and 85% (q=0.04) lower concentrations of the organophosphate esters (OPEs) 2-isopropylphenyl diphenyl phosphate (2IPPDPP), triphenylphosphate, 4-isopropylphenyl diphenyl phosphate (4IPPDPP), triisobutylphosphate, and bis(2-isopropylphenyl) phenylphosphate (B2IPPPP), respectively. Other analytes; including pesticides, brominated diphenyl ethers, phthalates, and polycyclic aromatic hydrocarbons; were not associated with COVID-19 restrictions. SOMs revealed 12 profiles organized primarily by triaryl OPE levels, and wristbands collected outside of pandemic restrictions predominantly sorted into profiles with higher triaryl OPEs.

CONCLUSIONS: OPE exposures in children were lower during COVID-19-related school closures, suggesting that these exposures may be higher outside the home and within schools. Given that OPEs have shown endocrine-disrupting and obesogenic properties, understanding behavioral predictors of exposure can better protect of children's health.

KEYWORDS: Exposome, COVID-19, Silicone wristbands, Organophosphate esters

P-0641 Association of short-term air pollution exposure with SARS-CoV-2 infection among young adults in Sweden

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BACKGROUND AND AIM: Many ecological studies reported associations of short-term air pollution exposure with Corona-virus disease (COVID-19), however, no study examined this association on individual-level. We aimed to estimate the association between short-term exposure to ambient air pollution and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection among Swedish young adults.

METHODS: We conducted a time-stratified case-crossover study within the Swedish prospective birth cohort BAMSE (Swedish abbreviation for Children, Allergy Milieu, Stockholm, Epidemiology). We linked the cohort to Swedish national infectious disease registry to identify SARS-CoV-2 PCR-test positive cases between May 5, 2020 and March 31, 2021. Daily air pollutant levels (particulate matter ≤2.5 µm [PM2.5], particulate matter ≤10 µm [PM10], black carbon [BC] and nitrogen oxides [NOx]) were estimated at residential addresses using dispersion models with high spatiotemporal resolution. Distributed-lag models combined with conditional logistic regression models were used to estimate the association.

RESULTS: A total of 425 cases were identified, of whom 229 (53.9%) were female and median age was 25.6 years. The median exposure level for PM2.5, PM10, BC and NOx was 4.4, 7.7, 0.3, 8.2 µg/m3 on case days and 3.8, 6.6, 0.2, 7.7 µg/m3 on control days, respectively. Each interquartile range (IQR) increase in short-term exposure to PM2.5 and PM10 on lag 2, BC on lag 1 was statistically significantly associated with a relative increase of 6.8% (95%CI: 2.1- 11.8), 6.9% (95%CI: 2.0 -12.1), and 5.8 % (95%CI: 0.3 – 11.6) of positive SARS-CoV-2 PCR test, respectively. There was no evidence of findings to be associated with NOx or modified by sex, smoking, asthma, overweight and self-reported COVID-19 respiratory symptoms.

CONCLUSIONS: Short-term exposure to PM and BC was associated with increased risk of testing PCR-positive for SARS-CoV-2 in young adults, supporting the broad public health benefits of reducing ambient air pollution levels.

P-0642 To what extend does exposure to air pollutants is linked with death in lung cancer patients with COVID-19 diagnosis? Primary observations by the Cancer Registry of Crete

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BACKGROUND: Emerging evidence, during the COVID-19 pandemic, supports a link between air pollution and other environmental factors and severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) transmission and COVID-19 susceptibility and severity. These effects seem to be even more intense in patients with chronic conditions, such as cancer.
Aim: To assess the differences in COVID-19 deaths, hospitalizations and survival in cancer patients with high or low exposure to air pollutants.

METHODS: We included 584 lung cancer patients with verified histological diagnosis from 2020 to March 2022 (107 of them had positive antigen or PCR test). The cases were obtained from the Cancer Registry of Crete and linked with data of outdoor air pollutants (OAP). The OAP indicators included measurements on particulate matter (PM)2.5, between 2.5 and 10 μm (PM2.5-10), PM10, PM2.5 absorbance (black carbon measure), nitrogen dioxide (NO2), and nitrogen oxides (NOx). The case fatality rate (CFR) of COVID-19 deaths in lung cancer patients per AOP exposure group was calculated and the Net-Survival was estimated (Kaplan-Meier Curves).

RESULTS: The prevalence of COVID-19 in lung cancer patients was 18.3% in the Cretan cohort. In these 107 case-series, the 71.9% required long hospitalization with median stay of 15 days. The vast majority of them (80.5%) were highly exposed to AOP, whereas only the 19.4% has low levels of AOP exposure ($p=0.03$). All patients were of stage I or II and presented an overall CFR of 74.6% during the 6-month follow-up period, with the majority being highly exposed to AOP ($p<0.001$). The 6-month Net-Survival for patients with high AOP exposure was 11.2% versus 33.5% in those with low AOP exposure.

CONCLUSIONS: The role of AOP seems to be integral in lung cancer patients survival during the COVID-19 pandemic, but further studies using genome-wide cohorts are required to establish a causal association.

P-0647 Atmospheric particulate matter effects on Sars-Cov-2 infection and its dynamics spreading: a spatio-temporal point process model

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BACKGROUND AND AIM: Particulate matter (PM) may play a role in differential distribution and transmission rates of SARS-CoV-2. Identification of factors affecting the transmission dynamics concerning the endemic (persistent sporadic) and epidemic (rapidly clustered) component of infection can helps to implement intervention strategies to reduce the disease burden. Aim of this study is to assess the effect of long-term residential exposure to PM on Sars-Cov-2 incidence and on the dynamics of infectious disease spreading in Marche Region (Central Italy).

METHODS: All individuals with first positive SARS-CoV-2 molecular test from February to May 2020, residing in the Marche region were analysed along with gender, age, employment, Nursing Homes and Long-Term Care Facilities (NH-LTCF) residence and socio-economic deprivation index (DI); long-term exposure to outdoor PM ≤ 10 µm (PM10) concentrations, Temperature and Relative Humidity were estimated at 10 km2 grid cells. The endemic-epidemic spatio-temporal regression model for individual-level data was used to identify factors influencing SARS-CoV-2 spreading and its infectious rate. Rate ratios (RR) and 95% confidence intervals (CI) were calculated.

RESULTS: 10-years average exposure to PM10 was associated with an increased risk of new endemic (RR 1.14, 95%CI 1.04-1.24) and epidemic (RR 1.15, 95%CI 1.08-1.22) infectious. Male gender, older age, living in NH-LTCF and the worsening of DI increased RR in epidemic component. Lockdown increase the risk of becoming positive to Sars-Cov2 as concerning endemic while it reduces virus spreading in epidemic component. Increased temperature was associated with a reduction of endemic and epidemic infectious.

CONCLUSIONS: Results show an increment of RR for exposure to increased levels of PM10 both in endemic and epidemic components. Targeted interventions are necessary to improve air quality in most polluted areas to minimize the burden of endemic and epidemic COVID-19 disease and to reduce unequal distribution of health risk.

KEYWORDS: air polltuion, Sars-Cov2, infectious disease

P-0654 Changes in household use of disinfectant and cleaning products during the first lockdown period in France

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BACKGROUND: Since the beginning of the COVID-19 pandemic, health measures have been introduced to limit the risks of contamination, including recommendations for cleaning and disinfection of surfaces at home. The use of Household Disinfectant and Cleaning Products (HDCP) has only been evaluated during this pandemic from national poison centers or cross-sectional surveys, but has never been compared before and after its beginning based on longitudinal data from a large population-based cohort.
AIM: To study changes in the use of HDCP during the first lockdown period based on longitudinal data from the large French population-based Constances cohort.

METHODS: Analyses were carried on 49,491 participants (mean age: 47 years, 51% women, 13% current smoker) who completed standardized questionnaires on household cleaning tasks in 2019 and during the first lockdown period in France (17th March to 3rd May 2020). We compared the household help (yes/no) and the duration of weekly use of HDCP (<10 minutes/week; 10-30 minutes/week; >30 minutes/week) at these two surveys by a McNemar's and a Bhapkar test, respectively. Moreover, we assessed self-reported changes in the frequency of HDCP use specifically since the beginning of the lockdown period (unchanged/increased).

RESULTS: Compared to 2019, the household help decreased (56% versus 3%; p<0.0001) and the duration of HDCP use increased (>30 minutes:16% vs. 63%; p<0.0001) during the lockdown period, especially for women compared to men (>30 minutes:71% vs. 54%, respectively; p<0.0001). Regarding the frequency of HDCP use, 83% of participants (86% of women vs. 81% of men; p<0.0001) reported an increased use since the beginning of the lockdown period.

CONCLUSIONS: The frequency and the duration of HDCP use have significantly increased. Further studies are now needed to evaluate the potential impact of these changes in respiratory health.

KEYWORDS: Lockdown period, COVID-19, Household disinfectant and cleaning products

P-0657 A View at the COVID-19 Pandemic under the Light of Socio-economic Inequalities in Rio de Janeiro City, Brazil

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BACKGROUND AND AIM: Brazil was one of the countries most affected by COVID-19. The pandemic raises concerns about inequality in Rio de Janeiro city becoming clear that it will interact with dimensions such: age, gender, ethnicity and geography. This study aimed to analyze the association between socioeconomic inequalities with the greatest influence on hospitalization in Rio de Janeiro city/Br.

METHODS: The data were obtained from the SIVEP-Gripe database of the Health State Department, from January 2020 to January 2021. The descriptive analysis was conducted and stratified by socioeconomic variables and health conditions and to estimate the model a logistic regression was used in software R. The death cases due to other morbidities and hospital discharge were censored. for socioeconomic analysis, the Social Development Index of the neighborhoods was considered.

RESULTS: The number of notifications of severe positive cases was 42,781 (74.09%), which 53.81% were men and 46.18% were women. The median was 66 years and the highest number of notifications was above 80 years. Regarding race, 29.78% were white, 0.45% yellow, 0.05% indigenous, 34.77% black, 30.39% ignored. Concerning schooling, 1.03% had no schooling, 11.26% had Elementary and Middle School, 9.88% had High School, 5.68% had College, 47.03% had ignored and 3.04% had not applied. Respecting hospitalizations, there were 92.47% of the total number of severe cases. The spread of the disease occurred from more to less developed regions at the beginning and inverting this profile (2nd wave).

CONCLUSIONS: The results showed that gender is a factor that involves notifications. It was possible to observe an increase in hospitalizations and more serious outcomes along with increasing age and that men were more affected. It pointed out the disparities between ethnicities. In addition, one can understand a historical-social contexts that explain such socioeconomic profile and socio-spatial cases inequality.

KEYWORDS: Covid-19; Hospitalization; Inequalities.

P-0658 Greenness and adolescents ‘mental health after Covid-19 pandemic lockdown: longitudinal perspective

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BACKGROUND AND AIM: Scientific evidences suggest that green space exposure can provide mental health benefits. The aims of this study are 1) to compare pre and post pandemic adolescents ‘mental health after Covid-19 pandemic lockdown 2) to compare mental health as a function of distance to a green environment greater than 5,000m2.

METHODS: The study participants were mother-adolescent pairs from the INMA Project (Environment and Childhood) from Gipuzkoa cohort (N=135). Adolescents ‘mental health (SDQ) and Quality of life (Kidscreen-27) were measured at 11 years follow up (pre pandemic) and (post pandemic). The distance to major green space (>5,000m2) was divided into 2 categories; >=100m or less than 100m).The statistical analysis consisted of making a descriptive analysis of the scales at "pre" and "post" pandemic lockdown, as well as the difference in these scores. Mixed effects models were fit to assess whether there were statistically significant differences in the "pre" and "post" scales and to observe the possible association with the other variables.

RESULTS: Differences have been observed between pre and post pandemic lockdown measures of total SDQ (mean dif CI95% 1.61 (1, 2.23)) and Kidscreen-27 (mean dif CI95% (-2.86 (-4.84, -0.89)). Total problem difficulties (SDQ) increased when stress perception was higher and they reduced at higher physical activity. Psychological wellbeing was inversely correlated with stress perception and with time spent resting; and adolescents 'psychological wellbeing was better when their mothers worked. These negative association is stronger when the exposition to greenness is >100metres.

CONCLUSIONS: Worsening mental health and quality of life of adolescents has been observed after pandemic lockdown. Protective mental health factors during confinement were physical activity and having a green environment of more than 5,000m2 near the home (<100metres).

KEYWORDS: Covid-19, Mental health, Greenness, adolescence

P-0659 Effects of long-term air pollution exposure on Covid-19 vaccine antibody response and “long-COVID” in a general population cohort (Covicat Study, Catalonia)

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BACKGROUND/AIMS: Ambient air-pollution has been associated with COVID-19 disease, disease severity, and antibody response induced by infection. We examined the association between long-term exposure to air-pollution with vaccine-induced antibody response and with post-COVID-19 condition ("long COVID").

METHODS: We re-contacted 6,945 adult participants from a population-based cohort study in Catalonia in May-July 2021 who had been contacted pre-pandemic and in summer 2020. We drew blood samples in 2021 from 1,076 of 4,103 participants who had provided samples in 2020 and measured immunoglobulin (Ig)M, IgA, and IgG antibodies against five viral-target antigens including RBD (receptor-binding domain), S (spike-protein) and S2 (segment spike-protein) triggered by vaccines available in Spain. We estimated pre-pandemic (2018-2019) exposure to particulate matter (PM2.5) and nitrogen dioxide (NO2) at the residence using ELAPSE models. Long-COVID was defined as SARS-CoV2 infection and self-report of at least one symptom lasting for at least 4 weeks after 3 months from infection. Estimates were adjusted for individual- and area-level covariates, time since vaccination, vaccine doses, and type.

RESULTS: Among vaccinated persons not infected by SARS-CoV-2 (n=630), higher pre-pandemic air pollution levels were associated with lower vaccine antibody response. Percentage change in geometric mean IgG levels per interquartile range of PM2.5 (1.7µg/m3) were -8.2 (95%CI -16.0, 0.4) for RBD, -9.7 (-16.0, -2.8) for S and -8.4 (-13.5, -3.0) for S2. Corresponding changes for NO2 (IQR 10.6µg/m3) were -2.3 (-10.6, 6.6), -7.3 (-13.8, -0.4) and -6.9 (-12.0, -1.4). The relative risk of long COVID was 1.29 (1.00-1.66) for PM2.5, and 1.07 (0.84-1.37) for NO2.
DISCUSSION: Exposure to air pollution was associated with lower levels of COVID-19 vaccine antibody response and with a higher risk of long-COVID. Whether the effect on vaccine response affects protection against future breakthrough infections and disease severity, should be evaluated in a longer follow-up.

KEYWORDS: air pollution; covid-19; vaccines; immune-response; long-COVID

P-0660 Long-term exposure to ambient air pollution and COVID-19 fatality in Italy

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BACKGROUND AND AIM: After the outbreak of SARS-CoV-2 pandemic in 2019, there has been a fast proliferation of epidemiological studies linking ambient air pollution to COVID-19 incidence or adverse prognosis. However, the role of chronic exposure to air pollutants in increasing COVID-19 fatality is still unclear.

METHODS: From the national surveillance database, we selected all COVID-19 cases from February 2020 to June 2021. We developed an air pollution exposure model with 1-km2 resolution for Italy, and assigned 2016-2019 mean concentrations of particulate matter < 10 micron (PM10), PM < 2.5 micron (PM2.5) and nitrogen dioxide (NO2) to each municipality (n=7,800) as estimates of chronic exposures. We applied a principal component analysis and a generalized propensity score (GPS) approach to an extensive list of area-level covariates related to geography and topography, population density, mobility, population health, socio-economic status, and access to healthcare services. Finally, we applied generalized negative-binomial regression models matched on GPS, age, sex, province and month.

RESULTS: We analyzed 3,995,202 COVID-19 cases which generated 124,346 deaths. Case-fatality rates (CFR) increased by 0.7% (95% confidence intervals [CI]: 0.5%, 0.9%), 0.3% (95% CI: 0.2%, 0.5%) and 0.6% (95% CI: 0.5%, 0.8%) per 1 µg/m3 increment in PM2.5, PM10 and NO2, respectively. Associations were higher among elderly subjects, they did not differ by sex or pre-existing diseases, and were higher during the first (Feb. 2020 – June 2020) and the third (Dec. 2020- June 2021) pandemic waves. In two-pollutant models, NO2 estimates were robust to PM adjustment, while PM estimates became null after adjustment for NO2.

CONCLUSIONS: We found suggestive evidence of association between long-term exposure to ambient air pollutants with mortality among ~ 4 million COVID-19 cases in Italy, highlighting the role of chronic air pollution exposure on the vulnerability of the exposed population.

KEYWORDS:
Air pollution, COVID-19, generalized propensity score

P-0661 Socioenvironmental determinants of maternal mental health during the COVID-19 pandemic: the MOOD-COVID project

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BACKGROUND AND AIM: We aimed to study the socioenvironmental determinants of maternal mental health during the COVID-19 pandemic in Barcelona, for which there is limited evidence.

METHODS: We assessed 394 pregnant women or women with a recent delivery who had participated in the Barcelona Life Study Cohort (BiSC) before March 14th, 2020. Participants filled five online questionnaires during the lockdown period (March-June 2020) and one year after. We characterized the presence of balcony/garden, plants, amount of green space and frequency looking through windows, and social conditions at home, among others. We used the Perceived Stress Scale (short version) in all surveys. Hair cortisol was analyzed at the end of the lockdown. Depression and anxiety were assessed with the Symptom Checklist-90-Revised at the end of the lockdown and one year after. Pre-pandemic data on the urban environment and mental health was also available.

RESULTS: The mean (SD) age was 25.6 (4.4) years. Perceived stress, depression and anxiety were higher after than before the pandemic, but anxiety levels went back to normal one year after. Cortisol levels were lower at the end than before the lockdown. The lack of balcony/garden was associated with greater perceived stress at the beginning of the lockdown β=1.40 (95%CI=0.05; 2.76). Presence of plants and frequent view of green spaces through windows were non-significantly associated with less cortisol and less depression and anxiety, respectively, at the end of the lockdown. Economical insecurities, inadequate conflict resolution styles with partners and childcare inequities were also associated with perceived stress during the lockdown.

CONCLUSIONS: Preliminary results suggest that maternal mental health worsened during the pandemic, except for cortisol levels. Lack of green spaces, socioeconomical and family situations could influence maternal mental health during COVID-19.

KEYWORDS: Pregnant women, maternal stress, mental health, COVID-19.
FUNDING: AXA Research Fund grant; ERC-AdG-2017 (785994); HEI (4959-RFA17-1/18-1).

P-0662 Antibody response to COVID-19 vaccines among workers with a wide range of exposure to per- and polyfluoroalkyl substances

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are a broad class of synthetic chemicals; some are detectable in serum in most humans in developed countries. Several studies have shown associations between certain PFAS, such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS), and reduced antibody concentration after vaccination against diseases such as Tetanus. Recent studies have reported associations between COVID-19 occurrence and severity and exposure to PFAS. However, studies of antibody concentration after COVID-19 vaccination in relation to PFAS serum concentrations have not been reported. We examined COVID-19 antibody responses to vaccines and PFAS serum concentrations among employees and retirees from two 3M facilities, one of which historically manufactured PFAS including PFOS, PFOA, and perfluorohexane sulfonic acid (PFHxS).

METHODS: Participants completed enrollment and follow-up study visits in the spring of 2021, when vaccines were widely available. In total 418 participants with 761 observations were included in the repeated measures analysis. Log-transformed concentrations of anti-spike IgG and neutralizing antibodies were modeled in relation to concentration of PFAS at enrollment after adjusting for antigenic stimulus group (11 groups determined by COVID-19 history and number and type of vaccination) and other variables.

RESULTS: The fully adjusted IgG concentration was 3.57% lower (95% CI -7.17, 0.17) per interquartile range increase in PFOS (14.6 ng/mL); results for neutralizing antibody and PFOS were similar. for PFOA, PFHxS, and perfluorononanoic acid (PFNA), the results were comparable to those for PFOS, though of smaller magnitude.

CONCLUSIONS: In our study data, the fully adjusted coefficients relating concentration of vaccine-induced antibodies to COVID-19 and interquartile range difference in serum concentration of PFOS, PFOA, PFHxS, and PFNA were inverse but small with confidence intervals that included zero. The coefficients for these four PFAS was considerably affected by adjustment for antigenic stimulus group.

KEYWORDS: antibody response, COVID-19, polyfluoroalkyl, perfluoroalkyl substances

P-0663 SARS-CoV-2 antibody prevalence and COVID-19 vaccination among industrial livestock operation workers and nearby community residents, North Carolina, USA

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BACKGROUND AND AIM: Industrial livestock operations (ILOs), particularly livestock processing facilities, emerged as centers of COVID-19 outbreaks across the USA early in spring 2020. We aimed to compare SARS-CoV-2-specific IgG positivity and COVID-19 vaccination status among ILO workers and their household members, neighbors of ILOs, and community residents in metropolitan areas of North Carolina, USA.

METHODS: This work represents a preliminary analysis within an ongoing study in North Carolina, the 2nd leading hog and turkey and 5th leading broiler chicken producing state. We enrolled 62 of a planned 100 ILO households with at least one adult working at an industrial hog or poultry operation, meatpacking plant, or animal rendering plant, 79 of 100 ILO neighbor (ILON) households, living in close proximity to these facilities but without occupational livestock exposure, and 53 of 100 households in metropolitan areas (Raleigh, Durham, Wilmington) between February 2021 and April 2022 via snowball sampling. Participants responded to a questionnaire and provided a saliva swab sample, which we analyzed for SARS-CoV-2-specific IgG using a multiplex immunoassay.

RESULTS: The prevalence of baseline SARS-CoV-2 anti-nucleocapsid IgG, which suggests recent/past SARS-CoV-2 infection, was higher among participants in the ILO compared to participants in the metro (PR=1.7; 95% CI 1.1, 3.0) and ILON (PR=1.6; 95% CI 1.0, 2.4) groups. Similar proportions across groups reached the CDC definition of fully vaccinated (53% of 234 total participants). The ILO group reached full vaccination later (median date: 8/29/21) than the metro (median date: 4/30/21) and ILON (median date: 4/13/21) groups.

CONCLUSIONS: Antibody results show high rates of exposure to SARS-CoV-2, especially among ILO workers and their household members. Delays in the timing of receipt of COVID-19 vaccination reinforce the importance of dismantling vaccination barriers for ILO worker populations.

KEYWORDS: COVID-19, serology, animal confinement, meatpacking

P-0664 Prevalence and predictors of SARS-CoV-2 seropositivity among volunteer firefighters (October 2020 - August 2021)

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BACKGROUND AND AIM: First responders are at increased risk of SARS-CoV-2 infection (COVID-19). In the US, 67% of firefighters serve as volunteers, yet few studies have assessed COVID-19 prevalence and predictors within this occupational group. The aim of this cross-sectional study was to assess SARS-CoV-2 seropositivity in US volunteer firefighters enrolled in the Cancer Assessment and Prevention Study (CAPS), a research partner of the Fire Fighter Cancer Cohort Study (FFCCS).

METHODS: Between October 2020 and August 2021, 124 non-COVID-19 vaccinated firefighters from ten New Jersey (US) volunteer departments were tested for SARS-CoV-2 seropositivity (IgM and/or IgG). They were compared to seronegative firefighters by firefighting characteristics (# monthly calls; years of firefighting) and demographics (age, sex, education, marital status) using Fisher's exact and Wilcoxon's rank tests; associations were explored using multivariable logistic regression.

RESULTS: SARS-CoV-2 seroprevalence was 12.1% (n=15). Participants were predominately male (94.4%) and non-Hispanic White (86.3%). Compared to seronegative participants, seropositive participants responded to fewer monthly calls (median (IQR) 9 (7.0, 15.0) vs. 15 (10.0, 25.0)), were younger (median (IQR) 39.3 (24.2, 56.3) vs. 47.0 (34.5, 59.1) years), and a higher proportion were non-White and/or Hispanic (26.7% vs. 9.2%). In multivariable analysis, participants responding to fewer monthly calls had lower odds of SARS-CoV-2 seropositivity (OR 0.91; 95% CI: 0.84, 0.98), adjusting for age and years of firefighting.

CONCLUSIONS: There was a high seroprevalence of SARS-CoV-2 among this cohort of volunteer firefighters. The inverse association between median number of monthly firefighting calls was unexpected. Among firefighters who respond to more calls, this finding may be attributable to: better adherence to infection control measures; increased use of personal protective equipment (PPE); and/or exposure to COVID-19 at their primary occupation. The small number of cases means that these results should be interpreted with caution.

KEYWORDS: firefighter, SARS-CoV-2, cross-sectional, seroprevalence

P-0665 Association of Outdoor and Indoor Environment with Mental wellbeing of Lebanese Mothers during COVID-19: Findings from the Environmental Exposures for Lebanese Infants (EELI) Study

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BACKGROUND AND AIM: COVID-19 containment efforts in Lebanon included movement restrictions, social distancing, and quarantine measures that confined EELI study participants in their homes during their pregnancy and in the early months of their maternity. Household characteristics and proximity and access to green spaces can potentially support wellbeing and mental health. The aim of this study is to explore the associations between factors of the immediate natural and built environments and mental health outcomes in a population of new mothers in Lebanon during the ongoing COVID-19 pandemic.
METHODOLOGY:
Participants were recruited as part of the ongoing EELI birth cohort study from Hôtel-Dieu de France hospital in Beirut, Lebanon. Participants (n=100) provided informed consent and data on variables of interest included in this analysis. The current wellbeing of the participants was assessed using WHO Wellbeing Index [WHO-5], pregnancy-specic and COVID-19-specic stress scales. Chi-square tests are used to analyze household and natural environment characteristics against wellbeing and mental health outcomes. An exploratory qualitative component is also conducted to inquire about the environmental factors affecting maternal mental health and wellbeing in the context of the pandemic.
FOCUS AND IMPLICATIONS: With its longitudinal design and its launch during the COVID-19 pandemic, the EELI Study is uniquely poised to assess the links between the deteriorating natural and built environments and its impact on maternal mental wellbeing and potentially the development of infants in the long run. We hope to inform mitigation strategies and home-based and/or internet-based interventions to address the damage that the pandemic has had on the mental health of new mothers.

KEYWORDS: COVID-19, Wellbeing, Prenatal health, Indoor Environment, Natural environment, Mental health

P-0666 Relationship between meteorological and air quality parameters and COVID-19 in Casablanca region, Morocco

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BACKGROUND AND AIM: COVID-19 and its emerging variants is continuing to spread around the world. Environmental factors may play a role in the transmission of COVID-19. The aim of this study was to investigate the relationship between meteorological parameters, air quality and daily COVID-19 transmission in Morocco, using General Additive Models.

METHODS: We collected daily data of confirmed COVID-19 cases in the Casablanca region- Morocco, as well as meteorological parameters (average temperature, wind, relative humidity, precipitation, duration of insolation) and air quality parameters (CO, NO2, 03, SO2, PM10) during the period of March 2nd, 2020, to December 31st, 2020. The General Additive Model (GAM) was used to assess the impact of these parameters on daily cases of COVID-19.

RESULTS: A total of 172,746 confirmed cases were reported in the study period. Positive associations were observed between COVID-19 and wind above 20m/s and humidity above 80%. However, temperatures above 25° were negatively associated with daily cases of COVID-19. PM10 and O3 had a positive effect on the increase in the number of daily confirmed COVID-19 cases, while precipitation had a borderline effect below 25mm and a negative effect above this value.

CONCLUSIONS: The findings in this study suggest that significant associations exist between meteorological factors, air quality pollution (PM10) and the transmission of COVID-19. Our findings may help public health authorities better control the spread of COVID-19.

KEYWORDS: COVID-19; Air pollutants; Air Quality; Meteorological parameters; time-series analysis; Generalized additive model; Morocco

P-0667 New York on PAUSE and traffic-related air pollution: quantifying diurnal changes in NO2 due to COVID-19 stay-at-home orders

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BACKGROUND/AIM: Policy responses to the COVID-19 pandemic, including the NY on PAUSE stay-at-home order, substantially reduced traffic and traffic-related air pollution (TRAP) in New York City (NYC). We evaluated the magnitude of TRAP decreases and identified modifying factors such as weekend/weekday, road proximity, location, and time of day—important variables for planning future traffic interventions.

METHODS: Hourly nitrogen dioxide (NO_2) concentrations from 1/1/2018 through 6/8/2020 were obtained from the Environmental Protection Agency's Air Quality System for six monitors in the NYC area. We used an interrupted time series design to determine the impact of NY on PAUSE on NO_2, using a mixed effects model with random intercepts for monitor location, adjusted for meteorology and long-term trends. We evaluated effect modification by weekend/weekday, road proximity, and time of day in stratified models, and location by including random slopes for each monitor.

RESULTS: NO_2 concentrations decreased due to NY on PAUSE by -3.2 ppb (95% confidence interval [CI]: -3.5, -3.0), on average. We found no evidence for modification by weekend/weekday, but found greater decreases in NO_2 at non-roadside monitors. We found weak evidence for modification by location. for time of day, we found the largest decreases for 5 am (-4.5 ppb, 95% CI: -5.7, -3.3) through 7 am (-4.0 ppb, 95% CI: -5.2, -2.8), followed by 6 pm and 7 pm (-3.7 ppb, 95% CI: -4.8, -2.6 and -4.8, -2.5, respectively), while the smallest decreases occurred from 10 pm (-2.3 ppb, 95% CI: -3.5, -1.1) to 1am (-1.9 ppb, 95% CI: -3.1, -0.7).

CONCLUSIONS: NY on PAUSE's impact on TRAP varied greatly diurnally. for future large-scale traffic interventions, our findings suggest that blanket policies not targeting specific time windows will likely result in larger NO_2 decreases during rush hour windows.

KEYWORDS: nitrogen dioxide; traffic-related air pollution; pandemic; policy; New York City

P-0668 Impact of the COVID-19 pandemic on physical and mental health over time in relation to chronic disease status and urbanicity

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Both direct and indirect health effects of living in COVID-19 pandemic conditions have been reported. General measures taken to manage the pandemic may impact physical and mental health and probably disproportionately affect chronically diseased individuals. Residents of urban and rural areas may be differently affected as well. The aim of this study is to assess the impact of the COVID-19 pandemic and the measures to manage the outbreak on physical and mental health, and whether the impact on wellbeing differs according to chronic disease status and urbanicity.
Participants of three Dutch prospective cohorts (AMIGO, VGO and PIAMA; n=27,763) were invited. The VGO cohort is situated mainly in a rural region, while the other two cohorts are mixed in terms of urbanicity. Respondents (n=5,420) were asked to complete an online baseline questionnaire regarding health status, followed by monthly follow-up questionnaires between September 2020 and October 2021. Questions on physical and mental health were answered using 5-point Likert scores (PHS/MHS). Chronic disease status included asthma, chronic obstructive pulmonary disease (COPD), diabetes and cardiovascular disease. Cumulative link mixed models adjusted for age, sex and BMI, were used to analyze the longitudinal data.
Preliminary results show that participants from the more rural cohort reported better PHS (OR=0.59,95%CI=0.48-0.71) and MHS (0.54,95%CI=0.43-0.66) compared to participants from the mixed urban/rural cohorts. Asthma and COPD were associated with worse PHS (OR=2.41;95%CI=1.90-3.09). The same was found for diabetes (OR= 2.23;95%CI=1.53-3.24) and cardiovascular disease (OR=2.16,95%CI=1.68-2.76). Similar associations were found for MHS.

Results suggest that both urbanicity and chronic disease status are relevant factors to consider when assessing (indirect) health effects of the COVID-19 pandemic. Additional multivariable analyses including detailed urbanicity indicators and stringency of governmental measures over time will be performed enabling deeper understanding of individual drivers of these effects.

KEYWORDS: COVID-19, urbanicity, urban-rural, chronic disease

P-0669 Long-term exposure to air pollution and COVID-19 mortality and morbidity in Denmark (AIRCODEN)

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BACKGROUND: Evidence on long-term exposure to air pollution and morbidity and mortality from coronavirus disease (COVID-19) is still sparse and inconclusive. We examined the association between long-term exposure to air pollution and COVID-19 incidence, hospitalization, and mortality.

METHODS: 3,721,813 subjects who were 30 years or older and resided in Denmark on March 1st, 2020 were followed for first COVID-19 positive test (incidence)/hospitalization/death until April 26th, 2021. We assigned annual mean concentrations to residential addresses in 2019, including particulate matter with a diameter <2.5 µm (PM2.5), nitrogen dioxide (NO2), black carbon (BC), and ozone (O3) estimated using 1x1km DEHM/UBM model. We linked air pollution levels with COVID-19 outcomes using random-effect (frailty) Cox proportional hazard models, adjusting for age, sex, and individual-level socioeconomic status (SES) (income, housing, occupation, marital status) with cluster term for parish. Additional analyses with adjustment for parish-levels SES will be presented at ISEE2022.

RESULTS: During 411–417 follow-up days, 138,742 individuals got tested positive for COVID-19, 11,270 were admitted to a hospital, and 2,557 died from COVID-19. PM2.5, NO2 and BC, but not O3, were significantly associated with COVID-19 mortality with hazard ratios (HRs) and 95% confidence intervals of 1.18 (1.10-1.27) per 0.53 µg/m3 increase in PM2.5, 1.82 (1.64-2.03) per 3.59 µg/m3 increase in NO2, and 1.10 (1.05-1.14) per 0.09 µg/m3 increase in BC. Somewhat weaker associations were found for COVID-19 related hospitalizations, with HRs of 1.21 (1.17-1.26) for PM2.5, 1.70 (1.60-1.81) for NO2, and 1.09 (1.05-1.13) for BC, and weakest with COVID-19 incidence, with HRs of 1.18 (1.15-1.21) for PM2.5, 1.55 (1.49-1.62) for NO2, and 1.09 (1.05-1.13) for BC. HRs for all-cause mortality were 1.02 (1.01-1.03) for PM2.5, 1.04 (1.02-1.06) for NO2, and 1.02 (1.01-1.03) for BC.
CONCLUSION: Long-term exposure to air pollution was associated with COVID-19 related morbidity and mortality.

KEYWORDS: Air pollution, COVID-19, hospitalization, incidence, mortality

P-0672 Sars-CoV-2 viral load in wastewater and its association with ambient temperature in the Athens, Greece, area

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BACKGROUND: Measurements of SARS-CoV-2 viral load in wastewater represents an objective assessment of the viral load in a population as it does not suffer from selection bias. The objective of this study was to evaluate the role of ambient temperature in the spread of COVID-19 in the Athens by using data from the wastewater viral load.

METHODS: Data on the daily SARS-CoV-2 viral load (copies/100,000 inhabitants), ambient temperature, public health control measures for COVID -19 (as expressed by sector-specific mobility data) were obtained on a daily basis from 31 August 2020 to 14 October 2021. Distributed lag non-linear regression models were applied with log-transformed viral load as dependent variable. Separate lags were alternatively investigated. Twenty four hour temperature was used as main exposure, adjusting for mobility data and particulate matter pollution. Solar radiation and relative humidity were also used.

RESULTS: There was an indication of an association of higher ambient temperature with an increase in the viral load, which became apparent after 3 days but did not always reach the nominal level of statistical significance. The association with daily PM10 concentrations was also not statistically significant. However, a statistically significant positive association was observed between viral load and retail/ recreation mobility.

CONCLUSIONS: The variability of viral load in wastewater appears to be dominated by public health control measures resulting to changes in mobility and the mean number of contacts within the population. The role of ambient temperature is not clear. The potential effect of ambient temperature was probably modified by changes in virus transmissibility during the emergence of variants of concern dominating in different time periods. In our setting, statistical power may have been limited by the relatively short period of data availability.

KEYWORDS: COVID-19, wastewater viral load, ambient temperature

P-0673 Covid-19 in Workers of an environmental sanitation company: Overview of cases and impact of a Safety and Health Protocol in a unit with 7,000 Workers. 2020 to 2022

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Since March 11, 2020, the planet has been living with a major pandemic. Human behavior and the environment are different at this point. Deaths are countless. Workers in environmental sanitation services, such as water and sewage, are characterized as essential and need a special approach to COVID-19. In Brazil the impact was important. This work describes safety measures in a group of 7 thousand workers of the largest environmental sanitation company in Latin America.
OBJECTIVE: to describe the measures adopted for COVID-19 through the safety and health protocol. METHODOLOGY: Describes the participation of the occupational service in the construction and institution of an appropriate protocol in the period from April 2020 to April 2022, considering bibliographic survey, management discussions, discussion with workers and measures implemented on site, visits to the work safety team, guidelines and preventive health care.

RESULTS: A specific protocol was implemented with occupational service in all areas for 7,000 workers. Implementation of telework in several areas, redistribution of teams with external activities, around 1,500 technical visits were carried out, implementation of measures in the places, adaptation of work stations, specific medical examinations. CONCLUSION: The adoption of specific measures and protocols increased worker participation and the impact of COVID-19 on environmental sanitation workers.

KEYWORDS: COVID 19 - Workers - Environmental

P-0675 Mitigating Indoor Risk of Airborne Infections: the MIRAI project

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BACKGROUND AND AIM: The risk of infection from SARS-CoV-2 and other airborne diseases is known to be higher in indoor environment, also depending on personal (e.g. individual susceptibility, modality of exposure, viral load) and environmental (e.g. airflow, temperature, humidity) factors. Measurements of CO_2 indoors are often used as a proxy for air quality and recent evidence suggests that its monitoring can be helpful to identify poorly ventilated multi-occupancy spaces like offices and classrooms, thus possibly evaluating the risk of exposure to indoor airborne contaminants, including infectious agents. In addition, the recent availability of portable low-cost sensors has been suggested to be effective in the prevention of SARS-CoV-2 infection and other airborne diseases.

METHODS: In this project, we will use low-cost sensors for the evaluation of CO_2 levels using Non-Dispersive InfraRed method. We will assess CO_2 levels in high school and university in Modena, Norther Italy from March 2022 up to end of the year. Information factsheets will be placed along with the sensors with detailed information about the project aim and purpose, guidelines for adequate CO_2 monitoring and alert thresholds (800 and 1400 ppm) indicating the need to increase the ventilation (e.g. opening doors and windows). Calibration and quality control of the low-cost monitors will be also performed to ensure the reliability of the measurements.

RESULTS: AND

CONCLUSIONS: The monitoring campaign has started as planned and the environmental and health data collection is ongoing. Considering the recommendations to prevent SARS-CoV-2 in Italy still indicate to wear masks for both students and personnel as well as the lowering of pandemic spread, no positive cases have been identified within the monitored classrooms. Project results will be presented during the conference.
Funded by grant "FAR 2021 Mission Oriented-Linea FOMO".

KEYWORDS: SARS-CoV-2; indoor air quality; CO_2 monitoring; low-cost sensors; risk assessment; prevention.

P-0676 Investigating links between air pollution, COVID-19 and lower respiratory infectious diseases – A review

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BACKGROUND/AIM: Hundreds of air pollution and COVID-19 papers have been published in a short time varying widely in quality. The Greater London Authority commissioned a comprehensive overview of the most credible evidence for the links between air pollution and COVID-19 and other lung infections.

METHODS: Building on the Brunekreef et al (2021) review, a literature search was performed from November 2020 – May 2021, classifying the evidence by exposure, the potential mechanism and the health outcome. Studies on hospital admissions for lower respiratory infections were reviewed from 2011

RESULTS: Long-term exposure increased the risk of hospitalization in people already infected with COVID-19 in two good-quality cohort studies with individual data, perhaps due to respiratory and cardiovascular disease from air pollution increasing vulnerability to COVID-19 adverse outcomes. Mortality results were conflicting. Inconsistent results were found for long-term exposure and COVID-19 cases in ecological studies. Studies on short-term exposure were unclear and hard to evaluate.
Several studies demonstrated that inhaled pollutant increased expression of the ACE2 receptor and other host susceptibility genes in both alveolar epithelial cells and macrophages. Susceptibility to infection by SARS-CoV-2 can be inferred from these results but only one study used SARS-CoV-2 directly.
Several studies from 2011-2021 showed a link between air pollution and hospital admissions for lung infections although the studies were spread across different age groups and disease definitions.
Particulate matter does not appear to play any important part in transporting COVID-19 in the environment, as had been suggested by some earlier studies.

CONCLUSIONS: The publication of cohort studies with individual data in this time period is an important step forward. Results are suggestive for long-term exposure and hospital admissions for COVID-19 and some toxicological effects are plausible but further research will be necessary to strengthen these emerging findings.

KEYWORDS: Air pollution, COVID-19, lower respiratory infections.

P-0677 Associations of air pollution with COVID-19 test positivity, hospitalisations, and mortality: observational evidence from UK Biobank

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BACKGROUND AND AIM: Individual-level studies with adjustment for COVID-19 risk factors suggest a weak positive association of long-term air pollution exposure (particulate matter and nitrogen dioxide) with COVID-19 positive test, hospitalisation, and mortality. The evidence, however, remains limited and mechanisms remain unclear. We aimed to investigate these associations within UK Biobank, and to examine the role of underlying chronic disease as a potential mechanism.

METHODS: UK Biobank COVID-19 positive test results were ascertained via Public Health England and general practitioner record linkage, COVID-19 hospitalisations via Hospital Episode Statistics, and COVID-19 mortality via Office for National Statistics mortality records from March – December 2020. We used annual average outdoor air pollution from a 2010 land-use regression model at residential addresses within England of UK Biobank participants (n = 424,721) and obtained important COVID-19 risk factors from baseline UK Biobank questionnaire responses (2006-2010) and general practitioner record linkage. We used logistic regression models to assess associations of air pollution with COVID-19 outcomes after adjustment for relevant confounders and conducted multiple sensitivity analyses.

RESULTS: We found positive associations of fine particulate matter (PM2.5) and nitrogen dioxide (NO2) with COVID-19 positive test result after adjustment for confounders, with odds ratio of 1.06 (95% confidence intervals (CI) = 1.03, 1.09), and 1.06 (95% CI = 1.02, 1.09) per interquartile range increase, respectively. PM2.5 and NO2 were positively associated with COVID-19 hospitalisations and deaths in minimally adjusted models but not in fully adjusted models. No associations for PM10 were found. In analyses with additional adjustment for pre-existing chronic disease, effect estimates were not substantially attenuated, indicating that underlying chronic disease may not fully explain associations.
CONCLUSION: We found some evidence that long-term exposure to PM2.5 and NO2 was associated with a COVID-19 positive test, though not with COVID-19 hospitalisations or deaths.

KEYWORDS: PM2.5, NO2, coronavirus

P-0681 Multi-strain integrated modelling for COVID-19

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BACKGROUND AND AIM: Quantitative forecasting of the COVID-19 pandemic evolution has become complex, due to the multiple parameters that affect disease dynamics, including (a) non-pharmacological interventions (such as social distancing, extensive (self)-testing), (b) pharmacological interventions (vaccines and antivirals), (c) weather and climate (d) different transmissibility, disease severity and reinfection capacities of the various co-existing strains.

METHODS: A multi-modal computational tool (CORE: COVID Risk Evaluation model), able to assess the impact of all the parameters mentioned above, has been developed to evaluate the COVID-19 health risk. The tool has been applied in Greece, Italy and USA. Contact matrices among the various population groups, accounting for their sociodemographic profiles (i.e. age, occupation etc), as well as the impact of targeted social distancing measures have been developed using agent-based modelling.

RESULTS: The evolution of the COVID-19 dynamics for Greece since February 2020, and the long-term prediction till the end of 2022, considering risk management has been successfully described. The implementation of the omicron strain dynamics in early December in Greece was critical, because it allowed us to identify at a very early stage the already significant dispersion of this highly contagious strain and warn in a timely manner public authorities, as well as to identify the timing and the height of the pandemics peak. Similarly, an early warning was issued on the advent of omicron 2 in the end of February.

CONCLUSIONS: CORE has demonstrated its efficacy in capturing the pandemic dynamics and issuing early warnings in time to take health risk management measures. Currently natural and acquired immunity declines gradually and a high rate of re-infections related to omicron 2 is observed. Thus, a high rate of booster vaccination in adults, rapid completion of schoolchildren vaccination and indoor air disinfection in public spaces are needed to adequately contain the COVID-19 dispersion.

P-0682 Associations of greenspace, including private residential gardens, with COVID-19 laboratory-confirmed positive test, hospitalisation and mortality in UK Biobank

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BACKGROUND AND AIM: Inequities in access to urban greenspace, such as gardens and parks, were highlighted by the COVID-19 pandemic, which underscored greenspace's utility for exercising and socialising. Initially, ecological studies suggested a protective association of greenspace with COVID-19 outcomes. The evidence, however, remains limited and lacking adequate adjustment for COVID-19 risk factors. We aimed to investigate associations of greenspace with COVID-19 positive test, hospitalisation and mortality using the UK Biobank cohort study.

METHODS: COVID-19 positive laboratory-confirmed test results, hospitalisations, and deaths were ascertained via UK Biobank linkage to Public Health England and general practitioner records, Hospital Episode Statistics and Office for National Statistics death records, from March – December 2020. We used Ordnance Survey Greenspace, categorised by function (e.g., private garden, public park, etc.), to assess greenspace in a 100 m distance buffer around residential addresses of UK Biobank participants who resided in urban areas of England (n = 276,805). We used logistic regression models to assess associations of greenspace with COVID-19 outcomes with adjustment for relevant COVID-19 risk factors and confounders, ascertained from baseline UK Biobank questionnaire responses (2006-2010) and general practitioner record linkage, and conducted multiple sensitivity analyses.

RESULTS: In age and sex-adjusted models, we found negative associations with all COVID-19 outcomes, however, in fully-adjusted models, associations were not significant. Unexpectedly, in fully-adjusted models, we found that both total greenspace (all types) cover and private residential garden cover within 100 m of addresses were positively associated with positive COVID-19 test (odds ratio (OR) 1.04 (95% confidence intervals (CI) = 1.01, 1.07); OR 1.08 (95% CI = 1.04, 1.13), respectively).
CONCLUSION: We found no evidence that greenspace was associated with COVID-19 hospitalisation or mortality in fully-adjusted models. Results suggest higher COVID-19 positive test result for those residing at addresses surrounded by higher total greenspace and private garden cover.

P-0686 Assessing COVID-19 Outcomes Among People Living Near Oil and Gas Wells in California

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BACKGROUND AND AIM: Researchers have identified associations between COVID-19 outcomes and environmental stressors such as ambient air pollutants including fine particulate matter (PM2.5). Prior studies have found that operating oil and gas wells are associated with higher PM2.5 emissions, placing the estimated 17.6 million USA residents near wells (<1.6 kilometer) at risk of exposure. In this study, we assessed whether exposure to oil and gas production was associated with higher rates of COVID-19 infection and COVID-related death.
METHODS: We conducted a population-based ecological study in California using census block groups, which include 600-3000 people. We obtained geocoded data on COVID-19 cases and deaths between February 2020 and January 2021 from state records. We then assessed exposure to cumulative oil and gas production, reported as barrels of oil equivalent from 2018 to 2020 at all wells within 1 km of populated areas of each block group. We fit hierarchical random intercept Poisson and negative binomial models adjusting for individual age and sex and area rurality and sociodemographic characteristics, and with clustering at the census tract level. We included an interaction with time period, to account for variation in testing and reporting rates.
RESULTS: In the first 4 months of the study period (Feb-May 2020), block groups in the highest tertile of production exposure had higher rates of infection (IRR 1.36, 95% CI: 1.22, 1.52) and death (MRR 1.57, 95% CI 1.18, 2.07) than(s unexposed block groups. Over the entire study period, the cumulative rates were 1.01 (IRR 95% CI: 0.95, 1.06) and 1.15 (MRR 95% CI: 1.00, 1.32) respectively.
CONCLUSIONS: In adjusted models, we observed a positive association between residential proximity to high oil and gas well production levels and risk of COVID-19 infection and mortality in the first months of the pandemic.

KEYWORDS: Oil, Gas, Wells, COVID-19, Air Pollution

THEMATIC 13: Exposure assessment

P-0817 Within-city variation in ambient carbon monoxide concentrations: Leveraging low-cost monitors in a spatiotemporal modeling framework

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Exposure to ambient carbon monoxide (CO) may be associated with cardiovascular disease outcomes based on human and animal experimental evidence, but current epidemiologic research is limited. The number and distribution of ground-level regulatory agency monitors are insufficient to characterize potential fine-scale variation of CO. This study aimed to develop a high-resolution ambient CO prediction model at the daily scale based on both regulatory agency monitoring data and measurements from calibrated low-cost gas monitors in Baltimore, Maryland. We also evaluated the contribution of three novel parameters to model performance, including high-resolution meteorological data, satellite remote sensing data, and co-pollutant concentrations (PM2.5, NO2, and NOx). The CO model had spatial cross-validation (CV) R^2 (RMSE) of 0.70 (0.02 parts per million, ppm) and temporal CV R^2 (RMSE) of 0.61 (0.04 ppm). The predictions revealed spatially resolved CO hotspots associated with population, traffic, and other non-road emission sources (e.g., railroads and airport), as well as sharp concentration decreases within short distances from primary roads. The three novel parameters did not substantially improve model performance, suggesting that our spatiotemporal modeling framework based on geographic features was reliable and robust. As low-cost monitors become increasingly available, this approach to CO concentration modeling can be generalized to resource-restricted environments to facilitate comprehensive epidemiologic research.

P-0821 Solar and Geomagnetic Activity Enhance the Effects of Air Pollutants on Atrial Fibrillation

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Cardiac arrhythmias have been associated with intense solar and geomagnetic activity (SGA) and exposures to air pollution.We examined whether oscillations of SGA can modify the effect of hourly exposures to air pollutants on atrial fibrillation ≥30 seconds (AF) risk in patients with dual chamber implantable cardioverter defibrillators (ICD). The effects of SGA on ambient particulate matter <2.5 µm (PM2.5), black carbon (BC), ultrafine particles (PN), and associations with AF were assessed. Measures of SGA included solar wind proton density (SW), total interplanetary magnetic field strength (IMF), and Kp index, a measure of global geomagnetic activity. Over all time lags between 0 and 24hr, periods of increased SGA (>50th percentile in SGA) enhanced the effects of all three air pollutants on AF, while during periods of reduced SGA the associations were considerably weaker or absent. During periods of intense SW 6 hours prior to an AF event, the odds ratio (OR) for PM2.5 exposure per IQR of 5.6 µg/m3 was 1.7 (95% CI: 1.3 to 2.3, p-value: 0.0001). for periods of reduced SW, the OR for PM2.5 exposure per IQR was 1.2 (95% CI: 0.9 to 1.5; p-value: 0.27). There were similar effects for PN and BC exposures. In patients with multiple AF events per hour, the associations with air pollutants during intense SGA were even greater. The effects of air pollutants up to 24 h before AF events were enhanced during periods of increased SGA. Our results suggest that these effects may account for variation in AF risk.

P-0825 Occurrence and spread of antibiotic−resistant enterococci in pork processing plants

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BACKGROUND AND AIM: Enterococci can form biofilms resistant to disinfectants. Moreover, due to their resistance to antibiotics, Enterococcus faecium and E. faecalis species are recognized as leading causes of infections worldwide. Detection of their reservoirs requires special attention not only in the context of food safety but also regarding the health of workers in meat processing plants. The aim of this study was to assess the prevalence of antibiotic−resistant enterococci in pork processing plants and to evaluate their biofilm-forming potential.
METHODS: In three pork processing plants, the samples of raw meat, swabs from work surfaces (tabletops, floors, machine parts, tools) and from employees' hands were collected. Bacteria were identified to species level using both the culture method and MALDI-TOF MS. The predominant enterococci were tested for susceptibility to 15 antibiotics by disc diffusion method. The assessment of biofilm-forming potential was studied by the microplate method.
RESULTS: The performed analyses indicate that all raw meat samples, plant surfaces and equipment were contaminated with enterococci. The highest level of enterococci was observed for floors, stainless tables and containers ($5.7*10^3$, $8.5*10^1$ and $13.5*10^1$ cfu/cm^2, respectively). Enterococcus faecium was the most frequently isolated species followed by E. faecalis. More than 63% of enterococci isolates had the ability to form a biofilm. E. faecium and E. faecalis isolates showed high resistance to penicillin (89%), vancomycin (71%), cefotaxime (68%), erythromycin (57%), rifampicin (56%) and imipenem (21%).
CONCLUSIONS: Resistance to several antibiotics and high adherence ability of enterococci isolates suggest that these agents may play an important role in the spread of drug resistance in the meat production chain through contaminated surfaces, raw meat and workers' hands. Controlling the contamination and antimicrobial resistance patterns of enterococci in meat processing plants is essential to public health and food safety.

KEYWORDS:
Enterococcus; pork processing plants; antimicrobial resistance; VRE

P-0828 A validated analytical method for biomonitoring the mycotoxins exposure in urine

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BACKGROUND AND AIM: Mycotoxin exposure from food may produce adverse effects in human health. Most mycotoxins are excreted in urine, but a reliable detection method is required considering the low levels present in this biological matrix. The aim of this work is to validate an analytical method for detecting and quantifying in urine different mycotoxins usually present in the food chain.
METHODS: HPLC-QTOF-MS method was used. The targeted mycotoxins were: Enniatin A (ENNA), Enniatin B (ENNB), Enniatin A1 (ENNA1), Enniatin B1 (ENNB1), Beauvericine, Aflatoxin B1 (AFB1), Aflatoxin B2 (AFB2), Aflatoxin G1 (AFG1), Aflatoxin G2 (AFG2) and Ochratoxin A. Different extraction procedures, liquid-liquid extraction, dilute and shoot, and Quick, Easy, Cheap, Effective, Rugged and Save (QuEChERS) methods were assessed followed by HPLC-QTOF-MS and different combinations of solvent extraction and mobile phases were tested. QuEChERS extraction was selected because better recoveries were achieved (>70%) for all mycotoxins. The method was applied to be validated in 150 samples of urine of women participating in the INMA (Environment and Childhood) Spanish project.

RESULTS: For all mycotoxins, matrix-matched calibration curves showed values of regression determination coefficients ranging from 0.998 to 0.999. The LOD and LOQ values ranged from 0.1 to 5.0 ng/ml and from 0.3 to 15.0 ng/ml, respectively. Assessed mycotoxins were detected in the 95% of samples and 8 out of 10 of them were quantified. Mostly quantified mycotoxins were: ENNB [% of detection (concentration range)] = 94% (0.54 – 2.83 ng/ml), ENNA = 47%, (0.30 – 0.68 ng/ml), ENNB1 = 35% (0.45 – 0.89 ng/ml), and AFB2 (18% (0.51 – 8.97 ng/ml).
CONCLUSIONS: The proposed analytical method quantified 8 out of 10 assessed mycotoxins (ENNA, ENNB, ENNA1, ENNB1, AFB1, AFB2, AFG1 and AFG2). These results support the methodology and provide a tool for identifying exposures in susceptible populations.

KEYWORDS:
biomonitoring, mycotoxins, urine

P-0829 Influence of genetic polymorphisms on arsenic methylation efficiency during pregnancy

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BACKGROUND AND AIM: Inorganic arsenic (iAs) is a widespread toxic metalloid. It is well-known that iAs methylation and toxicity is mediated by polymorphisms in AS3MT. Evidence on the role of genetic polymorphisms in this and other genes during pregnancy is more limited. We aimed at examining the role of genetic polymorphisms in AS3MT, GSTO2, N6AMT1, MTHFR, MTR, FTCD, CBS and FOLH1 on iAs methylation efficiency (AME) during pregnancy.

METHODS: The study included 541 pregnant women of the INMA (Environment and Childhood) Spanish cohort. Arsenic (iAs and the metabolites monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA)) were measured in urine samples collected during the first trimester of pregnancy, and the AME was determined by measuring the relative concentrations of the arsenic metabolites in urine. Single nucleotide polymorphisms (SNPs) in AS3MT, GSTO2, N6AMT1, MTHFR, MTR, FTCD, CBS and FOLH1 were determined in blood. Socio-demographic and dietary information was collected through questionnaires. The associations between genotypes and AME were assessed by using multivariate linear regression adjusted by confounding variables.

RESULTS: The median total urinary iAs concentrations (sum of MMA, DMA and iAs) was 7.1 µg/g of creatinine. The median %MMA and %DMA were 5.3%, and 89%, respectively. Four AS3MT SNPs (rs3740393, rs3740390, rs11191453 and rs11191454) were significantly associated with %MMA, %iAs and %DMA after adjustment for confounders. Statistically significant associations were also found for FOLH1 SNP rs202676 (β 0.89, 95%CI: 0.24, 1.55 for carriers of the G-allele vs. carriers of the A-allele).

CONCLUSIONS: Our study shows that genetic polymorphisms in AS3MT influence the arsenic methylation efficiency even in early pregnancy. FOLH1 seems to also play a role in arsenic methylation efficiency. These results provide support for the hypothesis that iAs metabolism is influenced by some polymorphisms, being a key element for identifying susceptible populations to As exposure.

KEYWORDS: Arsenic; single nucleotide polymorphisms; pregnancy.

P-0830 The Role of Solar Activity in Endothelial Activation and Inflammation in the NAS Cohort

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BACKGROUND AND AIM: Solar activity, which induces disturbances of the Earth's magnetic field, periodically oscillates between minimum and maximum sunspot activity in cycles of approximately 11-years. Exposure to broad-spectrum electromagnetic solar activity can adversely affect human physiology, leading to adverse health outcomes. Recent epidemiological studies have shown that solar and geomagnetic activity are associated with chronic diseases, including cardiovascular diseases (CVD). However, the impact of solar activity on biomarkers for CVD, including biomarkers for endothelial function and inflammation in a large cohort, has not been previously studied. This study investigated the associations between solar and geomagnetic activity and circulating biomarkers of systemic inflammation and endothelial activation in the Normative Aging Study (NAS) cohort.

METHODS: Mixed effects models with moving day averages from day 0 to day 28 were used to study the associations between solar activity [sunspot number (SSN) and interplanetary magnetic field (IMF)], geomagnetic activity [planetary K index (Kp index)] and various inflammatory and endothelial markers. Biomarkers included intracellular adhesion molecule-1 (sICAM-1), vascular cell adhesion molecule-1 (sVCAM-1), C-reactive protein (CRP), and fibrinogen.

RESULTS: After adjusting for demographic and meteorological variables, we observed significantly positive associations between sICAM-1 and sVCAM-1 concentrations and solar and geomagnetic activity parameters: IMF, SSN, and Kp index. Additionally, a negative association was observed between fibrinogen and Kp index and a positive association was observed for CRP and SSN.
CONCLUSION: These results demonstrate that solar and geomagnetic activity might be upregulating endothelial activation and inflammation.

KEYWORDS: Endothelial Activation, Inflammation, Solar Activity, Geomagnetic Activity, Geomagnetic Disturbance

P-0832 Creating an ontology of environmental exposure that captures the main components of epidemiological research papers

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BACKGROUND AND AIM: Environmental exposure is a central concept of the health and behavioral sciences needed to study the influence of the environment on the health and behavior of people within a spatial context. While numerous studies measure some form of exposure, including the influence of air quality, noise, crime, the built environment, and fast food outlets in neighborhoods, we lack a common conceptual model of environmental exposure that captures its main components across all this variety. In this article we propose an ontology design pattern that can be used for this purpose.
METHODS: To develop the pattern, we encoded the content of six scientific articles that each study a different urban environmental health issue. The ontology pattern specifies causal relations between concepts including persons, activities, exposures, environments and health risks on a conceptual level. On this basis, central notions like environmental stressors and active and passive exposure could be defined in Description Logic (DL) and automatically inferred from the content of a paper. Concepts were linked with data models and modelling methods used in a study in RDF. To test our pattern, we ask competency questions about main study characteristics and translate them to SPARQL queries over RDF content.
RESULTS: Results summarize epidemiological approaches, exposure concepts, findings, modelling methods, and data used for research in a transparent manner.

CONCLUSIONS: This ontology systematically distinguishes different methodological approaches. This not only helps us better understand and articulate methodological differences (and thus variations and validity of methods) in past studies, but also shows us the potential to better link the content of the vast amount of scientific publications on this topic regarding methods and data in a clear and systematic way.

KEYWORDS:
ontology, epidemiology, Python, RDF, health, GIS, computer science

P-0833 Assessing unconventional oil and gas exposure in the Appalachian Basin: Comparison of exposure surrogates and drinking water measurements in Ohio and Pennsylvania

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BACKGROUND/AIM: Epidemiologic studies have reported associations between residential proximity to unconventional oil and gas (UOG) development and adverse health outcomes. Proximity-based metrics are useful for retrospectively assessing aggregate exposures in large-scale studies, but do not provide information about specific exposures. We compared drinking water measurements of UOG-related chemicals to commonly-used proximity metrics and a newly-developed, groundwater-specific metric to advance understanding of exposure pathways.

METHODS: We compared UOG metrics with detection frequencies/concentrations of 64 organic and inorganic UOG-related chemicals/groups in residential groundwater from 255 homes (Ohio n=161, Pennsylvania n=94). Metrics included UOG well count within a buffer around the home, distance to nearest UOG well, inverse distance weighted (IDW) and ID-squared weighted (ID2W) well counts, and a water flow path-based metric (IDups: the inverse distance to the nearest UOG well upgradient of the residential groundwater source).

RESULTS: Twenty-seven chemicals were detected in ≥20% of water samples at concentrations generally below health-based standards. In Ohio, the odds of detecting toluene unexpectedly increased with increasing distance to nearest well (Odds Ratio [OR]: 1.48, 95% Confidence Interval [CI]: 1.12-1.95). In Pennsylvania, two organic chemicals/groups had reduced odds of detection with increasing distance to nearest well: 1,2-dichloroethene and benzene (OR: 0.46, 95%CI: 0.23-0.93) and m-and p-xylene (OR: 0.28, 95%CI: 0.10-0.80). Results were consistent across metrics. Correlations between inorganics and metrics were limited in both states (all $|\rho| \leq 0.28$).

CONCLUSIONS: Limited associations between metrics and UOG-related chemicals may indicate that water contamination by UOG occurs with low frequency/episodically, yielding temporal misalignments between measurements and metrics, chemical concentrations may reflect natural or other industrial sources, particularly for inorganics, more complex groundwater metrics may be needed to accurately capture drinking water exposure, and/or spatial metrics in health studies may be better reflecting exposure to other stressors or combinations of stressors.

KEYWORDS: Unconventional oil/gas, spatial metrics, drinking water, exposure assessment

P-0834 Predicting fine-scale daily NO_2 over Mexico City using an ensemble modeling approach

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BACKGROUND AND AIM: In recent years, there has been growing interest in developing air pollution prediction models to reduce exposure measurement error in epidemiologic studies. However, efforts for localized, fine-scale prediction models have been predominantly focused in the USA and Europe, with substantially less work conducted in low- and middle-income countries. Furthermore, the availability of new satellite instruments such as the TROPOspheric Monitoring Instrument (TROPOMI) provides novel opportunities for modeling efforts.

METHODS: We estimate daily ground-level nitrogen dioxide (NO_2) concentrations in the Mexico City Metropolitan Area at 1-km² grids from 2005 to 2019 using a multi-stage approach. In stage 1, we impute missing satellite NO_2 column measurements from the Ozone Monitoring Instrument (OMI) and TROPOMI using the random forest (RF) approach based on estimates from atmospheric ensemble models. In stage 2, we calibrate the association of column NO_2 to ground-level NO_2 using ground monitors and meteorological features using linear mixed-effects (LME) and RF models. In stage 3, we predict the stage 2 model over each 1-km² grid in our study area, then ensemble the results using a generalized additive model (GAM). In stage 4, we used RF to model the local component at the 200-m² scale by explaining the residual between predicted NO_2 from stage 3 and measured NO_2 at the monitoring stations.

RESULTS: The cross-validated R^2 of the LME and RF models in stage 2 were 0.69 and 0.75 respectively, and 0.83 for the ensembled GAM. Cross-validated root-mean-squared prediction error (RMSPE) of the GAM was 4.41 μg/m³. The RF model in stage 4 further explained on average 54% of the variation in the residual NO_2 concentrations.

CONCLUSIONS: Using novel approaches and newly available remote sensing data, our multi-stage model presented high cross-validated fits and reconstructs fine-scale NO_2 estimates for further epidemiologic studies in Mexico City.

P-0835 Horizon Shielding Factor: A Measure to Assess UV Exposure in Different Microenvironments

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BACKGROUND AND AIM: Skin cancer incidence rates have increased over recent decades worldwide. Ultraviolet radiation (UVR) is one of the main causes of skin cancer, as it induces mutations resulting from epidermal DNA damage. Exposure of people to UVR varies a lot depending on different factors such as the location of an individual. Additionally, UVR exposure can, for example, be lower due to shading effects. Being able to precisely measure UV exposure with a high repeatability on an individual level and to assess which microenvironments successfully reduce UV-exposure is, therefore, of high importance.

METHODS: In this analysis, we evaluated wearables at different body positions measuring ultraviolet radiation when worn during daily activities at different locations. First, we analyzed which of the body positions provide the most robust measurements. We then showed, that the measurements from the optimal body position can be used to infer the measurements taken at other positions. Using this optimal position, we devised a new measure, the horizon shielding factor, to evaluate the effect of horizon shielding. To explore if high/low horizon shielding factor values coincide with particular geospatial attributes, we inspected those values in their microenvironment on open street maps and found homogenous results per microenvironment.

CONCLUSIONS: The horizon shielding factor that has been developed in this project can be used to assess which microenvironments successfully reduce UV-exposure. It can be used in the future to find routes of transportation with less UV exposure due to horizon shielding. Systematic mapping of the horizon shielding factor in a given region may help policy makers and developers of new infrastructural projects to succeed in meeting the goals set by e.g. the National Climate Adaptation Strategy.

KEYWORDS:

- Ultraviolet radiation exposure
- Exposure assessment in microenvironments
- Horizon Shielding

P-0837 Coordinated Program of Research on Multi-Pathway Community Exposures Associated with Unconventional Oil and Gas Development

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BACKGROUND AND AIM: People can be exposed to chemical agents (e.g., benzene) and non-chemical agents (e.g., noise, light, and vibration) released from unconventional oil and gas development (UOGD). Important knowledge gaps limit our understanding of the temporal and spatial variability of these exposures, as well as the UOGD processes leading to potential exposures. We aim to describe a new coordinated program of research funded by HEI Energy that will investigate potential exposure pathways between UOGD releases of noise and chemicals to air and water and people in communities affected by this development in major oil- and natural gas-producing regions of the USA.

METHODS: Three research teams from different institutions are collaborating to: 1) develop and evaluate a novel combined emissions and dispersion model (Tracking Community Exposures and Releases from UOGD [TraCER] model) that can be used for future UOGD emissions and exposure research nationally, and 2) conduct air quality and noise monitoring to improve understanding of potential acute and chronic human exposures and to evaluate the model in Colorado and Texas. Research teams assessing water-related exposures are combining existing data with machine learning and fate and transport models to evaluate exposure pathways between UOGD processes and water sources in Colorado, New Mexico, and Pennsylvania. The research will involve meaningful engagement with stakeholders in the study locations.

RESULTS: HEI Energy's coordinated program of research and stakeholder engagement will provide critical information to support decision making about how best to protect human health. It will produce publicly available data for use in future UOGD health studies and accountability research, as well as models and frameworks, that can be applied to any region in the USA, to connect specific UOGD processes to potential exposures to noise and chemicals in air and water.

P-0838 A large-scale personal monitoring of air pollution during pregnancy in the BiSC cohort

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BACKGROUND AND AIM: Large-scale monitoring of personal exposure to air pollution remains scarce, especially for pregnant women. We present the results of one of the largest monitoring campaigns of personal, home-indoor, and home-outdoor air pollution on pregnant women.

METHODS: The Barcelona Life Study Cohort (BiSC) is an ongoing cohort of 1086 mother-child pairs in Barcelona, Spain (2018 onwards). We monitored personal exposure to particulate matter ≤ 2.5 µm (PM2.5; filter samples for chemical characterisation), Black Carbon (BC; MicroAeth AE51), and personal, home indoor and outdoor nitrogen dioxide (NO2; Gradko passive tubes) at first (week 12, w12) and third trimester (w32) of pregnancy. The Covid pandemic forced us to stop data collection on PM2.5 and BC.

RESULTS: Weekly averaged concentrations (for both w12 and w32) for NO2 were 28.5 ± 12.0, 24.2 ± 11.7, and 38.9 ± 15.8 µg/m3 for personal exposure (N = 1680), indoors (N = 1685) and outdoors (N = 1570), respectively. Personal 48h average concentration was 21.0 ± 15.7 µg/m3 for PM2.5 (N = 498) and 1.63 ± 0.78 µg/m3 for BC (N = 374). Compared to current WHO 24-h outdoor air quality guidelines, 55.5% of PM2.5 samples and 89 % (outdoor) and 58.6% (personal) NO2 samples were above the recommendations (15 and 25 µg/m3, respectively). Correlations were higher between personal and indoor NO2 (spearman coefficient, r, >0.74) than between personal and outdoor (r <0.42) in both w12 and w32, due to a larger time spent at home (indoors). Moderate correlations between indoor and outdoor NO2 may be explained by potential indoor sources and indoor consumption of NO2 in gas-phase reactions.

CONCLUSIONS: BiSC is one of the largest studies on air pollution exposure measurements on pregnant women. Participants were exposed to a wide range of air pollutants' concentrations.

KEYWORDS: Pregnant women, Personal exposure assessment, Air Pollution

P-0840 High Resolution and Spatiotemporal Place-Based Computable Exposures at Scale

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BACKGROUND AND AIM: Place-based exposures, termed “geomarkers”, are powerful determinants of health, but are often understudied because of a lack of open data and integration tools. Existing DeGAUSS (Decentralized Geomarker Assessment for Mulitsite Studies) software has been successfully implemented in multi-site studies, ensuring reproducibility and protection of health information. However, DeGAUSS relies on transporting geomarker data, which is not feasible for high resolution spatiotemporal data too large to store locally or download over the internet. We aimed to expand the DeGAUSS framework for high resolution spatiotemporal geomarkers.

METHODS: In our approach, dates are coarsened to year and geographic coordinates are up-scaled to safe harbor geohashes, gridded locations with at least 20,000 residents created to adhere to legal privacy guidelines. The safe harbor geohashes are used to download appropriate subsets of exposure estimates from an online repository. Finally, exposure assessment is completed locally using exact date and location. We implemented this approach by curating spatiotemporal data by safe harbor geohash and year and developing an R software package to query the online database. We also developed a DeGAUSS container that wraps this functionality into portable software.

RESULTS: Two free and open source DeGAUSS containers for estimation of high resolution, daily ambient air pollutants were created. We compared the DeGAUSS approach to traditional ArcGIS and manual linkage methods using 5,000 locations and found >99% agreement. Further, DeGAUSS was implemented within the Environmental influences on Child Health Outcomes (ECHO) cohorts to estimate ambient air pollution for 17,587 study participants across 53 cohorts, representing 1,590,931 person-months of follow up time.

CONCLUSIONS: We developed a DeGAUSS approach that makes high resolution spatiotemporal datasets findable, accessible, interoperable, and reusable (FAIR). Further, we transformed a published exposure assessment model into a computable exposure for geomarker assessment at scale.

P-0842 Personal exposure to black carbon in Stockholm, Sweden, compared to fixed-site monitoring and dispersion modelling

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INTRODUCTION AND AIM: Short-term studies of health effects from ambient air pollution usually rely on fixed site monitoring data or spatio-temporal models for exposure characterization, but the relation to personal exposure is often not known. We aimed to explore this relation for black carbon (BC) in central Stockholm.

METHODS: Families (n=36) with an infant, one parent working and one parent on leave, agreed to perform personal measurements of BC for the parents, with battery-operated aethalometers for 7 days. Routine monitoring data were from rural background (RB) and urban background (UB). Outdoor levels at home and work were estimated in 24h periods by dispersion modelling with real-time meteorological data. Global radiation, air pressure, precipitation, temperature, and wind speed data were achieved from an urban background station. All families lived within 4 km from the city center.

RESULTS: The average level of 24h personal BC was 370 (s.d. 200) ng/m3 for parents on leave, and 357 (s.d. 175) ng/m3 for working parents. The corresponding fixed-site monitoring observations were 148 (s.d. 139) at RB and 317 (s.d. 149) at UB. Modelled BC at home and at work were 493 (s.d. 228) and 331 (s.d. 173) ng/m3, respectively. UB, RB and air pressure explained only 21% of personal 24h BC variability for parents on leave and 25% for working parents. Modelled home BC and air pressure explained 23% of personal BC, and adding modelled BC at work increased the explanation to 34% for the working parents.
CONCLUSION: Both routine monitoring and modeled data explained less than 35% of variability in personal 24h observations of BC exposure. Any associated short-term health effects are likely to be underestimated in studies using such exposure data.

KEYWORDS: Black carbon, Personal exposure, Dispersion modelling

P-0845 Using mobile monitoring to map air pollution: A practical review

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BACKGROUND AND AIM: Mobile platforms can capture the hyperlocal variation of air pollutants in a complex urban terrain, in a limited time, and with a limited number of (costly) high-resolution monitoring devices, but limited temporal coverage per location. In this practical review, we focus on the applicability of mobile monitoring to develop air pollution maps for use in epidemiological studies.

METHODS: We assessed a wide range of mobile monitoring studies and summarize findings and conclusions, focusing on the critical design issues. We highlight the trade-off between the temporal and spatial variability, as well as differences between pollutants. We specifically assessed spatial coverage, number of streets and repeats per street, on-road versus of-road measurements, need for a reference site and statistical modeling options.

RESULTS: Robust mobile LUR models can be made with about 10% of the streets in the domain and limited (or no) repeats. Street segments with similar characteristics serve as pseudo repeats, meaning LUR models can be developed based on street segments with mobile measurements only measured once, if there is enough spatial and temporal coverage by including all spatial characteristics of the domain and measure during different parts of the day, days of the week and season. This also means that there is no critical need to temporally correct all measurements. To retain the local variation as much as possible, it is advised to keep the spatial resolution as low as possible (< 200m). It is possible to add data-only mapping on top of a LUR model in a mixed-model framework. Here, a LUR model is used to create a base map, and with more measurements more local variation can be added to the map.

CONCLUSIONS: Mobile monitoring is a cost-effective scalable approach to map air pollution at fine spatial resolution.

P-0848 Exposure Errors due to Inaccurate Residential Addresses and their Impact on Epidemiological Associations: Evidence from a National Neonate Dataset

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BACKGROUND AND AIM: Studies assessing the associations between prenatal air pollution exposures and birth outcomes commonly use maternal addresses at the time of delivery as a proxy for residency throughout pregnancy. In large-scale studies, administrative addresses are widely used as a proxy for maternal residency throughout pregnancy under the assumption that they are up-to-date. However, if residential mobility is not reported, inaccurate addresses may introduce exposure estimation errors that might affect the study results.
The aim of this study is to examine the use of the Israeli population registry addresses to assign exposure estimations and evaluates the impact of inaccurate addresses on estimates and association measures of prenatal exposures with congenital hypothyroidism.

METHODS: We used morbidity data from the national program for neonatal screening for 2009-2015 and address data from two sources. We selected neonates with geocoded addresses from both sources (N=685,491) and developed an address comparison algorithm. Next, we assigned neonates with exposures, evaluated exposure assessment differences, and used multivariable logistic regression models to assess the impact that these differences have on association measures.

RESULTS: We found that most of the exposure differences between neonates with addresses from both sources were around zero and had a leptokurtic distribution density, with most values being zero. Additionally, associations between exposure and congenital hypothyroidism were comparable, regardless of address source and when we limited the model to neonates with identical addresses. .

CONCLUSIONS: For our study population and based on the exposure estimation models we used, we found that ignoring residential inaccuracies results in only a small bias of the associations towards the null. The results validate the use of administrative residential addresses for exposure assessment in studies of PM, NO2, and NOX exposures when more detailed residential data are not available.

KEYWORDS: Exposure errors, particulate matter, nitrogen oxides, congenital hypothyroidism.

P-0851 Application of hybrid modelling techniques in the assignment of estimates of personal exposure to ambient air pollution: the MELONS study

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KEYWORDS: Air pollution, Personal exposure

BACKGROUND/AIM:
Hybrid modelling of ambient air pollution has the potential to improve the accuracy of personal exposure estimates assigned to individuals in cohort studies. Traditional modelling techniques neglect the movement of individuals and the gradients of exposures observed when indoors and in transport microenvironments. The present study aimed to assess the changes in assigned personal exposures after adjustment by estimated time-activity patterns derived from a representative sample.

METHODS: Travel survey data for ~19,000 respondents aged 50 and older, in addition to hourly residential CMAQ-urban dispersion model estimates of NO_2, PM_{10} and $PM_{2.5}$, were applied to each individual. The difference between these estimates and those adjusted for estimated location, transport mode and microenvironment were then calculated before aggregation by age and spatially across London (LHEM concentration factors). Ninety members of the COPE study were included in the present analysis and annual average concentration estimates from the nearest monitor were assigned before adjustment via the aforementioned LHEM concentration factors.

RESULTS: Annual average concentrations ($\mu g/m^3$) from the nearest monitor were assigned to each COPE individual for NO_2 (mean: 43.8; SD: 17.3), PM_{10} (21.4; 4.7) and $PM_{2.5}$ (12.7; 2.37). After adjustment for estimated time-activity by LHEM concentration factors, assigned personal estimates reduced to 15.5 (6.14), 6.42 (1.47) and 7.61 (1.34), respectively. Before- and after- adjustment estimates were highly correlated for NO_2 (r: 0.95) and $PM_{2.5}$ (0.96); suggesting that the ranking of estimates showed little change after adjustment. However, for PM_{10} (0.82) there was some change in the ranking of exposures after adjustment. The determinants of this change are explored.

CONCLUSIONS: Leveraging previously collected representative data through methods similar to those presented here, epidemiological studies may have the ability to incorporate complex population-level time-activity information into personal exposure estimates; potentially enhancing assignment using fixed-site monitors or traditional modelling techniques.

P-0853 Spatio-temporal Land Use Regression Modelling of PM2.5 Levels in Athens, Greece

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BACKGROUND & AIM: There is sufficient evidence of the adverse effects of exposure to short- and long-term particulate matter (PM) on health. However, in some study areas the PM2.5 monitoring network is spatially sparse. This may limit the possibility to model PM2.5 for subsequent use in large scale epidemiological studies. Our aim was to enhance our PM2.5 database in order to develop a spatio-temporal land use regression (LUR) model that estimates PM2.5 within the greater Athens area, Greece.

METHODS: The PM2.5 database in Athens was enhanced by using PM10 and nitrogen dioxide (NO2), meteorological and spatial variables to predict daily PM2.5 concentrations at the location of fixed monitors measuring PM10 but not PM2.5. This analysis was performed using regression modelling and a machine learning method (Random Forest-RF), as well as a combination of the two. Following, we developed a spatio-temporal LUR model for predicting PM2.5, by including linear and smooth functions of spatial and temporal covariates and a bivariate smooth thin plate function. The final set of explanatory variables was selected based on the adjusted-R2. We tested the predictive ability of the final model using 10-fold cross validation (CV).

RESULTS: We found that the combination of predictions by the regression model and the RF performed best, with CV-R2 of 98.2% and a Mean Square Error of 2.1, for the study period 2007-2019. The CV-R2 for the developed spatio-temporal PM2.5 LUR model was 81.8%.

CONCLUSIONS: The applied database enhancement method provided improved input for modeling PM2.5 with adequate accuracy. This is a useful tool for subsequent use in health effect studies, since exposure to PM2.5 especially, is a strong risk factor of morbidity and mortality.

KEYWORDS: Spatio-temporal modeling, PM2.5, Land use regression, Exposure, Epidemiology

P-0855 Application of low-cost, commercially available, wearable particulate matter sensors: a comparison

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BACKGROUND AND AIM: Low-cost, wearable PM sensors claim to measure air quality with high spatiotemporal resolution, potentially improving exposure assessment in studies on air pollution. Exposure during commutes or indoor/outdoor leisure activities is difficult to accurately estimate with models and activity diaries. Short-term fluctuations or peak concentrations could be more relevant than annual averages for some health endpoints. High resolution data from PM wearables can be linked to acute bodily responses, or for identification of high exposure activities and hotspots. Here, we investigated performance of different PM wearables.

METHODS: Five commercially available PM wearables were purchased in triplo: AirBeam2, Atmotube PRO, Plume Labs Flow 2, Wynd Air Quality Tracker and Nova Fitness SDL607. Devices were placed at two national air quality monitoring stations for several consecutive days (June/July 2020). Measurement intervals varied per wearable (1 sec. - 5 min). All provided PM2.5 data, which was the main interest as respirable fraction linked to several health effects. Agreement (spearman correlation) between and within wearables was investigated (5 min. averages), and with hourly reference data.

RESULTS: The AirBeam was omitted from analysis due to missing data. High agreement for PM2.5 was found within and between the Atmotube, Wynd and SDL607 wearables. Agreement with reference PM2.5 data was limited. Some short-term peaks did not appear in the (hourly) reference, but were consistently detected by several wearables.

CONCLUSIONS: Their absolute measurement value might not precise, but these PM wearables showed consistent and repeatable patterns, indicating that they can distinguish high vs. low exposure situations at a high temporal resolution. Missing data and connection problems and unknown internal calibration algorithms are issues for application. Based on several (user) parameters, the best performing wearable (Atmotube PRO) was further investigated and applied in volunteer experiments.

KEYWORDS:
Air pollution; PM; wearable; sensor; exposure assessment.

P-0858 2-Dimensional Benchtop X-ray Fluorescence Approaches to Exposure Assessment

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INTRODUCTION: Advances in benchtop micro-XRF allow for the potential expansion of 2D exposure assessment for epidemiological and toxicological samples down to a spatial resolution of 10um for simultaneous 30+ element quantification. We aimed to identify the advantages of this method in comparison to other more traditional methods.

METHODS: We used a comparison of methodologies between synchrotron XRF at the Advanced Photon Source at Argonne National Lab, laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS), and micro-XRF using a Bruker M4 Tornado system in order to measure sectioned human tibia bone samples, paraffin embedded rat lung, and sectioned human teeth samples to identify potential variations among the techniques by specimen type, limits of detection, and quantification.

RESULTS: We found strong agreements between the quantification results from each method (>90% agreement for samples). for a 1 second dwell time, we identified a detection limit of 4.8 ppm for a single 10um pixel. Using a longer dwell time or summation of pixels results in correspondingly lower detection limits. Quantification differences between approaches, particularly with LA-ICP-MS where data is normalized to a major element, did not have broad impacts on the data.
CONCLUSION: The detection limit of the micro-XRF was within range to analyze teeth and bone effectively with short measurement times. for tissue based toxicological studies, the time per pixel will need to be increased to take advantage of the 10um resolution, but for many epidemiological tissues such as teeth, the benchtop XRF can accurately quantify exposures. Micro-XRF has significant advantages over LA-ICP-MS sample destruction or the necessity for beamtime at a synchrotron source.

P-0859 Measuring the commuter exposure to air pollution in Lyon

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BACKGROUND AND AIM: Daily travel can represent a significant part of personal exposure to air pollution, up to 30% of the daily inhaled dose, despite very short exposure times (3-6% of circadian time). This exposure varies considerably depending on the mode of transport. This study aims to quantify the difference in exposure during daily mobility by carrying out a microsensor measurement campaign. The data collected will be used in epidemiological studies evaluating the link between chronic exposure to air pollution and the risk of breast cancer.

METHODS: We have undertaken a six-week measurement campaign (from November to December 2021) on three different routes in the metropolitan city of Lyon (France). These routes were chosen to be representative of different urban areas (e.g. city centre, periphery, vegetated areas). The measurements were taken twice a day (during the morning and evening peak hours) using simultaneously four different modes (walk, bike, car and public transport). Two different portable air quality sensors were used: the MONICA sensors (developed by ENEA) measuring PM1, PM2.5, PM10, NO2, CO and O3 and the AirBeam 2 sensors (provided by ATMO AURA) measuring the particulate matters.

RESULTS: In total, 242 measurements were made. Concerning PM10, PM2.5 and PM1.0, the highest concentrations were observed in the underground microenvironment. Cycling and walking were the most exposed modes in terms of NO2. Except for CO, the lowest concentrations were measured by car. Concerning the exposure ratios between modes, the highest variation was observed for PM, the lowest for ozone.

CONCLUSIONS: Preliminary results show that private car users are generally affected by lower levels of pollutants compared to the other modes, except for CO. Nevertheless, the concentrations by car can be strongly influenced by the type of ventilation used (internal/external air recirculation, windows open/closed).

KEYWORDS: Exposure assessment, air pollution, mobile monitoring, traffic, commuting

P-0860 Comparing air quality guidelines of fine particulate matter (PM2.5) on excess mortality: a country-wide small-area assessment in Great Britain

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BACKGROUND/AIM: The World Health Organization (WHO) has recently revised its air quality guidelines for fine particulate matter ($PM_{2.5}$), decreasing the recommended annual threshold from 10µg/m³ to 5µg/m³. Current limits in Great Britain are set to 25µg/m³ in England and Wales and 10µg/m³ in Scotland, and there is an ongoing debate to revise such thresholds. We provide a comprehensive assessment of the exposure to $PM_{2.5}$ and associated excess mortality in the whole population of Great Britain.

METHODS: We collected data on mortality and $PM_{2.5}$ for 41,739 small-area units during 2008-2018. Yearly exposure averages were assigned from a 1x1km grid of daily $PM_{2.5}$ levels produced by a spatio-temporal satellite-based machine learning model. Age-specific deaths were computed from small-area population data and regional age-specific rates. We estimated excess deaths and standardized rates associated with exposure to $PM_{2.5}$ overall and above different thresholds using published exposure-response functions.
RESULTS/DISCUSSION: The population-weighted yearly average of $PM_{2.5}$ across Great Britain decreased from 12.9µg/m³ to 10.4µg/m³ from 2008 to 2018. The percentage of the 60-million population exposed to levels higher than 10µg/m³ dropped from 93.1% to 63.8%. Despite the decrease, no area was compliant with the new WHO limit of 5µg/m³ in 2018. In 2018, we expected a total of 39,737 (95%eCI: 32,445-46,600) excess deaths due to exposure to $PM_{2.5}$, corresponding to a standardized rate of 74.4 (60.8-87.3) per 100,000 person-years. Restricting the levels below the 10µg/m³ and 5µg/m³ would have avoided 2,923 (2,372-3,448) and 20,307 (16,525-23,890) of these deaths, respectively.
CONCLUSION: This study indicates a strong decrease in $PM_{2.5}$ across Great Britain in the last decade. While all areas are below with current national limits, straightening these thresholds would bring substantial health benefits. Complying with the new WHO guideline of 5µg/m³ would require exceptional efforts, as such a level was not matched anywhere.

P-0861 Acquisition and Analysis of Crowd-Sensed Traffic Data at Multiple Spatial Scales

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BACKGROUND/AIM: Measuring traffic activity at high spatial (e.g., street level) and temporal (e.g., sub-hourly) resolution is critical for studying traffic-related exposures and evaluating the efficacy of traffic-reduction interventions, yet such data is not easily available. Crowd-sensed traffic data offer great promise to fill this resource gap, but often require complex collection pipelines, image processing, and GIS manipulation before use in exposure, health, or policy evaluations. We present a validated approach for acquiring and analyzing timeseries of crowd-sensed traffic data, at multiple spatial scales.

METHODS: We developed software to automatically download tiles of crowd-sensed Google traffic congestion maps for a user-specifiable region of interest. To support research, we used image-processing to identify the relevant features of interest (i.e., the congestion-color-coded streets), and aggregate the traffic data to user-specified time scales and spatial polygons (e.g., census tracts, zip codes). We performed quality assurance to assess the validity and reproducibility of our approach.

RESULTS: We demonstrate broad and international applicability of our method with examples of Manhattan in New York City and Mexico City. We also illustrate that the data has sufficient resolution and sensitivity to quantify decreases in traffic congestion due to COVID-19-related social distancing policies in the South Bronx in New York City. Our analysis identified decreases at the census tract level as well as for individual street segments, using traffic data at three-hour increments.

CONCLUSIONS: The methods presented here are broadly scalable and easy to replicate by other researchers across the globe, including communities with limited on-the-ground monitoring. Crowd-sensed traffic data have great promise for empirically modeling traffic congestion, evaluating interventions, assessing exposure for epidemiologic studies, and combining with other neighborhood level characteristics for environmental justice evaluations and other studies.

KEYWORDS: crowd-sensed data; traffic congestion; modeling; spatial scales

P-0862 Agreement between mothers and sons in early life exposures assessment in a multicentric case-control study investigating risk factors of testicular germ cell tumors in young adults (TESTIS study)

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BACKGROUND: Testicular germ cell tumor (TGCT) is the most common tumor usually occurring in young men between 15-45 years old. Environmental early life exposures are suspected to play a role in the etiology of TGCT. Assessment of early life exposures by subject in retrospective study designs might be prone to recall bias. Based on the TESTIS case-control study on TGCT, we investigated agreement between mothers and sons in early life exposures assessment.

METHODS: The TESTIS study is a multicentric case-control study, conducted between 2015 and 2018 in 20 University Hospitals in France, aiming to examine TGCT risk factors. 454 incident TGCT cases were recruited and matched to 670 controls on year of birth and hospital centers. Parental occupations at birth, prenatal and perinatal characteristics, and domestic use of pesticides during puberty were collected from both mothers and sons among 547 (48.6%) participants. Kappa coefficient, sensitivity, specificity and Pearson's correlation coefficient statistics were calculated to estimate the agreement, overall and separately between cases and controls.

RESULTS: Agreement varied from Cohen's Kappa values between 0.05 (use of pesticides on indoor plants during puberty) and 0.66 (maternal occupation status at birth) according to the types of exposure. The highest Kappa or correlation coefficients were observed for maternal occupation status at birth (Kappa, CI95%: 0.66[0.59-0.73]), some perinatal characteristics (admission to neonatology, Kappa: 0.61[0.48-0.74]; birth weight, correlation's coefficient: 0.85, $p<0.001$) and some domestic use of pesticides (pets' treatment, Kappa: 0.57[0.50-0.64]). Agreement was slightly higher among cases than controls.
CONCLUSION: Our study showed important variations in agreement between mother's and son's declarations in early life characteristics and pesticides exposures. These results provide important information for retrospective assessments in life-course epidemiology and potential recall bias in early life characteristics and exposures relevant to assess TGCT risk.

KEYWORDS: child-parent agreement, recall bias, retrospective study

P-0863 Reliability of low-mass toenail samples as biomarkers of chronic metal exposure

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BACKGROUND/AIM: Toenails are a promising matrix to assess chronic metal exposure, but questions remain about the sample mass requirements and temporal variability of metals measured in this matrix. This study evaluates the reliability of a ~25 mg toenail sample (1 - 2 clippings) for metals analysis and the temporal variability of the toenail biomarker over 2 - 4 years in a cohort of men from the Gulf Long-term Follow-up (GuLF) Study.

METHODS: Toenail samples from 106 GuLF Study participants were collected at two visits 2 - 4 years apart and analyzed for 18 metals (Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, Mg, Mn, Mo, Ni, Pb, Sb, Se, V, Zn) using inductively coupled mass spectrometry (ICP-MS). Participants with samples >120 mg (n=24) were selected for 3x repeated analysis using ~25 mg sub-samples. Intraindividual correlation coefficients (ICC) were used to assess the reliability of the sub-sample mass. Linear mixed models were used to assess toenail metal correlations over time.

RESULTS: ICCs and correlations over time were not reported for Cd, Co, Mo, Sb, and V which were detected in less than 60% of the samples. ICCs for the remaining metals ranged from 0.48 for Fe to 0.88 for Cu. Correlations of metal concentrations over time ranged from 0.06 to 0.66 with Ca (0.06), Zn (0.11), and Al (0.13) with the lowest estimated correlations and Cu (0.50), Hg (0.54), and Se (0.66) with the highest. As, Co, Mn, and Pb had correlations at 0.31, 0.32, 0.41, and 0.33, respectively.
CONCLUSION: Findings from this study suggest that a ~25 mg subset can be used for the analysis of most toenail metals with ICP-MS. As, Co, Cu, Hg, Mn, Pb and Se concentrations in toenail clippings can reasonably reflect chronic exposures over multiple years in the Gulf population.

KEYWORDS: Metals, Exposure Assessment

P-0865 Linking subject-specific environmental exposures to individual cohort data: an example with the UK Biobank

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BACKGROUND AND AIM: Health effects of spatially ubiquitous environmental factors are optimally assessed through cohort epidemiological analyses. However, their application requires the reconstruction of highly granular exposures summaries, which can show high variability within and between individuals. Availability of improved maps with finely resolved spatio-temporal measurements can address those limitations, but the linkage procedure poses methodological and practical problems. This study aims to describe a linkage framework to couple precise environmental measurements to subject-specific cohort data, maximizing the exposure information and accounting for privacy constraints and residential mobility.

METHODS: Accomplishment of this goal is conditional to the availability of subjects' residential mobility histories and geographical locations. The linkage process is carried out in three steps: (1) Spatial alignment of GIS exposure maps and the residential addresses, based on interpolation methods to avoid locations back-tracing; (2) Reconstruction of exposure histories accounting for residential changes in addresses during the follow-up; (3) Flexible definition of exposure summaries consistent with alternative research questions and epidemiological designs.

RESULTS: This procedure is illustrated with the linkage and processing of daily predictions of exposure of temperature and particulate matter to 502,408 participants of the UK Biobank cohort from gridded spatio-temporal maps across Great Britain. The outcome of the process is concretized with the extraction of exposure summaries defined at daily level, suitable for the investigation of complex temporal dependencies. Particularly, they can be applied to compute averages of the two stressors, subsequently included in traditional analyses of short- and long-term associations.

CONCLUSIONS: Embedding highly informative contextual data in cohorts characterized by extensive individual phenotypes and genetic information allows the quantification of independent and synergistic health risks associated with environmental exposures. Further frameworks development with public cohort data should be encouraged to ensure reproducibility and extension of epidemiological analyses.

KEYWORDS: Environmental exposures. Spatio-temporal models. data linkage. cohort analysis.

P-0866 Predictors of dietary intake of acrylamide in pregnancy and teenage life - A Danish Birth Cohort Food Frequency Questionnaire Study

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BACKGROUND AND AIM: Acrylamide forms in a wide variety of commonly consumed food and beverages such as fried potatoes, chips, biscuits, breakfast cereals, bread, and coffee as a result of high temperature cooking. In animals, acrylamide cause tumors, neurotoxicity, developmental, and reproductive effects. Acrylamide crosses the human placenta. Prenatal exposure to acrylamide from diet has been associated with fetal growth restriction and obesity whilst exposure in adulthood have been linked with cancers. However, the impact on health remains poorly understood as most studies have focused on cancer in adults and on assessment of dietary intake at a single time in adult life. We aimed to estimate dietary intake and predictors of acrylamide during pregnancy and puberty of the Danish National Birth Cohort participants.

METHODS: We included 68,419 women who completed a 360-item food frequency (FFQ) questionnaire at 25 weeks during pregnancy and 36,903 adolescents who completed a 150-item FFQ at age 14 years. Median [p5 – p95] acrylamide intakes were estimated for 50 food items by combining FFQ data with Danish food monitoring data in µg/kg and µg/kg per kg body weight (BW).

RESULTS: The median acrylamide intake of mothers was 27.0 [12.4 – 53.6] µg/day (0.41 [0.18–0.87] µg/BW/day) and adolescents' median intake was 29.3 [13.1 – 68.0] µg/day (0.55 [0.23–1.32] µg/BW/day). Out of 12 food groups evaluated, the main contributors were fried potatoes (24% for women and 40% for adolescents), chocolate, licorice, and dried fruits (18% for women and 13% for adolescents), and sweet bakery items for women (13%) and crisps for adolescents (11%).

CONCLUSIONS: We observe a wide range of acrylamide intakes in both populations. The estimated median intake of the adolescents was higher than the intake of the mothers. Foods contributing to acrylamide intake differed slightly.

KEYWORDS: Acrylamide, diet, pregnancy, adolescent, food contaminant, food contributor's, critical windows

P-0869 Evaluating Predictions of ELAPSE and Google Air View-based Mixed-effects LUR Models for Air Pollution in Copenhagen, Denmark

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BACKGROUND AND AIM: Fine scale exposure-assessment is needed for epidemiological studies on long-term health effects of air pollution (AP). We aimed to evaluate a) predictions of hyperlocal Google Air View-based mixed-effects land use regression (G-LUR) models for long-term AP for 2018-2020, and of ELAPSE (Effects of Low-Level AP: A Study in Europe) project LUR models for 2010 in Copenhagen, Denmark, and b) agreement of predictions between these two models.

METHODS: We analyzed concentrations and Spearman correlations of ultra-fine particles (UFP), nitrogen dioxide (NO2), and black carbon (BC) by G-LUR models that predicted AP across ~30,000 streets for 2018-2020, and of NO2, BC, and fine particulate matter (PM2.5) by ELAPSE models that predicted 2010 concentrations at 100m spatial resolution (ELAPSE10). Correlation of pollutants between the two models were also assessed. Using annual mean data for 2010 and 2019 monitored at regulatory network stations, 2019 predictions were estimated for ELAPSE (ELAPSE19) NO2 and PM2.5.

RESULTS: According to the G-LUR predictions, the long-term mean (SD) was 14,120 (8,849) particles/cm³ for UFP, 16.8 (8.3) µg/m³ for NO2, and 1.1 (0.4) µg/m³ for BC. According to the ELAPSE19 predictions, these were 21 (3.4) µg/m³ for NO2, and 11 (1.3) µg/m³ for PM2.5. The mean (SD) for BC was 1.6 (0.3) µg/m³ based on ELAPSE10. The correlation amongst predictions was highest between BC and NO2 (0.79 for G-LUR; 0.64 for ELAPSE). Between G-LUR and ELAPSE predictions, the highest correlation was for G-LUR NO2 and ELAPSE BC (0.64). The estimates of NO2 between the two models were moderately correlated (0.63), while for BC this was 0.51.

CONCLUSIONS: Air pollution is a public health concern in Copenhagen, Denmark. There was moderate correlation between BC and NO2 predicted by both models. The moderate correlation between G-LUR and ELAPSE predictions suggests that spatial patterns have been fairly stable over 10-years.

P-0870 Analysis of chlorinated volatile organic compounds in exhaled breath using Proton Transfer Reaction Time-of-Flight Mass Spectrometry (PTR-TOF-MS)

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BACKGROUND: Tetrachloroethylene (PCE) and Trichloroethylene (TCE) are neurotoxic and probable/known human carcinogens. Inhabitants' exposure to these and other chlorinated volatile organic compounds in communities near hazardous waste sites is common, but difficult to characterize.
AIM: The objective of this study is to quantify PCE and TCE in exhaled breath as an exposure measure in an epidemiological study of children 6 to 11 years of age living in a community that overlays multiple groundwater contamination sites with PCE and TCE being primary contaminants.

METHODS: Exhaled breath samples were collected from each participant on two days, one school day and one weekend day. Participants were instructed to avoid certain activities prior to the sample collection to reduce potential interferences. Information on children's activities on the sampling day was collected by a short survey. Participants were instructed to blow through a mouthpiece into a proton transfer reaction time-of-flight mass spectrometer (PTR-TOF-MS). Side-by-side breath samples were collected from a subgroup of participants using Tedlar bags that were analyzed by a U.S. EPA standard method (TO-15). Forty-one children participated in the breath testing, with thirty-nine tested on two days and two tested on one day.

RESULTS: Eleven participants (27%) had detectable concentrations of PCE in their exhaled breath on both days (overall mean = 0.27 ppb, SD = 0.12 ppb). Two participants had detectable levels of TCE (0.28 and 0.37 ppb). The differences in PCE concentrations were significant between school days and weekend days ($p = 0.035$) and between samples collected in the morning and in the afternoon ($p = 0.021$).

CONCLUSIONS: PTR-TOF-MS proved to be a more sensitive method than Tedlar bags analyzed by TO-15. The results will be used to estimate PCE exposure to assess the association between exposure and neurobehavioral performance among children.

KEYWORDS: Tetrachloroethylene, Exhaled breath, PTR-TOF-MS, Superfund site

P-0871 Vegetation Index Processing and Implications for Calculating Greenness in Population Health Studies

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BACKGROUND: Surrounding vegetation (greenness) is an emerging exposure in population health studies. Yet, methods for processing satellite remote sensing data to calculate greenness are inconsistent across studies, which undermines comparisons of the extent of greenness health effects.
AIM: We surveyed the literature for differences in calculating greenness indices and compared their summary values and classification into greenness quartiles (i.e., least to most green).

METHODS: We identified three main differences in vegetation index processing: 1) averaging period (growing season vs. entire year), 2) exclusion of negative values, and 3) cloud masking (filtering out high cloud cover pixels). for each processing regime, we calculated the normalized vegetation difference index (NDVI) and enhanced vegetation index (EVI). We then assessed area-weighted averages at the Census tract level and compared greenness from the different methods in North Carolina.

RESULTS: Differences in processing led to considerable differences in greenness summary values. NDVI and EVI were higher when the averaging period was restricted to the growing season instead of the entire year, or when negative values were omitted. In general, cloud masking led to higher NDVI or EVI. When categorizing North Carolina Census tracts into quartiles, cloud-masking reclassified as much as 70% of one quartile to another (i.e., third greenest to others). Comparing tracts' quartiles averaged over the entire year to only the growing season, there was less reclassification with cloud masking.

CONCLUSIONS: Methodological differences in data processing affect greenness exposure assessment (e.g., average NDVI / EVI, greenness quartiles). When comparing the magnitude and direction in health effects from greenness, such as in reviews or meta-analyses, researchers must account for methodological differences between each study's handling of satellite remote sensing data. Future research should identify best practices (e.g., cloud masking) for calculating greenness in population health studies.

KEYWORDS: Greenness, Vegetation, Exposure Misclassification, Nature, Remote Sensing, Methods

P-0873 Children's exposure to bisphenols, phthalates and non-phthalate plasticizers in Poland

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BACKGROUND AND AIM: Bisphenols, phthalates and non-phthalate plasticizers are a group of chemical compounds widely used in the industry, e.g., in the production of plastics, and as precursor of epoxy resins. Some of them may affect the hormonal balance in both children and adults. This study aims to determine the urinary concentrations of bisphenols and metabolites of phthalates and non-phthalate plasticizers in children from Poland, estimate their daily intakes and cumulative risk assessment, and examine the main factors of exposure.

METHODS: A total of 400 urine samples of 7 year-old children from the Polish Mother and Child Cohort (REPRO_PL) were analyzed using high performance liquid chromatography with online sample clean-up coupled to tandem mass spectrometry (online-SPE-LC-MS/MS). Daily intakes from each compound were calculated based on urinary excretion rates, specific Fue values for each compound and children's body weights.

RESULTS: The main compounds were ΣDEHP, ΣDnBP, MEP and ΣDEHTP, quantifiable in all samples at median concentrations of 69.5 µg/l, 58.2 µg/l, 42 µg/l and 35.4 µg/l, respectively. BPA accounted for the majority of bisphenols exposure (64%), although around 20% of the children had quantifiable concentrations of BPF and BPS. Certain socio-demographic and life-style characterisitcs were found to have a positive trend with the concentrations of the aforementioned compounds. The individual and cumulative risk assessment of exposure to the studied compounds confirmed that children in Poland are still broadly exposed to several phthalates, bisphenols and non-phthalate plasticizers. Daily intakes and hazard index calculations revealed that a small percentage of children (around 3-10%) exceeded the tolerable daily intakes established by international institutions in relation to phthalates.

CONCLUSIONS: Further studies are required in order to recognize other compounds used as phthalates and BPA replacements, and their exposures among critical life stages such as pregnant women and children.

P-0875 Review of air pollution monitoring designs in new monitoring paradigms for epidemiology

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BACKGROUND AND AIM: Both exposure monitoring and exposure prediction have played key roles in assessing individual-level long-term exposure to air pollutants and their associations with human health. While there have been notable advances in exposure prediction methods, improvements in monitoring designs are also necessary, particularly given new monitoring paradigms that leverage low cost sensors and mobile platforms. We aim to investigate characteristics of novel monitoring designs for air pollution cohort studies that leverage new technologies in order to provide practical guidance to future studies.

METHODS: We focus on two overarching types of monitoring designs, mobile and non-mobile, as well as their subtypes. We define the mobile monitoring design as monitoring from a mobile platform, and the non-mobile monitoring design as stationary monitoring from permanent or temporary locations that incorporates cost-effective sampling devices. In our scoping review, we discuss similarities and differences in these designs across previous studies with respect to spatial and temporal representation, data compatibility between design classes, and the data leveraged for model development.

RESULTS: In published studies applying mobile or non-mobile designs, monitoring sites were mostly selected based on land use instead of residences, and deployed over a short time period which makes representation of long-term average spatial variability challenging. A limited number of studies applied multiple design and/or sub-design classes to the same area, period, or instrumentation, to allow comparison across measurement approaches. There were fewer studies that leveraged monitoring data from different designs to improve exposure assessment by capitalizing on the different strengths of the designs.

CONCLUSIONS: In order to maximize the benefit of new monitoring technologies in assessing the health effect of long-term air pollution, our review suggests specific monitoring designs that prioritize residence-based site selection with comprehensive temporal coverage and leverage data from different designs for model development given good data compatibility.

P-0876 Representativeness of the 2010 EPA PM Monitoring Site Locations to the US Population

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BACKGROUND AND AIM: Exposure prediction modeling establishes relationships between measurements and geographical characteristics to infer concentrations at locations without measurements. Since monitors are limited in number, predictions can be generated for locations very different than those used to train the model. The epidemiologic impacts of this potential mismatch hinge on whether the population resides in areas not well-represented by monitoring sites. Here we quantify the fraction of the US population with geographical characteristics reflected by regulatory monitoring sites to determine the effectiveness of US monitoring in capturing the population experience.

METHODS: We compared 2010 US Census blocks to the 1km area around EPA monitoring sites for particulate matter (PM2.5 and PM10) in terms of several characteristics often used by prediction models: elevation, population density, and road density. We then quantified the fraction of the US population that resided in census blocks with predictor values observed at the EPA monitoring sites. We also evaluated these fractions by state since not all exposure modeling is conducted nationally.

RESULTS: In 2010, over 98% of the US population resided in census blocks with population densities, road densities, and elevations that were represented by EPA PM2.5 sites. PM10 results were similar, although only 93% of the population was covered by monitors in terms of population density. These results varied by state, however, especially in terms of population density, where 25 states had less than 75% of their population represented by their PM2.5 monitoring sites (34 states for PM10).

CONCLUSIONS: While PM regulatory monitoring sites are very representative of the US population, results were less consistent within states. This suggests that sub-national exposure modelling should carefully consider the representativeness of monitors for their populations. It also highlights that exposure models often need to borrow information from more distal places to predict exposures for the full population.

P-0878 Effects of exposure to noise, PM2.5 and NO2 on emotional well-being during daily travel

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BACKGROUND AND AIM: Urban residents are exposed to the environment during everyday travel. While previous studies have shown the potential impacts of environmental exposure on mental health and subjective well-being, few studies have examined this relationship in the dynamic transportation context. We aim to address this gap by using smartphone-survey data to quantify the impacts of exposure to PM2.5, NO2, traffic noise, and green/blue space on monetary mood and energy level during daily travel.

METHODS: We conducted a smartphone-app survey in the Columbus metropolitan area in Ohio, USA in 2019 (n=465 people). We used the ecological momentary assessment approach and GPS tracking to track travelers' movement and subjective well-being over the course of 14 days. Using a buffer of 300m along the travel routes, we tabulated the area of green space, traffic noise level, PM2.5 and NO2 concentrations, and travel time by each mode every day. We calculated the dose inhaled based on exposure duration during transportation by each travel mode. We then quantified the impacts of exposure to these environmental factors on positive mood, energy level, calmness, and stress.

RESULTS: Our multilevel models show that PM2.5 and noise level were associated with a decrease in positive feeling. On the other hand, NO2 and noise were associated with an increase in stress level, while PM2.5 shows the opposite effect. Noise was found to reduce energy level while green space and water show the opposite effect.

CONCLUSIONS: Our study adds further evidence to the relationship between environmental exposure and momentary subjective well-being during daily transportation. The findings imply the need for cities to provide open space and reduce noise and air pollution to promote well-being, especially for vulnerable mode users such as pedestrians and cyclists. Who are more exposed to these factors at a higher level.

KEYWORDS: GPS, mental health, exposure

P-0880 Environmental determinants of serum selenoproteins concentrations and composition in the Aragon Workers Health Study - SelenOmics project.

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BACKGROUND: Identifying potencial determinants of serum selenoproteins and selenometabolites can help understanding selenium-related metabolism and health consequences. We evaluated the cross-sectional association between environmental factors and serum selenoproteins and total selenometabolites concentration and composition in the Aragon Workers Health Study (AWHS), a participating cohort in the SelenOmics project.
MATERIALS AND

METHODS: Serum selenoproteins (glutathione peroxidase [GPx], selenoprotein P [SeP], selenoalbumin [SeAlb]), selenometabolites (Se-metabolites) and total selenium and urine metals were measured using HPLC/ICP-MS in 862 AWHS participants. We estimated a Healthy Lifestyle Score (HLS), which included diet, physical activity, smoking, BMI and alcohol consumption. Selenoproteins and Se-metabolites concentrations (log-transformed) and composition (logit-transformed specific species proportion) were introduced as dependent variables in linear regression models adjusted by age, sex and education.

RESULTS: Serum GPx, SeP, SeAlb, total Se-metabolites and selenium median concentrations were, 15.82, 66.07, 14.04, 0.07 and 96.44 µg/L, respectively. We observed statistically significant associations [GMR (95% CI), two-fold change for continuous variables] between ever smoking [0.96(0.93,0.99)], HLS [1.02(1.00,1.05)], total serum selenium [1.08(1.04,1.13)] and tungsten [1.03(1.01,1.05)] with GPx and tungsten with GPx% [1.04(1.02,1.06)]; arsenobetain-corrected arsenic [1.01(1.00,1.02)], chromium [0.98(0.97,1.00)] and total selenium [1.13(1.09,1.16)] with SeP, and age[1.07(1.01,1.13], ever smoking [1.04(1.00,1.07)] and HLS [0.98(0.95,1.00)] for SeP%; ever smoking [0.93(0.90,0.97)], HLS [1.03(1.01,1.06)], BMI [0.81(0.69,0.94)], arsenic [1.02(1.00,1.03)], chromium [1.03(1.00,1.05)] and total selenium [1.10(1.05,1.15)] with SeAlb, and ever smoking [0.95(0.92,0.99)], chromium [1.04(1.01,1.07)] and vanadium [0.96(0.93,1.00)] with SelAlb%; and sex [1.80(1.13,2.89)], physical activity [1.17(1.01,1.38)] and tungsten [0.91(0.85,0.97)] with Se-metabolites and sex[1.68(1.04,2.69)], tungsten [0.92(0.86,0.98)] and selenium[0.84(0.73,0.96)] with Se-metabolites%. The association of tungsten with GPx, selenium with SeP, smoking and BMI with SeAlb, and sex with Se-metabolites, remained after additional adjustment for statistically significant determinants.
CONCLUSION: Serum selenoproteins and selenometabolites concentrations and composition were associated with several environmental determinants, which support that the environment play a relevant role in selenium-related metabolic pathways.

KEYWORDS: selenium, selenoproteins, selenometabolites, environmental determinants

P-0881 Determinants of agricultural pesticide concentrations in homes located in wine-growing areas

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BACKGROUND AND AIM: Epidemiological studies have shown that populations residing near agricultural areas were more exposed to pesticides than the general population. However, the determinants of exposure are poorly known. The main objective of the PESTIPREV study is to identify the determinants of agricultural pesticide exposure among residents of wine-growing areas in France.

METHODS: A sampling campaign was conducted in 31 homes adjacent to vineyards in 2020 and 2021 during summer. at total, 1079 samples were collected (surfaces and animals sampled with wipes, waters from hand washings, carpet/doormat dust) of which 116 were unwashed, indoor surfaces in height. Protected from sunlight and microbial degradation, these surfaces represent the prolonged residential exposure to pesticides. Eight fungicides were searched (benalaxyl, boscalid, cyflufenamid, cymoxanil, folpet, pyraclostrobin, tebuconazole, trifloxystrobin). Limits of quantification per wipe ranged from 0.05ng for pyraclostrobin to 5ng for folpet. Information on the potential determinants of exposure (agricultural activities, meteorological data, buildings and occupants' characteristics) was collected by questionnaire and database consultation. We performed structural equation models (SEM) to explore the role of these parameters on the pesticides concentrations found on surfaces in height.
RESULTS: First results showed that while tebuconazole and trifloxystrobin were quantified in nearly 100% of the samples, the quantification rates were lower for the other pesticides (from 19.8% for cymoxanil to 85.3% for boscalid). Median surface loadings ranged from 13.8ng/m² for pyraclostrobin to 2370ng/m² for folpet. Statistical analyses (SEM) are currently being processed.

CONCLUSIONS: The observed quantification rates are partly explained by the differences in quantification limits between the eight compounds. The surface loading measured will be used to study the effect of several determinants on the residents' exposure. The knowledge of these determinants is crucial to improve the conduct of epidemiological and regulatory studies, and to elaborate preventive measures.

KEYWORDS:
Exposure, pesticides, agriculture, residents

P-0882 Aircraft noise and cardiovascular disease hospitalization and mortality near major airports in the UK

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BACKGROUND AND AIM: Transport noise in Europe has an associated disease burden reported as next highest after air pollution, but most studies to date relate to road traffic noise. We quantified associations between long-term aircraft noise and cardiovascular disease hospitalizations and deaths due to all cardiovascular disease (CVD), coronary heart disease (CHD) and stroke in a population of 3.1 million living near four major English airports in 2006-15 in a small-area study.

METHODS: Health outcome data for 2006-10 and 2011-15 and annual average aircraft noise exposure measurements for day/evening/night time (Lden ≥ 50dB) and night time (Lnight ≥45dB) noise in 2006 and 2011 were obtained for 9,860 census output areas near London Heathrow (8,147), London Gatwick (228), Manchester (898), and Birmingham (587) airports. To overcome the issue of data sparsity, hierarchical Poisson regression models were specified, accounting for airport-specific heterogeneity and overdispersion. Additionally, spatial random effects were included, to model local correlation. Adjustment was made for potential confounders including ethnicity, deprivation, road traffic noise and NO2 at small area level.

RESULTS: We reported evidence of increased risk of hospital admissions for CHD per 5dB increment in Lden (1.057; 95% Credible Interval: 1.027-1.089) and Lnight (1.047; 1.018-1.076). A Heathrow-specific analysis showed evidence of elevated risk of an association between daytime noise and risk of CHD hospital admissions (1.043; 1.000-1.084) and mortality (1.083; 1.007-1.165); some evidence of an effect on mortality risk was also seen for all CVD (1.051; 0.994-1.111) and stroke (1.071; 0.951-1.206) per 5dB Lden.

CONCLUSIONS: Findings from our study have important implications for aircraft noise policies and evaluation of ongoing public health initiatives to reduce noise pollution around major airports in England and its impact on cardiovascular health.

KEYWORDS: Aircraft noise, small area study, CVD outcomes, Bayesian hierarchical model, Poisson regression

P-0884 Optimization and Process Design Tools for estimation of weekly exposure to air pollution integrating travel patterns during pregnancy

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A growing number of international studies have highlighted that exposure to air pollution contributes substantially to the burden of preterm birth and infant death. Several other epidemiological studies have also suggested associations between air pollutants' concentrations and adverse birth outcomes including low birth weight and preterm birth.To do so, researchers need to estimate exposure levels to air pollution throughout everyday life. In the literature, the most commonly used estimate is based on home address only or taking into account, in addition, the work address. However, several studies have shown the importance of daily mobility in the estimate of exposure to outdoor air pollutants.
In this context, we developed an R procedure that estimates individual exposures combining home addresses, several important places, and itineraries of the principal mobility during a week. It supplies researchers a useful tool to calculate individual daily exposition to air pollutants weighting by the time spent at each of the most frequented locations (work, shopping, residential address, etc.) and while commuting. This task requires the efficient calculation of travel time matrices or the examination of multimodal transport routes. This procedure is freely available from the Equit'Area project website: (www.equitarea.org)
This procedure is structured in three parts: the first part is to create a network, the second allows to estimate mains itineraries of the daily mobility and the last one tries to reconstitute the level of air pollution exposure. One main advantage of the tool is that the procedure can be used with different spatial scales and for any air pollutant.

KEYWORDS: Travel pattern, Road network, Air Pollution Exposure, optimization tool, process design

P-0887 Rapid bioanalytical screening for the assessment of internalized exposure to Polycyclic Aromatic Hydrocarbons in clinical samples of Florida Firefighters

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BACKGROUND AND AIM: Polycyclic aromatic hydrocarbons (PAHs) are toxic byproducts of combustion and ubiquitous environmental pollutants which can cause carcinogenesis. Firefighters are routinely exposed to these contaminants and numerous studies have described a high incidence of various cancer types in firefighters compared to the general population. Our aim was to develop a streamlined process that allows accurate quantitative evaluation of PAH exposure in clinical samples collected from Florida Firefighters.

METHODS: Urine samples were collected from twenty-five (25) active firefighters stationed in Florida at the beginning and end of a 24-hour shift, and twenty-one (21) new recruits after the completion of different fire trainings. We developed a rapid, non-invasive method to assess their internalized exposure to PAHs as part of the Firefighter Cancer Initiative (FCI). The use of automated extraction systems and Gas Chromatography – Mass Spectrometry enabled the accurate, qualitative, and quantitative detection of PAHs identified as priority pollutants by the USA Environmental Protection Agency.

RESULTS: Total PAH exposure levels of the 25 active firefighters were significantly higher after the completion of the 24-hour shift, with those that answered fire-related calls, rather than EMS calls, exhibiting the highest concentrations of individual and gross PAHs. Similarly, total internalized exposure was increased in firefighter trainees compared to controls. We observed that participation in a Class B fire training, which involves flammable liquid materials, is associated with higher exposure to PAHs compared to participation in Class A exercises that employ ordinary combustible materials.

CONCLUSIONS: Our findings showcase the unsafe levels of carcinogen exposure faced routinely by firefighters, highlighting the need for further investigation of the link between occupational exposure and health-related effects. The novel biomonitoring tool we developed facilitates large-scale screening of clinical samples and can be used for real-time assessment of carcinogen exposure.

KEYWORDS: PAHs, exposure assessment, firefighters, biomonitoring, occupational exposure

P-0889 Environmental urban exposure to rubidium in a healthy group of Spanish adolescents.

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BACKGROUND AND AIM: Rubidium (Rb) is a rarely studied alkali metal with different applications in the manufacture of photocells and engines for vehicles/machines, which can biomagnify in the food web. The study evaluates the environmental exposure to Rb in a teenage population group living in Alcalá de Henares (Spain).

METHODS: Scalp hair was collected from 96 adolescents (13-16 years-old; 68 girls) born and residing in Alcalá. Rb was analysed by ICP-MS after removal of exogenous contamination using Triton X-100/bath sonication. Data was processed using statistical methods applied to censored data ('NADA' statistical package).

RESULTS: Rb was only detected in 25.8% of the hair samples (LoD=0.011 µg/g), specifically in male (13/29) compared to female (12/68) participants. Owing to the high levels of censored data, 95th percentile and range for Rb in scalp hair of female participants is provided (µg/g): 0.041 (0.013-0.073); meanwhile the median and range for the male population was (µg/g): 0.0101 (0.011-0.106). The presence of Rb in scalp hair show sex dependency (p=0.00127), which agrees with a study performed in Italian teenagers (11-13 years), although they did not observe significance. The geometric mean and median in Alcalá hair samples were (0.0359, 0.0038) higher than in the Italian study (6.0E-03, 6.3E-03; µg/g), which suggests some environmental exposure to this element in our monitored population. Rb salts are used in glasses and ceramics, important industrially in Alcalá which might explain the exposure. Thus, significantly higher concentrations of Rb were found in males living close to glass/ceramic manufacturers (0.0493 vs. 0.0116, 0.0154 and 0.0136 µg/g)

CONCLUSIONS: Although preliminary, our results could suggest that Alcalá's teenage population would have been environmentally exposed to Rb, especially male teenagers, which logically could be due to boys spending more time outdoors and therefore more exposed to this element.

KEYWORDS: Rubidium, human hair, monitoring, Spanish teenagers, exposure

P-0890 Estimating spatiotemporally resolved PM2.5 concentration across the contiguous USA using Super learning

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BACKGROUND AND AIM: Spatiotemporally resolved predictions of PM2.5 concentration are essential for studying associations between long-term and short-term exposures and adverse health outcomes in epidemiological studies. An improved statistical ensemble modeling approach with novel covariates was used to estimate daily 1x1 km PM2.5 concentrations across the contiguous US for the years 2000-2019, and 250 m resolution in urban areas.
METHODS: The approach integrates the predictions from five different base learners (random forests (RF), support-vector machine, stochastic gradient boosting, extreme gradient boosting and neural networks) using a super learner model that combines the individual predictors with another machine learner. This machine learning (ML) ensemble model aims to provide a prediction with minimized root mean square error compared to the base learners. The following spatial and temporal variables were used as predictors: satellite-based products (aerosol optical depth (AOD), land surface temperature, surface reflectance, vegetation indexes, light at night, fires), human modification of land, land use variables, meteorology, topography, population density, proximity, and density of multiple possible sources of air pollution. 30% of monitors were left out for testing and hyperparameter tuning for the models was done using 5-fold cross validation on the training data. Missing satellite based AOD were filled using a RF model with the following predictors: estimated AOD from different chemical transport models, meteorology, topography, land use, climatic regions, and cloud cover.
RESULTS: The performance of the RF model that aims to fill in missing AOD observations was evaluated for one year based on the out-of-bag samples and showed good performance with R2 = 0.90.
CONCLUSIONS: The ensemble model suggests an improved statistical approach for integrating PM2.5 concentration predictions from multiple ML models.

KEYWORDS:
Air pollution modeling, ensemble, machine learning, satellite-based products, aerosol optical depth

P-0891 The use of snapshot personal exposure monitoring in estimating annual exposure to air pollutants for epidemiological studies

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BACKGROUND:
While advancements in sensor technology have broadened the use of personal monitors to estimate individual exposure to air pollution in recent years, significant challenges remain in extending their use for application in epidemiological studies. By collating measurements from several personal exposure (PE) campaigns in London, we aimed to develop a method for extending snapshot PE monitoring to estimates of annual mean exposure to pollution from outdoor sources at individual level.

METHODS: Our conceptual model for annual extrapolation included three factors: a) variation in ambient concentrations, b) variation in infiltration efficiency of residence and other frequently inhabited buildings, and c) mobility behaviour. We utilised a dataset of 200+ million PE measurements from 427 participants of diverse demographics - school children, COPD patients, professional drivers and healthy adults - to characterise these three factors during snapshot monitoring (varying from four days to six months). Location-adjusted ambient concentrations, coupled with seasonal infiltration factors were used to extend results to annual mean personal exposure estimates for PM2.5, NO2, O3 and BC. Methods described elsewhere were used to censor exposure to indoor sources from the measurements.

RESULTS: Residential infiltration factors did not show significant variation between seasons, suggesting that ventilation behaviour was not a major determinant. Each demographic exhibited distinct patterns in mobility behaviour, although impact was limited by relatively small proportion of time spent travelling. Behaviour modelling of participants with at least four months' PE measurements showed that some participants had repeated routines, but others were unpredictable.

CONCLUSIONS: The extension of snapshot PE monitoring to annual mean exposure estimates requires assumptions relating to participant behaviour over time, notably mobility and residential ventilation. The impact of these assumptions will vary between individuals and demographics. Extrapolation of snapshot monitoring is more robust for those with predictable routines.

KEYWORDS: Air pollution, personal exposure, sensors, measurement error

P-0892 Assessing exposure to pesticides with short biological half-lives: Use of a repeated longitudinal biomonitoring strategy to estimate glyphosate exposure during pregnancy

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BACKGROUND: Glyphosate is the most heavily used herbicide in the world, and recent studies raise concern about previously unrecognized toxic effects at environmentally-relevant levels, particularly during fetal development. Despite glyphosate's extensive use and potential toxicity, little data exists to characterize human exposures. Use of such data is further complicated by the fact that – like many modern pesticides – glyphosate is metabolized quickly, with an estimated half-life of less than 12 hours. Individual spot urine samples have been used to estimate glyphosate exposure but may result in exposure misclassification. We employed a temporally-rich longitudinal biomonitoring strategy to assess between- and within-individual variability in glyphosate exposure throughout pregnancy.

METHODS: We recruited pregnant women living both near and far from agricultural fields from Women, Infants and Children (WIC) clinics in southern Idaho. We collected weekly urine samples from enrollment through delivery, and daily urine samples during a two-week dietary intervention. Samples are currently being analyzed by the Centers for Disease Control and Prevention for glyphosate concentrations.

RESULTS: We recruited a cohort of 40 pregnant women during their first trimesters of pregnancy, and maintained a 97.5% retention rate through delivery. Half of the participants lived within 500 m of the nearest agricultural field. Mean study duration was 21 weeks, and we collected a total of 1,395 spot urine samples, including 864 weekly and 531 daily samples, representing 96.9% of the study goal. These data will allow us to estimate the number of individual samples needed to stably assess glyphosate exposure across pregnancy, and to understand exposure variability within and across individuals.
CONCLUSION: This is the first study to longitudinally assess glyphosate exposure throughout pregnancy, and the results of this work have important implications for developing appropriate exposure assessment methods for other chemicals with short biological residency.

KEYWORDS: glyphosate; pesticide exposure; biomonitoring

P-0894 Particulate Matter (Pm2.5) concentration among hypertensives primary cooks in Obuasi Municipality, Ghana

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BACKGROUND/AIM:
There is a paucity of epidemiological evidence on the potential association between exposure to household air pollution (HAP) from combustion of solid fuels (SF) (e.g., wood, charcoal) for cooking and raised blood pressure in sub-Saharan Africa.

METHODS: As part of the CLEAN-Air(Africa) project, we measured 24-hour exposure to particulate matter (PM2.5) among cooks primarily using either SF (n=35) or liquefied petroleum gas (LPG) (n=35) in Obuasi, Ghana. The cook's blood pressure (systolic/diastolic) was assessed two months prior to measurement of air pollution using standardized methods. Blood pressure (BP) levels were then categorized into two levels: normal and severe. Basic descriptive statistics were used to describe the data.

RESULTS: Personal exposure to PM2.5 was higher in cooks primarily using SF (geometric mean (GM)=65.6 µg/m3 (range: 15.3-234.4) than those using LPG (GM=45.9 µg/m3 (CI: 5.2-232.6). Blood pressure was higher in cooks using SF (mean systolic blood pressure was 118.5 (±17.1) mmHg) than those using LPG (115.9 (±16.6) mmHg; mean difference 2.55 mmHg (p=0.5291)). Average diastolic blood pressure was 77.3 (±12.4) mmHg in SF users compared to 76.2(±13.2) mmHg in LPG users; mean difference 1.1 mmHg (p=0.7300). Primary cooks with normal BP were exposed to 60.8 µg/m3 (CI:49.7– 74.5) PM2.5 and 52.0 µg/m3(CI: 30.7 – 88.2) for cooks with severe BP.
CONCLUSION:
Average exposure to PM2.5 is significantly greater than the World Health Organizations Interim Target 1 level (35µg/m3) in both hypertensive and non- hypertensive primary cooks. Therefore, more efforts are required to reduce household air pollution and ambient air pollution.

KEYWORDS: Particulate matter, exposure assessment, LPG, blood pressure, Ghana

P-0895 Radon Exposure to Community Members Living Near a Uranium Procession Plant

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BACKGROUND: Members of the Fernald Community Cohort (FCC, N=9782) are persons who lived within 5 miles of the uranium processing plant at Fernald, Ohio, USA. From 1951 to 1989 the site processed uranium ore and recycled materials to make highly refined uranium metal products used in the USA Department of Energy nuclear weapons production. The aqueous raffinate or waste from the chemical digestion process was pumped into two large concrete silos for storage and were found to be sources of radon decay products. Vents in the protective dome covers were not sealed until 1979. Source terms and dosimetry algorithms for exposure to both uranium particulates and radon were developed by CDC.

METHODS: Based on the CDC prior work, we developed a mathematical model to estimate yearly outdoor radon exposure persons in the cohort from the K-65 silos during 1952-1988. We collected and verified residential history information from members of the cohort. We used the radon source terms developed by CDC, yearly wind speed and direction data, and applied the model to the residential history for each member of the cohort.

RESULTS: 9306 members of the cohort had sufficient residential history information to be used for radon dosimetry calculations for individual cohort members. The population mean value (sd) of total cumulative exposure (over the years 1952-1988) was 460.70 (508.84) pCi/m2-years, median 299.60 pCi/m2-years, with a large range of 0-4625.75 pCi/m2-years. Arithmetic median exposure also was calculated for each person, or the median of yearly exposure, with a population mean of 20.43 pCi/m2, also with a large range 0 to 200.57 pCi/m2.

CONCLUSIONS: Using reliable data and well-developed algorithms we estimated environmental (outdoor) radon exposure for members of the FCC and found a wide range of cumulative outdoor radon exposure.

KEYWORDS: uranium, radon, community cohort

P-0900 The LIFE Index-Air integrated exposure - dose management tool for the reduction of PM pollution and the protection of public health – Development and implementation in 5 European Cities

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BACKGROUND AND AIM: Air pollution remains a major health concern in Europe, despite the adoption of mitigation policies over the last decades. The LIFE Index-Air project developed a novel policy support tool, aiming to cover the gap between ambient air quality management and real-life exposure of urban populations and related health risks. This work presents the main features of the Tool and results from its implementation in five European cities: Lisbon and Porto (Portugal), Treviso (Italy), Athens (Greece) and Kuopio (Finland).

METHODS: The tool is based on an integrated exposure-dose-burden of disease assessment. It incorporates a number of specialised models and provides (1) the spatial distribution of pollutants emissions, ambient concentrations, citizens' exposure, and respective Burden of Disease; (2) the PM dose deposited in the respiratory system. The Tool also allows users to build scenarios of emission control measures and exposure scenarios, based on modified time activity patterns.

RESULTS: PM concentration and exposure mapping, provided by the Tool, revealed the pollution hot spots in each city. Exposure was found higher for young children, in comparison to adults. The school / work microenvironments and outdoor physical activities were responsible for the highest doses of PM. The implementation of control measures related to vehicular traffic resulted in 7 - 10% reduction in mortality in Lisbon, Porto and Athens. A reduction of 10% in mortality was also estimated for Treviso if efficient wood burning devices were to be used for residential heating.

CONCLUSIONS: Index-Air Tool provides, for the first time, quantitative assessment of the effectiveness of control policies, with respect to citizens' exposure and related health. It also addresses measures aiming at reducing citizens' exposure through the adoption of alternative, less impacted by air pollution, everyday schedules.

KEYWORDS: Policy tool, Particulate pollution, Population exposure, Deposited dose, Burden of disease, Emission / exposure scenarios.

THEMATIC 16: Neurobehavioral changes in children/adults

P-1001 Maternal Urinary Fluoride levels during pregnancy and ADHD symptoms during childhood

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BACKGROUND AND AIM: There is little evidence linking fluoride in urinary levels and symptoms or diagnosis of ADHD. In the Basque Country, the fluoridation of drinking water is compulsory for municipalities >30,000 inhabitants. The objective is to analyze the relationships between fluoride levels in urine collected during pregnancy and ADHD symptomatology at 4, 8 and 11 y

METHODS: Data from 201 to 255 mother-child pairs from the Infancia y Medio Ambiente (INMA) birth cohort with maternal urinary F adjusted for creatinine (MUFcr) during pregnancy and child assessments of ADHD-like behaviors at age of 4, 8 and 11 years was available. ADHD symptoms were reported by ADHD-DSM-IV checklist at age 4, and Conners' Rating Scales-Revised at age 8 and 11. Clinical approach was also carried out using the cut offs of each test. Multiple linear regression and zero inflated binomial regression were used when the outcomes were analyzed as continuous; for a clinical approach, logistic regression was used. Covariates, and biomarkers of neurotoxicants were available.

RESULTS: MUFcr levels in pregnancy varied according to the source of drinking water [(mean (95% CI)] being 0.85 (0.77, 0.93) in mothers drinking fluoridated water and 0.45 (0.40, 0.51) in those drinking non-fluoridated water ($p<0.01$). No association was found between MUFcr levels during pregnancy and inattention, hyperactivity or ADHD score of symptoms at 4, 8 or 11 years. E.g. at the age of 4, for each 1 mg F/g increase across the whole pregnancy, inattention, hyperactivity-impulsivity and ADHD scores did not change significantly: (β =0.16, CI 95%:-1.58, 1.90), (β =0.19, CI 95%: 1.56, 1.95) and (β = 0.35, CI 95%: -2.75, 3.46). Nor was any association observed when a clinical approximation of the problem was used.

CONCLUSIONS: Higher levels of MUFcr in pregnant women were not associated with global measures of ADHD during childhood

P-1003 Fetal exposure to cannabis and childhood behavior at age 5 years: The Healthy Start study

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OBJECTIVE: To assess whether fetal exposure to cannabis is associated with childhood behavior, independent of fetal exposure to nicotine.

Study design: This pilot study included 97 mother-child pairs from a Colorado-based cohort. Maternal urine was collected at ~27 weeks gestation and analyzed for cotinine and twelve cannabinoids/metabolites (including delta 9-tetrahydrocannabinol and cannabidiol). Fetal exposure to cannabis was dichotomized as exposed (any cannabinoid≥limit of detection [LOD]) and not exposed. Fetal exposure to nicotine was dichotomized as exposed (cotinine≥LOD) and not exposed. Generalized linear models examined the associations of fetal exposure to cannabis with Child Behavior Checklist T-scores at age 5 years, with and without adjustment for fetal exposure to nicotine.

RESULTS: Compared to non-exposed offspring, cannabis-exposed offspring exhibited more externalizing behaviors (β: 4.3; 95% CI: 0.2, 8.5; p=0.04). However, this association was attenuated after adjusting for fetal exposure to nicotine (β: 2.1; 95% CI: -2.5, 6.6; p=0.38). Fetal exposure to nicotine was associated with several behavioral outcomes, including externalizing behaviors (β: 10.2; 95% CI: 2.9, 17.5; p<0.01), sleep problems (β: 4.5; 95% CI: 2.5, 7.6; p<0.01), and attention problems (β: 4.8; 95% CI: 1.7, 8.0; p<0.01), independent of cannabis exposure.

CONCLUSIONS: Our study confirms that fetal exposure to nicotine is associated with childhood behavioral outcomes, but more studies are needed to understand the long-term impact of fetal exposure to cannabis. Nevertheless, the potential risks of nicotine and cannabis use during pregnancy should be more widely communicated to limit behavioral problems in the offspring.

P-1005 Childhood exposure to per- and polyfluoroalkyl substances and neurodevelopment in the CHARGE case-control study

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BACKGROUND/AIM: Per- and polyfluoroalkyl substances (PFAS) are shown to have neurotoxic effects on animals. Several epidemiological studies reported associations between childhood exposure to PFAS and neurodevelopment in childhood, but the results remain inconclusive. We examined if childhood PFAS concentrations were associated with a diagnosis of autism spectrum disorder (ASD), developmental delay (DD), and other early concerns (OEC).

METHODS: We included 551 children 2 to 5 years old from the CHildhood Autism Risks from Genetics and Environment (CHARGE) study. Children were clinically diagnosed and classified into ASD (n = 190), DD (n = 103), OEC (n = 78), and typical development (TD; n = 180) groups. Fourteen PFAS were quantified in their serum samples collected when diagnostic assessments were performed. We used multinomial logistic regression models to investigate the associations of individual PFAS concentrations with neurodevelopmental outcomes and weighted quantile sum (WQS) regression models to assess the mixture effects of PFAS.

RESULTS: Childhood perfluorooctanoate (PFOA) was associated with increased odds of ASD (odds ratio [OR] = 2.41, 95% confidence interval [CI]: 1.43, 4.08) and DD (OR = 2.28, 95% CI: 1.25, 4.16) versus TD. Perfluoroheptanoate (PFHpA) was associated with increased odds of ASD (OR = 1.71, 95% CI: 1.29, 2.28). However, perfluoroundecanoate (PFUnDA) was associated with decreased odds of ASD (OR = 0.44, 95% CI: 0.27, 0.71). From mixture analyses, one unit increase in the WQS index was associated with increased odds of ASD (OR = 1.70, 95% CI: 1.19, 2.43).

CONCLUSIONS: In this case-control study, childhood PFOA, PFHpA, and a PFAS mixture was associated with increased odds of ASD, while PFUnDA was associated with decreased odds of ASD. Because we used concurrent measurements of PFAS, our results do not imply causal relationships and thus need to be interpreted with caution.

KEYWORDS: PFAS, mixture, child serum, autism spectrum disorder, developmental delay

P-1008 Topological network properties of resting-state functional connectivity patterns are associated with metal mixture exposure in adolescents

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BACKGROUND: Exposure to neurotoxic metal adversely impact cognitive, motor, and behavioral development. Only few studies have addressed the underlying brain mechanisms of metal-associated developmental outcomes. Furthermore, metal exposure occurs as a mixture, yet often consider only a single exposure. In this cross-sectional study, we investigated the relation between exposure to neurotoxic metals and topological brain metrics, such as global, local efficiency and centrality measures, in adolescents.

METHODS: In 193 participants (53% females, ages: 13-25 years) enrolled in the Public Health Impact of Metals Exposure (PHIME) study, we measured concentrations of five metals (manganese, lead, zinc, copper and chromium) in biological matrices (blood, urine, hair, and saliva) and acquired resting-state functional magnetic resonance imaging scans. Using graph theory metrics, we computed caudate eigenvector centrality (EC) and efficiency (global:GE; local:LE) in 111 brain areas (Harvard Oxford Atlas). Weighted quantile sum (WQS) regressions were used to examine association between metal mixtures and each graph metric (GE, LE or EC), adjusted for sex and age.

RESULTS: We observed significant negative associations between the metal mixture and GE and LE (β_GE = -0.004, 95% CI [-0.006, -0.002]; β_LE= -0.011, 95% CI [-0.02, -0.003]). Blood lead (18%) and hair chromium (17%) contributed most to this association. The metal mixture was positively associated with EC in the caudate (β_EC = 0.625, 95% CI [0.144, 0.825]). Blood manganese (24%) and copper (11%) contributed most to the mixture association.

CONCLUSIONS: Our results suggest that exposure to the metal mixture during adolescence reduces the efficiency of integrating information in brain networks at both local and global levels. Results further suggest these associations are due to combined join effects to different metals, rather than to a single metal.

P-1012 Maternal exposure to life events, daily stressors and green spaces during pregnancy is associated with changes in NR3C1 and IGF2/H19 ICR methylation patterns three decades later

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BACKGROUND AND AIM: Maternal mental state has been associated with offspring NR3C1 promotor and IGF2/H19 imprinting control region (ICR) methylation patterns. However, more prospective studies with long-term follow-up are needed, and protective factors such as proximity to green spaces during pregnancy remain understudied. In this study, we investigated the associations between these maternal exposures, and the methylation patterns in adult offspring (28-29 y/o).

METHODS: 51 mother-newborn pairs were followed up from 12-22 weeks of pregnancy until 28-29 years after birth. During pregnancy, participants filled out questionnaires measuring the impact of important life events and of daily stressors. Using addresses, quantities of green space around the residence were determined using high-resolution map data (1 m2). 28-29 years later, blood and saliva samples were collected from the offspring. DNA methylation levels were determined on the NR3C1 promotor, and on the IGF2/H19 ICR using a bisulfite PCR and sequencing method. Mixed effect models were used to test the associations between maternal exposure to stressors and green spaces, and methylation patterns.

RESULTS: We found significant associations between the life events and daily stressor scores, and methylation patterns on two out of the four NR3C1 promotor region amplicons in offspring blood 28 years later. The same maternal stress measures were not associated with IGF2/H19 methylation levels. Maternal exposure to green spaces 1000m around the residence was associated with IGF2/H19 ICR methylation, but not with NR3C1 promotor methylation.
CONCLUSION:
We observed significant effects of maternal stress exposure during the pregnancy on the methylation patterns on the NR3C1 promotor into adulthood, which implies that maternal mental states during the pregnancy can induce HPA-axis regulation changes that can be persistent into adulthood. The observation that prenatal exposure to green spaces is associated with IGF2/H19 ICR methylation generates new hypotheses around the environmental determinants of DNA methylation patterns.

P-1014 Prenatal, early-life, and childhood exposure to source-specific air pollution and behavioural problems in the ALSPAC cohort

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BACKGROUND AND AIM: Particulate matter ≤10 µm in aerodynamic diameter (PM10) exposure may influence brain development and be related to emotional and behavioural problems in children.
This study aims to investigate emotional and behavioural problems at ages 9 and 16 years in relation to PM10 exposures during pregnancy, infancy, and childhood in the Avon Longitudinal Study of Parents and Children (ALSPAC).

METHODS: We assessed individual exposures to modelled PM10 (PM10_total) as well as PM10 specifically from road traffic (PM10_road) during pregnancy, 0–6 months, 7–12 months, and up to age 16 years. We used parent-completed Strengths and Difficulties Questionnaire (SDQ) to assess emotional and behavioural development at age 9 (N=5,209) and 16 (N=3,609) years. Associations between PM10 and behaviour problems were examined using linear regression models, adjusted for individual-level confounders.

RESULTS: We found adverse associations with behavioural problems at age 9 but not age 16 years. Exposure to PM10_total during the whole pregnancy period was positively associated with higher total difficulties score (0.049; 95% confidence interval [CI], 0.004 to 0.095) per 1 µg/m3 higher, suggesting more frequent behavioural problems. We did not find clear evidence of a sensitive exposure period for PM10_road. at age 9 years, 1 µg/m3 higher PM10_total during pregnancy was associated with lower prosocial scores (-0.115; 95% CI, -0.185 to -0.044), indicating less well developed prosocial behaviour, but similar associations were seen for 0–6 months, 7–12 months, and 0–8 years. We also found associations between higher PM10_road with conduct problems .
CONCLUSION: Exposure to higher PM10 during pregnancy in the early 1990s was associated with increased behavioural problems in children at age 9 years in the ALSPAC cohort.

KEYWORDS: Air pollution; behavioural problems; ALSPAC

P-1016 Exposure to urban environmental stressors in pregnancy and postpartum depression: A meta-analysis of 11 European birth cohorts

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BACKGROUND AND AIM: Urban environmental stressors have been associated with adult depression, but few studies on postpartum depression (PPD) exist. We investigated associations between exposure to urban environmental stressors in pregnancy and PPD.

METHODS: We included women from 11 European birth cohorts within the EU Child Cohort Network with singleton pregnancies between 1990-2016 and no previously reported depression. Exposures included ambient air pollution (NO2, PM2.5 and PM10), road traffic noise, natural spaces (Normalised Difference Vegetation Index; NDVI, access to major green and blue spaces) and built environment (population density, facility richness and walkability). PPD was assessed using self-report questionnaires collected 3 – 18 months after birth (e.g. Edinburgh Postnatal Depression Questionnaire). We used adjusted logistic regression to estimate cohort-specific associations between single exposures and PPD and pooled results via meta-analysis using DataSHIELD. We also fit multiple exposure models where we hypothesised one exposure may confound the relationship between another exposure and PPD.

RESULTS: Rates of PPD ranged from 2 – 17% across cohorts (n = 39,329). In the pooled sample higher levels of NDVI were associated with reduced odds of PPD (OR per IQR difference in NDVI = 0.94, CI 0.89, 1.00), although results were not consistent across indicators of green spaces. We also found a trend for higher levels of traffic noise to be associated with increased odds of PPD (OR Lden >70dB = 1.19, CI 0.89, 1.59). for all other urban stressors associations were close to null and there was considerable heterogeneity between cohorts. Multiple exposure models showed similar results.

CONCLUSIONS: Overall, this large European meta-analysis provides little evidence for an association between urban environmental stressors and PPD, although our findings provide some evidence that lack of green spaces may be associated with greater risk of PPD.

KEYWORDS: post-partum depression, air pollution, natural spaces, traffic noise

P-1017 Long-term exposure to air pollution and traffic noise and incidence of mental disorders: a large administrative cohort of adults

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BACKGROUND AND AIM: Air pollution is related to a global increase in mortality and morbidity. The literature on the adverse effects on mental disorders is limited. We aimed to investigate the associations between air pollutants and traffic noise with incidence of different categories of mental disorders and drug prescriptions in a large administrative cohort.

METHODS: We enrolled 1,739,277 individuals 30+ years living in Rome at 2011 census, and followed them up until 31st December 2019. We excluded subjects with prevalent mental disorders at baseline to evaluate the incidence of schizophrenia, bipolar, anxiety, personality and substance use disorders, as well as prescriptions of antipsychotics, antidepressants and mood stabilizers. We assigned annual average concentrations of fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), black carbon (BC), ultrafine particles (UFPs) and traffic noise to baseline residential addresses. We applied Cox proportional hazards models with adjustment for individual and area-level covariates.

RESULTS: This study identified variable numbers of incident cases, from 1,280 cases for personality disorders to 200,549 for antidepressants. Each interquartile range increase in $PM_{2.5}$ (1.13 μg/m³) was associated with a hazard ratio (HR) of 1.070 (95% confidence interval: 1.017, 1.127) for schizophrenia spectrum disorder, 1.135 (1.086, 1.186) for depression and 1.097 (1.030, 1.168) for anxiety disorders. Positive associations were also detected for the other exposures and with the three categories of drug prescriptions. In two-exposure models, $PM_{2.5}$, UFPs and noise remained associated with schizophrenia spectrum disorders, depression and antidepressant drugs use. The effects were higher in the age group 30-64 than in the 65+. Sensitivity analyses generally yielded similar results.

CONCLUSIONS: Long-term exposure to air pollutants and noise was associated with increased risks of schizophrenia spectrum disorders, depression and anxiety disorders. The associations with prescriptions of specific drugs increased the credibility of the results.

KEYWORDS: air pollution, noise, mental disorders, drug prescriptions.

P-1018 Exposure to phthalates, non-phthalate plasticizers and bisphenols and neurodevelopmental outcomes in school age children from Poland

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BACKGROUND AND AIM: Exposures to phthalates, non-phthalate plasticizers and bisphenols may play a role in the development of child behavioral and psychomotor problems. The aim of the study was to evaluate the association between childhood exposures to these compounds and neurodevelopmental outcomes in the REPRO_PL birth cohort (Poland).

METHODS: Urine samples were collected at the time of children's neurodevelopmental assessment (age 7). HPLC-MS/MS was used for the determination of BPA and 21 phthalate metabolites (n=400) and their replacement alternatives BPF, BPS, three metabolites of DEHTP and three metabolites of DINCH (n=150). Behavioral, cognitive and psychomotor development of children were assessed by the Strengths and Difficulties Questionnaire (SDQ) and the Intelligence and Development Scales (IDS). Multivariate linear regression models accounting for sex-specific effects were applied, including the use of stratification and interactive approaches.

RESULTS: BPA and BPF were found to be associated with emotional symptoms (0.54 [0.035; 1.0] and 0.93 [0.051; 1.8], respectively), and the latter was additionally associated with total difficulties (2.8 [0.30; 5.2]) and peer-relationship problems (0.90 [0.13; 1.7]) in boys. In addition, boys with higher exposures to DEHTP performed worst for conduct problems (1.1 [0.41; 1.7]) and the pro-social behavior (-1.0 [-1.9; -0.15]). Conversely, among girls, the compounds which were significantly associated with poorer behavioral scores were MMP, ΣDnBP and ΣDiBP. for IDS, higher exposures to BPF were associated to lower scores in Fluid IQ (-6.7 [-12.6; -0.88]) and Cognition (-6.0 [-10.8; -1.3]) in boys. Among girls, however, we found a negative association between DINCH and MMP and mathematical scores, with statistically significant results.

CONCLUSIONS: This study indicates that children's exposure to several replacement compounds of BPA and phthalates, such as BPF and DEHTP, are associated with adverse effects on behavioural and cognitive development of school age children, with a divergent sex-specific effects.

P-1020 Prenatal Exposure to Tailpipe and Non-Tailpipe Particulate Matter Pollution and Autism Spectrum Disorders

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BACKGROUND: Traffic-related air pollution is associated with increased risks for autism spectrum disorders (ASD). However, it is unknown whether carbonaceous material from exhaust emissions or redox-active non-tailpipe metals emissions are responsible for this association. We examined ASD risk associated with fine particulate matter (PM2.5) tracers of tailpipe (elemental carbon [EC] and Organic Carbon [OC]) and non-tailpipe (copper [Cu]; iron [Fe] and manganese [Mn]) sources during pregnancy.

METHODS: This retrospective cohort study included 189,480 children born in Kaiser Permanente Southern California (KPSC) hospitals during 2001-2009. Children were followed until ASD diagnosis or age 5, whichever occurred first. Monthly estimates of PM2.5 EC, OC, Cu, Fe, and Mn with 4 km spatial resolution were obtained from a source oriented chemical transport model. Prenatal exposure to these trace elements was assigned to each maternal address during pregnancy; associations with ASD diagnosis were assessed using Cox regression models adjusting for covariates. To evaluate independence of these associations, we further adjusted the models for PM2.5. To disentangle ASD risk attributable to non-tailpipe from tailpipe sources, we conducted separate two-pollutant models examining the associations with Cu, Fe, and Mn, additionally adjusting for EC and OC.

RESULTS: 2127 children had ASD diagnosis. ASD was positively associated with exposure to tracers of both tailpipe and non-tailpipe emissions in single pollutant models. Observed associations with trace metals reflecting non-tailpipe source of PM2.5 were robust to the adjustment for total PM2.5 and to adjustment for EC and OC.
CONCLUSION: Results suggest that non-tailpipe emissions may be contribute to ASD. Implications are that future conventional vehicles with reduced tailpipe emissions may not eliminate ASD associations with traffic-related air pollution. In contrast, widespread adoption of electric vehicles with zero tailpipe emissions and lower non-tailpipe emissions due to regenerative braking may reduce future ASD associations with traffic-related air pollution.

KEYWORDS: ASD; tailpipe; non-tailpipe

P-1023 Age Acceleration is Associated with Reduced Cognitive Function in Older Men: Results from the Normative Aging Study

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BACKGROUND AND AIM: DNA methylation (DNAm) has been used to quantify the biological effects of external factors on aging processes. This study examined the association between age acceleration and cognitive function in older men using DNAm-based clocks.

METHODS: We evaluated the associations of age acceleration on cognitive function among participants in the Normative Aging Study (NAS). We tested GrimAgeAccel (a biomarker linked with mortality), PhenoAgeAccel (capturing risks for diverse outcomes), Intrinsic (IEAA), and Extrinsic (EEAA) Age Acceleration, and the DNAm-related mortality risk score (DNAmRS). DNAm was determined using Illumina 450K arrays. We modeled six cognitive tests (Mini-Mental State Examination [global function], Word List Memory Task [recent memory], Digit Span Backwards [executive function], Verbal Fluency Test [language], Sum of Drawings [visuospatial ability], and Pattern Comparison Task [visuospatial function]) in linear mixed models adjusted for chronological age, alcohol, smoking status, fish consumption, physical activity, hypertension, diabetes mellitus, English as the first language, computer experience, education, body mass index, and methylation technical covariates.

RESULTS: We evaluated 549 men (mean age: 74.3 years, standard deviation: 6.5 years), mostly white (91.23%). GrimAgeAccel showed significant negative associations with global cognition (β = -0.029, 95% Confidence Interval [95%CI] -0.043, -0.015, p-value < 0.001) and visospatial ability (β = -0.018, 95% CI -0.033, -0.003, p-value = 0.019). PhenoAgeAccel was negatively associated with executive function (β = -0.009, 95% CI -0.017, -0.001, p-value = 0.041) and visuospatial ability (β = -0.019, 95% CI -0.029, -0.008, p-value < 0.001). DNAmRS was negatively associated with recent memory and executive function. IEAA and EEAA did not show consistent results.

CONCLUSIONS: Selected age acceleration biomarkers were associated with accelerated cognitive decline in older men. DNAm-based biological clocks may help identify individuals at higher risk for age-related cognitive decline.

KEYWORDS: Aging, age acceleration, cognitive function, age-related, DNA methylation.

P-1024 Higher surrounding green space is associated with better attention in Flemish adolescents

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BACKGROUND AND AIM: Previous studies suggested that green space is beneficial for the cognitive development in children. However, evidence in adolescents is limited. Therefore, we aim to investigate green space exposure in association with attention and behaviour in adolescents.

METHODS: This study includes 596 Flemish adolescents between 13 and 17 years old. Attention was assessed with Stroop Test (selective attention) and Continuous Performance Test (sustained and selective attention). Behaviour was determined based on the Strengths and Difficulties Questionnaire. Green space was estimated in several radius distances around their current residence and school based on high-resolution land cover data. Multilevel regression analyses were used adjusting for participant's age, sex, education level of the mother, and area deprivation index.

RESULTS: Surrounding green space in a 2000 m radius is associated with a faster reaction time in adolescents. An IQR (13%) increment in total green space within 2000 m of the residence and school combined, is associated with a 32.7 milliseconds (95%CI: -58.9 to -6.5; p = 0.02) and a 7.28 milliseconds (95%CI: -11.7 to -2.8; p = 0.001) shorter mean reaction time between the presentation of a stimulus and the response based on the Stroop Test and the Continuous Performance Test. Subdividing green space based on vegetation height, shows that green space higher than 3 meters is associated with a faster reaction time (-6.50 milliseconds; 95%CI: -10.9 to -2.2; p = 0.004), while low green is not. We did not find an association between green space and behavioural development in adolescents.

CONCLUSIONS: Our study shows that green space, especially trees, surrounding the residence and school combined is associated with better sustained and selected attention in adolescents. These findings indicate that the availability of green is important for adolescents that are growing up in a rapidly urbanizing world.

KEYWORDS: Green space, attention, behaviour, adolescents.

P-1025 Does low-level cadmium exposure affect cognitive functions? Results from the Malmö Diet and Cancer Study

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BACKGROUND AND AIM: Elevated cadmium exposure is toxic for the brain, but it is unclear if low-level exposure is a risk factor for cognitive impairment. We aim at examining the association between blood cadmium and cognitive functions in a Swedish population-based cohort with a follow-up period of 20 years.

METHODS: The Malmö Diet and Cancer Study – Cardiovascular Cohort (aged 46-67 years) was recruited in 1991-1994. After 20 years, a subsample of individuals underwent a clinical reexamination including a global cognitive screening test (Mini-Mental State Examination, MMSE) and a test of processing speed, attention and executive function (A Quick Test of Cognitive Speed, AQT). Associations with blood cadmium (in quartiles, Q1-Q4) at baseline were analyzed using linear regression and adjusted for confounders and known risk factors for cognitive impairment in 2805 individuals with data on blood cadmium and cognitive screening.

RESULTS: The mean total score of MMSE was 28.3 (SD 1.7) points (maximum score 30). The MMSE score was 0.38 points lower (95% CI -0.62, -0.13) among individuals in Q4 (median blood cadmium 1.0 µg/L) compared with those in Q1 (median blood cadmium: 0.13 µg/L). The mean total test time for AQT was 136 (SD 30) seconds. Individuals in Q4 of blood cadmium were on average 7.2 seconds slower (95% CI 2.69, 11.8) than those in Q1. Associations were similar among men and women, and among never, former, or current smokers.

CONCLUSIONS: Blood cadmium in the highest quartile was associated with worse results in two common cognitive tests in a sample from the general population with cadmium exposure comparable to those of most European countries and the U.S. Our findings strengthen the need for further actions to reduce cadmium exposure in the general population.

KEYWORDS: cadmium, cognitive tests, general population

P-1026 Behavioral and Emotional Outcomes in a Cohort of Healthy Young Adults Before and After the COVID-19-related Lockdown

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BACKGROUND AND AIM: The COVID-19 related lockdowns and social restrictions aiming to curb disease transmission negatively impacted mental health. This longitudinal study aims to examine the impact of covid-related lockdowns on the mental health of young adults residing in the Brescia province, Northern Italy, one of the first epicenters of the pandemic in Europe.
METHODS: The Public Health Impact of Metals Exposure (PHIME)study is an ongoing environmental health study of adolescents and young adults living in Northern Italy. 167 PHIME participants completed the Adult Behavioral Checklist (ABCL) by email or phone interview between April 2017-January 2020 (pre-pandemic). We repeated the ABCL in June-July 2020, following the first COVID-19 lockdown in Italy (March-May 2020). 65 subjects (38.5% male) completed pre- and post-ABCL. We used sign test and multiple linear regression models to examine changes in pre- and post-COVID lockdown ABCL scores adjusting for sex, age, IQ, and time (weeks) in lockdown and social restrictions. We also examined differences by sex including an interaction term between time and gender.
RESULTS: Time in lockdown and social restriction until the day of the second interview ranged from 12 to 18 weeks. Overall, thought problems increased between pre- and post-lockdown (median difference: 1.0; 1st, 3rd quartile: -1.0, 4.0; p=0.049).Among males, a longer time in lockdown and social restrictions (> 14 weeks) was associated with increased rule-breaking behaviors (β = 2.8, 95%CI 0.08, 5.5).
CONCLUSIONS: This survey was carried out on a particularly significant sample: the survey participants had already answered previously to the same questionnaire proposed even after the lock-down.These results confirm a negative impact of the pandemic-related lockdown on behavior of young adults with greater impacts on males.These results may inform interventions aimed at minimizing or eliminating the consequences of social isolation experience in youth.

KEYWORDS:
Mental Health, COVID-19 Pandemic and Lockdown, Young Adults

P-1027 Real-life panel study on the associations between electromagnetic fields (RF-EMF) from mobile phones and cognitive performance, sleep, and health-related quality of life

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INTRODUCTION:
The SPUTNIC study (Study Panel on Upcoming Technologies to measure Non-Ionizing radiation and Cognition) aimed to investigate real-life short-term associations between electromagnetic fields (RF-EMF) from mobile phones and cognitive performance, sleep, and health-related quality of life (HRQoL), which have not been well studied.

METHODS: Participants tracked their RF-EMF exposures (cordless calls, mobile calls, and mobile screen time four hours prior to each assessment) as well as health outcomes over ten study days: 1) cognitive performance, through a platform, consisting of six "game-like" tests which assessed verbal and spatial memory repeatedly; 2) HRQoL, reported as mood, tiredness and stress on a Likert-scale and 3) sleep duration and quality measured using Fitbit activity trackers. We fitted mixed models with random intercepts per participant on eight cognitive, three HRQoL and seven sleep scores. Possible time-varying confounders were assessed at daily intervals by questionnaire and used for model adjustment.

RESULTS: We included 121 participants (63 from Besancon and 58 from Basel). We found sporadic significant associations between cordless call duration and a decrease in "Rotations" and combined spatial memory test score, and between mobile phone call duration and an increase "Spatial span" test score. Cordless or mobile phone calls were not associated with any HRQoL indicators but we found a significant association between screen time and decrease in mood score and increased stress. No RF-EMF indicators were associated with any of the 7 sleep duration and quality indicators, except a single association between cordless phone calls and a reduced deep sleep duration, which may have occurred by chance.
DISCUSSION:
We did not find conclusive evidence for adverse health effects of RF-EMF on cognitive performance, HRQoL, or sleep duration and quality. The most consistent finding was a worse mood and increased stress in relation to more screen time, which is consistent with previous studies.

P-1028 Prenatal exposure to polycyclic aromatic hydrocarbons and cognition in preschool-aged children

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BACKGROUND AND AIM: Prenatal exposure to polycyclic aromatic hydrocarbons (PAH) is linked to adverse child neurodevelopmental outcomes, including cognition, but epidemiological evidence is inconsistent and little is known about modifying factors or critical windows of exposure. We investigated associations between prenatal PAH exposure and child cognition in a large, multi-site study.

METHODS: We included nonsmoking mother-child dyads from two prospective pregnancy cohorts (CANDLE and TIDES) in the ECHO-PATHWAYS Consortium. Mono-hydroxylated PAH metabolites (1-hydroxypyrene;1- and 2-hydroxynaphthalene; 1/9-, 2-, and 3-hydroxyphenanthrene; and 2/3/9-hydroxyfluorene) were measured in second trimester urine in both cohorts and additionally in first and third trimesters in TIDES. Full-scale intelligence quotient (FSIQ) was assessed between ages 4-6. Associations between individual PAH metabolites and FSIQ were estimated with multivariable linear regression adjusted for numerous potential confounders. In a TIDES-only sample, we estimated associations with metabolites in each trimester. We assessed modification by child sex and maternal obesity and explored associations of PAH metabolite mixtures with FSIQ using weighted quantile sum regression with a permutation test to control Type I errors.

RESULTS: The pooled sample (N =1,223 dyads) spanned five US regions and was sociodemographically diverse. All associations between PAH metabolites, whether assessed individually or as mixtures, and FSIQ were null after full adjustment. Associations were similar across trimesters of exposure (TIDES-only analysis). We did not observe modification by sex or maternal obesity, except in associations between 2-hydroxynaphthalene and FSIQ, which were adverse in males (β_males= -0.67 [95%CI: -1.5, 0.13] and β_females= 0.31 [95%CI: -0.52, 1.1] per two-fold increase in metabolite; p_interaction = 0.04).
CONCLUSION: In this longitudinal multi-cohort analysis with rigorous adjustment for potential confounders, we found little evidence that prenatal PAH exposure adversely impacts cognition in early childhood. Prenatal PAH could exert neurodevelopmental toxicity but affect endpoints other than cognition, such as behavior.

KEYWORDS: polycyclic aromatic hydrocarbons; neurodevelopment; mixtures

P-1030 Developmental language disorders in preschool children after high exposure to perfluoroalkyl substances from contaminated drinking water in Ronneby, Sweden

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BACKGROUND: There are indications that prenatal exposure to perfluoroalkyl substances (PFAS) might impact neurodevelopment, including language and communication, but results from epidemiological studies are inconclusive and studies from high-exposed populations are sparse.
OBJECTIVE AND AIM: To investigate associations between prenatal exposure to primarily PFHxS and PFOS and developmental language disorder in children up to seven years of age.

METHODS: Register-based cohort of children, born 1998-2013 in the county of Blekinge, Sweden. Maternal residency in Ronneby municipality, with or without highly PFAS contaminated drinking water during the five-year period before childbirth, was used as a proxy for increased prenatal exposure. We included 646 Ronneby children with high PFAS exposure, 1,650 children with intermediate exposure and 9,599 children from county with background exposure. We used Cox proportional hazards regression to estimate hazard ratios (HR) for 1) referral to speech- and language pathologist (SLP) after screening at Child Health Services and 2) ICD-10 diagnosis from at least two clinical assessments by a SLP. Models were adjusted for parity, maternal age, education level, and smoking. We explored effect modification by sex.

RESULTS: The overall adjusted HR for referral to SLP for children with high prenatal exposure was 1.23 (95% CI: 1.03-1.47). Girls had a higher risk than boys.
The HR for ICD-10 diagnosis for children with high prenatal exposure was 1.13 (95% CI: 0.97-1.56), and the association was among girls. Children with intermediate PFAS exposure did not differ from background exposed children.

CONCLUSIONS: Children, particularly girls, with high prenatal exposure to PFAS had an increased risk of developmental language delay and disorders. Further research is needed on the role of PFAS in the context of general neurodevelopment, for which language development is a proxy.
KEYWORD
Register-based population study
Delayed language development
Developmental language disorder
Prenatal exposure
Perfluorohexane sulfonic acid (PFHxS)
Perfluorooctane sulfonic acid (PFOS)

P-1032 Joint Associations of phthalates with social responsiveness in Singaporean Children and potential effect modification by child sex and folate levels: Growing Up in Singapore Towards healthy Outcomes

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BACKGROUND AND AIM: Previous research shows associations between phthalates and folate, and autistic traits, but little is known about their interplay in the etiology of autistic traits. We sought to investigate the joint association of multiple phthalates and social responsiveness in Singaporean children, and the potential effect modification by folate levels.

METHODS: We used data on 431 mother-child dyads from the Growing Up in Singapore Toward healthy Outcomes cohort with available data on phthalates, folate, and social responsiveness scale (SRS-2) scores in 7-years children. We measured six phthalate metabolites in cord blood and used quantile g-computation with interaction terms to assess the joint associations of phthalates with SRS-2 scores and specific sub-scores and potential effect modification by folate concentrations measured at 26-weeks of pregnancy. We also evaluated effect modification by child sex.

RESULTS: The mean SRS-2 score was 55.4 (SD: 7.1). Higher SRS-2 scores indicate more autistic traits. Overall, phthalate metabolites were positively associated with total SRS scores, whereas folate levels were negatively associated with total SRS-2 scores, but none reached the level of significance at $p<0.05$. Mono-2-ethylhexyl phthalate showed stronger association in boys (β for a twofold increase = 1.5; 95% CI: 0.2, 2.8) compared to girls (β = -0.1; 95% CI: -1.2, 1.1). We did not find associations between the joint mixture and SRS-2 scores, however, folate significantly modified the association between the mixture and the SRS-2 social motivation sub-score (p-EM = 0.01), with associations stronger at lower levels of folate (β = 2.1; 95% CI: 0.5, 3.7 when folate at the 25th percentile and β = 0.3; 95% CI: -1.3, 1.8 when folate at the 75th percentile).

CONCLUSIONS: In this cohort study, folate was found to modify the association between phthalates and specific SRS sub-scores and the results varied by child sex.

P-1033 Meta-analysis of head trauma and subsequent risk of brain cancer comparing R and Stata statistical packages

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BACKGROUND AND AIM: Epidemiology research has demonstrated a link between traumatic brain injury (TBI) and subsequent risk of gliomas and meningiomas. McElvanny et al (2021). conducted a meta-analysis using Stata biostatistical methods and found all brain cancer meta-analysis relative risk (MRR) of 1.40 (95% CI 1.11, 1.77). for gliomas the MRRs was 0.96 (0.49, 1.88) and 1.53 (1.02, 2.27) for cohort and case-control studies, respectively. for meningiomas they found MRRs of 1.22 (0.95, 1.76) and 1.88 (0.84, 4.19) for cohort and case control methods.

METHODS: We utilized the same studies selected by McElvanny but used the R statistical software to conduct the meta-analysis to contrast the findings.

RESULTS: For all brain tumors, the cohort MRR was 1.19 (95% CI 0.88, 1.61), while the case-control MRR was 1.58 (1.09, 2.29). Overall, the MRR was 1.40 (1.11, 1.77). for gliomas we found MRR of 1.53 (1.02, 2.99) using case-control design, using cohort studies the MRR 0.96 (0.49, 1.88). Overall, the MRR was 1.33 (0.94, 1.89). for meningiomas cohort studies the MRR was 1.22 (0.85, 1.76); for case-control study designs the MRR was 1.88 (0.84, 4.19); and overall, the detected MRR was 1.65 (0.97, 2.81). for all brain tumors, gliomas, and meningioma studies there was significant heterogeneity between studies ($p < 0.001$). Funnel plots and Egger's test were used to assess publication bias. There was no strong evidence ($p>0.05$) for publication bias for all brain tumors, gliomas, and meningioma meta-analyses.
CONCLUSION:
Contrasting R and Stata for this meta-analysis suggest both packages are measuring the same risk levels for brain cancers after head trauma. These results support further studies focusing on the association between TBI and brain cancer, especially gliomas. Our assessment also suggests the need for more research on TBI and brain tumors among veterans.

KEYWORDS: meta-analysis, head trauma, brain cancer

THEMATIC 19: Reproductive outcomes

P-1176 Association between ambient air pollution and polycystic ovarian syndrome: A 2010-2019 national populational-based cohort study in Korea

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BACKGROUND: Several studies have indicated that prenatal exposure to ambient air pollution is associated with an increased risk of gestational diabetes mellitus, hypertensive disorder during pregnancy, preterm birth, and stillbirth. However, no previous study has focused on the association between the number of pregnancy complications and exposure to ambient air pollution.
Objectives: To investigate the association between prenatal exposure to ambient air pollutants and the number of pregnancy complications in high-risk pregnancies.

METHODS: We collected data on gestational diabetes mellitus, hypertensive disorder during pregnancy, preterm birth, and stillbirth from the National Health Information Databases, provided by the Korean National Health Insurance Service. To assess individual-level exposure to air pollutants, a spatial prediction model and area-averaging approach were used.

RESULTS: From 2015 to 2018, data of 789,595 high-risk pregnancies were analyzed. The ratio of gestational diabetes mellitus in the country was the highest, followed by preterm birth, hypertensive disorder during pregnancy, and stillbirth. Approximately 71.7% of pregnant women (566,143) presented with one pregnancy complication in identical pregnancies, 27.5% (216,714) presented with two, and 0.9% (6738) presented with three or more. Multiple logistic regression models with adjustments for age, residence, and income variables indicated that the risk of having two or more pregnancy complications was positively associated with the exposure to higher levels of PM10 (odds ratio [OR], 1.11; 95% confidence interval [CI], 1.09–1.12) and PM2.5 (OR, 1.14; 95% CI, 1.12–1.15). The highest quartile presented higher odds of two or more pregnancy complications compared with the lower three quartiles of PM10, PM2.5, CO, NO2, and SO2 exposures ($p < 0.001$).
CONCLUSION: The results indicate that the risk of pregnancy complications is positively associated with the exposure to the high concentrations of PM10, PM2.5, CO, NO2, and SO2.

P-1183 Cumulative risk assessment of phthalates exposure for recurrent pregnancy loss in reproductive-aged women population using multiple hazard indices approaches

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BACKGROUND AND AIM: Phthalates, which are commonly used in flexible plastics and consumer products, have been reported to be toxic to reproductive and developmental function in mammals. Past studies have focused on the toxic effects on male reproduction, with only a few studies conducted on the risks that cumulative exposure to phthalates have on the female reproductive system.

METHODS: We recruited 260 patients with recurrent pregnancy loss (RPL) of unknown etiology and 203 controls from the clinics of Obstetrics and Gynecology at a medical center in southern Taiwan from 2013 to 2020. The daily intake of phthalates was estimated from urine samples using the back-calculation method, after which the cumulative risk was determined using multiple hazard indices, including a dose-addition model, a receptor effect model, and a hazard index approach.

RESULTS: The patients with RPL had a significantly higher cumulative exposure to phthalates ($p < 0.05$) than did the controls with a hazard index above one. After adjusted logistic regression analysis, we found that the risk of RPL was strongly related to the higher quartiles of DEHP, the DEHPTEQ for the antiandrogenic effect and adverse effects of the female reproductive system and the ERα binding effect ($p < 0.05$).

CONCLUSIONS: Our work suggests that more attentions should be paid to the adverse effects induced by phthalates on female reproduction, especially the effects caused by the cumulative exposure to phthalates in women of reproductive age.

KEYWORDS: Phthalates; Cumulative risk assessment; Relative potency factor; Recurrent pregnancy loss

P-1184 Associations between Gestational Exposure to Air Pollution and Maternal Vitamin D Levels

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BACKGROUND AND AIM: Individuals living in areas with higher air pollution have lower levels of vitamin D than residents of areas with lower pollution. Evidence suggests non-optimal gestational vitamin D as an important determinant of pregnancy and child health outcomes. We investigated the association between gestational exposure to air pollution and maternal vitamin D levels.
METHODS: Participants were 16,553 pregnant women from birth cohorts in the UK (BiB), US (Project Viva), Netherlands (ABCD and Generation R), Poland (REPRO_PL), and Spain (INMA). Averaged concentrations of air pollutants from conception until vitamin D measurement were estimated at participants' residential addresses using land-use regression or other spatiotemporal models. Cohorts measured 25-hydroxy vitamin D [25(OH)D] and/or 25(OH)D3 in serum or plasma at early or mid-pregnancy. We performed linear regression models in each cohort to estimate the association between air pollution exposure and vitamin D levels and pooled cohort-specific results in a random-effect meta-analysis. Models were adjusted for sociodemographic characteristics, smoking and alcohol use, parity, body mass index, and month of conception.
RESULTS: Concentrations of nitrogen dioxide and fine PM (PM2.5) were lower and had less variation in Project Viva and BiB than other cohorts. In REPRO_PL, 95% of women had vitamin D<20 ng/ml; this rate was 85% in BiB, 52% in Generation R, and <50% in other cohorts. We found an inverse association between PM2.5 and vitamin D levels (-1.4 ng/mL, 95%CI:-2.6,-0.2, per 5 µg/m3 increase in PM2.5). Heterogeneity was high among cohorts, with associations driven by ABCD, BiB, and INMA. There was no association between nitrogen oxide exposure and vitamin D levels.
CONCLUSIONS: PM2.5 exposure might contribute to non-optimal levels of vitamin D in pregnancy. Future studies should focus on underlying mechanisms, including biological pathways, e.g., inducing metabolism of vitamin D, or other factors, e.g., reduced outdoor activity.

KEYWORDS: 25(OH)D; PM2.5; pregnancy; women

P-1187 Relationship between PM2.5 and low birth weight infant in Ho Chi Minh City: a spatial nested case control study

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BACKGROUND AND AIM: The study aims to determine the average PM2.5 concentration and the association between PM2.5 and low birth weight infant in Ho Chi Minh City (HCMC), Vietnam 2020.

METHODS: The concentration of PM2.5 is extrapolated from 31 monitoring air stations of PAMAIR network that distributed across districts in HCMC, and the individual exposure was assigned base on their living address. The relationship between PM2.5 and low birth weight infant was determined through odds ratio and multivariable logistic regression model.

RESULTS: The annual average concentration of PM2.5 was 27.8 µg/m3, which was higher than the WHO standard (PM2.5 < 10 µg/m3) and higher than the Vietnamese standard (PM2.5 <25µg/m3). The study found that exposure to high levels of PM2.5 during maternal pregnancy was a risk factor for having a low birth weight infant with OR: 1.01 (95% CI: 1.003- 1.019). The study proposes that there should be measures to minimize the harmful effects of PM2.5 on the birth outcomes of the maternal women.

KEYWORDS: PM2.5, air pollution; low birth weight, infant; birth outcomes

P-1190 Disentangling the influence of temperature and season on weekly birth rates in Vienna, Austria

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BACKGROUND: Before examining other environmental predictors of weekly birth- and conception rates, we set out to investigate seasonal and meteorological predictors in a time series of births given by Viennese women between 1999 and 2019.

METHODS: We extracted week of birth and duration of gestation in weeks to calculate number of conceptions and of births per week. for both outcomes (birth and conception numbers) we first applied negative binomial regression models. But, when we saw that over-dispersion was negligible, we reverted to Poisson regression models. As predictors, we included a linear term, sine-cosine functions with a wave-length of one year, and another one with a wavelength the average duration of a lunar cycle. In addition, we included temperature as a linear and a quadratic term.

RESULTS: On average 341.4 births and 344.1 conceptions occurred per week. The number of births and conceptions increased over the years and within each year seasonal variation was visible. Birth numbers according to the annual sine-cosine model were lowest in January and February and highest in July and August. The number of conceptions were lowest in May and highest in November. Adding another sine-cosine function for the lunar cycle did not improve the model fit much. Nevertheless, that parameter was still significant, with the highest birth numbers occurring roughly between the waxing crescent and the first quarter moon, and the highest conception numbers conceptions occurring at the full moon. Extremer temperatures (both hot and cold) decreased conception numbers and increased birth numbers.
CONCLUSION: While the effects of temperature and the annual variation resembled our expectations, the lunar influence was unexpected. This latter finding should be treated with care, because it was not hypothesis driven.

KEYWORDS: annual & lunar cycle, births, temperature, births, conceptions

P-1192 Traffic-related air pollution and fetal growth in Eastern Massachusetts, USA

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BACKGROUND AND AIM: Previous studies have examined the association between prenatal nitrogen dioxide (NO2) —a traffic emissions tracer— and fetal growth based on ultrasound measures during pregnancy. Yet, most have used exposure assessment methods with low temporal resolution, which limits the identification of critical exposure windows given that pregnancy occurs over a relatively short period. Here, we used NO2 data estimated from a high-resolution spatiotemporal model to examine the association between weekly NO2 exposure during pregnancy and fetal growth in a Massachusetts-based cohort.

METHODS: We used data from 9,446 singleton births at Beth Israel Deaconess Medical Center in 2011-2016. Fetal growth parameters included birth weight, and ultrasound measures of biparietal diameter (BPD), head circumference (HC), femur length, and abdominal circumference. Ultrasound parameters were classified into three distinct gestational periods: 16-23 weeks, 24-31 weeks, and 32+ weeks. We used distributed lag models to estimate the time-varying association between weekly NO2 exposure and fetal growth. All models were adjusted for sociodemographic characteristics, time trends, particulate matter less than 2.5 microns (PM2.5), and temperature.

RESULTS: We found that higher NO2 was negatively associated with all fetal growth parameters. The critical window differed depending on the fetal growth parameter and when it was assessed, with associations particularly strong for head parameters. for example, for BPD and HC measured after week 32, the critical exposure window appeared to be around weeks 15-25; a 10-ppb higher NO2 exposure sustained from conception to the time of measurement was associated with a lower mean z-score of -0.26 (95% CI: -0.39, -0.13) and -0.13 (95% CI: -0.25, 0.00) for BPD and HC, respectively.

CONCLUSIONS: Higher NO2 was associated with smaller fetal growth measures. We identified several critical exposure windows that varied by parameter and timing of measurement.

KEYWORDS: air pollution, traffic, nitrogen dioxide, fetal growth, ultrasound, pregnancy, critical window

P-1194 Traffic-related air pollution and birth weight: the roles of noise, placental function, green space, physical activity, and socioeconomic status (FRONTIER)

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BACKGROUND AND AIM: FRONTIER aims to study the impact of maternal exposure to traffic-related air pollution (TRAP) on fetal growth while disentangling the effects of noise, elucidating the role of placental function as an underlying mechanism; and exploring the potential of greenspace to mitigate it.

METHODS: FRONTIER has established a new pregnancy cohort of 1,086 pregnant women in Barcelona (BiSC), Spain. Fetal growth was characterized by anthropometric measures at birth together with ultrasound-based measures of fetal development. We are integrating objective data on time-activity patterns with a hybrid modeling framework combining dispersion and land use regression models and campaigns of personal and home-outdoor air pollution monitoring to estimate maternal exposure level and inhaled dose of NO2, PM2.5, and PM2.5 light absorption and contents at the main microenvironments (home, workplace, and commuting routes). We are assessing maternal exposure to noise by integrating measurements at participants' home-outdoor using noise monitors together with modeled microenvironmental noise levels and data on noise sensitivity, annoyance, and protections against noise. We will develop single- and multi-pollutant models to evaluate the impact of air pollution exposure and inhaled dose on fetal growth and the mediatory role of placental function.

RESULTS: BiSC mothers had an average age of 34.8 years with 31.1% having high school education and less and 73.6% having European origin. The mean (SD) of the first and third trimester measured personal NO2 levels were respectively 31.9(11.7) and 31.0(12.1)µg/m3 for the pre-pandemic period and 26.6(10.9) and 25.1(12.1)µg/m3 for the pandemic period. The mean (SD) of measured home-outdoor noise levels (LAeq,24h) was 61.5 (6.7)dB(A). 49.2% of newborns were girl and the mean (SD) of birthweight was 3276.8 (508.2)g The analyses are still ongoing.

CONCLUSIONS: FRONTIER will provide a robust and comprehensive evaluation of the impact of TRAP exposure on fetal growth using high-resolution exposure data.

P-1195 A comparison of the systematic reviews and meta-analyses conducted to explore the effect of air pollution exposure during pregnancy and the risk of preterm birth

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BACKGROUND AND AIMS:
There has been a rapid rise in systematic reviews and meta-analyses (SR/MAs) conducted on the association between air pollution exposure during pregnancy and the risk of preterm birth in recent years. Few studies have examined differences in their quality and if they have provided additional insight into the field. This study analysed previous SR/MAs to explore their practices and identify gaps and opportunities for the research field. This work was done to determine if an upcoming SR/MA was needed.

METHODS: A literature search using major English and Chinese databases was performed to find SR/MAs published from 2010 onwards. Information regarding publication date, methods of quality assessment, consideration of population overlap, and primary studies included in their analysis were extracted and compared.

RESULTS: Seventeen SR/MAs, which included thirteen MAs were conducted from 2010 onwards. A large variety of quality assessment tools were used, but the Newcastle-Ottawa Scale was the most common (n=6). Seven MAs explicitly mentioned that they took population overlap into account. Four SR/MAs were found in 2021 alone, but three did not examine the whole literature and focused on specific study designs or exposure assessment methods. They were thus unable to build on finding of previous work due to exclusion of studies that were included in other SR/MAs.

CONCLUSIONS: A considerable number of SR/MAs provided limited addition to the field as they were conducted without sufficient rigour. This may hinder coming to a consensus on the effect estimate of interest and overlook field-specific biases. Therefore, a new SR/MA with improvements in transparency in reporting, replicability of findings, and quality assessment of studies is required. The protocol of this SR/MA is now registered on PROSPERO and will begin in due course.

KEYWORDS: Maternal exposure; preterm birth; meta-analysis; birth outcomes, air pollution; pregnancy

P-1198 The association between metals, vitamin D and preterm birth in the MIREC Cohort Study

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BACKGROUND:
Toxic metals, like lead, are risk factors for preterm birth (PTB), but few studies have explored this association at the low levels currently found in the Canadian population. Conversely, studies suggest that vitamin D may have antioxidant activity and protect against PTB. In this study, we sought to investigate associations between toxic metals (lead, mercury, cadmium and arsenic) and PTB, and to determine if maternal plasma vitamin D concentrations modify these associations.
METHODS: We investigated whether metals in whole blood measured in early and late pregnancy were associated with PTB (<37 weeks) and spontaneous PTB (a subset of PTBs with spontaneous labour) in 1,851 pregnancies resulting in live births from the Maternal-Infant Research on Environmental Chemicals Study (MIREC) using discrete time survival analysis. In addition, we investigated whether the risk of PTB was modified by plasma 25OHD concentration measured in the 1st trimester.
RESULTS: Six percent (n=117) of live births in the MIREC study were PTBs; 4% (n=89) were spontaneous PTBs. A 1 µg/dL increase in blood lead concentrations during pregnancy was associated with increased risk of PTB (OR=1.5, 95% CI: 1.0, 2.3) and spontaneous PTB (OR=1.7, 95% CI: 1.1, 2.8). In stratified analysis, the risk of PTB (OR=2.7, 95% CI: 1.0, 7.2) and spontaneous PTB (OR=3.4, 95% CI: 1.1, 10.8) was higher in women with insufficient vitamin D concentrations (25OHD <50 nmol/L). However, a statistical interaction was not seen. Arsenic was associated with a higher risk of PTB (OR=1.1, 95% CI: 1.0, 1.2) and spontaneous PTB (OR=1.1, 95% CI: 1.0, 1.2) per µg/L, but these associations were not modified by vitamin D.
CONCLUSIONS: Low levels of lead and arsenic may increase the risk of PTB and spontaneous PTB; the association with lead was stronger in participants with insufficient plasma vitamin D. Replication of these findings is warranted.

P-1200 Internal exposure levels of persistent organic pollutants, ovarian function and in vitro fertilization outcomes: a multipollutant analysis

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BACKGROUND AND AIM: Women are exposed to complex mixtures of persistent organic pollutants (POPs), with the potential to interfere with the reproductive system. This study aimed 1) to characterize the internal exposure levels of polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and perfluoroalkylated substances (PFAS) in women undergoing In vitro fertilization (IVF); and 2) evaluate their association with markers of ovarian function and IVF outcomes.

METHODS: Women (n=136) attending the Assisted Reproductive Technology service from Nantes University Hospital (France) were prospectively recruited. Serum samples were analysed using liquid chromatography with tandem-mass spectrometry for 14 PFAS. Follicular fluid was analysed with gas chromatography coupled to high resolution mass spectrometry for 30 PCBs and 14 OCPs. Ovarian function markers, biological and clinical IVF outcomes were ascertained by embryologists or clinicians using standardized protocols. The associations were assessed with multivariate regression models and Bayesian Kernel Machine Regression (BKMR).

RESULTS: Twenty-seven POPs were frequently quantified in almost all women attending IVF. Positive associations were found between the pesticides hexachlorobenzene, β-hexachlorocyclohexane and epoxy-heptachlor with Follicular Output RaTe (FORT). Our results globally showed that most POPs were not associated with clinically relevant IVF outcomes, like live birth rates. Nonetheless, negative associations between PCB138 and trans-nonachlor with the number of usable blastocysts were observed, β -0.28 (95%CI [-0.52; -0.04] p=0.02) and β -0.22 (95%CI [-0.40; -0.03] p=0.02.

CONCLUSIONS: Altogether, our results indicate a lack of associations between most individual chemicals or their mixtures with markers of ovarian function and IVF outcomes. Nonetheless, some highly prevalent OCPs were linked with markers of ovarian responsiveness like FORT and the number of usable blastocysts, supporting the need of conducting further studies in a larger populations sample in order to ensure sufficient statistical power to identify mild effects and a robust stratification analysis to account for the large underlying disease heterogeneity.

P-1202 Per- and polyfluoroalkyl substances in early to mid-pregnancy and gestational diabetes mellitus: A multi-racial/ethnic longitudinal study

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) as endocrine disruptors have been linked to glucose homeostasis. Data on PFAS and gestational diabetes (GDM) are scarce and inconclusive. We examined prospective associations of PFAS in early to mid-pregnancy with GDM risk.

METHODS: Within the prospective Pregnancy Environment and Lifestyle Study, we conducted a nested case-control study of 41 GDM cases diagnosed at gestational weeks 24-28 and 87 controls. Fourteen PFAS analytes were measured in serum collected in the first and second trimesters, with cumulative concentrations estimated by area-under-the-curve (AUC). Weighted logistic regression examined seven PFAS with at least 50% of values above the limit of detection in association with GDM risk, adjusting for age, race/ethnicity, pre-pregnancy body mass index, and parity. P-values were corrected using false-discovery-rate (FDR). We examined effect modification by Asian/Pacific Islander (A/PI) or non-A/PI given the higher risk of GDM in A/PI.

RESULTS: Per interquartile range (IQR) increase in first-trimester concentrations of perfluorodecanoic acid [PFDA; adjusted odds ratio (95% CI): 1.23 (1.09-1.38)], perfluorononanoic acid [PFNA; 1.40 (1.24-1.58)], and perfluorooctanoic acid [PFOA; 1.15 (1.04-1.27)] were associated with a higher GDM risk; results were similar for the second-trimester and AUC concentrations (all FDR <0.01). Per IQR increase in concentrations of perfluorooctanesulfonic acid [PFOS; 1.41 (1.17,1.71)] and perfluroundecanoic acid [PFUnDA; 1.49 (1.18-1.89)] in the second trimester were associated with a higher GDM risk (both FDR <0.01). These associations were more prominent among A/PI who had higher PFAS concentrations than non-A/PI. Perfluorohexane-1-sulphonic acid (PFHxS) concentrations across different times were inversely associated with GDM risk (aOR ranged 0.46-0.49); however; these associations were positive among A/PI (all FDR <0.001).

CONCLUSIONS: Early to mid-pregnancy serum concentrations of PFDA, PFOA, PFOS and PFUnDA were positively, whereas PFHxS were inversely associated with GDM risk. Future work examining PFAS in mixture and GDM risk is underway.

P-1204 Longitudinal Associations between Air Pollution and Angiogenic Factors among Pregnant Women

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BACKGROUND AND AIM: Exposures to air pollution during pregnancy have been linked to adverse pregnancy outcomes, such as spontaneous preterm birth and preeclampsia (PE), and to later life risk of cardiovascular disease (CVD). Disordered angiogenesis is one potential linking mechanism between the impact of air pollution on pregnancy outcomes like PE and later life outcomes like CVD.We aimed to examine longitudinal associations between air pollution exposure and angiogenic factors among pregnant women in the Boston, MA based biorepository, LIFECODES.

METHODS: Placental growth factor (PlGF) and soluble fms-like tyrosine kinase 1 (sFlt-1) were measured between 2006-2008 among pregnant women using plasma samples collected at 10, 18, 26, and 35 weeks' gestation. Women's time-varying exposures to ozone and fine particulate matter (PM2.5) between plasma sample collections during pregnancy were estimated based on geocoded residential addresses using U.S. Environmental Protection Agency's Fused Air Quality Surface Using Downscaling Files. Mixed effect linear regression models were fitted to assess the associations between ozone (ppb), PM2.5 (ug/m3) and PlGF (pg/mL), sFlt-1 (ng/mL) and sFlt-1:PlGF ratio. Coefficients for log-transformed outcomes (interpreted as percentage changes) for each interquartile range increase in exposures were reported, along with their 95% confidence intervals (95% CI).

RESULTS: A total of 718 pregnant women were included in this study. In the co-pollutant models, higher exposures to ozone and PM2.5 were associated with a 20.8% (95% CI: 5.3%, 36.2%) increase in sFlt-1 and a 16.6% (95% CI: 4.6%, 28.6%) decrease in PlGF during pregnancy, respectively.

CONCLUSIONS: Exposures to air pollution during pregnancy were associated with lower PlGF and elevated sFlt-1 among pregnant women, which may be a potential mechanism underlying air pollution's impacts on adverse pregnancy outcomes like PE and later life outcomes like CVD.

KEYWORDS: air pollution, angiogenic factors, fine particulate matter, ozone.

P-1205 Associations of blood cadmium, lead, and mercury levels with age of menarche, menopause, and reproductive lifespan of Korean women: KNHANES 2008-2017

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BACKGROUND AND AIM: Lead and cadmium have been suggested for delayed pubertal development and menopause of women, but these findings are often inconsistent or based on a small number of humans, and have not been studied in the Korean populations.

METHODS: The multi-cycle data from Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2017, were used and two groups of women (15≤, and 55≤ years of age) were identified. Survey regression analysis was conducted to find the relationship of blood levels of cadmium, lead, mercury, with age of menarche, age of menopause, and reproductive lifespan. for these analyses, women with pathological menarche/menopause, artificial menopause, current pregnancy, and breast cancer, were excluded. Multivariable analysis models were constructed with relevant covariates.

RESULTS: Age of menarche was significantly increased with higher blood cadmium, lead, and mercury levels ($p<.0001$). for the age of menopause, blood cadmium levels were positively associated ($p=0.03$). However, blood lead and mercury levels did not show significant relationship with menopause. Positive relationship between cadmium and age of menarche and menopause was also observed in sensitivity analyses employing different age groups (15≥, and 55≥ years of age). Reproductive lifespan was increased as blood cadmium level increased ($p=0.04$).

CONCLUSIONS: In a large group of Korean women, we observed that the ages of menarche and menopause were associated with blood cadmium levels, and increased the reproductive lifespan. Underlying mechanisms of delayed pubertal onset and menopause by metal exposure, and public health implication of longer endogenous estrogen exposure deserve further investigation.

KEYWORDS: Heavy metals, menarche, menopause, reproductive lifespan
This research was supported by a National Research Foundation of Korea (NRF) grant funded by MSIT (No. 2020R1A2C3011269) and a grant of the Korea Health Technology R&D Project through KHIDI, funded by the Ministry of Health & Welfare, Republic of Korea (grant number : HI19C1194).

P-1206 Adverse neonatal outcomes among high-risk pregnant women in the State of Rondônia, Amazon, Brazil

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Amazon urbanization drives profound changes in the environment, and rising exploitation of natural resources, resulting in greater exposure to environmental contaminants and pregnancy complications.
AIM: To describe the adverse outcomes of high-risk pregnant women attending a reference hospital in Rondônia State (RO).

METHODS: Cross-sectional study with high-risk pregnant women residing in RO for at least two years, with a singleton pregnancy, and no alcohol, cigarettes, and drugs consumption during pregnancy. Information on pregnancy, adverse pregnancy outcomes (malformation, low birth weight, preterm infants), sociodemographic characteristics, gestational history, and birth data were collected throughout the questionnaire. Data were described as absolute and relative frequencies.

RESULTS: Among 330 mother/child binomials assessed, 57% of newborns were premature, 53% had low birth weight, and 37% had congenital malformations, being the most frequent those related to the cardiovascular, digestive, musculoskeletal, and neurological systems. About 68% of newborns required neonatal intensive care. Most mothers were younger than 35y (70%), were married or had a stable partner (70%), had completed high school or more (58%), had family income of up to two minimum wages (74%), and used water from a well (51%). The majority had six or more prenatal consultations (61%) and were multiparous. The most frequent clinical complications were urinary tract infection, hypertension, preeclampsia, and anemia. Most women (56%) reported using some “household pesticides” (mainly insecticides and herbicides). Some women have worked in agriculture (16%), livestock (9%), and gold mining (2%). and about 80% reported having a partner currently or previously working in these activities.

CONCLUSIONS: Adverse pregnancy outcomes can be related to individual, socio-environmental and clinical factors. Therefore, understanding these risk factors makes it possible to glimpse paths towards an assistance capable of protecting maternal and child health, with particular attention to vulnerable populations.

P-1207 Associations between follicular fluid trace elements and ovarian reserve during in vitro fertilization

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BACKGROUND AND AIM: Exposure to trace elements (TE) has been associated with female reproductive function, including among women using in vitro fertilization (IVF). Our aim was to estimate associations between TEs in ovarian follicular fluid (FF) and measures of ovarian reserve among women using IVF.

METHODS: We collected up to 4 individual ovarian FF specimens from 56 women. We determined concentrations (µg/L) of essential and non-essential TEs in FF (As, Cd (ng/L), Co, Cu, Hg, Mn, Mo, Pb, Se, Sr, and Zn) using inductively coupled plasma-tandem mass spectrometry. We estimated associations between women's averaged individual FF TEs, per interquartile range (IQR) difference, and measures of ovarian reserve using linear (peak estradiol (E2), baseline anti-mullerian hormone (AMH), and peak endometrial thickness) and negative binomial (baseline antral follicle count (AFC)) regression, adjusted for age, race/ethnicity, and BMI. We also estimated associations of joint exposure to FF TE with ovarian reserve using principal component analysis (PCA).

RESULTS: Higher FF Cu was individually associated with a 22.88% greater E2 (95%CI:4.24% 44.85%). Higher FF Pb and Se were individually associated with -35.78% (95%CI:-53.43%, -11.45%) and -16.44% (95%CI:-32.28%, 3.11%) differences in AMH, and joint exposure to greater FF Cd and Pb was associated with a -22.25% (95%CI:-39.82%, 0.45%) difference in AMH. Higher FF Co was individually associated with 21.79% (95%CI:4.20%, 42.67%) greater AFC. Higher FF Co was individually associated with a 1.24 mm (95%CI:0.23, 2.25) thicker endometrium, and greater joint FF Se, Cu, and Zn (β=0.60 mm; 95%CI:-0.11, 1.30), lower joint Co and Mn combined with higher Hg and Sr (β=-0.72 mm; 95%CI:-1.48, 0.04), and higher joint Cd and Pb (β=-0.86 mm; 95%CI:-1.60, -0.11) were associated with greater and lesser endometrial thickness, respectively.

CONCLUSIONS: Our results suggest that essential and non-essential TEs in FF were associated with ovarian reserve among women using IVF.

KEYWORDS: Metals, ovary

P-1208 Associations between Preterm Birth and Wastewater Injection-Induced Earthquakes in Oklahoma

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BACKGROUND AND AIM: Oil and gas wastewater injection has contributed to increased seismicity in Oklahoma. Prior work has linked gestational exposure to single large earthquakes to higher risk of adverse birth outcomes. We aimed to assess the effect of exposure to all earthquakes with a moment magnitude 4.0 or greater (≥M 4.0) during pregnancy on preterm birth risk in Oklahoma.

METHODS: We used Oklahoma live birth data from the US National Center for Health Statistics and seismic data from the USA Geological Survey between 2010 and 2017. for our main analysis, we assigned exposure by counting the number of ≥M 4.0 earthquakes that occurred within 100km of each Oklahoma county and linked these to pregnant individuals during each week of gestation by county of residence. We assigned secondary exposures using a crowdsourced earthquake catalog, Did You Feel It. We ran Cox proportional hazards models to estimate the association between pregnancy-wide earthquake count and preterm birth adjusting for maternal age, parity, race, and educational attainment and county-level poverty, income, temperature, and $PM_{2.5}$ concentration. We assessed potential effect modification by trimester of exposure using interaction terms between earthquake exposure and trimester.

RESULTS: We examined 420,485 live births in Oklahoma and 86 earthquakes ≥ M 4.0 from 2010–2017. We observed associations in primary analyses between counts of pregnancy-wide earthquakes ≥M 4.0 and preterm birth (hazard ratio (HR) = 1.018; 95%CI: 1.008, 1.028) and first trimester earthquake exposure (HR = 1.064; 95%CI: 1.047, 1.082), with no significant association observed in exposure during the second or third trimesters. Secondary analyses with Did You Feel It data yielded slightly attenuated pregnancy-wide results (HR = 1.01; 95%CI: 1.00, 1.01).

CONCLUSIONS: Policymakers may wish to consider these findings to inform oil and gas wastewater regulation to protect maternal and child health.

KEYWORDS: earthquakes, Oklahoma, preterm birth

P-1209 Associations between Residential Proximity to Major Roads and Semen Quality: Results from a North American Preconception Cohort Study

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BACKGROUND: Metrics related to semen quality are clinically relevant markers of male fertility, and they could plausibly be affected by traffic-related air pollution. Existing studies yielded conflicting results.

METHODS: In a large preconception cohort study (Pregnancy Study Online [PRESTO]), we examined associations between traffic-related air pollution exposure and semen quality. From 2015-2019, male participants aged ≥21 years who resided in the USA were invited to complete semen testing using a validated at-home testing kit that provides quantitative measures of semen quality parameters (semen volume, sperm concentration, sperm motility). Using geocoded residential addresses at baseline, we estimated exposure by calculating the distance from residential location to the nearest major road and traffic intersection. We estimated the association between roadway proximity measures and log-transformed semen parameters by linear regression, adjusting for demographic and reproductive characteristics and used generalized estimating equations to account for correlation from participants who contributed two semen samples.

RESULTS: 196 participants contributed 333 samples for preliminary analysis. Mean sperm count was 243.2 million (142.4 motile), and mean sperm concentration was 66.5 million/mL (39.6 motile). Compared to participants who resided ≥400 m from a major road, we found suggestive evidence of reductions in semen parameters among participants who resided <100 m from a major road for sperm concentration (-15.3, 95% CI: -31.9, 1.3), motile sperm concentration (-10.4, 95% CI: -24.1, 3.4), total sperm count (-48.9, 95% CI: -120.0, 22.3), and total motile sperm count -39.5, (95% CI: -94.3, 15.3) . We did not find evidence of an association with distance to the nearest intersection.
CONCLUSION: Residing close to a major road might be associated with small reductions in semen parameters, adding to the growing body of evidence that traffic-related air pollution may affect male fertility.

KEYWORDS: reproductive outcomes, traffic-related air pollution, male fertility, semen quality, sperm

P-1210 Drinking Water Arsenic, Hemoglobin, and Anemia among Pregnant Women in Rural Northern Bangladesh

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BACKGROUND AND AIM: Anemia afflicts ~40% of pregnant women worldwide, increasing risks of maternal and perinatal mortality. Arsenic exposure has been positively associated with anemia in adults, but evidence during pregnancy is limited. We assessed whether drinking water arsenic was associated with anemia among pregnant women in an area of rural northern Bangladesh where a high prevalence of anemia without iron deficiency was reported.

METHODS: We enrolled pregnant women (n=784) in the second trimester (median [IQR] gestational week: 14 [13-15]) in Gaibandha District, Bangladesh, 2018-2019. We measured drinking water arsenic (w-As) and iron (w-Fe) by ICPMS and capillary blood hemoglobin (Hb) by photometry at enrollment (Visit 1, n=778) and ~4 weeks post-enrollment (Visit 2, n=733). Anemia was defined as Hb <11 g/dL. We estimated expected differences in Hb and odds ratios for anemia per IQR-unit increase in w-As, adjusting for w-Fe, age, gestational week, parity, education, living standards index, mid-upper arm circumference, husband's smoking, and visit. We used generalized estimating equations with an exchangeable correlation structure.

RESULTS: At Visits 1 and 2, median (IQR) w-As, w-Fe, and Hb were 5.1 (0.5-25.1) and 5.3 (0.39-26.8) µg/L, 4.7 (0.49-19.0) and 4.5 (0.57-18.3) mg/L, and 11.8 (11.2-12.5) and 11.3 (10.7-11.9) g/dL, and anemia prevalence was 16.5 and 33.4%, respectively. In crude models, the per-IQR-unit w-As expected difference (95% confidence interval [CI]) in Hb was 0.18 (0.07-0.30) g/dL and the odds ratio (95% CI) for anemia was 0.68 (0.54-0.85). After adjustment, the expected difference (95% CI) in Hb was 0.15 (0.00-0.30) g/dL and the odds ratio (95% CI) for anemia was 0.65 (0.47-0.92).

CONCLUSION:

Contrary to prior research in adults, arsenic was positively associated with Hb and negatively associated with anemia in pregnancy. Results might be attributable to reduced plasma volume expansion and hemodilution, but further research is needed.

KEYWORDS:

Anemia, Arsenic, Hemoglobin, Pregnancy

P-1212 Urinary paraben and phenol concentrations driving markers of inflammation among pregnant women in Puerto Rico

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BACKGROUND AND AIM:
Widespread exposure to phenols and parabens is a potential contributing factor for increased inflammation and adverse birth outcomes, but these effects are not well-studied in humans. This study aimed to investigate relationships between urinary concentrations of 8 phenols and 4 parabens with 6 inflammatory biomarkers (C-reactive protein (CRP), matrix metalloproteinases (MMP) 1, MMP2, MMP9, intercellular adhesion molecule 1 (ICAM-1), and vascular cell adhesion molecule 1 (VCAM-1)) repeatedly measured across pregnancy in the Puerto Rico PROTECT birth cohort. We hypothesized that biomarkers of phenol and paraben exposure would be associated with upregulation of inflammatory markers.

METHODS: Phenol and paraben concentrations in spot urine samples were measured using tandem mass spectrometry. Inflammation biomarkers were measured in blood serum using customized Luminex assays. Linear mixed models were used to assess relationships between exposures, outcomes, and covariates (maternal age, education, pre-pregnancy BMI, and specific gravity), and in sensitivity analyses, models were stratified by fetal sex. Results are expressed as the percent change in outcome per interquartile range increase in exposure.

RESULTS: Significant positive associations were found between bisphenol-A and CRP (9.68%, CI: 0.56, 19.62); bisphenol-S and MMP9 (6.41%, CI: 0.92, 12.19); and methylparaben and MMP1 (10.94%, CI: 2.31, 20.30). Many associations were stronger among women carrying a female fetus in sex-stratified models. However, significant negative relationships were also observed between several phenols and inflammatory markers.

CONCLUSIONS: Our preliminary results suggest that bisphenol-A, bisphenol-S, and methylparaben may upregulate inflammatory processes pertaining to systemic inflammation and uterine remodeling, with important implications for pregnancy outcomes. However, several phenols may also interfere with inflammatory regulation, leading to downregulation. More research is needed to further our understanding of these relationships in an effort to improve reproductive and developmental outcomes.

KEYWORDS: inflammation, phenols, parabens, PROTECT, pregnancy

P-1216 Prenatal exposure to heavy metal mixtures and anthropometric birth outcomes

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BACKGROUND AND AIM: A growing body of evidence has suggested various associations between prenatal exposure to heavy metals and newborn anthropometric measures. However, little is known about the effect of various metal mixtures at relatively low concentrations. Hence, this study aimed to investigate the associations between prenatal exposures to a wide scope of individual metals and mixtures to newborn's anthropometric measures.

METHODS: We recruited 975 mother-infant pairs, from two major hospital in Israel. Associations between eight metals (arsenic, cadmium, chromium, mercury, lead, nickel, selenium and thallium) detected in maternal urine samples from day of delivery to weight, length and head circumference at birth were estimated using linear and Bayesian Kernel Machine Regression (BKMR) models.

RESULTS: Most metals examined in our study observed in lower concentrations compared to other studies, except of selenium. Birthweight was found negatively associated to levels of chromium and thallium in the linear models. In the BKMR analysis positive association for selenium was found with birthweight. Inverse association of selenium and birth length was detected, and positive association between nickel and both weight and length. Cubic shaped associations for chromium and selenium to weight and length suggested metals interactions that were further analyzed. Associations between most metals and head circumference were U-shaped, suggested interactions among them.

CONCLUSION: Maternal urinary concentrations of chromium and thallium were individually associated to decreased birthweight. The application of novel statistical approach enabled us to detect various relations between metals in the analysis and anthropometric measures, which can be a result of complex biochemical processes, that should be further investigated.

KEYWORDS: Anthropometric Measures; Prenatal Exposure; Pregnancy; Metals; BKMR;

P-1218 Young women's reproductive and health effects from the Chernobyl nuclear accident: a qualitative historical study

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BACKGROUND AND AIM: s: The Chernobyl disaster of April 26, 1986 is still considered the worst nuclear power accident in terms of its long-term health effects, including both thyroid and reproductive effects. This study aims to give voice to exposed women, highlighting reproductive and chronic health issues.

METHODS: In-depth, narrative interviews were conducted with 18 women who experienced the Chernobyl nuclear accident as children or adolescents and later immigrated to Israel, aged 2-19 at the time of the accident and 31 to 50 at interview. Half of the women originated in high contamination towns in terms of ionizing radiation (based on cesium-137 measured at the time), and the 9/18 from low-contamination towns . The interviews were analyzed by thematic, content analysis.

RESULTS: Thyroid and hormonal imbalances were the most widespread health issues reported (10/18). Most had some chronic health issues (14/18), which often started in the years immediately following the accident. Once treated, full-term pregnancies resulted in healthy children for 14 of the 18 women. Fears of cancer and birth defects led two to decide not to procreate, one to decide to procreate at an early age, and another to decide not to get pregnant again after having one healthy child. In recalling the accident and its impact, they often fused personal memories with media accounts and stories heard. We explored whether respondents with current health problems attributed them to the radiation exposure and found that those who had family members who were ill or developed cancer, were more likely to attribute these outcomes to the Chernobyl exposure.
CONCLUSION: Exposure to Chernobyl during their formative years was a significant life event that affected their physical, reproductive and emotional health as adults for most respondents.

P-1221 Extending non-targeted exposure discovery of environmental chemical exposures during pregnancy and their association with pregnancy complications

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BACKGROUND: Non-targeted Analysis (NTA) methods identify novel exposures; however, few chemicals have been quantified and interrogated with pregnancy complications.
OBJECTIVES: We characterize levels of nine exogenous and endogenous chemicals in maternal and cord blood identified, and confirmed in prior NTA steps including: linear and branched isomers perfluorooctane sulfonate (PFOS); perfluorohexane sulfonate (PFHxS); monoethylhexyl phthalate; 4-nitrophenol; tetraethylene glycol; tridecanedioic acid, octadecanedioic acid; and deoxycholic acid. We evaluate the relationship gestational diabetes mellitus (GDM) and hypertensive disorders of pregnancy in a diverse pregnancy cohort in San Francisco.

METHODS: We collected matched maternal and cord serum samples from 302 pregnant people at delivery from the Chemicals in Our Bodies cohort in San Francisco. We calculate distributions and Spearman correlation coefficients testing the relationship of chemicals within and between the maternal and cord blood matrices. We used logistic regression to calculate the odds of GDM and hypertensive disorders of pregnancy associated with an interquartile range (IQR) increase in maternal chemical exposures.

RESULTS: We detected linear PFOS, PFHxS, octadecanedioic acid, and deoxycholic acid in at least 97% of maternal samples. Correlations ranged between -0.1 and 0.9. We observed strong correlations between cord and maternal levels of PFHxS (coefficient = 0.9), linear PFOS (0.8), and branched PFOS (0.8). An IQR increase in linear PFOS, branched PFOS, and octadecanedioic acid is associated with increased odds of GDM [OR (95%CI): 1.43 (0.96, 2.14), 1.56 (1.00, 2.44), and 1.26 (0.83, 1.92) respectively] and tridecanedioic acid positively associated with hypertensive disorders of pregnancy [1.28 (0.90, 1.86)].
DISCUSSION: We identified both exogenous and endogenous chemicals, two of which (octadecanedioic acid and tridecanedioic acid) have both endogenous and exogenous sources, and which have seldom been quantified in pregnant people or related to pregnancy complications.

KEYWORDS: Non-targeted analysis, linear and branched PFOS, tridecanedioic acid, fatty acids, gestational diabetes mellitus, pregnancy hypertension

P-1222 Agricultural Pesticides During Pre-Conception and Pregnancy, and Associations With Extremely Preterm Birth: a Pesticide-Wide Association Study

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BACKGROUND/AIM: Although pesticides have unique mechanisms of action, most pesticides also affect common biologic pathways relevant for preterm birth, including oxidative stress, inflammation, and detoxification. However, virtually no epidemiology studies have studied pesticide associations with extremely preterm birth (EPTB; <28 weeks). We adopted an agnostic methodology to conduct a pesticide-wide association study of all pesticides applied in Arizona, with EPTB <28 weeks.

METHODS: We linked all active ingredients (AIs) reported to Arizona's (AZ) Pesticide Use Registry from 2011-2016 with AZ birth certificates of women living in agricultural regions during this period. Women were considered exposed to a specific pesticide if that pesticide had been applied within a given buffer (2000m, 1500m, 1000m, 500m, 100m) during pre-conception or pregnancy. We calculated exposures separately for pre-conception (90 days before last menstrual period), and 1st and 2nd trimesters, and used logistic regressions to estimate associations for each pesticide, and common pesticide classes, during each time window and each buffer, with EPTB. We controlled for maternal race/ethnicity, child sex, maternal education, and birth year, and applied FDR-adjustment.

RESULTS: The study sample consisted of 119,090 births in agricultural regions. of 233 unique AIs studied, 44 were significantly associated at FDR<0.05 during at least one window. of these, 29 were associated during pre-conception, 14 during 1st trimester, and 6 during 2nd trimester. for most AIs, we observed dose-response relationships according to buffer size, with effect estimates weakening and confidence intervals becoming more precise as buffer size increased. Pesticides with the strongest effect sizes included Reynoutria sachalinensis, rimsulfuron, mecoprop-p, potassium laurate, and bromoxynil octanoate. Other notable AIs with consistent effects across buffers and FDR<0.05 included malathion, and the classes of pyrethroids and carbamates.

CONCLUSIONS: Several lesser-studied pesticides may be associated with EPTB, and Pre/peri-conception and early gestation may be sensitive windows of exposure.

KEYWORDS: pesticides, preterm birth

P-1223 Perinatal morbidity and mortality associated with reductions in household air pollution: results from Poriborton:the CHANge trial

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BACKGROUND: Household air pollution is a leading health risk for global morbidity and mortality and a major health risk in South Asia. However, there are no prospective investigations powered to detect the impact of reduced exposure to household air pollution on perinatal morbidity and mortality.
AIM: To assess the impact of liquefied petroleum gas (LPG) for cooking to reduce household air pollution exposure on perinatal morbidity and mortality compared to usual cooking practices in Bangladesh

METHODS: A two-arm community-based cluster randomised controlled trial in the Sherpur district, Bangladesh. In the intervention arm, pregnant women receive an LPG cookstove and LPG in cylinders supplied throughout pregnancy until birth. In the control or usual practice arm, pregnant women continue their usual cooking practices, predominately traditional stoves with biomass fuel. Eligible women are pregnant with a gestational age of 40–120 days, aged between 15 and 49 years, and permanent residents of the study area. The primary outcome is the difference in perinatal mortality between the LPG arm and the usual cooking arm.

RESULTS: We recruited 4972 pregnant women beginning in 09/2019 thru to 03/2022, the trial has been impacted by COVID which has delayed analysis. Data are being cleaned. The perinatal mortality rate difference between the intervention and the control arm will be presented. Other outcomes will be preterm birth (birth before 37 completed weeks gestation), birth weight, cost-effectiveness, satisfaction and acceptability of the LPG stove.

CONCLUSIONS: This trial will provide high-level evidence of the effect of reduced exposure to household air pollution from cooking with LPG on pregnancy outcomes, specifically perinatal mortality and morbidity.

KEYWORDS: Household air pollution, Perinatal mortality, Cluster randomised controlled trial

THEMATIC 20: Respiratory disorders in children/adults

P-1224 Comparison of factors affecting parameters of pulmonary function test between Taiwan and UK

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BACKGROUND AND AIM: Demographic, physiological and behavioural factors affect the parameters of the pulmonary function test (PFT). We aimed to investigate selected predictors of DLCO, VA and KCO in Taiwan and the UK.
MATERIALS AND

METHODS: We collected selected demographic, physiological and behavioural factors and PFT data from medical records in Tri-Service General Hospital (TSGH) in Taiwan from June 2017 to May 2018 and Royal Berkshire Hospital (RBH) from January to June 2019 in the UK. There were 1943 subjects in the TSGH group and 691 subjects in the RBH group. Then, we analyzed factors that might affect the PFT data. We created predictive models for DLCO, VA and KCO based on two hospitals' datasets, and therefore the estimated DLCO, VA and KCO for each individual with different characteristics could be calculated.

RESULTS: The predictive model for DLCO in TSGH estimated: (Male) 6.607-0.216×Age(yr) +0.119×Height(cm)+0.107×weight(kg); (Female) -3.089-0.121×Age(yr) +0.131×Height(cm)+0.119×weight(kg) and the predictive model for DLCO in RBH: (Male) -4.963-0.189×Age(yr) +0.243×Height(cm); (Female) -10.651-0.142×Age(yr)+0.240×Height(cm). The results showed that males had a higher value of DLCO and VA than females; DLCO and VA were positively associated with height; DLCO and KCO were negatively associated with age. Asian population showed a slightly lower value of DLCO compared to the Caucasian population, which could be explained by VA and height differences. Smoking status may not affect DLCO.

CONCLUSIONS: Overall, we found that sex, age, height and weight affected the PFT data, including DLCO, VA and KCO in both TSGH and RBH groups. Further research on the combined effects of ageing and smoking on PFT data could be explored.

KEYWORDS: PFT, Pulmonary function, DLCO, VA, KCO

P-1225 Phthalate Exposures and Oxidative/ Nitrosative Stress among Childhood Asthma: A nested Case-Control Study with Propensity Score Matching

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BACKGROUND AND AIM: Whether low-dose phthalates exposure trigger children's asthma and underlying mechanisms are still under debate. Recent studies revealed that oxidative/ nitrosative stress and lipid peroxidation may play as a mediator of phthalate exposure on certain respiratory outcomes. We aims to evaluate the individual and mixed effects of low-dose phthalate exposure on asthmatic children, and to assess the mediating effect of five (oxidative/nitrosative stress/ lipid peroxidation stress) mechanistic biomarkers, 8-OHdG, 8-NO_2Gua, HNE-MA, 8-isoPF2α and MDA, on the association between phthalate exposure and asthmas.

METHODS: We conducted a case-control study using propensity score matching, including 41 asthma and 111 controls. Eleven phthalate metabolites and oxidative/nitrosative stress biomarkers have been analyzed by LC-MS/MS and ELISA, respectively. The association among high oxidative/nitrosative stress biomarker, high urinary phthalate metabolites level (75th %tile) and risk of asthma was analyzed by conditional logistic regression. Weighted Quantile Sum Regression will also be used to estimate the contribution of individual exposure.

RESULTS: The median MBzP concentrations in the case groups was significantly higher than those in the control group (3.94 vs. 2.52 ng/mL, p= 0.02), which indicated dust could be an important source. After adjustment for confounding factors, some associations between certain oxidative stress biomarkers and phthalate metabolites were found, such as MMP with 8-NO_2Gua (OR: 2.66, 95% CI: 1.03–6.92) and 8-isoPF2α (OR: 4.04, 1.51–10.8), and MiBP with 8-isoPF2α (OR: 2.96, 1.13–7.79). We found MBzP contributed more than a half of the association (56.8%), followed by MiBP (26.6%) and MiNP (8.77%). However, there is no significant association between higher phthalate metabolites levels or oxidative stress biomarkers with risk of asthma.

CONCLUSIONS: Our findings supported the adjuvant effect of phthalates in enhancing immune system response. However, no clear evidence of a link between higher oxidative stress biomarkers and asthma, possibly due to limited sample size and exposure window.

P-1226 Longitudinal assessment of maternal depression and later life childhood asthma and wheeze: effect modification by child sex

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BACKGROUND AND AIM: Studies report associations between maternal mental health and adverse respiratory outcomes in children; however, the impact of timing and duration of maternal distress remains understudied. We sought to longitudinally examine associations between maternal depression and childhood asthma and wheeze, and explore sex differences.

METHODS: We assessed 605 mother- child dyads enrolled in the Programming Research in Obesity, Growth, Environment, and Social Stressors birth cohort in Mexico City. Maternal depression was assessed using the Edinburgh Depression Scale questionnaire a) during pregnancy, b) postpartum, and c) at both postpartum and subsequent time points postnatally (recurrent depression). Report of wheeze in the past 12 months (current wheeze), and asthma were obtained using the validated survey at 48 and 72 months. Associations were analyzed using modified Poisson regression adjusted for covariates, and in interaction models. Models were then stratified by child sex to assess effect modification.

RESULTS: Prenatal depression was observed in 17%, postpartum depression in 25%, and recurrent depression in 16% of mothers. Current wheeze and asthma at either time point was reported in 14% and 5% of children, respectively. Both postpartum and recurrent depression were associated with higher risk of current wheeze (RR: 1.88, 95% CI: 1.21, 2.92; RR: 2.39, 95% CI: 1.52, 3.78) and asthma at 48 months (RR: 2.79, 95% CI: 1.13, 6.87; RR: 3.14, 95% CI: 1.26, 7.84). Recurrent depression was also associated with higher risk of ever wheeze at 72 months (RR: 1.76, 95% CI: 1.12, 2.77). In interaction analyses, associations were stronger in females than males.
CONCLUSION: Postpartum and recurrent depression were associated with higher risk of wheeze and asthma in children, and associations were stronger in females than males. Our results highlight the importance of maternal depression on respiratory disease.

KEYWORDS: respiratory outcomes; maternal stress; asthma; wheeze; children's environmental health; non-chemical stressors

P-1228 Early life exposure to $PM_{2.5}$ and lung function: A pooled analysis from two North American longitudinal pregnancy cohort studies

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BACKGROUND: Exposure to particulate matter <2.5 microns in diameter ($PM_{2.5}$) produces pediatric respiratory morbidity. Lung development occurs in stages and the effects of $PM_{2.5}$ may differ based on timing of exposure. Data integration of multiple epidemiologic studies can provide enhanced power and exposure contrast to examine associations between $PM_{2.5}$ and respiratory outcomes.
AIM: To combine data from two longitudinal cohorts while accounting for underlying heterogeneity and examine effects of early childhood $PM_{2.5}$ exposure on lung function.

METHODS: Analyses included children from the Asthma Coalition on Community Environment and Social Stress Project in Boston, Massachusetts and the Programming Research in Obesity, Growth, Environment and Social Stressors study in Mexico City. Propensity scores were estimated from logistic models and 1-1 nearest neighbor matching method was used (n=300). Residential daily $PM_{2.5}$ exposure was estimated from 2 months prior to birth to age 6 years using a validated satellite-based spatiotemporal model. Lung function was tested at ages 6-11 years and age, height, race and sex adjusted z-scores were estimated for FEV_1, FVC, FEF25-75% and FEV_1/FVC. Using distributed lag models, we examined associations between monthly averaged $PM_{2.5}$ levels and lung function outcomes adjusting for maternal age, education, postnatal environmental tobacco smoke exposure and monthly temperature.

RESULTS: $PM_{2.5}$ exposure between postnatal months 23-40 was associated with a lower FEV_1 z-score. A 5 $\mu g/m^3$ increase in $PM_{2.5}$ throughout this window was associated with a reduction in FEV_1 z-score of -0.36 (95% CI:-0.66, -0.05). Similarly, a 5 $\mu g/m^3$ increase in $PM_{2.5}$ throughout 18-39 months postnatal was associated with a reduction in FEF25-75% z-score of -0.56 (95% CI:-0.99, -0.14).

CONCLUSIONS: Methodological tools enhanced our ability to combine multi-site data while accounting for study heterogeneity. Ambient $PM_{2.5}$ exposure in early childhood was associated with an obstructive pattern on spirometry in middle childhood.

KEYWORDS: air pollution, respiratory, children's health

P-1230 Early-life exposure to ambient air pollution and asthma in the children of the Danish National Birth Cohort – does asthma definition and adjustment for cohort-specific covariates matter?

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BACKGROUND AND AIM: Ambient air pollution exposure has been associated with asthma, but evidence from children is mixed. We examined associations between early-life exposure to air pollution and childhood asthma.

METHODS: We included singletons of the Danish National Birth Cohort born in 1997-2003 to women with complete address, registry-based, self-reported data on health and asthma risk factors (e.g. smoking, breastfeeding, pets, mold) collected from pregnancy and follow-up questionnaires until age 11. We defined asthma incidence from hospital admission, emergency room or outpatient contact using ICD-10 codes and prevalence of doctor-diagnosed asthma from parental recalls at age 7.

RESULTS: Out of the 22,084 children included, 1,475 children had asthma according to the ICD-10 code, of which 51% had asthma according to parental recall of a doctor-diagnosis, whilst 35% of children with a parental recall of doctor-diagnosis also had an ICD-10 code for asthma. The prenatal mean (SD) exposure to PM2.5 and NO2 at the home addresses was 11.5 (1.4) and 18.6 (7.3) µg/m3, respectively. A 5 µg/m3 increase in prenatal exposure to PM2.5 was associated with an HR of 1.05 (95%CI: 0.81, 1.36) for ICD-10-defined asthma and an OR of 0.85 (0.70, 1.04) for doctor-diagnosed asthma in the adjusted models. The corresponding effect estimates associated with a 10 µg/m3 increase in prenatal exposure to NO2 were 1.03 (0.92, 1.15) and 0.95 (0.87, 1.03), respectively. All point estimates were higher among children with the same address at birth as at age 11 when data on home characteristics was collected than movers. Results from models adjusted with register-based covariates were similar to models above that included cohort-specific covariates.

CONCLUSIONS: These findings suggest that the associations between ambient air pollution and asthma in children depend more on the asthma definition than further adjustment for cohort-specific variables in settings like Denmark with rich registry data.

P-1233 Decoupling race/ethnicity from pediatric lung function metrics to investigate potential misclassification bias in environmental epidemiologic research

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BACKGROUND AND AIM: Electronic health records (EHR) are increasingly being used in environmental epidemiologic research. Respiratory studies of asthma commonly use derived spirometry metrics, such as percent predicted forced expiratory volume in one second (FEV1%predicted), that are calculated from age, height, sex, and – controversially – race/ethnicity. We examine potential misclassification bias introduced by historically race/ethnicity-adjusted pediatric lung function metrics.

METHODS: Spirometry results for children with asthma ages 5-17 years were obtained from a clinical EHR data repository at Boston Medical Center (BMC) from 2003 to 2019. BMC is New England's largest safety net hospital, serving a racio-ethnically diverse pediatric population. Recorded lung function metrics included FEV1 (liters), forced vital capacity (liters), and previously calculated FEV1%predicted (%) that adjusted for race/ethnicity. We recalculated FEV1%predicted values by standardizing to a global, multiethnic population using the Global Lung Initiative equations and compared to original FEV1%predicted from the EHR data repository.

RESULTS: The EHR included 1141 children that had 2651 spirometry measurements. Mean FEV1%predicted was 91.6% from the EHR and 87.2% when recalculated. Original FEV1%predicted values were higher compared to recalculated values for Black children (mean=89.3% [standard error=0.56] vs. 82.5% [0.42], n=1526, $p<0.01$), but not for Asian (93.8% [3.72] vs. 92.0% [3.59], n=32, p=0.72), Hispanic (96.5% [1.65] vs. 94.4% [1.56], n=129, p=0.37), Other (93.8% [3.55] vs. 91.3% [2.52], n=47, p=0.57), Not Recorded (94.7% [0.73] vs. 94.1% [0.66], n=720, p=0.25), and White (94.1% [1.72] vs. 94.1% [1.42], n=195, p=0.97).

CONCLUSIONS: Race/ethnicity-adjustment of a commonly used "objective" lung function metric in EHR may artificially improve lung function test results, particularly for Black children with asthma, resulting in a potential source of misclassification bias in environmental epidemiologic research. Continued use of historically race/ethnicity-adjusted lung function metrics warrants critical reevaluation, especially in research aimed at disentangling the environmental drivers of health disparities driven by structural racism.

P-1235 Effects of short- and long-term air pollution exposure on the course of idiopathic pulmonary fibrosis

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BACKGROUND & AIM: Urban air pollution has recently emerged as a significant risk factor for developing IPF Acute Exacerbation (AE-IPF). The aim of this study was to simultaneously investigate the effects of short- and long-term ambient air pollution exposure at patients' residence, on the clinical course of IPF.

METHODS: Stable IPF patients, residents of the Greater Athens Area, and closely monitored at regular intervals in our interstitial lung disease (ILD) referral center were followed intensively for a total of 13 non-consecutive weeks between July 2020 and September 2021. Information on lifestyle, medical history, daily symptoms (cough, dyspnea, wheezing, expectoration, common cold) and activities was collected through questionnaires. Exposure to daily mean NO2, PM10 and 8h-max O3 concentrations at patients' residence was estimated using spatio-temporal land use regression models. We used multiple mixed effects logistic regression models to investigate the simultaneous short- and long-term effects of exposure to air pollutants on the risk of symptoms' occurrence, adjusting further for confounders.

RESULTS: Data collected from up to 24 IPF patients (male: 66.7%; mean age:72.3±7.7 years) were analyzed. A 10 μg/m3 increase in short-term exposure of NO2, PM10 and O3 was associated with an increased risk of cough (OR=1.72, 95%CI: 1.10-2.69; OR=2.73, 95%CI: 1.69-4.42; OR=1.18, 95%CI: 1.00-1.40) and an increased risk of any symptom occurrence (OR=2.10, 95%CI: 1.22-3.63; OR=3.29, 95%CI: 1.78-6.09; OR=1.21, 95%CI:0.94-1.55). In contrast, no association was found between long-term exposures to PM10, NO2 and O3 and risk of symptom occurrence.

CONCLUSIONS: Short-term personal exposure to increased concentrations of air pollutants is an independent risk factor for IPF aggravation leading to appearance of symptoms.

KEYWORDS: idiopathic pulmonary fibrosis, air pollution, progression, symptoms, ozone, PM, short-term, long-term, personal exposure

P-1236 Toenail metal concentrations and lung function among residents living near urban oil site

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BACKGROUND AND AIM: Urban communities may be exposed to various toxic metals, especially communities near industries. Given prior evidence suggesting that toxic metals exposure may influence respiratory health, we aimed to assess the relationship between toenail metal concentrations and lung function in a diverse cohort of residents living near an urban oil drilling site.

METHODS: Through a community-academic partnership, we recruited 161 Latinx, Black, and Asian adults who lived within 1 km of an active oil drilling site in south Los Angeles. We assessed lung function using spirometry and collected toenail clippings to assess exposure to arsenic (As), cadmium (Cd), manganese (Mn), nickel (Ni), lead (Pb), and antimony (Sb). We conducted linear regression between individual metal concentrations and forced vital capacity (FVC) and forced expiratory volume in the first second of exhalation (FEV1), adjusting for sex, age, height, asthma diagnosis, distance to freeway, cigarette smoking status, and lung function assessor. We examined effect measure modification by sex using stratified models.

RESULTS: We observed an inverse association between toenail Mn concentration and FEV1 (difference=-83mL, 95% confidence interval (CI): -159, -7) and no association for As, Cd, Ni, Pb, and Sb. We observed a similar association for FVC with Mn (Mn: -82 mL, 95% CI: -163, 0) and no significant associations for the other metals. The associations between Mn and lung function were predominantly observed in men (Men: FEV1 difference: -91, 95% CI: -194, 11; FVC difference: -74, 95% CI: -181, -33; Women: FEV1 difference: 10, 95% CI: -137, 157; FVC difference: -32, 95% CI: -212, 149).

CONCLUSIONS: We found higher toenail Mn concentration to be associated with lower lung function among residents—particularly male residents—near an urban oil well.

KEYWORDS: Metals, mixtures, respiratory outcomes, environmental epidemiology

P-1237 The environmental factors for different seasonal attack patterns in asthmatic children

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BACKGROUND AND AIM: Asthma is the most common chronic childhood disease worldwide. The incidence and mortality of asthma, outpatient visits, and hospital admission all vary by seasons, and are also affected by various environmental factors. However, limited studies have classified asthmatic children into subgroups according to their seasonal attack patterns. This study aims to identify the specific hereditary and environmental factors associated with different seasonal attack patterns of childhood asthma.
METHODS: The study collected the Taiwanese children's allergic status, hereditary and living environmental factors from one elementary and one middle schools in each of the 22 cities/counties in 2016. Ambient temperature, relative humidity, and air pollution were obtained from air monitoring stations. The weighted moving average of monthly attack score in current asthmatic children was calculated, and principal component analyses was then applied to categorize asthma attack subtypes. Multinomial logistic regression and Generalized Estimating Equation were used to study the effects of environmental exposure on each asthma attack subgroup.
RESULTS: Among 11,585 respondents in the study, 6.6% reported asthma attack in the past 1 year. Four attack patterns were identified: spring, summer/fall, winter and perennial. Younger age, parental atopic diseases, and exposure to secondhand smoke at home are important factors for childhood asthma. As for each seasonal attack pattern of asthmatic children, spring-attack was related to molds in residence; winter-attack was related to lower temperature, male gender, parental higher education, and the presence of cockroaches in the house; perennial-attack was related to water damage at home and traffic-related air pollutants.
CONCLUSIONS: Schoolchildren with current asthma demonstrate different seasonal attack patterns, which are related to specific environmental factors. Consideration of the individual subtypes of childhood asthma will help to develop appropriate preventive and therapeutic strategies.

KEYWORDS:
asthma; seasonal attack pattern; environmental factors; GEE; multinomial logistic regression

P-1242 Respiratory diseases caused by anthropogenic activities in children and adults of rural communities of Brazil. Review of epidemiological status following fuel policy changes

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BACKGROUND AND AIM: Research points out that emission from diesel-powered vehicles such as trucks and buses, account for about half of the pollutants of the atmosphere including benzene, toluene and particulate matter (ICCT, 2018).
According to the Brazilian National Agency for Road Transportation- ANTT, in charge of monitoring of road freight transport activity, the average age of Brazilian trucks, owned by self-employed haulers, companies and cooperatives, was 14.32 years in 2020. The average age of more than one million Brazilian self-employed haulers' trucks is over 20 years. As an example Diesel-powered heavy-duty vehicles accounts for almost half of the emissions of air pollutants.
This fact exacerbates the health impact of other relevant sources of air pollution as intentional wildfires affecting rural communities in Brazil, associated with deforestation, generalized agricultural malpractices and climate change adverse effects (droughts)
As a negative example, the opening of highway MS-156 in Mato Grosso do Sul, Brazil, worsened the health status and chronic health problems of the indigenous population living in the Itaporã peri-urban indigenous reserve in Dourados (MS), which this road split in two.
METHODS: A qualitative document analysis based on the synthesis of existing literature has been complemented with the critical review of relevant outcome of health surveys.
RESULTS: The traffic-related air pollution aggravates existing health problems impacting the health status of the Guarani-Kaiowá community worsen the adverse common trends measured in other Brazilian communities, with a increase of adverse health indicators associated with environmental stress as pneumonia and other respiratory disorders.
CONCLUSIONS: We observed an increase in morbidity in less populated, rural areas close to transport hubs linked to poor fuel quality, aggravating the negative impact of other concomitant anthropogenic factors as wildfires and agriculture malpractices.

KEYWORDS:
air pollution, road traffic emissions, health risks; health determinants; wildfires

O-SY-133 Association between drinking water arsenic and urinary inorganic arsenic in the US: NHANES 2003-2014

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BACKGROUND AND AIM: Important inequalities exist in arsenic (As) in drinking water across US populations. A critical research gap is how water As corresponds to internal dose, measured by urinary biomarkers. We evaluated the association between assigned private well and regulated community water system (CWS) As and urinary As concentrations in the National Health and Nutrition Examination Survey (NHANES).

METHODS: We assigned 13,163 NHANES 2003-2014 participants county-level population- weighted CWS concentrations (μg/L) and private well estimates (probability >10 μg/L) using published nationwide estimates from US Environmental Protection Agency and US Geological Survey datasets, respectively. The internal dose of inorganic As related to drinking water was estimated by recalibrating urine dimethylarsinate (DMA) concentrations to adjust for arsenobetaine, seafood, smoking status, and past 24-hour intake of rice and other dietary sources. We evaluated geometric mean ratios (GMRs) of DMA across tertiles of water As, the lowest tertile as reference, for all participants and stratified by census region and quartile of geologic risk of elevated water As.

RESULTS: Among CWS users, participants in the highest tertile of CWS As had significantly higher DMA overall (GMR= 1.17, 95% CI 1.09, 1.26) and in the South (GMR =1.23, 95% CI 1.09, 1.38), compared to participants in the lowest tertile. Among private well users, participants in the highest tertile of private well As had significantly higher DMA overall (GMR = 1.23, 95% CI 1.01, 1.50) and in the West (GMR = 1.34, 95% CI 1.18, 1.53).

CONCLUSIONS: Arsenic in private wells and CWSs contributes to As exposure, measured in urine, in general US populations. Water As and urine DMA were more strongly associated among private-well users compared to CWS users nationwide, with differences by region. Positive associations were also observed among CWS users in the highest two quartiles of geologic risk.

KEYWORDS: arsenic, exposure, water quality

DAY 2 (Tuesday, 20 Sept 2022)

THEMATIC 02: Aging and Environment

P-0039 Association of residential road proximity with cognitive decline and dementia: The Atherosclerosis Risk in Communities (ARIC) Study

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BACKGROUND AND AIM: Increasing evidence links higher air pollution exposures to increased risk of cognitive impairment, and there is growing interest in the role of noise in cognitive aging. Although risk factor associations with incident dementia are often strongest when midlife values of risk factors are considered, few studies have considered associations between midlife exposures to traffic-related air pollution or road noise and late life cognition. Our aim was to determine if midlife residential proximity to major roads, a proxy for traffic-related air pollution exposure and road noise, is associated with increased risk of incident dementia in the Atherosclerosis Risk in Communities (ARIC) study.

METHODS: ARIC participants were enrolled from 4 US sites in 1987-1989 at ages 45 to 65. We considered data from 12,135 participants of ARIC Visit 2 (1990-1992, study baseline). We calculated midlife residential Euclidean distance to a major (A1, A2, or A3) road based on geocoded residential addresses at Visit 2. We ascertained dementia status through 2019 via in-person study visits with neurocognitive assessment, telephone cognitive interview, informant interview, and access to hospitalization and death records. We estimated the association between midlife residential road proximity and incident dementia using adjusted Weibull models.

RESULTS: at study baseline, the mean age of participants was 57 years, 22% were black, 56% were female. 48% lived within 200m and 36% lived within 200 to 500m of a major road. 20% developed dementia during follow-up. While residing closer to major roads in midlife was associated with increased risk of incident dementia in unadjusted models, this association did not persist in adjusted analyses.

CONCLUSIONS: Residence near a major road in midlife, a proxy for higher exposure to traffic-related air pollution and noise, does not appear to increase risk of dementia.

KEYWORDS: dementia, air pollution, roadway, roads, particulate matter, cognition, aging, epidemiology

P-0041 The role of polygenic susceptibility on air pollution-associated asthma between Caucasian and Asian elderly women

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BACKGROUND AND AIM: Polygenic susceptibility likely influence the individual response to air pollutants and the risk of asthma. We compared the role of polygenic susceptibility on air pollution-associated asthma between Caucasian and Asian elderly women.

METHODS: Women enrolled in the German SALIA cohort study (n=771, mean age=73 years) and Japanese Shika cohort study (n=847, mean age=67 years) with asthma status available (self-response on doctors' diagnosis) were investigated. Adjusted main environmental, main polygenic, and gene-environment interaction (GxE) logistic regression models were fitted with average concentrations of particulate matter with a median aerodynamic diameter ≤2.5µm ($PM_{2.5}$) and respectively nitrogen dioxide (NO_2) at residential addresses 5 years prior to the asthma assessments or/and weighted polygenic risk scores (PRS).

RESULTS: We found high-risk effects of low exposures on asthma in Asian women ($PM_{2.5}$: median=12.7µg/m³, p-value<0.001, NO_2: median=8.5µg/m³, p-value<0.001), and protective polygenic effects in Caucasian women (p-value=0.008). While we found no significant GxE effects on asthma, the main effects remained stable in the GxE models. In both ancestry groups, the PRS increased the effect of $PM_{2.5}$ exposure and decreased the effect of NO_2 exposure on asthma. The trends were mostly robust to potential effect modifications according to smoking and residential moves.

CONCLUSIONS: Our study confirmed high-risk effects of low exposures on asthma in Asian elderly women and provided indications for polygenic effects in Caucasian, but no evidence for GxE effects in Asian or Caucasian elderly women. Further genome-wide GxE studies exploring the role of ancestry-specific polygenic susceptibility on air pollution-associated asthma are required.

KEYWORDS: Asthma, Air Pollution, Gene-Environment Interaction, Aged, Whites, Asians

P-0042 Association of long-term exposure to ambient air pollution with retinal neurodegeneration on optical coherence tomography: the prospective Alienor study

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BACKGROUND AND AIM: Chronic exposure to air pollution may have adverse effects on the central nervous system (CNS). The retinal nerve fiber layer (RNFL) is a part of the CNS. RNFL thinning is a hallmark of glaucoma, the second leading cause of blindness worldwide and may constitute a biomarker of neurodegenerative processes. We investigated the relationship of air pollution exposure with longitudinal RNFL thickness changes.

METHODS: The Alienor study is a cohort of residents of Bordeaux, France, aged 75 years or more. RNFL thickness was measured using optical coherence tomography imaging every 2 years from 2009 to 2017. Exposure to air pollutants during the 10 years preceding the first RNFL measurement (particulate matter with diameter ≤2.5 µm (PM2.5 (µg/m3), black carbon (BC (10-5/m)) and nitrogen dioxide NO2 (µg/m3)) were estimated at the participants' geocoded residential address using Land-Use Regressions models. Longitudinal associations of air pollution exposure with RNFL thickness were assessed using linear mixed models adjusted for potential confounders.

RESULTS: The study included 694 subjects, 62% were female and the mean age was 82 years. The median concentration (Interquartile Range (IQR)) were 22.03 (1.57) µg/m3 for PM2.5, 2.26 (0.30) 10-5/m for BC and 29.04 (6.32) µg/m3 for NO2. Exposure to higher levels of PM2.5 and BC in the previous 10 years was significantly associated with a faster RNFL thinning during the 8-year follow-up (-0.39 microns/year (95% confidence interval (CI) [-0.57;-0.20]) and -0.33 microns/year (95% CI [-0.50;-0.16]) per IQR increment; p<0.001 for both). The size of the effect was similar to one year of age (-0.36 microns/year). No statistically significant associations were found with NO2.

CONCLUSIONS: This study evidenced a strong association of chronic exposure to fine particulate matter with retinal neurodegeneration, at air pollution levels below the current recommended thresholds in Europe.

KEYWORDS: air pollution, retina, neurodegeneration

P-0046 Ambient air pollution, cardiovascular burden, and incident depression among older adults

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BACKGROUND AND AIM: Studies suggest a harmful effect of air pollution on mental health including depression, but neither results are concordant, nor the mechanisms are clear. We aimed to examine the association between exposure to long-term ambient air pollution and depression incidence among older adults and to understand the modifying effect of age and cardiovascular diseases (CVDs).

METHODS: Depression-free older adults (n=2812) from the Swedish National Study on Aging and Care in Kungsholmen (SNAC-K) were followed up over 12 years. Incident minor and major depression cases were ascertained using the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The time-varying 3-year average level of particulate matter (PM2.5 and PM10) and nitrogen dioxide (NOx) were obtained using spatial dispersion models. We estimated hazard ratios of depression (HRs) according to 1-µg/m3 increase of PM2.5 and PM10 and 10-µg/m3 increase of NOx considering potential confounders (age, sex, neighborhood and individual social-economic status, smoking, alcohol consumption, physical activity, medications, exposure to road traffic noise, and greenspace accessibility). The modifying effects were tested by adding interaction terms of age and CVDs (including ischemic heart disease, atrial fibrillation, heart failure, and stroke) to the models.

RESULTS: During the follow-up, 137 incident depression cases were identified. Higher hazard ratios of incident depression were observed with each 1-µg/m3 increase of PM2.5 (HR=1.68, 1.30-2.16) and PM10 (HR=1.07, 0.97-1.18) and each 10-µg/m3 increase of NOx (HR=1.23, 0.97-1.57). The observed association was enhanced among individuals with stroke (PM2.5: HR =2.71, 1.59-4.64; PM10: HR =1.34, 1.12-1.61; and NOx: HR =2.14, 1.41-3.25) and aged 78+ (PM2.5: HR =1.82, 1.42-2.34; PM10: HR =1.14, 1.03-1.26; and NOx: HR =1.45, 1.14-1.83).

CONCLUSIONS: Air pollution was associated with an increased risk of depression among older adults. Importantly, stroke and advanced age may amplify such associations.

KEYWORDS: Depression, Air pollution, Particulate Matter, Nitrogen Dioxide, Cardiovascular Disease, Population-based Study

P-0049 Potential modifying factors for the older people feeling cold/warm in the English dwellings

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BACKGROUND AND AIM: Excess winter mortality (EWM), estimated at more than 36,000 in 2019 in the UK, is an important health issue among older households who are vulnerable to cold-related diseases. EWM is related to exposure to low indoor temperature; many English homes experience indoor winter conditions <18oC. This study aims to understand the relationship between building energy performance, indoor temperature and reported indoor thermal experience of older households.

METHODS: In a sub-survey of the 2010/2011 English Housing Survey, 823 homes with temperature loggers, monitored indoor temperatures at different seasons to assess the risk of cold exposure and self-reported feelings of discomfort among older households (aged 60+). Linear regression and chi-square automatic interaction detection (CHAID) was used for indoor temperature and indoor thermal experience respectively. The analyses compared conditions against younger households (<60) as a basis for understanding the difference in risk factors.

RESULTS: Dwelling energy performance and household characteristics are important determinants affecting living and bedroom temperatures. for the bedroom, older households had higher odds of keeping warm in the wintertime (OR=1.02, 95%CI=1-1.05) and of feeling too warm in the summertime (OR=1.9, 95%CI=1.62-2.62). In the living room, the younger households had higher odds of feeling cold in the wintertime (OR=1.08, 95%CI=1-1.16) and too warm in the summertime (OR=1.61, 95%CI=1.43-1.82). The determinants of discomfort also differed by age with older households, mainly affected by property energy performance (e.g., having double glazing windows and air conditioning), while younger households related to socio-economic factors (especially household income and tenure type).

CONCLUSIONS: This research highlights the need to focus on older households and risk factors of low temperature that can help reduce temperature-related disease, such as the energy performance of housing, which has been shown to improve indoor temperatures.

KEYWORDS:
English dwellings, Indoor temperature, Elderly population, Thermal comfort

P-0051 Associations between short-term air pollution and temperature and markers of arterial stiffness and central hemodynamics in an elderly population

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BACKGROUNDS AND AIMS: Our study adds to the sparse literature that examines whether arterial stiffness, related to cardiovascular risk, increases with exposure to air pollution. We assessed the associations between spatio-temporally resolved air pollutants and vascular and hemodynamics parameters in an elderly population based in Eastern Massachusetts.

METHODS: Among 401 men living in Eastern Massachusetts between 2007 and 2019, we utilized time-varying linear mixed-effects regressions to examine associations between central augmentation index (%) and central pulse pressure (mmHg) and short-term (0-5 days) exposure to air pollution concentrations (fine particulate matter (PM2.5), ozone (O3), nitrogen dioxide (NO2)) and temperature adjusted for known cardiovascular risk factors. Central augmentation index and pulse pressure were measured at each visit by using radial artery applanation tonometry for pulse wave analysis. Each air pollutant and temperature were geocoded to the participant's residential address using validated ensemble and hybrid exposure models and gridMET predictions.

RESULTS: We found consistent results that higher PM2.5 concentrations at a one-day distributed lag was associated with significantly higher measures of arterial stiffness. Each 5.24 µg/m3 interquartile range (IQR) increase in daily PM2.5 for a 1-day distributed lag was associated with a 3.19% (95% confidence interval (CI): 1.54, 4.83) increase in augmentation index and a 1.87 mmHg (95% CI: 0.38, 3.36) increase in pulse pressure. Also, each 5.64 µg/m3 IQR increase in daily PM2.5 for a 0-day distributed lag was associated with a 1.39 mmHg (95% CI: 0.18, 2.59) increase in pulse pressure. We found no clear association between O3, NO2 and temperature and the outcomes.

CONCLUSIONS: Short-term exposure to PM2.5 was associated with markers of arterial stiffness and central hemodynamics.

KEYWORDS: Air pollution; arterial stiffness; pulse pressure; temperature; hemodynamics.

P-0053 Health promoting environments for an ageing population: A register and GIS-study of associations between urban greenness and formal social services in Sweden

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BACKGROUND AND AIM: The ongoing urbanization and densification of cities is intensifying the competition of available space in urban areas. The resulting decrease in urban greenness may have a negative health impact for residents, with possible sociodemographic injustices. Our overarching aim is to investigate if access to urban greenness increases the chances of independent living among older people, measured by use of formal social services and taking sociodemographic factors into account. However, this abstract focuses on access to urban greenness and sociodemographic factors.

METHODS: This register-based study investigates all people aged 65+ years in two Swedish municipalities in 2010, 2015 and 2019. Data include sociodemographic variables (type of housing, place of birth, cohabitation, sex, and year of birth on individual level, and socioeconomic status [SES] on area level) and coordinates of residential location. The proportion of total, publicly available and quiet urban green spaces, respectively, in 300m and 100m buffers around the residency were assessed with Geographical Information systems (GIS).

RESULTS: In Malmö, a high proportion of urban green spaces was found for those living in house, living alone, being born before the median year of birth, and living in an area with low SES. A similar pattern was found for public green spaces, except for living in a house where the results were opposite. Although having access to more public green, being born abroad and living in an area with low SES were associated with having access to less quiet green. In Kristianstad living in a house and being born abroad were associated with higher access to urban green spaces, whereas living in a house was associated with lower access to public green spaces.

CONCLUSIONS: There may be sociodemographic differences in access to urban green.

KEYWORDS: Urban green, Social services, Longitudinal, GIS, Register

P-0054 Factors associated with middle-aged adult obstructive lung function deficits in the grass pollen season

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BACKGROUND AND AIM: Impact of grass pollen season (GPS) on lung function is not well-studied at a community level. We assessed this in middle-aged participants from the Tasmanian Longitudinal Health Study (TAHS), and potential modifiers of this association.

METHODS: Spirometry was performed at the TAHS 53-year follow-up (n=2478). We compared lung function for those tested in the GPS (Oct-Jan) to those tested outside GPS using linear regression. Interactions were investigated for: questionnaire-reported asthma, hay fever, eczema and grass pollen allergy symptoms in the past 12 months; traffic-related air pollution (TRAP) exposure defined by living <200m from a major road; and glutathione S-transferase (GST) polymorphisms (GSTM1, GSTT1, GSTP1) for a subsample.

RESULTS: An association between GPS and reduced lung function was observed among those with allergic disease, also those living <200m from major roads or with a GSTM1 genotype (p for interaction≤0.1). Participants with current asthma tested in the GPS had increased mid- to small-airway obstruction compared to out of GPS, with $zFEV_1/FVC$ ratio = -0.3 (95% CI = -0.6,-0.1) and zFEF25-75% = -0.4 (95% CI= -0.6,-0.07). Similar evidence of obstruction was observed in current hay fever, eczema, grass pollen allergy or living <200m from major roads. A modest association was found with bronchodilator responsiveness = 18 ml (95% CI = -18,54) in those with GSTM1 null genotypes.

CONCLUSION: Middle-aged adults with allergic disease or TRAP exposure may be more susceptible to obstructive lung function deficits during the grass pollen season. Genetics may also play a role, but further research on this is required.

KEYWORDS: Asthma, air pollution, eczema, grass pollen, genetics, lung function

P-0055 Lack of association between air pollutants and telomere length: findings from the UK Biobank study

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BACKGROUND: Air pollution has been extensively associated with diseases more common in the elderly, and with disease risk factors associated with ageing such as atherosclerosis and reduced lung function. Shorter telomere length (TL) is often considered a biological marker of advanced biological ageing, also and is associated with the risk of many age-related degenerative diseases. Common mechanisms of oxidative stress and inflammation have been identified for TL shortening and air pollution damage. There are few studies of air pollution and TL in adults, but associations were seen between in utero and early life air pollution exposures and shorter TL at age 8 years in the HELIX study (Clemente, 2019).

METHODS: We investigated cross-sectional associations between European Study of Cohorts and Air Pollution Effects (ESCAPE) modelled air pollutants (NO2, NO, PM10, PM2.5, PM2.5absorbance, PMcoarse) and leucocyte TL (LTL) in 299,786 UK Biobank participants. We used multivariable linear regression models adjusted for age, sex, ethnicity, white cell blood count, deprivation, family income, education, and smoking.

RESULTS: The association between any air pollutant and LTL was negligible, after accounting for major determinants of LTL, socio-economic status and smoking. Findings were unchanged in multiple imputation models to investigate impact of missing confounders, and when stratifying by deprivation quintile.

CONCLUSIONS: Studies using UK Biobank have found associations between air pollution and organ damage also associated with ageing such as reduced lung function (Doiron, 2019), but we did not find associations with TL shortening in cross-sectional analyses, suggesting air pollution mediated TL damage is unlikely to be a key mechanism. However, findings need confirmation in longitudinal analyses, ideally complemented by experimental studies and further epidemiological studies investigating other air pollutants.

KEYWORDS: Air pollution; Ageing; Telomere length

P-0057 Association between climate and skin aging: A cross-sectional analysis from three metropolitan cities of India

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BACKGROUND AND AIM: Skin aging is driven by a large extent by environmental factors such as air pollution. However, it is unknown if and how climate parameters contribute to skin aging and/or if the association is modified by air pollution. To address the above research gap, we analyzed the association between skin aging traits and ambient temperature (AT), relative humidity (RH), and solar radiation (SLR).

METHODS: This study was conducted in three metropolitan Indian cities; Delhi, Mumbai, and Bangalore with 1510 women aged between 20-91 years between May 2018 to Feb 2019. SCINEXA™, a validated visual score was used to measure extrinsic facial skin aging. We used an ordinal multiple logistic regression model for the analysis adjusting for air pollutants (PM2.5 and NO2) and psychological stress each at a time with AT.

RESULTS: We here report a positive and significant association between AT, and skin aging parameters- wrinkles under the eyes (OR: 1.10, 95% CI; 1.03, 1.19), hyperpigmentation on the forehead (OR: 1.19, 95% CI; 1.08, 1.31), and dark circles under eye (OR: 1.64, 95% CI; 1.51, 1.78). These skin aging signs also showed a positive and significant association with RH and SLR. The association of skin aging signs with AT was robust after accounting for the confounding effect of PM2.5 and NO2 and psychological stress.

CONCLUSIONS: The study shows epidemiological evidence of an association between long-term exposure to high AT, RH, and SLR and skin aging parameters and that it might increase the effect of particulate and traffic-related air pollution on skin aging.

KEYWORDS: Skin aging; climate; temperature; air pollution; India

P-0062 Differential association of metabolomic patterns with bone mineral density and fractures by metal exposure biomarker levels in The Hortega Study

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BACKGROUND AND AIM: The bone remodeling process may be influenced by metabolic factors. We evaluated the cross-sectional association of metabolic patterns with reduced bone mineral density (BMD) and the prospective association of metabolic patterns with incident osteoporosis-related bone fractures. Since copper, selenium, zinc, arsenic, antimony, cadmium and cobalt have been related to metabolic patterns and oxidative stress biomarkers in our study population, and redox balance play a key role in bone metabolism, we also assessed potential differential associations in subgroups defined by metals above and below median (p50) biomarker levels.

METHODS: In 507 participants older than 50 years from the Hortega Study, a representative sample from a region in Spain, we estimated metabolic principal components (mPC) from 54 plasma metabolites with NMR-spectrometry. BMD was calculated in the right calcaneus using Peripheral Instantaneous X-ray Imaging system. Copper, selenium and zinc were measured in plasma by AAS, arsenic, antimony, cadmium and cobalt were measured in urine by ICPMS, and arsenobetaine was measured by HPLC-ICPMS.

RESULTS: In reduced BMD models, the association was inverse mPC1 (reflecting non-essential and essential amino acids, including branched chain, and bacterial co-metabolism versus fatty acids and VLDL subclasses) and positive for mPC2 (reflecting essential amino acids, including aromatic, and bacterial co-metabolism), and mPC3 (reflecting LDL subclasses). In incident bone fracture models, the association was inverse for mPC2, but positive for mPC1 and mPC4 (reflecting HDL subclasses). The association between mPC2 and bone fractures showed statistically significant interactions by antimony (p50=0.07 µg/g) and arsenobetaine-corrected arsenic (p50=6.81 µg/g), and selenium (p50=85.3 µg/L) (P interaction = 0.02, 0.001 and 0.03 respectively).

CONCLUSIONS: Our results support the hypothesis that bone remodeling is influenced by metabolic factors, including amino acids, lipids and microbiota co-metabolism. Ageing individuals may benefit from intensified preventive interventions to reduce bone disease based on their metal exposure levels.

P-0063 Urinary Zinc and Incident Diabetes: Prospective Evidence from the Strong Heart Study

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BACKGROUND AND AIM: Diabetes, a chronic metabolic condition, is a major risk factor for cardiovascular disease. Hyperglycaemia can increase zinc excretion due to its insulin-mimetic function. We aimed to assess the association between urinary zinc and incident diabetes in two populations with a high burden of diabetes from Arizona, Oklahoma, North Dakota and South Dakota.

METHODS: Baseline urinary zinc was measured using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) in 1,339 adults free of diabetes at baseline (1989-1991) and followed through 1998-1999 in the Strong Heart Study (SHS) and in 1,905 family members of SHS participants free of diabetes at baseline (1998-1999) followed as part of the Strong Heart Family Study (SHFS) through 2006-2009.

RESULTS: In the SHS, diabetes incidence was 14.7% (mean follow-up 6.6 years). Median urinary zinc was 0.46 mg/g and 0.50 mg/g for participants without and with diabetes, respectively. After adjustment for sex, site, education, smoking status, and BMI, the hazard ratio (HR) (95%CI) of diabetes comparing IQR percentiles of urinary zinc distribution was 1.21 (1.08, 1.36). In the SHFS, diabetes incidence was 13.5% (mean follow-up 5.6 years). Median urinary zinc was 0.59 and 0.65 for participants without and with diabetes, respectively. The HR(95%CI) in the SHFS was 1.12 (0.96, 1.31). These associations were attenuated in the SHS after adjustment for insulin levels, fasting glucose levels and HOMA-IR score. Excluding participants with prediabetes at baseline, the association of urinary zinc with incident diabetes remained significant in the SHS and suggestive for the SHFS.

CONCLUSIONS: Baseline urinary zinc concentrations were associated with diabetes incidence even after adjustment for fasting plasma insulin and plasma glucose levels in adult populations with a high burden of diabetes. These results highlight the need for greater understanding of zinc metabolism in diabetes pathology and identify possible treatment approaches for diabetes prevention.

P-0065 Associations between personal fine particulate matter elemental constituent mixtures and blood lipid profiles: A panel study in Chinese people aged 60-69 years

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BACKGROUND AND AIM: Dyslipidemia may be a potential mechanism linking Fine Particulate Matter (PM2.5) to adverse cardiovascular outcomes. However, the associations between PM2.5 and blood lipid have been inconsistent and the joint effect of PM2.5 elemental constituent on lipid profiles and the role of each constituent are still unclear. We aims to investigate the overall associations of PM2.5 elemental constituent with lipid parameters, and assess the relative importance of each constituent for lipid parameters.
METHODS: Sixty-nine older individuals were visited between September 2018 and January 2019 with five repeated measurements (237 blood samples in total). Each participant wore a PM2.5 monitor for 72 hours before each health examination, including a questionnaire survey, physical examination, and biological sample collection. Bayesian kernel machine regression (BKMR) model was implemented to estimate the joint effect of the seventeen elemental constituent on various lipid parameters.
RESULTS: We found that significant increases in total cholesterol (TC), lowdensity lipoprotein cholesterol (LDL-C), and non-high-density lipoprotein cholesterol (non-HDL-C) levels in older adults when exposed to the mixture of PM2.5 elemental constituents. Copper and titanium had higher posterior inclusion probabilities than the other constituents ranging from 0.76 to 0.90 and 0.74 to 0.94. Copper and titanium in the PM2.5 elemental constituent mixture played a significant role in the changes observed in the blood lipid profiles.
CONCLUSIONS: This study highlights the importance of identifying critical hazardous PM2.5 constituents that may cause adverse cardiovascular outcomes in the future.

KEYWORDS:

PM2.5 constituents; Lipid parameters; Personal exposure monitoring; Complex mixtures； BKMR models

P-0072 Associations of long-term exposure to community noise and traffic air pollution with cause-specific morbidities in older adults

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BACKGROUND AND AIM: Cardiovascular health of long-term exposure to noise and air pollution has been examined worldwide while few studies have been conducted in U.S. especially in aging population. We examined the effects of community noise and traffic air pollution exposures on incidences of cardiovascular (CVD) and neurological diseases in older adults.

METHODS: We constructed a cohort comprising Medicare beneficiaries aged over 65 years in New York state from 2000 to 2018. Annual mean nitrogen dioxides (NO2) and noise exposures combining road traffic and aviation sources were estimated using advanced geo-statistical models and assigned to the participants according to their ZIP-code of residence. We applied Cox proportional hazards models to examine the associations of exposure to community noise and NO2 with incidences of CVD and its subtypes, depression, and Alzheimer's disease and related dementias (ADRD), adjusting for potential confounders.

RESULTS: of 742,366 participants, 38% developed their first CVD and 7% and 9% had new ADRD and depression during 9.3 years mean follow-up. Community noise exposure (per 25 dB) was significantly associated with increased hazard ratio (HR) of ADRD (1.047, 95%CI: 1.023, 1.073) and overall CVD incidences (1.092, 95% CI: 1.079, 1.105) including its subtypes (ischemic heart disease: 1.099, 95%CI: 1.086, 1.113; heart failure: 1.079, 95%CI: 1.064, 1.095; stroke: 1.116, 95%CI: 1.095, 1.137), but not with depression, acute myocardial infraction and atrial fibrillation, after mutual adjustment for NO2 exposure. for NO2 (per 10 ppb) exposure, the associations remain significant with incidences of ADRD and CVDs (except stroke) though the estimated HRs were attenuated compared to the effects of community noise.
CONCLUSION: Long-term exposure to community noise and traffic air pollution are associated with increased risks of CVD and ADRD in older adults, with noise effects being dominant.

KEYWORDS: Community noise; traffic air pollution; cardiovascular disease; dementia

P-0079 Effect of Frailty on Cancer Mortality Among Never Smoking Older Adults: The Moderating Role of Exposure to Secondhand Smoke

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BACKGROUND AND AIM: Exposure to secondhand smoke is a major cause of cancer morbidity and mortality. Additionally, frailty, an aging-related condition of decreased physical functioning, increases the risk for mortality. However, studies have not evaluated the possible joint effects of frailty and exposure to secondhand smoke on cancer mortality. We investigated whether exposure to secondhand smoke modifies the association between frailty and cancer mortality among never smoking older adults in the U.S.

METHODS: We studied 3,308 never smoking adults aged ≥60 years who participated in the National Health and Nutrition Examination Survey (NHANES) from 2007-2014 and were followed for cancer mortality through December 2015. Exposure to secondhand smoke was assessed based on detectable serum cotinine concentrations. Frailty was defined using an adapted Fried criteria. We estimated multivariable adjusted hazard ratios (HR) for cancer mortality comparing joint categories of secondhand smoke exposure (exposed vs. unexposed) and frailty status (frail, prefrail vs. robust) with robust unexposed adults as the reference group.

RESULTS: 52% percent of never smokers were exposed to secondhand smoke. The prevalence of prefrailty and frailty in the study population was 50% and 5%, respectively. After a mean of 4.5 years of follow-up, there were 89 deaths due to cancer. After multivariable adjustment, the risk for cancer mortality was markedly higher for adults who were both frail and exposed to secondhand smoke (HR: 4.35, 95% CI: 1.33, 14.23) than for adults who were frail and unexposed (HR: 2.54, 95% CI: 0.79, 8.19), compared to robust unexposed adults.

CONCLUSIONS: In a representative sample of the U.S. population, joint exposure to secondhand smoke and frailty was associated with higher risk for cancer mortality among never smokers. These findings support the need for legislation measures that ensure complete protection from secondhand smoke for older adult populations.

KEYWORDS: secondhand tobacco smoke, mortality, aging, cancer

P-0080 Association of Tobacco Exposure and Biomarkers of Tobacco Exposure with Frailty Among US Older Adults: the 2007-2018 National Health and Nutrition Examination Survey (NHANES)

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BACKGROUND AND AIM: Adults with a history of cancer and those who use tobacco are at increased risk for frailty. However, studies have not evaluated the impacts of smoking on frailty among those with a history of cancer. We investigated the association of tobacco use, and exposure to secondhand smoke (SHS), and biomarkers of tobacco use on frailty among adults with and without a history of cancer.

METHODS: We studied 8,542 adults aged ≥60 years, including 1,705 adults with a prior cancer diagnosis, who participated in NHANES 2007-2018 and had data on self-reported smoking characteristics and biomarkers of tobacco smoke exposure (serum cotinine and blood cadmium). Exposure to SHS was assessed based on detectable serum cotinine levels among nonsmokers. Frailty was defined using an adapted Fried criteria.

RESULTS: The prevalence of frailty was 5%. After multivariable adjustment, the odds ratio (OR, 95% CI) for frailty was 1.51 (1.19, 1.91) for former smokers and 1.63 (1.19, 1.22) for current smokers, compared to never smokers. The impact of tobacco smoking on frailty was stronger for adults with a history of cancer (OR for frailty comparing current smokers to never smokers was 1.75 for adults with a cancer history vs. 1.54 for adults without a history of cancer). Serum cotinine and blood cadmium concentrations were more strongly associated with frailty compared to self-reported measures. Among nonsmokers, the OR for frailty was 1.19 (95% CI: 0.92, 1.55) for nonsmokers exposed to SHS compared to unexposed participants.

CONCLUSIONS: In a representative sample of the U.S. population, tobacco use and exposure to SHS were associated with greater odds of frailty among adults with and without a history of cancer. These findings support the need for smoking cessation efforts and access to smoke-free environments for older adults, especially older cancer survivors.

KEYWORDS: tobacco, secondhand smoke, aging, cancer

THEMATIC 03: Air pollution (ambient & indoor) and Sources

P-0086 Acute ambulatory blood pressure response to short-term black carbon exposure: the MobiliSense sensor-based study

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BACKGROUND/AIM: Documented relationships between black carbon (BC) exposure and blood pressure (BP) have been inconsistent. Very few studies measured both BC exposure and ambulatory BP across the multiple daily environments visited in the general population, and none adjusted for personal noise exposure, a major confounder. Our study addresses these gaps considering 245 participants living in the Grand Paris region.

METHODS: Personal exposure to BC was monitored for 2 days using AE51 microaethalometers. Ambulatory BP was measured every 30 minutes after wake up using Arteriograph 24 monitors (n =6772). Mixed effect models with a random intercept at the individual level and time-autocorrelation structure adjusted for personal noise exposure were used to evaluate the associations between BC exposure (averaged from 5-minutes to 1-hour before each BP measurement) and BP. To increase the robustness of findings, we eliminated confounding by unmeasured time-invariant personal variables, by modelling the associations with fixed-effect models as well. All models were adjusting for potential confounders and short term time trends. Results from mixed models show that a 1-µg/m3 increase in 5-minutes averaged BC exposure was associated with an increase of 0.57 mmHg in ambulatory systolic blood pressure (SBP) (95% CI: 0.30, 0.83) and with an increase of 0.36 mmHg in diastolic blood pressure (DBP) (95% CI: 0.14, 0.58). The slope of the exposure-response relationship gradually decreased for both SBP and DBP with the increase in the averaging period of BC exposure from 5 minutes to 1 hour preceding each BP measurement. Findings from the fixed-effect models were consistent with these results.
CONCLUSION: We found evidence of a relationship between BC exposure and acute increase in ambulatory SBP and DBP after adjustment for personal noise exposure, with potential implications for the development of adverse cardiovascular outcomes.

KEYWORDS: ambulatory blood pressure; air pollution; black carbon exposure; sensors

P-0087 Time trends of PM2.5 exposure between 2000 to 2018 in the SCAPIS cohort

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BACKGROUND AND AIM: The Swedish CArdioPulmonary bioImage Study, SCAPIS, is a nationwide population-based cohort for the study of cardiovascular and pulmonary disease. A total of 31,265 men and women aged 50-64 years old were recruited and investigated including detailed imaging of the cardiovascular and pulmonary systems. The database currently covers over 1,300 different variables and is growing.

METHODS: We modelled yearly PM2.5 levels in the six SCAPIS regions, including major source types, traffic exhaust, road wear and resuspension, residential heating, shipping, with a spatial resolution of 50 x 50 m and assigned participants exposure 2000, 2011, and 2018. These areas cover over 40% of the total population in Sweden.

RESULTS: The time trend within the cohort showed a strong decrease in Long Range Transported (LRT) pollutants for the 2000s for all study regions, but for Stockholm Uppsala and Umeå the LRT exposure levels levelled out during the 2010s. There was a decreasing gradient of LRT concentrations from the highest levels in the south to the lowest levels in the north. The relative importance of the different local sources, and their respective temporal trends, were site dependent. Malmö was strongly influenced by the closeness to Copenhagen, especially in the beginning of the study period. Gothenburg had the strongest influence from shipping, and the relative importance of residential heating was strongest in Umeå in the north. Another general trend was that traffic exhaust particles decreased over time, while the particle concentrations from traffic road wear and resuspension instead increased, illustrating the tail pipe emission reduction and the traffic increase.

CONCLUSIONS: Exposure to air pollution in Sweden have decreased in the last two decades, but the pattern varies for the different regions and sources.

P-0088 Long-term exposure to air pollution and the development of airflow obstruction in the population-based Dutch Lifelines cohort

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BACKGROUND: Recent evidence reports a strong association between PM2.5 and NO2, and the development of chronic obstructive pulmonary disease, contrary to PM10 which showed no association. However, longitudinal data from large cohorts are lacking.
Aim: We studied the longitudinal association between air pollution exposure at the home-address and the development of airflow obstruction (AO) in the large population-based Lifelines cohort study.

METHODS: We included subjects from the Lifelines cohort study (http://www.lifelines.nl) without airflow obstruction (AO - defined as FEV1/FVC < lower limit of normal) at baseline and spirometry after 4.5 years of follow-up (n=25,506). Exposure levels at the home-address at baseline for black carbon (BC), NO2, PM10, and PM2.5 were estimated using land-use regression models from the ESCAPE study. A multiple logistic regression on the development of AO at follow-up was performed with adjustment for age, sex, body mass index, pack-years, educational level, monthly income and FEV1/FVC at baseline. We conducted both single and two pollutant models.

RESULTS: of the 25,506 individuals without AO at baseline, 2,464 (9.7%) had developed AO at follow up. Higher levels of BC, NO2, and PM2.5 were significantly associated with a higher odds to develop AO in the single pollutant models.In the two pollutant models NO2 and PM2.5 still showed a significant association with AO development while BC was no longer significant. Due to high correlation between BC, NO2 and PM10, two pollutant models could not be performed for these combinations. When, stratifying by gender and by smoking status, similar associations were observed mainly in males and current smokers.

CONCLUSIONS: This novel longitudinal study suggests that exposure to NO2 and PM2.5 are strong independent risk factors for the development of AO. In future studies we will focus identifying the most genetically susceptible individuals for these air pollutants.

P-0089 Impact of Air Pollution on the Health of Trees in Dhaka, Bangladesh

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BACKGROUND AND AIM: In cities, air pollution exposure may affect the roadside species by impacting their physiology, morphology, and biochemistry. In the present study, an investigation was conducted to evaluate the tolerance or sensitivity of four roadside tree species (Ficus benghalensis, Ficus religiosa, Mangifera indica, and Polyalthia longifolia) in four locations of Dhaka towards air pollutants, including particulates.

METHODS: Air pollution tolerance index (APTI) of the studied species was assessed employing their total chlorophyll content, ascorbic acid content, relative water content, and the pH of their leaves' extract. Anticipated performance index (API) was also calculated to assess the overall performance of a plant in a particular region where some socioeconomic and biological characteristics were taken into consideration.

RESULTS: The total chlorophyll content was found to decrease with the increasing particulate matter loads. The highest percentage change in the chlorophyll a/b ratio was found in M. indica (12.3%) at the highest traffic-intensity location. A significantly strong positive correlation was found between APTI and relative water content and between APTI and ascorbic acid content. Different tolerance orders of species were found for the four sampling sites owing to the varying level of air pollution. APTI of the investigated plants ranged from 10.31 to 12.51 meaning they were either sensitive or intermediately tolerant. M. indica was found to be intermediately tolerant in three sampling sites. From the API, M. indica was judged as good performer maintaining the highest score (68.75%) amongst the selected plant species irrespective of different sites.

CONCLUSIONS: The results suggested that these plant species are good indicators of air pollution and can be employed as an early warning tool for air pollution level.

KEYWORDS: Air pollution, Particulate matter, Air pollution tolerance index, Anticipated performance index, Metal accumulation index

P-0090 Nationwide assessment of ambient monthly fine particulate matter (PM2.5) and its associations with total, cardiovascular and respiratory mortality in the USA

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KEYWORDS: PM2.5, time series, cardiovascular disease, respiratory disease, mortality

BACKGROUND AND AIM: High air pollution events spanning multiple months caused by environmental perturbations such as droughts and wildfires are increasing in frequency, intensity and duration due to climate change. While both daily and annual exposure to PM2.5 have regulatory standards in the USA, mid-scale exposure at the monthly interval remains unregulated and the public health impacts of mid-duration ambient air pollution exposure are poorly understood. These present a new public health challenge in mitigating harmful effects of ambient air pollution on community health.

METHODS: We executed an ecological study of the associations between monthly mean PM2.5 exposure with total, cardiovascular and respiratory mortality counts, stratified by age, sex and race, from 698 counties in the conterminous USA from 1999 – 2018. A two-stage model was used to estimate the risk and number of deaths associated with this exposure reported as incidence rate ratios (IRR) and absolute risk differences per million persons (ARD).

RESULTS: Increased mortality of all types was positively associated with monthly mean PM2.5 exposure (total mortality IRR: 1.011, 95% CI: (1.009,1.013), ARD: 8.558, 95% CI: (6.869,10.247); cardiovascular mortality IRR: 1.014, 95% CI: (1.011,1.018), ARD: 3.716, 95% CI: (2.924,4.509); respiratory mortality IRR: 1.016, 95% CI: (1.001, 1.023), ARD: 1.676, 95% CI: (1.261,2.091)). Our results suggest the elderly, non-black minorities and males to be the most impacted subgroups along with metropolitan and highly socially vulnerable communities. Heterogeneities in the magnitude and direction of association were detected across climate regions of the U.S.

CONCLUSIONS: In the general population, monthly PM2.5 was associated with an increased risk and number of deaths of total, cardiovascular and respiratory mortality. Our results demonstrate a need for future public health policy to be initiated for this currently unregulated interval of ambient air pollution exposure.

P-0091 Variation in PM2.5, PM10 and atmospheric conditions in the three (3) ecological zones in Ghana

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INTRODUCTION:
While clean air is a basic human requirement, air pollution continues to be a major global health problem. This is largely due to its impact on climate change and significant association with morbidity and mortality. This study focused on particulate matter with an aerodynamic diameter less than 2.5 microgram (PM2.5) and 10 micrograms (PM10) with atmospheric conditions in the three ecological zones (Savannah Belt, Forest Belt and Coastal Belt) of Ghana which exhibit different climatic characteristics.
MATERIALS AND METHODS: The Community Air Pollution Study (CAPS) installed 18 Purple Air Monitors across Ghana, 6 in each ecological zone. The data was extracted, cleaned and aggregated based on zones. The median (IQR) was used to summarize skewed PM values and mean (±SD) was used for the weather data analysis. Correlation between PM levels and weather data were computed using spearman's correlation.
RESULTS: The study collected data from June 2020 to February 2022. Humidity correlated negatively with PM2.5 and PM10 concentrations, but positively with temperature. In terms of ecological variations, the savannah zone had the best air quality levels with median PM2.5 and PM10 values of 16.07µg/m3 and 19.47µg/m3 respectively. The corresponding mean temperature was 31.67oC and 35% humidity. This was followed by the forest zone with PM2.5 = 29.17 µg/m3, PM10 = 36.96 µg/m3, mean temperature = 31.11 oC and humidity levels of 50%. The Coast ecological zone of Ghana had the worst air quality measuring PM2.5 and PM10 levels at 42.11 µg/m3 and 51.81 µg/m3 respectively and temperature of 30 oC with humidity of 88%.
CONCLUSION:
The three ecological zones studied had average PM2.5 and PM10 levels higher than recommended by the Air Quality Guidelines of the World Health Organization (WHO). The Savannah zone which recorded the least had levels about two or three times higher than recommended by WHO.

P-0093 Environmental monitoring air pollution of Santa Cruz industrial district in Rio De Janeiro using a plant fertility model

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BACKGROUND: Pollen abortion assay is considered a bioindicator of genotoxic air effects. In 2010, a Steel company was settle in Santa Cruz, Rio de Janeiro. In 2012 occurred silver rains arising concerns on human and environmental impact. In 2013, the company signed an adjustment of conduct term(ACT).Aim:to evaluate air pollution in steel company vincinity based on plant fertility essay.

METHODS: A pollen abortion assay was performed with flower buds of Bauhinia Forficata in 2013, and Delonix Regia in 2015. Unexposed sites were those over 5km from steel company, highway and tunnels; exposed sites were those up to 5km from highways/tunnels; and from to Steel company only. During dry and rainy season, over 10plants were randomly collected per site, 300cells were evaluated per slide. Aborted grains were analyzed using a microscope under 400-fold magnification. Statistical analyses considered a significant level of 5%.

RESULTS: In 2013 were selected 02unexposed, 18exposed to highway/tunnel, and 07exposed to Steel company sites. In 2015 were selected 14unexposed, 18exposed to highway/tunnel, and 02exposed to Steel company sites. In both years, pollen abortion percentage medians were statistically higher in dry season for sites exposed to highway/tunnel(p=0.000), and to Steel company(p=0.005). In 2013 pollen abortion were significantly higher in sites exposed to highway/tunnel compared to unexposed(p=0.004), and for sites exposed to Steel company compared to highway/tunnel(p=0.034). In 2015, compared to unexposed sites, pollen abortion averages were significantly higher in sites exposed to highway/tunnel(p=0.014), and in exposed Steel company(p=0.000). Overall, compared to unexposed sites, pollen abortion averages were 5.79-fold in exposed to Steel company sites, and 4.08-fold in exposed highway/tunnel sites.
CONCLUSION: for both years, stronger effects on pollen abortion were observed on sites exposed Steel company as compared to unexposed, and exposed to highway/tunnel. Air pollution effect was higher in sites exposed Steel company regardless of ACT.

KEYWORDS: environmental epidemiology,environmental exposure,Steel company exposure,pollen abortion,air pollution

P-0094 Poultry house as point source of intense bioaerosol emission

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BACKGROUND AND AIM: Intensive poultry farming is usually associated with massive exposure to organic dust, which is largely composed of microbiological origin particulates. This study aimed to assess occupational and environmental exposures to airborne bacteria and fungi emitted from poultry house.

METHODS: The concentrations of airborne microorganisms in henhouse and its vicinity (250–500m) at 3 different stages of production cycle (i.e. in clean and disinfected poultry house without chickens, with 7-day-old, and 42-day-old chickens, i.e. one day before they departure to the slaughterhouse) were measured using impactor, impinger, and filter samplers. The collected microbiota was taxonomically identified using biochemical and molecular methods to characterize occupational exposure and its spatial dissemination.

RESULTS: Intensive chicken breeding resulted in very high bacterial and fungal concentrations (up to 8.1×10^7cfu/m³ and 3.3×10^4cfu/m³, respectively) in poultry house exceeding at the end of production cycle the threshold limit values proposed for such working environment. The presence of numerous human (e.g. Actinomyces, Clostridium, Corynebacterium, Enterococcus, Klebsiella, Proteus, Prevotella, Escherichia, Staphylococcus, Streptococcus, Listeria, Salmonella, Shigella, Pseudomonas, Bacteroides, Burkholderia, and Aspergillus) and chicken (e.g. Salmonella and Escherichia) pathogens posed a real health threat to both employees and animals. Efficiently working ventilation system in this facility was able to capture majority of airborne particulates released during breeding cycle (on average 8-fold/14-fold decreases between the henhouse and 250m/500m circles around it); however, the indoor-outdoor migration of microbial contaminants with fine aerodynamic diameters was constantly visible.

CONCLUSIONS: The employees in poultry house were exposed to high concentrations of airborne microorganisms, including pathogens that may lead to adverse health outcomes. To protect them, highly efficient hygienic and technical measures regarding henhouse interior and its ventilation, respectively, should be introduced to prevent both unwanted pollution and subsequent emission of microbial contaminants during intensive chicken breeding.

KEYWORDS: bioaerosol, poultry house, point emission, occupational exposure, spatial dissemination

P-0101 Association between traffic density exposure during pregnancy and low birthweight in Spain, 2000-2017

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BACKGROUND AND AIM: Low birthweight (LWB) is an indicator of intrauterine growth restriction and birth outcomes. Several pollutants have been associated with adverse birth outcomes, especially those involved in traffic-related air pollution exposure. A good approximation to measure the exposure is the traffic density. The aim of this study is to estimate the association between traffic density exposure during pregnancy and low birthweight in Spain, for the period 2000-2017.
METHODS: A retrospective, cross-sectional study was conducted. Data from Spanish Birth Registry database was used with a total number of 4.934.810 birth records from all the regions of Spain, only full-term pregnancy (37 to 42 weeks) with one single live fetus. We defined LBW as newborn who weigh less than 2.500gr. We estimated traffic density exposure using the annual average daily traffic, calculated as the total volume of traffic of a road for a year divided by 365 days, measured at the mother's home address. The variable was categorized in quartiles in order to compare the highest level of traffic density with the lowest level. Socio-economic covariates were included in the analysis too.
RESULTS: Traffic density exposure was associated with a risk of LBW, with an OR=1.08 (95%CI 1.06, 1.10) for very high traffic density compared to low traffic density. Mothers that lived in cities with more than 100.000 inhabitants, with lower socio-economic condition and higher economic activity rate had LBW children.
CONCLUSIONS: This study found an association between high traffic-density exposure and LBW in a large nation-wide study.

KEYWORDS:
Low birthweight; Traffic-density; Air pollution.

P-0104 Associations between grass pollen counts and allergen (Phl p 5) levels with respiratory allergic health outcomes

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BACKGROUND/AIM:
Previous studies have linked daily pollen counts to respiratory allergic health outcomes, but none have considered allergen levels, although daily allergen release from a single pollen grain can vary 10-fold. This study assessed associations of grass pollen counts and allergen levels with respiratory allergic health symptoms in a panel of 93 adults with moderate-severe allergic rhinitis living in London.

METHODS: Participants in an allergy clinical trial scored their daily symptoms and medication use from 17 May to 31 August, 2013. Daily combined symptom and medication (CSM), overall symptom, and overall medication scores were calculated. Daily grass pollen counts (grains/m3) and allergen levels (Phlp 5, pg/m3) were measured at a monitoring site in central London and categorized into tertiles. Associations of health scores with pollen counts and allergen levels were assessed using generalized estimating equations linear models, adjusted for sex, age, as well as daily mean temperature, relative humidity, precipitation and nitrogen dioxide levels.

RESULTS: Daily CSM scores ranged from 0.77 to 16.42. Compared to the lowest exposure tertile, CSM scores were on average 2.42 [95% confidence interval: 2.00, 2.83] and 6.65 [5.87, 7.43] higher for the medium and highest tertile of pollen counts (p-trend <0.001), respectively. The corresponding values were 1.47 [1.12, 1.81] and 8.21 [7.21, 9.22] for allergen levels (p-trend <0.001). In models mutually adjusted for pollen counts and allergen levels, associations with allergen levels remained similar (1.26 [0.96, 1.57] and 7.30 [6.33, 8.27]) whereas those for pollen counts were attenuated (0.53 [0.29, 0.77] and 1.50 [1.18, 1.82]).

RESULTS: were consistent across various sensitivity analyses (e.g. analysing symptom and medication scores separately, adjusting for PM2.5 instead of nitrogen dioxide).

CONCLUSIONS: In mutually adjusted models, associations were stronger for allergen levels than pollen counts, suggesting measurement of allergen levels may improve risk prediction.

KEYWORDS: Pollen, allergens, air pollution, allergies

P-0106 Traffic density exposure and metabolomics in a population-based sample: The HORTEGA Study

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BACKGROUND AND AIM: Metabolites participate in biological responses to exposure to various external factors such as disease, or environmental pollution, among others. Although the literature in humans is still scarce, several studies have shown that exposure to air pollution causes changes in various metabolic pathways. The aim of this study is was to evaluate the association between traffic density at the street of residence with plasma metabolomic profiles of a population-based sample.

METHODS: The subjects of this study belong to the Hortega Study cohort, which is a representative sample of the population of Valladolid, Spains. To assess the effect of traffic exposure and metabolite levels the Annual average daily traffic of the roads in the studied region was used, calculated as the total volume of transportation traffic of a road or highway for a year divided by 365 day. Metabolomic profile was determined by Nuclear Magnetic Resonance Spectroscopy in non-fasting plasma.

RESULTS: Traffic density was positively associated with lipoprotein profile and fatty acids levels and inversely associated with amino acid levels, the metabolites associated with fluid balance and the products derived from bacterial co-metabolism. As for oxidative stress markers, MDA levels show a decrease of one tenth in the most exposed subjects. In relation to energy metabolism, the association is positive for lactate and acetone.

CONCLUSIONS: We observed a strong association of high traffic density exposure with changes in certain metabolic patterns.

KEYWORDS:
Metabolomics; Traffic-density; Air pollution.

P-0108 Can the UK achieve the $PM_{2.5}$ WHO 10 µg m-3 interim target by 2030?

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BACKGROUND: The UK Government is currently setting two $PM_{2.5}$ targets for its Environment Bill. The first is a concentration target to be met by some future date and the second a population exposure reduction target, aimed at reducing exposure gradually over time.
AIM: The aim of this research was to combine existing UK 2030 emissions forecasts, the UK's Climate Change Committee (CCC) Net Zero vehicle forecasts, and the Greater London Authority's policy forecasts, to establish whether the UK can meet the $PM_{2.5}$ WHO 10 µg m-3 interim target by 2030, and to assess the likely exposure reduction.
METHOD: We used a combination of European, UK National and London Atmospheric Emissions Inventory forecasts between 2018 and 2030. for road transport we calculated emissions for the Balanced Net Zero Pathway, published by the CCC, which includes widespread vehicle electrification, and two London specific policies aimed at reducing $PM_{2.5}$. The emissions were combined with the WRF met. model and the CMAQ-urban coupled model, providing UK $PM_{2.5}$ concentrations down to 2km spatially and then every 20m close to major roads.

RESULTS: UK $PM_{2.5}$ concentrations in 2030 were below 10 µg m^{-3}, for over 99% of the UK population. In London, the second scenario reduced $PM_{2.5}$ locally, with <1% of the area of London predicted to be above 10 µg m-3. Accounting for model uncertainty resulted in ~4% of the UK remaining at risk of exceeding 10 µg m-3 albeit in cities such as Birmingham and Manchester.

CONCLUSIONS: We have shown the combined benefits of UK air quality, Net Zero and local policies for $PM_{2.2}$ control, in almost achieving the $PM_{2.5}$ WHO interim target. We identified important but uncertain emissions sources, such as non-exhaust vehicle emissions, cooking aerosol and domestic and industrial wood burning. This work has been submitted to the UK Environment Bill consultation.

P-0110 Characterisation of volatile organic compounds in hospital indoor air and the potential impact on healthcare worker health

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BACKGROUND AND AIM: Indoor air quality is affected by various activities, including activities taking place inside the building, the outdoor air quality and the building materials themselves. This study focused on the characterisation of volatile organic compounds (VOCs) present in Respiratory Departments of two hospitals, due to their widely recognized impact on human health. There is evidence that the occurrence of adverse respiratory symptoms is higher in hospital workers compared to other occupations, and a recent study has shown that there are significantly higher numbers of complaints from healthcare workers compared to administrative workers at the same hospital. Recently, the UK Health and Safety Executive (HSE) has updated the workplace exposure limits for several VOCs, but some known for their detrimental impact on human health are absent from this list.

METHODS: VOCs were quantified at two hospital sites; over 600 samples of air were collected over 31 months (2017-2020) onto sorbent tubes and analysed by two-dimensional gas chromatography.

RESULTS: 99 VOCs were present in every sample and 557 VOC in 50% of samples. The most abundant compounds found were 2-propanol, acetone, hexane and 2-butanone, with respectively median concentrations of 358.41 µg/m3, 84.40 µg/m3, 58.55 µg/m3 and 4.90 µg/m3. Our results showed that the most frequently detected VOCs, at the highest concentrations are most likely released by healthcare activities such as the use of hand sanitiser as well as ingress of vehicle emissions.

CONCLUSIONS: Whilst these VOC concentrations are under the workplace exposure limits for long-term (8-hours) defined by HSE, the mean concentration of acetone, 2-propanol and hexane measured were 4, 9 and 30-fold higher compared to similar studies performed in other hospitals. Long-term exposure to VOCs at moderate concentration could still have an impact on healthcare workers, especially those which pre-existing conditions.

KEYWORDS: hospital, indoor air, VOCs, exposure, healthcare workers

P-0114 Source-Apportioned Particulate Air Pollution and 30-day Readmissions Among Heart Failure Patients

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BACKGROUND AND AIM: Fine particulate air pollution (PM2.5) exposure is associated with increased risk of hospital readmissions. This study aims to determine if this association differs according to the attributable source of the PM2.5.

METHODS: We used zero-inflated poisson mixed-effects models to associate source-apportioned PM2.5 with the number of 30-day readmissions after HF diagnosis. The study cohort included patients diagnosed with HF who had a hospital visit at a University of North Carolina Healthcare System facility between July 5, 2004, and December 31, 2010. The exposure was the annual average source-apportioned PM2.5 at the date of HF diagnosis. Patient zip code was included as a random effect and models were adjusted for year of diagnosis, sex, race, age, smoking status and 2010 census block group measures of urbanicity, percent receiving public assistance, median income, and median house value. PM2.5 was apportioned into the sources using a Chemical Mass Balance Gas Constrained-Iteration model. Results are presented as the percent change in number of expected readmissions per interquartile range increase in source-apportioned PM2.5 and the associated 95% confidence interval (CI).

RESULTS: We observed associations with 30-day readmissions for gasoline (16.89%; 95% CI = 4.82-30.36), diesel (9.87%; 95% CI = 1.72-18.69), and secondary organic carbon (SOC; 20.44%; 95% CI = 8.29-33.95) PM2.5. Associations were greater for study participants in a census block group with an income below the median value. Associations were also greater for Black HF patients compared to white HF patients.
CONCLUSIONS: Associations between 30-day readmissions and PM2.5 appear greatest for traffic and SOC-related sources which may be due to a combination of differential toxicity as well as the distribution of these sources amongst HF patients. This abstract does not necessarily represent the views or policies of the US Environmental Protection Agency.

KEYWORDS: Heart failure, hospital utilization, particulate matter, air pollution

P-0115 Modification of Associations Between PM2.5 and Blood Pressure by Anti-Hypertensive Medication Usage in Heart Failure Patients

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BACKGROUND:
Fine particulate matter (PM2.5) is associated with cardiovascular morbidity and mortality. Medications that target similar pathophysiologic pathways as PM2.5 may modify PM2.5-related health risks. Here, we used EPA CARES, a collection of electronic health records (EHRs) linked to environmental data, to examine whether anti-hypertensive medications modify associations between PM2.5 and blood pressure (BP).

METHODS: For this study, we used EHRs from 27,953 heart failure patients observed from 2014-2016. Daily PM2.5 was measured at the nearest US EPA monitor to each study participant's primary residence. Linear mixed models adjusted for age, sex, race, season, relative humidity, temperature, and a natural spline term for time since study start were used to estimate associations between systolic and diastolic BP and daily PM2.5 on the day of measurement and up to 4 days before measurement as well as the 5-day average. Associations were stratified on use of anti-hypertensive medications and a multiplicative interaction term was used to estimate the interaction between PM2.5 and medication usage. Results are presented as the change in BP (mmHg) per 10 µg/m3 PM2.5 and the associated 95% confidence interval (CI).

RESULTS: The pattern of associations was consistent for all time periods examined so we present here just the 5-day average PM2.5 associations. for BP assessed when on anti-hypertensive medications we observed negative associations for systolic (-0.30, CI= -0.42, -0.18) and diastolic (-0.19; CI= -0.27, -0.12) BP. Conversely, for time-periods not on anti-hypertensive medications associations were positive for systolic (0.42, CI= 0.27, 0.57; interaction P= 5.3x10-12) and diastolic (0.13; CI= 0.04, 0.23; interaction P= 2.3x10-9) BP.

CONCLUSIONS: Anti-hypertensive medication usage likely has interactions with short-term PM2.5 and medication usage in general should be accounted for when possible and explored for its ability to modify PM2.5-related health risks. This abstract does not necessarily reflect the policies of the US EPA.

P-0116 Exposure to Ambient Air Pollution is Associated with Expression of Breastmilk miRNAs

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BACKGROUND AND AIM: Breastmilk EV-miRNAs are RNAs contained within extracellular vesicles, which regulate post-transcriptional gene expression. EV-miRNAs potentially function as mother-infant messages with implications for infant growth and immune development. Several EV-miRNAs are associated with cigarette exposure, which contains particles found in ambient air pollution (AAP). Previous research has not explored whether prenatal AAP exposure is associated with breastmilk EV-miRNAs.

METHODS: Participants included 110 mother-infant dyads from the Southern California Mother's Milk Study, EV-miRNAs were measured 1-month postpartum, and AAP was modeled using spatial interpolation of monitoring stations via an inverse distance-squared algorithm. Principal components analysis (PCA) was used to assess associations between EV-miRNA profiles and maternal characteristics. Negative binomial models were used to estimate associations between AAP and EV-miRNA counts. Analyses adjusted for proportion of rRNA reads, EV extraction date, and volume of skim milk. The Benjamini-Hochberg procedure was used to adjust for multiple testing, with $P<0.05$. DIANA MirPATH was used to predict mRNA targets (extracted from Tarbase) of AAP-associated EV-miRNAs, followed by KEGG pathway analysis.

RESULTS: Principal component 1 (PC1) and PC2 explained 18.6% and 15.6% of the variance in miRNA, respectively. Breastfeeding frequency (PPC1=0.03, PPC2=0.002), breastmilk collection time (PPC1=0.007), and pregnancy PM2.5 exposure (PPC2=0.02) predicted EV-miRNA profiles. Pregnancy AAP exposure was also associated with EV-miRNAs; NO2 was associated with three EV-miRNAs, PM2.5 with 17, and PM10 with two, after additional adjustment for breastfeeding frequency and breastmilk collection time. All AAP exposures were positively associated with miR-200b-3p and miR-200c-3p. The top pathways for AAP-associated EV-miRNAs were fatty acid biosynthesis, hippo signaling pathway, and fatty acid metabolism.

CONCLUSIONS: This analysis provides preliminary evidence that breastmilk EV-miRNAs may be impacted by pregnancy AAP exposure. AAP exposure was associated with expression of miR-200b-3p and miR-200c-3p. Expression of these miRNAs is linked with breast cancer.

KEYWORDS:
PM2.5, PM10, NO2, microRNA, breastmilk

P-0117 Alpha particle radioactivity from indoor radon decay products and pulmonary function among chronic obstructive pulmonary disease patients

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BACKGROUND AND AIM: Radionuclides attached to particulate matter (PM), referred to as particle radioactivity (PR), are mainly from radon decay and continue to emit radiation after inhalation. Decay products that emit α-radiation have the greatest potential of pulmonary damage due to high energy transfer to surrounding tissues.

METHODS: Our study included 143 patients (90% male, mean age±SD=72.8±8.2 years) with chronic obstructive pulmonary disease (COPD) in Eastern Massachusetts, USA who were not current smokers. Up to four one-week long seasonal indoor samples of PM ≤2.5 μg/m3 (PM2.5) were collected for each patient (n=467), followed by spirometry pre- and post-bronchodilator (BD). α-activity was measured on archived sampling-date-matched ambient and indoor PM2.5 Teflon filter samples (α-PR), which represents the decay of 210Pb, the longest-lived radionuclide (t1/2=22 years), to 210Po. Indoor/ambient sulfur ratio in the filter samples was used as a measure of air infiltration.
Exposure surrogates indicating greater exposure to radon decay products from an indoor source were derived: indoor/ambient α-PR and high indoor α-PR (>median) with low air infiltration (<median sulfur ratio). We fitted generalized additive mixed models adjusted for meteorological variables, seasonality, and patient characteristics. PM2.5 mass was additionally adjusted for as sensitivity analysis.

RESULTS: An interquartile range increase in indoor/ambient α-PR was associated with a -8.9 (-24.2, 6.3) mL and a -7.7 (-31.6, 16.2) mL reduction in average post-BD forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC), respectively. The greatest effects were found for homes with high indoor PR and low air infiltration compared to others, a -26.9 (95% CI: -61.4, 7.7) mL reduction in post-BD FEV1 and a -75.4 (95% CI: -128.6, -22.2) mL reduction in post-BD FVC. Associations remained after PM2.5 adjustment.

CONCLUSIONS: Indoor sources of α-PR from radon decay products may reduce pulmonary function in COPD patients.

KEYWORDS: air pollution, radiation, pulmonary function

P-0118 Prediction of Short-Term Ultrafine Particle Exposures using Street-Level Images and Air Quality Data Based on Mobile Monitoring

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BACKGROUND: Within-city UFPs vary sharply since they are influenced by various factors, e.g., local sources, built environment, and meteorology. The long-term spatial distribution of UFPs has been investigated using mobile platforms. As computer vision techniques develop rapidly, recent studies employed convolutional neural networks (CNNs) to investigate the spatial variations in UFPs. This study developed prediction models for short-term UFP exposures using street-level images and air quality data based on mobile measurements.

METHODS: UFP concentrations were measured in a large-scale mobile monitoring campaign between August 2020 and August 2021 in Toronto, Canada. Second-by-second level measurements were paired with street-view images collected by a 360degree camera on the vehicle rooftop. We systematically designed routes to capture exposures across various road types, land use, and built environments. The dataset includes over 1 million data points, covering about 1400 unique kilometers and 8000 unique roads. CNN models were trained to extract detailed traffic characterization and built environment features from images captured by the rooftop camera. Using only 10s averaged features extracted from images as well as regional meteorology and air quality at fixed stations, a machine learning model was used to predict UFPs.

RESULTS: The prediction accuracies for 'Low' and 'High' UFP levels achieved 77% and 70%. NO2 levels measured at Toronto's downtown air quality station had an impact on model output. Larger green areas and building footprints in images were associated with lower UFP exposures, while the presence of trucks and other traffic parameters were associated with higher UFPs.

CONCLUSIONS: This study demonstrates that a picture captured on an urban street, associated with regional air quality and meteorology, can adequately predict short-term exposure. This approach can be deployed through crowdsensing platforms to track the frequency and severity of UFP spikes in urban environments.

KEYWORDS: UFP exposures; computer vision; mobile measurements; interpretable machine learning

P-0119 The Design, Calibration, and Evaluation of a Mobile Sensor System for Air Pollution Measurement and Prediction in Urban Areas

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BACKGROUND: The increasing ubiquity of low-cost air quality sensors has been recently met with a growing body of research on sensor calibration and validation. While most studies documenting low-cost sensor performance are limited to the analysis of fixed sensors, there is still much to be learned from the performance of air quality sensors in a mobile environment. This study presents the design and testing of a mobile platform for simultaneous air quality, traffic, and built environment characterization.

METHODS: The Urban Scanner is a platform mounted on the rooftop of a vehicle and equipped with air quality sensors (NO2, O3, PM2.5, PM10, CO) and ancillary instruments such as GPS, 360degree camera, LIDAR 3D scanner, and wind anemometer. It also includes a data acquisition module with real-time analytics for traffic characterization from video imagery (cars, trucks, buses) and built environment features (trees, sidewalk, building façade, building height). Air quality sensor calibration was conducted through co-location against reference instruments with novel signal processing techniques. A year-long data collection campaign in the City of Toronto, along routes carefully designed to maximize the variability in road types, land-use, and built environment features.

RESULTS: After urban scanner development and calibration, all sensors exhibited small standard errors and significant relationships with reference data. Traditional land-use regression models explained spatial variations in NO2 and O3 across Toronto, with R2 = 0.64 and 0.65, respectively. In addition to linear regression, a principal component analysis of the predictors was first conducted and subsequently used in Bayesian Regularized Neural-Networks models (BRANN). This approach yielded R2 of 0.82 and 0.80 for O3 and NO2.

CONCLUSIONS: The combination of a fully calibrated sensor system and a carefully designed data collection protocol that optimizes spatial variability and temporal representation, can give rise to a powerful tool for air quality prediction in urban areas.

P-0122 Land Use Regression Model for Exposure Assessment to Pollutant Gases in Rio de Janeiro City, Brazil

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BACKGROUND AND AIM: Air pollution is a public health problem. The data from WHO show that nine out of 10 people breathe air containing high levels of pollutants and the exposure to fine particles caused about 4.2 million deaths in 2016. Therefore, the aim of this study was to elaborate a model for long-term exposure assessment to air pollution gases.

METHODS: This study was developed in Rio de Janeiro city, Brazil; it has 1,200.255 km² large, about 6.7 million residents and located in the southeastern region of country. The information of O_3, SO_2 and predictor variables were obtained from government agencies. The potential predictor variables have been used: temperature, relative humidity, vehicular traffic, Census, altitude, vegetation cover, land use, rock masses, hydrographic and hydrographic sub-basins, urban zoning and road network. Linear regression models were specified using the supervised stepwise procedure for the development of Land Use Regression models. Cook-D statistics were used to detect influential observations. The overall model performance was evaluated by leave-one-out cross validation (LOOCV).

RESULTS: The annual average of O_3 and SO_2 was 117.68 (SD=±36.83) and 8.796 (SD=±4.93) μg·m−3, respectively. The final model for O_3 included four predictor variables: ADHHOLD_300, SQRALT, GREEN_5000 and DPOP_5000. The adjusted R^2 value was 0.83 and p-value=2.359E-05. The performance evaluated by LOOCV presented R^2=0.74, RMSE=18.26 and MAE=14.26. for SO_2 included three predictor variables: SQRALT, INDUSTRY_100 and PORT_5000. The adjusted R^2 value was 0.91 and p-value=0.002. The performance showed R^2=0.52, RMSE=3.60 and MAE=2.73.

CONCLUSIONS: It was possible to elaborate a model applicable to areas where there is no air quality monitoring. The model allows an evaluation of the impact on the health of exposed populations, serving to support decision-making and the development of public policies and investments, in the medium and long term.

KEYWORDS: Ozone, Sulfur dioxide, Air pollution.

P-0126 Changes in the short-term relationship between air pollution and mortality over thirty years (1990-2019) in New York City

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BACKGROUND AND AIM: The short-term impacts of air quality on health have long been established, but prior studies evaluating their connection have limited study periods. We aim to characterize changes in the relationships between the Environmental Protection Agency's (EPA's) criteria air pollutants and natural-cause mortality in New York City (NYC) over three decades (1990-2019).

METHODS: Using daily city-wide average concentrations from EPA's Air Quality System of carbon monoxide (CO), sulfur dioxide (SO_2), fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), and ozone (O_3) and mortality counts from NYC Vital Statistics, we ran quasi-Poisson distributed lag models for each pollutant, considering up to three lag days and adjusting for temperature and seasonal trends. Change in each pollutant's effect estimate over time was examined by (1) five-year rolling segments in the time-series model, and (2) case-crossover analysis with an interaction term based on air quality trends splitting the 30 years.

RESULTS: One lagged day conferred the highest percent excess risk (PER) (95% CI) – CO: 0.5 (0.2, 0.7); $PM_{2.5}$: 0.7 (0.4, 1.1); SO_2: 2.3 (1.5, 3.2); NO_2: 1.2 (0.8, 1.7) per EPA's standard increments (0.75 ppm, 10 μg/m³, 40 ppb, and 30 ppb, respectively). Seasonal stratification did not greatly alter the magnitude of associations. PER from warm-season O_3 was 0.8 (0.3, 1.3) per 30 ppb and sustained for three lag days. Seasonality patterns for O_3 and NO_2 changed around 2005 and $PM_{2.5}$ in 2008. Segmented estimates from years prior to and after these changes indicate an increase in post-period warm-season PER from NO_2 and O_3. Interaction terms, though, did not suggest changes in risk over time.

CONCLUSIONS: Evidence from the analyses conducted reinforce previously known risks from $PM_{2.5}$ and O_3 exposure, and elevate risk of NO_2. Because observed change in risk depends on model specifications, further research is warranted.

KEYWORDS: Air pollution, Mortality

P-0127 Triggering of cardiovascular hospitalization by short-term increases in PM2.5 in New York adults: changes following Tier 3 vehicle introduction

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BACKGROUND and AIM: Previously, increased hospitalizations for cardiovascular disease (CVD) were associated with PM2.5 concentrations in New York State (NYS) adults from 2005-2016, with higher rates after air quality policies and a recession reduced PM2.5 concentrations (2014-2016), suggesting PM had become more toxic. Following introduction of Tier 3 light duty vehicles in 2017, which should produce less secondary organic carbon than previous vehicles likely making PM less toxic, we hypothesized that there would be a lower relative rate in 2017-2019 than 2014-2016.

METHODS: From the SPARCS database (~95% of hospital admissions in NYS), we included hospitalizations with a primary diagnosis of CVD from 2014-2019 to adults living within 15 miles of PM2.5 monitoring stations in Buffalo, Rochester, Albany, Bronx, Queens, and Manhattan. Using daily PM2.5 concentrations from these sites, a case-crossover design, and conditional-logistic regression, we separately estimated the rate of CVD hospitalizations associated with increased PM2.5 concentrations in 2014-2016 and 2017-2019.

RESULTS: Interquartile range (IQR) increases in PM2.5 were associated with increased excess rates of ischemic heart disease hospitalizations in 2014-2016 (lag days 0-3: 2.0%, 95% CI = 0.9%, 3.2%), but not 2017-2019 (-0.8%, 95% CI = -2.3%, 0.6%). However, IQR increases in PM2.5 were associated with larger excess rates of heart failure hospitalizations in 2017-2019 (lag day 0: 4.4%; 95% CI = 1.3%, 7.7%) than 2014-2016 (1.1%; 95% CI = -0.1%, 2.2%), with a similar pattern for hypertension hospitalizations.

CONCLUSIONS: We did not find consistent differences in rates of cause-specific CVD hospitalizations associated with increased PM2.5 concentrations in the previous 1-7 days in NYS adults, before and after Tier 3 vehicles were introduced. However, there may need to be more time for more Tier 3 vehicles to be in the vehicle fleet, and for greater retirement of the older more polluting vehicles.

KEYWORDS: cardiovascular hospitalizations, air pollution, case-crossover

P-0130 Examining associations between long-term exposures to PM components and arterial stiffness using a Bayesian kernel machine regression approach

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BACKGROUNDS AND AIMS: While many studies have found adverse health effects to ambient air pollution exposure, the combined effects of particulate matter (PM) components on measures of arterial stiffness (central augmentation index and central pulse pressure) have not been evaluated. We aimed to model central augmentation index and pulse pressure and the individual and joint associations of long-term exposure to PM components using a Bayesian Kernel machine regression (BKMR) approach and compare the results to those from individual linear mixed-effects regressions.

METHODS: Central Augmentation index (%) and pulse pressure (mmHg) were measured among 398 participants in the Normative Aging Study (NAS) in Eastern Massachusetts between 2007 and 2013 with radial artery applanation tonometry for pulse wave analysis. Fifteen PM components at a 50m x 50m spatial resolution assigned to participants based on residential address from a well-validated ensemble weighted averaging model. BKMR was utilized to assess the overall joint and individual effect of the PM components (bromine, calcium, copper, elemental carbon, iron, potassium, ammonium, nickel, nitrate, organic carbon, lead, silicon, sulfate, vanadium, and zinc).

RESULTS: In the BKMR analysis, the overall joint effect of the PM components was associated with an increase in central augmentation pressure, particularly when the exposures were above their 60th percentile. for example, the joint effect of the PM components at the 80th percentile (compared to the median) was a 0.33SD (95% CI: -0.13, 0.78) change in augmentation index. However, 95% credible intervals around all the joint effect estimates contained the null value. From the mixture, calcium and elemental carbon were the most influential PM components on central augmentation pressure.

CONCLUSIONS: From this mixture analysis, we find suggestive adverse effects of long-term joint exposure to PM components on cardiovascular health in an elderly population.

KEYWORDS: Air pollution, BKMR, particulate matter, cardiovascular

P-0131 Long-term Exposure to Ambient Ozone and Mortality in a population-based cohort of South Korea

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BACKGROUND AND AIM: Compared to robust evidence from studies on short-term exposure, the health effects of long-term ozone exposure have been less studied, and the results are mixed. One of the potential sources of inconsistency is the difference in exposure metrics. This study aimed to investigate the association between long-term exposure to ambient ozone and mortality in South Korea, using different exposure metrics. We also examined sources of heterogeneity between previous studies.

METHODS: The study population comprised 179,806 subjects from the National Health Insurance Service-National Sample Cohort (2002-2015) residing in 7 major cities in South Korea. Several ozone exposure metrics (year-round 24-h, year-round 8-h, warm-season 24-h, and warm-season 8-h) were calculated for each district. Time-varying Cox proportional hazards models were adopted to estimate the association between ozone and all-cause and cause-specific mortality. Random-effects meta-analysis and meta-regression analysis were performed to pool the effect estimates of previous studies and examined whether selected study characteristics can explain between-study heterogeneity.

RESULTS: The HRs per 10 ppb increment in year-round 24-h ozone for all-cause (HR, 1.18; 95% CI, 1.07-1.29) and circulatory (HR, 1.52; 95% CI, 1.25-1.84) mortality were higher than that of other exposure metrics. for respiratory mortality, year-round 8-h ozone showed the largest associations (HR per 10 ppb, 4.13; 95% CI, 1.04-1.96). The meta-analysis of 26 previous studies and the present study showed a positive association between long-term ozone exposure and all-cause mortality, with the largest HR from warm-season 8-h ozone (HR, 1.042; 95% CI, 1.015-1.071). The exposure metric was significantly associated with the effect estimates in the multivariable meta-regression model.

CONCLUSIONS: In the population-based cohort of South Korea, we found positive associations between several long-term ozone exposure metrics and mortality. Different ozone exposure metrics could be an important source of heterogeneity between studies.

KEYWORDS: ozone, mortality, long-term exposure, cohort study, meta-analysis

P-0132 Air pollution and Venous Thromboembolism in the Malmö Diet and Cancer cohort

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BACKGROUND: Air pollution is a major contributor to the global burden of disease and has been linked to several diseases and conditions. The mechanisms are related to inflammation and increased coagulability, factors that play an important role in the pathogenesis of venous thromboembolism (VTE). We investigated if long-term exposure to air pollution was associated with increased VTE incidence.

METHODS: The study followed 29,408 participants from the Malmö Diet and Cancer (MDC) cohort. The population-based cohort recruited adults aged 44-74 from Malmö, Sweden between 1991-1996. Participants were assigned annual mean residential exposure to particulate matter <2.5µg (PM2.5) and <10µg (PM10), nitrogen oxides (NOx) and black carbon (BC) from enrollment up to 2016. Those with previous VTE events or VTE occurring close to a malignancy diagnosis were excluded from main analysis. Analyses were done using Cox proportional hazard models for air pollution in the year of VTE event (lag0) and the mean of 1-10 years before VTE event (lag1-10). VTE was defined as deep vein thrombosis (DVT) of the legs and pulmonary embolism (PE).

RESULTS: The means of annual air pollution exposure during the observation period were 15.8µg/m3 for PM10, 10.8µg/m3 for PM2.5, 27.7µg/m3 for NOx, and 0.96µg/m3 for BC. The mean follow-up period was 19.5 years, with 1418 VTE events recorded during this period. Exposure to lag1-10 PM2.5 was associated with increased risk of VTE (HR 1.17(95%CI 1.01–1.37) per 0.75µg/m3(IQR) increase in PM2.5 exposure) when adjusting for likely confounders. No association was found with lag0 air pollution exposure. Similar results were found for DVT, but no association was observed with PE. Results persisted in sensitivity analyses.
CONCLUSION: Long-term exposure to moderate levels of ambient air pollution was associated with increased risks of VTE in the general population in Sweden.

KEYWORDS: Air pollution, venous thromboembolism, survival analysis, deep vein thromboembolism.

P-0134 Changes of PM2.5 population exposure and its sources in the US from 1990 to 2010

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KEYWORDS:
PM25, air pollution sources, exposure

BACKGROUND AND AIM: The quantification of the contributions of sources of air pollutants, especially PM2.5, can be used for the improvement of our understanding of PM2.5 health effects. Three-dimensional chemical transport models are well suited to address this problem, since they simulate all the major processes that impact PM2.5 concentrations and transport.
In this work, we quantified the changes in the concentration, exposure, composition, and sources of PM2.5 in the US. Significant reductions of emissions of SO2, NOx, VOCs and primary PM have taken place.
METHODS: We evaluate our understanding of the links between these emissions concentration and exposure changes combining a chemical transport model (PMCAMx) with the Particle Source Apportionment Algorithm.
RESULTS: Results for 1990, 2001 and 2010 are presented. The 63% reduction in PM2.5 sulfate concentrations from electrical generation units during these 20 years has led to a 60% reduction in PM2.5 sulfate exposure. Also, the reductions in elemental carbon (EC) concentrations from road transport by 72% have led to a reduction of PM2.5 EC exposure of 70%.
CONCLUSIONS: In 1990 90% of the US population was exposed to PM2.5 concentrations to equal and higher than the suggested annual mean by the WHO, but this reduced to 70% in 2010. These results are the basis for an epidemiological study linking PM2.5 sources in the US and their health effect (Pond et al., 2021).
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P-0136 Untargeted metabolomics analysis of human milk samples from Guatemalan mothers in the Household Air Pollution Intervention Network (HAPIN) Trial

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BACKGROUND/AIM: Globally, 3 billion people rely on solid fuels for cooking and heating, which generates household air pollution (HAP), contributing to preventable morbidity and mortality. The Household Air Pollution Intervention Network (HAPIN) trial was designed to assess the effect of a liquid petroleum gas (LPG) stove intervention on HAP exposure and maternal-child health outcomes. We conducted a sub-study to explore the breastmilk metabolomes among women in the rural Guatemala HAPIN site.

METHODS: Participants were excluded if they delivered by cesarean section, did not intend to breastfeed, or experienced mastitis or antibiotic use in the previous 48-hours. Breastmilk samples were collected from 75 women at six months postpartum using a standardized protocol, transported on dry ice, and processed using high-resolution mass spectrometry. Metabolic features were enhanced, and batch corrected with high quality control methods. Annotated features were quantile normalized, log transformed and analyzed using MetaboAnalyst 5.0.

RESULTS: Thirty-eight breastmilk samples were collected from women in the LPG intervention arm; 37 samples were collected from women in the control arm exposed to solid biomass fuels. The two-sample t-test with equal variances identified 262 significant features with one remaining significant after controlling for the false discovery rate. The fold change analysis (threshold of 2.0) revealed twenty-five up-regulated and four down-regulated features in the LPG group, compared to control ($p<0.05$). Pathway enrichment analysis identified significant pathway disruption in the carnitine shuttle, arginine and proline metabolism, aminosugar metabolism and lysine metabolism when comparing breastmilk from participants using LPG versus solid biomass (all $p<0.05$).

CONCLUSIONS: Minimal significant features were identified among breastmilk samples from participants in the study based on study arm assignment, but several variations were seen among metabolic pathways. Further exploration of maternal nutrition in concurrence with environmental exposures may provide additional differences in the breastmilk metabolome.

KEYWORDS: Metabolomics, Nutrition, Breastmilk, Air Pollutants, Exposure

P-0140 Inflammatory markers, lung function, and respiratory events in relation to indoor and ambient air pollution

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BACKGROUND AND AIM: Ambient air pollution causes a range of adverse health effects, whereas effects of indoor sources of air pollution are not well described in high-income countries. We compared hazards of ambient air pollution and indoor combustion sources with respect to respiratory events and preceding lung function and inflammatory response in the blood in a middle-aged Danish cohort.

METHODS: Our cohort comprised 4,812 men and women aged 49 to 63 years at the recruitment in 2009-11, with information on exposure to second-hand smoke (SHS) and use of candles and wood stove, as well relevant covariates. Ambient air pollution exposure was assessed as 2-year mean nitrogen dioxide (NO2) at the address. Lung function was assessed as % predicted forced expiratory volume in the first second (FEV1) and inflammatory markers comprised interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF-α) at baseline. We followed the cohort up for the first hospital contact for respiratory events [asthma, chronic obstructive pulmonary disease (COPD), pneumonia] until 2018. We used regression and Cox proportional hazard models for biomarkers and respiratory events, respectively, associated with indoor and ambient air pollution exposure after controlling for potential confounders.

RESULTS: We observed a decrease in FEV1 and increased IL-6 and TNF-α associated with exposure to SHS and NO2, but not with use of candles or wood burning. Respiratory events, including COPD incidence, showed positive associations with SHS, but not with other indoor combustion sources (candle use or wood burning) or ambient air pollution.

CONCLUSIONS: These results suggest that the levels of exposure to SHS and ambient air pollution are more harmful for lung function and inflammatory response in the blood than the levels of exposure to indoor combustion sources from candles and wood stoves in a high-income setting.

KEYWORDS: Ambient air pollution, indoor air pollution, inflammation, lung function, second-hand smoke

P-0141 Source apportionment of particulate matter (PM2.5) using Positive Matrix Factorisation in Thohoyandou, South Africa

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BACKGROUND AND AIM: Human health, visibility degradation, and global climate change are all influenced by airborne particles. The study of chemical compositions and sources of particulate matter (PM2.5) is crucial due to the health problems associated to its exposure and the impact on climate change. Investigating the contribution of natural and anthropogenic sources to PM levels and their spatial gradient, particularly in inhabited areas, as well as the information about their origin and source of emission revealed by their composition is key to this study.

METHODS: 24-h fine aerosol particles were collected in Thohoyandou, a rural area of Limpopo province of South Africa sharing boarder with Mozambique and Zimbabwe, every third day from 17 April 2017 to 18 April 2018 and analysed for their elemental composition using an XEPOS 5 energy-dispersive X-ray fluorescence (EDXRF) spectrometer (SPECTRO Analytical Instruments, Germany). The USEPA 5.0 positive matrix factorization program was used to perform source apportionment analysis on this dataset. Six sources were identified and their contributions to the total PM2.5 mass were calculated.

RESULTS: The mean average for PM2.5 (10.8 µg/m3) in Thohoyandou was lower than the yearly WHO guideline (5 µg/m3) and the South African standard (20 µg/m3). S, Si, K, Fe, Ca, Cl had the highest concentrations with C greater than 1µg/m3. The identified sources include secondary sulphur, vehicle exhaust, coal combustion, road/soil dust, biomass burning, and industry/metal processing. It was observed that PM2.5 levels in Thohoyandou were significantly influenced by local anthropogenic sources.
CONCLUSION: Emission reduction strategies aim at reducing coal burning, secondary sulphur, biomass burning etc. are important in combatting the effect of air pollution. Lastly, the finding of the study will support the reviewing and drafting the air quality management plan for the country.

KEYWORDS: Climate Change, Emission, Source apportionment, South Africa, Particulate matter

P-0142 Particulate matter (PM2.5) characterization and air quality level in an urban background in Pretoria

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BACKGROUND: More than ever before, air pollution has become a great importance to the world because of it deleterious effect on human and the environment coupled with the effect of global warming. The presence of PM2.5 in the ambient air have showed strong association of adverse health outcomes for morbidity and mortality such as respiratory problems, cardiovascular diseases, asthma. Chemical characteristics and sources of trace elements in PM2.5, as well as the air quality index, were investigated.
METHOD: 24-h fine aerosol particles were collected in an urban area in Pretoria, South Africa, from 17 April 2017 - 18 April 2018. Eighteen trace elements were determined using an XEPOS 5 energy-dispersive X-ray fluorescence (EDXRF) spectrometer (SPECTRO Analytical Instruments, Germany), while black and organic carbon were estimated using an optical transmissometer from the samples collected. The HYPLIT model (version 4.9) was used to estimate air mass trajectories. Potential health risk was calculated by comparing it to the World Health Organization's air quality index (AQI).
RESULT: The overall mean PM2.5 concentration of the collected sample equals 21µg/m3, this value exceeds WHO air quality limit but below the European Union annual air quality standards. Among these constituents C and S had the highest, greater than 1µg/m3. Ni, Se, Br and Sb showed they were extremely enriched, (EF>10) and suggestive of anthropogenic or non-crustal origin. The 24-h PM, soot, BC and OC were significantly different by the geographical origin of air masses ($p<0.05$). The AQI showed that 70% of the samples showed levels above the AQI range of good and healthy air.
CONCLUSION: The findings include details on the concentration, composition, and potential sources of fine PM2.5, which is essential for policy formulation and mitigation strategies in South Africa's fight against air pollution.

KEYWORDS: Air pollution, transport cluster, particulate matter, trace elements, biomass burning, South Africa.

P-0143 Associations between pre-natal exposures to fine particulate matter (PM2.5), carbon monoxide, and black carbon and birthweight in the multi-country Household Air Pollution Intervention Network (HAPIN) trial

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BACKGROUND AND AIM: Low birth-weight is a leading contributor to the burden of disease in low- and middle-income countries (LMICs). Household air pollution (HAP) has been reported to impact birth-weight, but evidence of quantitative exposure-response relationships is limited. As part of the multi-country Household Air Pollution Intervention Network (HAPIN) trial, we examined associations between prenatal exposure to HAP and birth-weight, as well as weight-for-age z-scores, among 3200 pregnant women (recruited between 9 to <20 weeks of gestation). Women randomized to the intervention arm received an LPG stove and free fuel while women in the control arm continued using biomass for cooking.

METHODS: We measured pre-natal 24-hour personal exposures to $PM_{2.5}$, CO, and BC at baseline (pre-intervention), 24-28 and 32-36 weeks of gestation. Gestational age was determined by ultrasound examination in all women and birthweight was measured within 24-hours of birth using standardized procedures. We developed multiple regression models to examine the association of estimated average exposure during gestation with birthweight and weight-for-age z-scores, adjusting for confounders.

RESULTS: Exposure-response models included live births (n=3,060) with valid birth weight (n=3,002) and pollution measurements ($PM_{2.5}$; n=2717), (CO; n=2560), and (BC; n=2772). In adjusted linear models, an inter-quartile increase in average pre-natal exposure to BC (7.3 µg/m³) was associated with a 22.8g reduction in birthweight (95% confidence interval [CI]:-39.5g,-5.8g) and with reduced weight for age Z-scores of -0.05 standard deviations (95%CI: -0.08, -0.01 standard deviations). The associations between $PM_{2.5}$ and birth-weight were in the same direction, but less robust. Relationships between CO exposures and birth-weight were consistent with a null association.

CONCLUSIONS: While modest, the observed associations between HAP exposure during pregnancy and birth-weight, particularly for BC, provide support for continuing efforts to address exposure to HAP alongside other drivers of low birth-weight in LMICs.

KEYWORDS: Exposure-response, household air pollution, low birth-weight, HAPIN Trial

P-0144 Solid fuel combustion exposure and respiratory health in children and adults in Europe, USA, Canada, Australia and New Zealand: a systematic review and meta-analysis

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BACKGROUND/AIM: Epidemiological studies in low- and middle-income countries have shown a positive association between solid fuel (SF) burning exposure and adverse effects in children and adults. However, as the evidence is less clear in other countries, we investigated the associations between indoor and outdoor SF combustion (biomass and coal) and respiratory health in children and adults in studies conducted in Europe, North America, Australia, and New Zealand.

METHODS: We performed 2 systematic reviews of epidemiological studies for children and adults. A meta-analysis was performed on the association between indoor wood burning exposure and respiratory outcomes in children only. Pooled relative risks (RRs) and 95% confidence intervals (CI) were calculated using random-effects models.

RESULTS: We identified 74 articles conducted in children. The RR for indoor wood exposure was 0.90 (95%CI 0.77-1.05) for asthma, 1.11 (95%CI 0.88, 1.41) for lower respiratory infection and 1.11 (95%CI 0.85, 1.44) for upper respiratory infection. No association was found with wheeze and cough risk. Inconsistent and limited results were found considering other respiratory outcomes. Results from studies evaluating exposure to outdoor emissions derived from indoor SF combustion were limited. Among 34 articles identified in adults, positive associations were found between indoor SF combustion exposure and lung cancer and COPD risk, although based on limited studies. Inconsistent results were found considering other respiratory outcomes. Exposure to residential coal burning was associated with an increased risk of adverse respiratory effects. The introduction of measures to reduce SF use showed an improvement in air quality resulting in a reduction of adverse respiratory effects.

CONCLUSIONS: Exposure to SF burning was associated with some adverse respiratory effects in children and adults. However, due to limited number of studies for each outcome and several limitations, additional and better studies in high-income countries are needed.

KEYWORDS:
Epidemiology; Respiratory disease; Solid fuels; Systematic review.

P-0147 Burden of disease due to PM2.5 and NO2 emissions from coal-fired power plants in Germany

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BACKGROUND:
Coal combustion emits pollutants that affect human health. We aimed to quantify the environmental burden of disease (EBD) due to PM2.5 and NO2 emissions from coal-fired power-plants (CFPPs) in Germany.

METHODS: Emissions from CFPPs and other sources were extracted from official German and European inventories. The contribution of CFPPs to AP in Germany was calculated with the chemical transport model REM-CALGRID on a grid of 2x2 km2 for 2015. Mean annual PM2.5 and NO2 exposure was assessed by intersecting the contribution of CFPPs to AP with the population distribution in Germany for 2015. Age- and sex-stratified mortality data and life-expectancy were extracted from the Federal Health Monitoring. The attributable EBD, expressed as Years of Life Lost (YLL), was calculated based on relative risk estimates for natural cause mortality from single- and multi-pollutant models for PM2.5 and NO2 from the ELAPSE (Effects of Low-Level Air Pollution: A Study in Europe) study. for disease-specific endpoints, we calculated YLL using relative risk estimates for PM2.5 from the Global Burden of Disease 2019 study and for NO2 from the ELAPSE study.

RESULTS: The mean (min; max) calculated contributions of CFPPs to ambient PM2.5 and NO2 concentrations in Germany in 2015 were 0.25 µg/m3 (0.05 µg/m3; 3.11 µg/m3) and 0.48 µg/m3 (0.03 µg/m3; 14.95 µg/m3), respectively. The combined attributable EBD for natural cause mortality was 71,912 YLL (95% CI 52,818; 91,510). The sum of YLL for disease specific endpoints was 12,483 YLL for PM2.5 (coronary heart disease 49.7% of YLL, lung cancer 29.5%, COPD 8.9%, stroke 8.6% and diabetes mellitus type 2 3.3%) and 18,380 YLL for NO2 (cardiovascular mortality 96.8%, COPD mortality 3.2%).
CONCLUSION:
In 2015, disease burden due to PM2.5 and NO2 emissions from CFPPs in Germany was substantial and dominated by coronary heart disease and cardiovascular mortality.

KEYWORDS: Coal-fired power-plants; health

P-0149 Effect of long-term exposure to UFP on birth outcomes around Schiphol airport, the Netherlands

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BACKGROUND AND AIM: people who live near airports are exposed to higher concentrations of ultrafine particles (UFP) from aviation. Pregnant women and the fetus in particular are considered to be highly susceptible to environmental exposures. We investigate associations between birth outcomes and exposure to UFP from aviation at the residential address during pregnancy.

METHODS: We identified approximately 286,000 singleton birth records (2006-2018) from mothers that lived at least 6 months during pregnancy in a 45x50 km area around Schiphol Airport. This information was linked to modelled monthly averaged UFP concentrations from aviation at the residential address during pregnancy. We modelled the association between exposure to UFP from aviation during pregnancy and pregnancy outcomes through logistic regression adjusting for individual and neighbourhood-level covariates. We performed a number of sensitivity analyses to investigate the robustness of the results, including adjustment for other air pollutants and noise. Effect estimates were expressed per 3,500 #/cm3 (~p5-p95 difference).

RESULTS: Effect estimates were generally positive, but statistically non-significant in the main model for preterm birth (PTB: OR 1.02 (95%CI 0.96-1.07), small for gestational age (SGA: OR 1.02 (95%CI 0.98-1.07)) and congenital anomalies (any CA: OR 1.05 (95%CI 0.98-1.07)). Associations with UFP reached (borderline) statistical significance in some of the sensitivity analyses, such as when the 4 municipalities with the lowest exposure were excluded (for PTB, SGA, CA), when the population was restricted to mothers with a Dutch background (PTB), after non-linear adjustment for NO2 and EC (PTB), after including municipality as random effect (CA) and in some specific strata of the population. No associations were found with infant mortality, low Apgar score and low birth weight.

CONCLUSIONS: We found suggestive evidence for associations between exposure to UFP from aviation during pregnancy and pregnancy outcomes.

KEYWORDS: ultrafine particles, aviation, airport, air pollution, birth outcomes

P-0151 Associations between air pollution and multimorbidity: results from the population-based UK Biobank study

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BACKGROUND AND AIMS:
Long and short-term air pollution exposures are well established to be associated with single conditions, but its role in multimorbidity (MM) has not been investigated. We aimed to assess associations between air pollution exposure and MM status and severity, as well MM patterns using the UK Biobank cohort.

METHODS: MM status was calculated based on 41 physical and mental conditions We assessed cross-sectional associations between particulate matter (PM)2.5, PM10, nitrogen dioxide (NO2), and total nitrogen oxides (NOx) in µg/m3 and MM status at the baseline assessment (2006-2010) in 364,144 people (mean age: 52.2±8.1 years, 52.6% female) who had complete data for all study variables. Air pollutants were categorised into quartiles to assess dose response associations. Among those with MM (≥2 conditions; n=156,395) we assessed associations between air pollutants and MM severity. We used factor analysis to identify MM patterns. Potential associations were explored using generalised linear models adjusted for socioeconomic and neighbourhood-level indicators.

RESULTS: Higher exposures to PM2.5, NO2, and NOx was associated with MM status in a clear dose response manner (PM2.5 quartile 1 vs quartile 4: adjusted odds ratio (aOR)=1.21; 95% CI=1.18, 1.24; NO2 quartile 1 vs quartile 4: aOR=1.19; 95 % CI=1.16, 1.23). Among people with MM, higher exposure to air pollutants was linked with increased MM severity. We identified 11 MM patterns. Air pollution was associated with multiple MM patterns with strongest associations observed for neurological (stroke, epilepsy) (PM2.5: aOR=1.31; 95% CI=1.14, 1.51; NO2: aOR=1.33; 95% CI=1.11, 1.60) and respiratory patterns (COPD, asthma) (PM2.5: aOR=1.24; 95% CI=1.16, 1.33; NO2: aOR=1.26; 95% CI=1.15, 1.38).

CONCLUSIONS: This cross-sectional study suggests that exposure to air pollution might be associated with the accumulation of long-term, multi-organ conditions. Prospective studies are needed to investigate associations between air pollution and multimorbidity trajectories.

KEYWORDS: Air pollution; multimorbidity; Factor analysis

P-0152 Air pollution exposure in mid-life and cognition over 25 years later: a prospective longitudinal cohort study

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BACKGROUND AND AIM: Existing evidence of the association between air pollution and cognition uses cross-sectional or longitudinal studies with short observation periods. The objective of this research was to investigate this association over a 25-year period.

METHODS: Data were obtained from the MRC National Survey of Health and Development comprising 2125 participants at age 68-70. Annual average sulphur dioxide (SO2), nitrogen dioxide (NO2), and black smoke (BS) air pollution measurement units were obtained from land use regression models and were assigned to place of residence for 1989 and 2010-2011 (only for NO2) when participants were 43- and 64/65-year-old. Cognition was assessed at ages 68-70 using the Addenbrooke's cognitive examination III (ACE-III), which includes measures of attention, memory, verbal fluency, visuospatial skills, and language. Prospective associations between air pollution and cognition over this ~25-year period was investigated using linear regression models adjusted for socioeconomic and neighbourhood-related indicators.

RESULTS: The median (IQR) µg/m3 levels of pollutants in which participants were exposed at age 43 were 28.2 (8.1) for SO2, 29.8 (10.2) for NO2, 11.4 (5.9) for BS and 22.5 (9.1) for NO2 at age 64/65. No associations were observed between pollutants at ages 43 and 64/65 and total score of ACE-III. We found evidence of increases in NO2 and BS at age 43 to be associated with a reduction in total scores for attention (NO2: mean difference (MD) across the interquartile range: -0.27; 95% CI: -0.45 to -0.08; BS: MD: -0.23; 95% CI: -0.36 to -0.10) and memory (BS; MD: -0.23; 95% CI: -0.36 to -0.10).

CONCLUSIONS: The findings suggest that outdoor air pollution in mid-adulthood could potentially affect cognition in later life. Whilst causation cannot be proved, this work suggests decreases in cognitive ability in later life may be avoided with improved air quality.

KEYWORDS: Air pollution, birth cohorts, cognition

P-0153 Fatal unintentional non-fire related carbon monoxide poisoning: Data from Narrative Verdicts, England and Wales, 1998-2019

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BACKGROUND AND AIM: Unintentional non-fire-related (UNFR) carbon monoxide (CO) poisoning continues to cause fatalities. Coroners' narrative verdicts concerning fatal UNFR CO poisoning in England and Wales, 1998-2019, were collated by the Office for National Statistics.

METHODS: Search terms related to CO exposure were used to obtain information regarding the circumstances of death. Findings were grouped by location of death, source of CO, and reason or behaviour underlying the exposure.

RESULTS: There were 750 deaths (77% male). Annual numbers of deaths decreased over the period studied. Two-thirds (68%) of the deaths occurred in the autumn/winter. of records with information, 59% of deaths occurred in a dwelling (67% male). Males also predominated in deaths in vehicles (91%) and garages/outbuildings (95%). of deaths with information, domestic piped gas was the most common source of CO (36%), and the most frequent underlying factor was inadequate ventilation of exhaust gases (39%, 91% male).
CONCLUSION: Despite the decrease in the annual numbers of deaths over the study period, there remains a clear need for measures to raise awareness of the dangers of CO poisoning, especially amongst men working alone in garages/outhouses. Education campaigns and fitting and maintaining CO alarms in high-risk areas should be encouraged.

KEYWORDS: carbon monoxide, CO, unintentional poisoning, environmental epidemiology, environmental public health, unintentional death, preventing CO poisoning

P-0154 Pathways associated with air pollution exposure and cognitive outcomes: a systematic review of the epidemiological studies

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BACKGROUND AND AIM: Air pollution is a modifiable risk factor for dementia, however the pathways through which air pollution affects cognition in the elderly are not well-understood. We reviewed the epidemiological evidence on the factors mediating this association.

METHODS: We systematically searched three databases (Medline, Scopus, Web of Science) for observational studies about the mediators of the association between outdoor air pollution and cognition in older adults until February 2022. The risk of bias (ROB), and mediation reporting quality were assessed by Navigation Guide, and AGReMA Statement respectively.

RESULTS: Through 1229 items, nine reported mediation analyses. Six had "yes/probably yes", and three "no/probably no" ROB. The average quality of reporting of mediation analysis was good (20 out of 25). Reported exposures were PM2.5, NO2, NOX, PM10, and black carbon (BC). The reported outcomes were episodic memory, cognitive processing time (CPT), visuo-construction performance (VCP), global cognitive performance, dementia, and non-dementia cognitive impairment. Totally 41 exposure-mediator-outcome associations were reported, with six classes of mediators: mental health, lung function, cardiovascular factors, systemic inflammation, type-2 diabetes, and brain anatomic changes. Evidence suggests a mediating role of mental health, particularly of depression. Lung function was found as a mediator for the association between PM2.5, BC, and CPT but not VCP. Type-2 diabetes was found as a mediator for NOX-cognitive impairment and dementia association. Stroke mediated the PM2.5- dementia association; no evidence of mediation was found for cardiovascular factors. Grey matter atrophies mediated PM2.5-associated decline in episodic memory. Systemic inflammation was not suggestive for mediation.

CONCLUSIONS: The available evidence on mediators of the association between air pollution and cognition is very limited. Furthermore, results are not always consistent according to the pollutant and the cognitive outcome. Mediation pathways especially for depression need to be further explored.

KEYWORDS:
Particulate matter; Cognitive function; Dementia; Alzheimer's disease; Mediation analysis

P-0155 A knowledge transfer approach to improve maps of long-term air pollution concentrations using short-term mobile measurements

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BACKGROUND AND AIM: Mobile measurements are increasingly used to train empirical land-use regression models (LUR) to produce spatially resolved (hyperlocal) air quality maps. However, most mobile monitoring campaigns only measure short-term and on-road air pollution during the daytime on weekdays. We hypothesize that LUR models trained with mobile measurements are not optimized for estimating residential long-term exposure. The association between mobile measurements and land-use covariates (mobile knowledge) may differ from the actual association between long-term residential concentrations and the corresponding covariates (long-term knowledge). To bridge this gap, we propose transfer-learning techniques to improve LUR models trained with mobile measurements by explicitly incorporating long-term knowledge.

METHODS: We implemented a boosting-based transfer-learning algorithm (TrAdaBoost) and a random-forest-based domain adaptation method (Prior_RF) as transfer-learning LUR models. They were trained with mobile measurements and long-term knowledge. Mobile measurements of Nitrogen Dioxide (NO2) and Ultrafine Particles (UFP) were measured on every street in Amsterdam by two Google Street View cars equipped with high-quality instruments (1 Hz for 10 months). The performance of two transfer-learning LUR models tested was compared with two popular LUR models trained exclusively with mobile measurements, namely the random-forest-based LUR model (RF_LUR) and the stepwise linear regression LUR model (LSR).

RESULTS: Our proposed transfer-learning LUR models performed 55% better than RF_LUR and 32% better than LSR, evaluated by normalized mean absolute error against external long-term validation data of NO2. for UFP, the improvements were 27% and 14%, respectively. The predictions of transfer-learning LUR models retained the detailed hyperlocal spatial variations.

CONCLUSIONS: Transfer-learning LUR models improve the assessment of long-term residential (near-road) air pollution exposures, as opposed to LUR models trained with short-term on-road mobile monitoring only.

P-0158 Biomonitoring cadmium and nickel using native mosses in Leicester, UK

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BACKGROUND AND AIM: Mosses provide information about atmospheric contamination by metals and their local spatial distribution. The aim was to conduct a preliminary analysis of cadmium (Cd) and nickel (Ni) in mosses collected from rural and urban environments in Leicester, UK.

METHODS: Native mosses were sampled from green spaces across Leicester/rural surroundings. Species identification was performed by DNA barcoding using bryophyte-specific primers on DNA extracted from 100 mg of frozen, homogenised, ground moss using Isolate II Plant DNA Kit®. After processing (soil removal, drying and homogenising), forty [31 urban; 9 rural] samples were mineralised with HNO3/H2O2. Cd and Ni were determined by atomic absorption spectroscopy; limits of detection were 0.0008 and 0.0072 µg/g, respectively.

RESULTS: Four moss species were identified: Ceratodon purpureus, Brachythecium spp., Hypnum cupressiforme, Kindbergia praelonga; H. cupressiforme is a useful, well recognised biomonitor. Cd was not detected in any of the samples, which agrees with recent work from Poland. Ni was observed in 13 samples, which were processed using maximum likelihood estimation method available in 'NADA' for the software R. Concentrations of Ni for the urban and rural areas (median and interquartile limits; µg/g): 0.0057 (0.0039-0.0084), and 0.0024 (0.0009-0.0064), respectively. Although slightly higher concentrations of Ni were found in the native mosses collected in the urban areas, perhaps reflecting different sources of pollution within Leicester city, the means did not show statistical difference (p-value, 0.626). The level of Ni was within the same range but lower than the medians described in larger biomonitoring studies performed in Germany (1.6 µg/g) and Moscow (2.87 µg/g), suggesting lower emission of this metal in Leicester.

CONCLUSIONS: Undetectable Cd suggests environmental pollution with this toxic metal is minimal in Leicester, whereas Ni pollution may be more prevalent, however in both cases, analysis of more samples are needed to confirm these preliminary observations.

P-0159 Using naturally growing mosses as passive biomonitors of cobalt and zinc in Leicester, UK

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BACKGROUND AND AIM: Mosses can be used to assess the impact of metal pollution in urban areas. A study was performed to assess cobalt (Co) and zinc (Zn) contamination in the urban and rural atmospheres of Leicestershire, UK.

METHODS: Forty (31 urban; 9 rural) naturally growing mosses were collected from green spaces across Leicester/rural surroundings. Species identification was performed by DNA barcoding using bryophyte-specific primers on DNA extracted from 100 mg of frozen, homogenised, ground moss using Isolate II Plant DNA Kit®. Metals were monitored by atomic absorption spectroscopy after mineralising each sample with HNO3/H2O2. Data was processed using maximum likelihood estimation method available in 'NADA' for the software R.

RESULTS: Different moss species were identified, which have been suggested as good biomonitors: Ceratodon purpureus, Brachythecium spp., Hypnum cupressiforme, Kindbergia praelonga. In contrast to Co, which was not detected (LoD=0.0141 µg/g) in any of the moss samples, Zn was observed in 9 samples, specifically in mosses sampled in the urban area (7 samples). Moreover, these mosses also showed higher contents of Zn than those from rural locations (median and interquartile limits; µg/g): 0.0071 (0.00494-0.01012), and 0.003516 (0.001342-0.00921). Zn is strongly related to car exhaust, as it is present in fuels, lubricants, oils and engines. However, the levels of Zn found were much lower than those reported in similar studies, suggesting minimal contamination in the atmosphere in Leicester city. The ranges of Zn (µg/g) found in Norway's largest city Oslo (18.5-106), were much higher than the found in Leicester city (0.011-0.020), perhaps because Oslo has more inhabitants, industry and traffic density.

CONCLUSIONS: Although our results should be considered as preliminary, the fine atmospheric dust present in urban and rural areas from Leicestershire might not be notably contaminated by either element, especially cobalt, although a more comprehensive biomonitoring study is needed.

P-0160 Household's heating type and energy sources and cause-specific mortality: a census-based cohort study in urban Belgium

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BACKGROUND/AIM: In high-income countries, individuals spend most time indoors. Low-income urban dwellers may have inadequate heating while overexposed to environmental hazards. We aimed to investigate the associations between household's heating type and energy sources and cause-specific mortality among Belgian urban dwellers.

METHODS: Data from the 2001 Belgian census was linked to register mortality data for the follow-up period 2001-2014. Our study population included all individuals aged ≥30 years and residing in the largest Belgian urban areas (Brussels, Antwerp, Ghent, Charleroi, and Liège) in 2001. Using information on household heating (type and energy used) from the census, we categorised individuals as: having central heating (CH) (reference category); no CH and using safe energies for heating (butane, electricity, or natural gas); and no CH and using solid fuels (charcoal or wood). We used Cox proportional hazards models to investigate the associations between household's heating type and energy and cause-specific mortality (from natural causes, cardiovascular and respiratory diseases, dementia, and lung cancer), controlling for baseline sociodemographic and building characteristics, and outdoor particulate matter concentrations.

RESULTS: 2,595,266 individuals were included at baseline, from which 423,843 (16.3%) had no CH and used safe energies for heating, and 192,463 (7.4%) had no CH and used solid fuels. Associations generally attenuated with increasing covariate adjustment, especially with educational level. Relative to having CH, no CH and using safe energies increased between 9-12% the mortality risk from most studied causes after complete adjustment. No CH and using solid fuels increased around 23% the risk of dying from natural causes and lung cancer, 29% from CVDs (95%CI: 1.26, 1.31), and 34% from respiratory diseases (95%CI: 1.30, 1.38). No associations were found with dementia mortality.

CONCLUSIONS: Not having central heating was independently associated with increased mortality rates, especially for individuals using solid fuels.

KEYWORDS: Household air pollution, Solid fuels, Coal, Wood, Mortality, Socioeconomic position.

P-0162 The short-term effects of fine dust on suicide death in Korea

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Air pollution can cause various respiratory and neurological diseases and lead to death if continuously exposed. Previous studies have reported that fine dust increases the risk of mental illness such as stress, depression, suicidal ideation, and physical health problems. This study aims to identify the relationship between air pollution and suicide deaths.

Fine dust data from the Korea Environment Corporation, autopsy data from the National Police Agency, and death statistics database from the National Statistical Office were used. Additionally, meteorological data and claim data were used. The study design was time series analysis, and we confirmed the effect of single lag, cumulative lag, and moving average of the amount of fine dust from day 0 to day 7 using a distributed non-linear model.

We analyzed 64,150 people who died by suicide from 2013 to 2017 and confirmed the statistically significant result that as the PM_{10} concentration increased, the risk of suicide death increased. Also, as the cumulative number of days increased from 1 to 7 days, the dose-response effect of increasing the risk of suicide was confirmed. Stratified analysis was performed according to gender, age, presence of a suicide note, presence of mental illness, and presence of warning signs before suicide. In particular, in subjects with psychiatric disorders, when the cumulative concentration of $PM_{2.5}$ until 3 days and 5 days before suicide death increased by 10μg/m³, the risk of suicide death increased by 3.1% and 3.2%, respectively.

These results show an association between short-term exposure to fine dust and suicide deaths. It can be suggested that more attention should be paid to fine dust exposure, especially in the group with a vulnerable mental illness.

P-0163 Traffic and air pollution impacts of Low Traffic Neighbourhoods (LTNs)

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BACKGROUND AND AIM: Measures to reduce traffic flows through neighbourhoods have gained popularity as means of creating safe, attractive and healthy places for community members. Their relatively rapid expansion during post-COVID times, however, has been controversial. Detractors' main arguments have centred on the potential for traffic, and hence air pollution, to be displaced to surrounding streets. Our aim is to assess impacts of Low Traffic Neighbourhoods (LTNs) on air pollution and traffic flows in and around intervention areas.
METHODS: We obtained monthly traffic count and monthly nitrogen dioxide (NO2) concentration data from the London Borough of Islington where three LTNs were implemented in 2021. The local council regularly measures nitrogen dioxide (NO2) around the borough using passive samplers, but with no systematic approach to monitoring campaigns for evaluation purposes. We identified for each LTN the pre-and post-intervention monitoring periods and eligible monitoring sites to represent conditions: 1) within LTNs, 2) at the boundary of LTNs (less than 500m away), 3) in control areas unaffected by the LTNs. A generalised difference in difference approach was then developed to evaluate whether LTN implementation had a significant causal effect on NO2 and traffic volumes, accounting for road type and time period.
RESULTS: 697 monthly NO2 and 108 monthly traffic counts were usable as pre- and post-intervention observations for the evaluation. LTN implementation led to statistically significant reductions in NO2 both within the intervention areas (5.7%) and in boundary areas (8.9%), compared to the external control sites. Large and statistically significant traffic volumes reductions were found within LTNs (58.2%), and more moderate but not statistically significant reductions at LTN boundary sites (13.4%).
CONCLUSIONS: Neighbourhood traffic reductions measures have the potential to reduce air pollution and traffic in target areas, without necessarily causing displacements in surrounding streets.

KEYWORDS:
Built environment, planning, policy, car-free, NO2, difference-in-differences.

P-0164 Temporal and spatial distribution of PM2.5 pollution in Taipei City and its association with traffic flows assessed by microsensor data

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BACKGROUND AND AIM: Due to the insufficient number and distribution of air monitoring stations, we can't represent and estimate the more accurate PM2.5 pollution situation and its association with important exposure sources within the district of Taipei City. This study tries to apply the two datasets of micro sensors and vehicle detectors to further explore the relationship between PM2.5 concentration and traffic flow in Taipei City.

METHODS: We collected PM2.5 data from 90 micro sensors (Airbox) and traffic flow data from 934 vehicle detectors from August 2020 to July 2021 in Taipei City. We used simple linear regression to quantify the relationship between annual average of hourly PM2.5 concentration and traffic flow in each administrative district of Taipei City. and we further develop hourly PM2.5 land-use regression models by combing the traffic flow and land-use data.
RESULTS: It showed significant correlation between traffic flow and PM2.5 concentrations with the R2 of 12 districts from 0.72 to 0.89. An increase of 10,000 vehicles per hour in the total traffic flow could increase the PM2.5 concentrations in each district of Taipei City from 0.36μg/m3 to 1.64μg/m3. In advanced, we developed the land-use regression model in Shilin District and Zhongshan District. The R2 of the hourly PM2.5 land-use regression model in the Shilin District and Zhongshan District is 0.87 and 0.66. The models could reflect the impacts of traffic flow and land-use variables.
CONCLUSIONS: This study used the data of Airbox with large sample size and high density in a small area after combining the hourly traffic flow and land-use data, we successfully established the PM2.5 land-use regression models with the characteristics of different administrative districts. In accordance with this model, the Taipei City hourly model will be further established.

KEYWORDS: micro sensor, AirBox, PM2.5, traffic flow, Land-use regression model

P-0165 Spatio-temporal modeling of airborne pollen concentrations

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KEYWORDS: Pollen, Machine Learning, Allergic Disease

Abstract

BACKGROUND AND AIM: High concentrations of airborne pollen trigger seasonal allergies and possibly severe adverse respiratory and cardiovascular health events. Predicting pollen concentration accurately is valuable for epidemiological studies to determine the effects on cardiovascular, respiratory, and cognitive health. We aimed to develop a spatiotemporal land-use regression model for pollen, predicting daily concentrations at a fine spatial resolution of 1x1km across Switzerland between 2003 and 2020.

METHODS: Daily pollen concentrations for hazel, alder, ash, birch, and grasses were available from 14 sites. We considered a range of spatial (elevation, tree type), temporal (date, season, month, week and day of the year, national daily pollen concentration) and spatiotemporal predictors (wind speed, wind direction, temperature, precipitation, relative humidity, satellite-observed Normalized Difference Vegetation Index (NDVI), and land-use (CLC, Landsat satellite) to explain variation in total pollen concentration for five specific pollen species. We applied a range of feature engineering techniques to encode categorical variables (land-use) and fill in missing values (Landsat). We applied a random forest model with 5-fold cross-validation.

RESULTS: The median grass pollen concentration was 24 pollen/m3 (P5-P95 range 0-187 pollen/m3) during the main grass pollen season (May-July for all years). Preliminary results of a model predicting grass pollen concentration achieved an overall R2 of 0.74 and a root mean squared error (RMSE) of 24.12 pollen/m3 (cross-validation). Temperature, humidity, wind speed, NDVI, Landsat, average national daily pollen concentration and date features were the most important predictors for grass pollen concentration.

CONCLUSIONS: Building upon national observed pollen concentrations and using random forest machine learning, these spatiotemporal pollen models will serve to estimate individual residential pollen exposure. Resulting estimates will enable us to study respiratory and cardiovascular mortality and hospital admissions using historical data from the Swiss National Cohort and the Swiss Federal Office of Statistics.

P-0166 Impact of short-term ambient PM2.5 exposure on the all-cause and cause-specific mortality among rural population in North India

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BACKGROUND AND AIM: Air pollution due to ambient fine particulate matter (PM2.5) is an environmental hazard. There is dearth of evidence linking PM 2.5 exposure to mortality among rural population in India. We aimed to assess impact PM2.5 exposure on non-trauma all-cause and diseases specific mortality in villages of district Faridabad in north India using eleven years data.

METHODS: Study site was health and demographic surveillance site with yearly approximately 500 deaths where all deaths were recorded by trained field staff. Cause of death was ascertained by verbal autopsy using validated tool. Daily PM 2.5 exposure at village level was assessed using satellite-based PM2.5 (1-km) exposure that was calibrated against the ground-based measurements. Surface PM2.5 concentrations were estimated by converting aerosol optical depth (AOD) from Moderate Resolution Imaging Spectroradiometer (MODIS). Multivariable analysis were done including information on demographic variables, meteorology, Normalised Difference Vegetation Index, Land Surface Temperature using a generalised linear model with Poisson's distribution.
RESULT: Mean daily average PM 2.5 level was 99.97 microgram/m3 with range (15.7 to 968.8) in the study area. We have observed 0.3% rise in the Incidence Rate Ratio (IIR) of non-trauma mortality (IRR 1.003, 95% CI: 0.998-1.007) every 10 units increase of daily PM 2.5. Two days Lag model analysis showed significant relationship between PM 2.5 level and daily mortality with IRR of 1.006 (95% CI: 1.0001-1.011) for every 10 unit rise in the monthly average ambient PM2.5 level, there was 10.5% increase monthly deaths. Impact of ambient PM 2.5 was more among elderly population. No statistically significant association of PM 2.5 exposure on cardiovascular or respiratory diseases related deaths was observed in multivariate analysis.
CONCLUSION: Short-term ambient exposure of PM 2.5 was highly correlated with increase in mortality among rural population in north India. Elderly population reported higher vulnerability to PM 2.5 exposure.

P-0169 An Evaluation of the Cardiovascular Impacts of the Closure of a Coking Operation - An Interrupted Time Series Analysis

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BACKGROUND AND AIM: Coke plant operations are known to generate high emissions of particulate matter, SO_2, heavy metals and volatile compounds, which likely induce oxidative stress and inflammation, and thus increase the cardiovascular disease risk in the local community. Inducing a distinctive alteration of the air pollution profile, the shutdown of the Shenango, Inc. coke plant in Pennsylvania, US, in January 2016 has become an ideal case to evaluate the impacts of air pollution improvements from emission reductions. To better understand the results of this 'natural experiment', our study investigated the changes in local air pollution and constituents associated in time with the closure of the coke plant, followed by a test as to whether there is also a coincident reduction in cardiovascular hospitalizations in the community.

METHODS: Air pollution data were obtained from Allegheny County Health Department Air Monitoring Network and the EPA Chemical Speciation Network. Quarterly inpatient hospitalization data were obtained from the Pennsylvania Health Care Cost Containment Council. Data from 2013 to 2018 were assessed and compared for potential changes in trends before and after the closure of the coke plant using the interrupted time series method.

RESULTS: We found statistically significant local reductions in ambient SO_2, particulate matter sulfate and heavy metal concentrations at air quality monitoring sites near the plant after the shutdown. A statistically significant immediate decrease and a downward trend of total cardiovascular inpatient hospitalization cases were observed in areas near the plant after the closure, whereas no significant change was observed in control populations. We also found a significant decrease in ischemic heart disease and cerebrovascular diseases inpatient cases in areas near the coke plant.

CONCLUSIONS: Our study provides new evidence that interventions eliminating air pollution sources improve the air quality and health of the local community.

KEYWORDS: air pollution, cardiovascular health

P-0170 Associations between short and long-term $PM_{2.5}$ exposure and blood lipid concentrations in myocardial infarction survivors

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BACKGROUND AND AIM: Ambient particulate matter ($PM_{2.5}$) increases morbidity and mortality, particularly for those with underlying chronic disease. Examining disease risk factors such as blood lipids can reveal the early stages of the pathophysiologic processes triggered by $PM_{2.5}$.
METHODS: We examined associations between short-term $PM_{2.5}$ and blood concentrations of total cholesterol, high-density lipoprotein cholesterol (HDL), and low-density lipoprotein cholesterol (LDL) among myocardial infarction (MI) survivors (N = 8,740) seen at a University of North Carolina Healthcare System facility between January 1, 2004 and December 31, 2016. Lipid measurements were extracted from electronic health records along with geocoded residential address, patient demographics, and disease history. Daily $PM_{2.5}$ was estimated at 1x1 km resolution using an ensemble machine learning model. We used linear mixed-effects models with a random intercept for each individual to model the associations while adjusting for age, sex, race, temperature, relative humidity, socioeconomic status, and a natural spline for time since study start. We also examined annual average $PM_{2.5}$ in separate models adjusted for age, race, sex and socioeconomic status. Results are presented as the regression coefficient (β, per 1 μg/m³ higher $PM_{2.5}$) and associated 95% confidence interval (CI).
RESULTS: For short-term $PM_{2.5}$, exposure associations were seen between 5-day average $PM_{2.5}$ and HDL (β = -0.06; CI= -0.10, -0.02) and total cholesterol (β = -0.18; CI= -0.37, 0.01). Annual average $PM_{2.5}$ was associated with total cholesterol (β = 1.57; CI= 1.05, 2.12), HDL (β = 0.57; CI= 0.42, 0.72), and LDL (β = -0.95; CI= -1.95, 0.05).
CONCLUSIONS: Short and long-term $PM_{2.5}$ exposures are associated with changes in blood lipids among MI survivors, however with opposite directions of associations for HDL and total cholesterol. Further evaluation of these associations may reveal important insights into the actions of $PM_{2.5}$ for clinically vulnerable individuals.

KEYWORDS:
Particulate matter, short-term, long-term, myocardial infarction

P-0172 Short-term mortality risks associated with sulfur dioxide: a multi-country analysis in 399 cities

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BACKGROUND AND AIM: Epidemiological evidence on the health effects of ambient sulfur dioxide (SO2) is limited compared to other pollutants, and doubts remain on aspects such as the nature of the dose-response relationship and the potential role of co-pollutants, as well as the actual risk at low concentrations. Here we assess the short-term association between exposure to ambient SO2 and daily mortality in a large multi-city multi-country dataset, using advanced study designs and statistical techniques.

METHODS: The analysis included 43,780,911 deaths that occurred in 399 cities within 31 countries between 1979 and 2018. A two-stage design was applied to assess the association between the daily concentration of SO2 and mortality counts, including first-stage time series regressions with distributed lag models and second-stage multilevel random-effects meta-analyses. The associations were reported as relative risks (RRs) and as numbers/fractions of excess deaths computed at different geographical aggregation levels.

RESULTS: On average, a 10 µg/m3 increase in daily SO2 level was associated with a RR of mortality of 1.0044 (95%CI: 1.0019 to 1.0070) with substantial heterogeneity between countries. Short-term exposure to SO2 was associated with an average 16,134 (95%eCI: 13,836 to 18,418) excess deaths per year in the 399 cities, corresponding to 0.50% (95%eCI: 0.43% to 0.57%) of mortality. Levels above the WHO guidelines for SO2 (>40 µg/m3 average over 24 hours) occurred on average in 4.6% of days, although predominantly in selected locations, and were associated only with 2,980 (95%CI: 1,498 to 4,358) yearly excess deaths. Significant positive associations remained after controlling for other pollutants.

CONCLUSIONS: The analysis indicates an independent short-term effect of exposure to SO2, with no evidence of a threshold. Levels below the current WHO guidelines for 24-hour averages are still associated with substantial excess mortality, indicating the potential benefits of stricter air quality standards.

KEYWORDS: pollution; time series.

P-0175 Investigating the Regional Concentrations-Response Relations between PM2.5 and daily mortality in Japan

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BACKGROUND: The concentration-response (CR) functions of PM2.5 are sensitive to various local factors, such as meteorological conditions, PM sources and components, and population sensitivity to PM. However, the shape of local CR functions remains unclear in many regions in Japan. This research investigates the association between PM2.5 and cause-, age-, and location-specific mortality to identify susceptible subpopulations and regions using a nationwide dataset.

METHODS: A two-stage analysis was performed to quantify the associations of PM2.5 with mortality. In the first stage, regional differences in the effects of PM were investigated. A time-series quasi-Poisson model, combined with a distributed lag non-linear model and a flexible functional form of splines, was applied to evaluate the location-specific associations between PM2.5 and mortality. Various covariates were controlled, including weather variables, day of the week, and seasonal and long-term time trends. Stratified analyses were performed by age groups and death cause categories. We used a random-effects meta-analytic model to estimate the pooled cumulative association in the second stage. Potential reasons for the regional heterogeneity of PM2.5 effects were further explored through random-effects meta-regression analyses, separately carried out for multiple variables as meta-predictors.

RESULTS: Geographic variations in the concentration of PM2.5 were observed in Japan. An increase in PM2.5 concentration was associated with an increase in excess risk of mortality, and the magnitude of the corresponding associations appeared to vary by region in Japan.

CONCLUSIONS: The regional risks of premature mortality from exposure to PM2.5 were investigated. We identified vulnerable regions and susceptible subpopulations. The disparity in the association of mortality risks and PM2.5 was apparent between geographical regions, indicating the importance of developing area-specific strategies and local risk prevention plans that can serve as a basis for policymaking to reduce the corresponding health effects.

P-0176 Long-term exposure to low level air pollution and the relationship with lung and bladder cancer in older men, in Perth, Western Australia

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BACKGROUND AND AIM: Ambient air pollution has been classified as a human carcinogen for lung cancer and possible carcinogen for bladder cancer. However, the evidence remains sparse in regions with low ambient pollution. We examined the associations between long-term low level exposure to fine particulate matter (PM2.5), nitrogen dioxide (NO_2) and black carbon (BC), and both lung and bladder cancer.

METHODS: 12 203 men ≥65 years old were recruited (1996-1999) from the Health in Men Study. Air pollutant concentrations at baseline and for the follow-up period were estimated at participants' residential addresses using land use regression models. Lung and bladder cancer cases up until 2018 were identified through the Western Australian Cancer Registry. We used Cox proportional hazard models, and adjusted for age, smoking, socioeconomic status, and other pollutants.

RESULTS: Lung cancer was associated with annual average follow-up concentrations of: PM2.5 (HR:1.86 per 5 $\mu g/m^3$; 95%CI: 1.42-2.45), NO_2 (HR:1.48 per 10 $\mu g/m^3$; 95%CI:1.25-1.77) and BC (HR:1.49 per 0.5x10-5m-1; 95%CI: 1.30-1.72), increase respectively. Bladder cancer was associated with annual average follow-up concentrations of NO_2 (HR:1.56; 95%CI: 1.15-2.12) and BC (HR:1.47; 95%CI: 1.15-1.88). Two-pollutant models indicated that BC but not NO_2 was associated with increased lung and bladder cancer. Neither NO_2 nor BC attenuated the findings for PM2.5. Baseline concentrations of air pollution was not associated with lung or bladder cancer. In our lung histological subtype analysis, squamous cell carcinoma was associated with PM2.5 (HR:2.09; 95%CI: 1.11-3.91), NO_2 (HR:1.61, 95%CI: 1.09-2.38) and BC (HR:1.68; 95%CI: 1.23-2.30). Adenocarcinoma was also associated with BC (HR:1.40, 95%CI: 1.08-1.82).

CONCLUSIONS: Long-term exposure to low annual concentrations of PM2.5, NO_2 and BC were associated with both lung cancer and bladder cancer incidence among older men. This supports the literature that there is no known safe threshold for air pollution.

KEYWORDS: ambient air pollution, lung cancer, bladder cancer

P-0181 Air pollution and bone mineral density among Women's Health Initiative participants: A mixture analysis

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BACKGROUND AND AIM: Ambient air pollution has been associated with bone damage, but no studies have examined the role of mixtures (i.e., biological effective components) on bone mineral density (BMD) in postmenopausal women.

METHODS: We conducted a prospective study using data from the Women's Health Initiative (WHI, N=9,041 at baseline, postmenopausal women aged 50 to 79 years from 1993 to 1998). We included participants in both the Clinical Trials (CT) and Observational Study (OS), but only those with BMD and air pollution data were included. We used log-normal, ordinary kriging to estimate daily mean PM10 concentrations, NOx, NO2, and SO2 at geocoded participant addresses. We averaged the mean concentrations over 1-, 3-, and 5-year periods before BMD assessments (and T-scores) at the whole-body, total hip, femoral neck, and spine using dual-energy X-ray absorptiometry. After multiple imputation of missing covariates data, we estimated air pollutant-BMD associations in multivariable linear and linear mixed-effects models controlling for correlation of repeated measures and adjusting for several covariates. We also estimated air pollutant mixture-BMD associations using Bayesian kernel machine regression (BKMR).

RESULTS: at baseline, women were on average 63.29 years old (SD: 7.39 years). In cross-sectional analyses, 1-, 3-, and 5-year mean PM10, NOx, NO2, and SO2 were inversely associated with all BMD sites as well as T-scores. In longitudinal analyses, 1- and 5-year mean PM10, NOx, NO2, and SO2 were associated with whole-body BMD. These results suggest that, for example, lumbar spine BMD decreased 0.023 (95%CI: 0.017, 0.028) g/cm2/year per 10% increase in 5-year mean NO2 concentration. Similar associations were observed at other BMD sites. BKMR suggested that only NO2 was inversely associated with BMD at all sites.

CONCLUSIONS: Our findings suggest air pollution, particularly NO2, has clinically relevant effects on BMD and potentially fracture risk in postmenopausal women.

KEYWORDS: Air pollution, bone, osteoporosis.

P-0182 Application of a hierarchical Bayesian model for air pollution prediction in Poland and its association with neurodevelopmental outcomes in children

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BACKGROUND/AIM: Air pollution has been associated to adverse health effects. Poland is one of the most polluted countries in Europe in terms of air quality, with levels exceeding the maximum values established by the UE for several pollutants, including PM10 and PM2.5. This study aims to assess whether air pollution exposures during vulnerable periods (pregnancy, early childhood) affects cognitive/psychomotor development of school-age children.

METHODS: Hourly levels from air pollutants (PM10, PM2.5, NO2, O3) for the prenatal period (2006-2008) was obtained from both the European air quality database (EEA) and Polish institutions. Health data was collected from the Polish Mother and Child Cohort prospective study conducted in Poland since 2007, with around 400 pregnant women and their children followed up until the age of 7 years. Neurodevelopmental outcomes were assessed through the Strengths and Difficulties Questionnaire and the Intelligence and Development Scales. Spatial prediction of air pollution levels in a 100km radius around the geolocation where pregnant women lived during a 3-years period was performed using a hierarchical Bayesian spatiotemporal model. Afterwards, multivariate regression models between the predicted air pollution levels and neurodevelopmental outcomes in 7-year old children were applied, including different approaches to account for sex-specific effects.

RESULTS: Median predicted concentrations of PM10, PM2.5, NO2 and O3 at 91 different locations were 19.6 µg/m3, 16.1 µg/m3, 8.4 µg/m3 and 71.7 µg/m3, respectively. Prenatal exposures to O3 were associated with poorer scores on Hyperactivity/Inattention, specifically in boys. Conversely, PMs and NO2 were associated with poorer scores on Fluid IQ and Total Cognition, specially in girls.

CONCLUSIONS: The present study suggests that air pollution exposures during the prenatal period might have an impact on children's development. Due to the diversity of mechanisms involved in child's neurodevelopment, further studies are required in order to elucidate which are the most critical periods of exposure.

P-0183 Exposure to ambient air pollution and oxidative stress biomarkers in the NYU CHES cohort

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BACKGROUND AND AIM: Emerging evidence suggests associations between air pollution exposure and adverse fetal growth, yet the exact mechanisms behind the impaired growth have yet to be elucidated. One possible linkage can be through oxidative stress mechanisms. This study investigates the extent to which exposure to the traffic-related air pollutants NO2 and PM2.5 is associated with urinary concentrations of Oxidative Stress Biomarkers (OSBs) in pregnant women.

METHODS: Participants were 626 pregnant women enrolled in the New York University Children's Health and Environment Study (2016-present). We used a tree-based machine learning method to predict daily NO2 and PM2.5 at residential addresses. Average NO2 and PM2.5 exposures during the first trimester of pregnancy were calculated using daily exposure. OSBs were measured in spot urine samples provided by women at <18, 18-25, and >25 weeks of gestation. Seven OSBs were measured: MDA (malondialdehyde), 8-PGF2α (8−isoprostaglandin F2α), 11−PGF2α (11β−isoprostaglandin F2α), 15−PGF2α (15(R)-prostaglandin F2α), 8,15−PGF2α (8-iso-15(R)-prostaglandin F2α), 8-OHdG (8-hydroxy-2'-deoxy guanosine), and diY (o,o'-Dityrosine). We examined the associations of exposures to air pollutants with OSB levels using linear regression models. We included averaged concentrations of OSBs, adjusted for urinary creatinine levels, and log-transformed for normality. Models were adjusted for sociodemographic characteristics and health-related factors such as body mass index.

RESULTS: In the first trimester, average NO2 exposure was 19.71 ppb and average PM2.5 exposure was 7.81 µg/m3. OSBs were detected in 88.98% of total urine samples. Higher exposure to NO2 in the first trimester was associated with higher MDA (β=0.02 per ppb, 95% CI: 0.01, 0.03, p=0.003) and diY (β=0.02 per ppb, 95% CI: 0.01, 0.03, p=<0.0001). First trimester PM2.5 exposure was associated with higher 15-PGF2α (β=0.13 per µg/m3, 95% CI: 0.04, 0.22, p=0.01).

CONCLUSIONS: Exposure to NO2 and PM2.5 during early pregnancy may influence maternal oxidative stress.

KEYWORDS: Air pollution, pregnancy, oxidative stress biomarkers

P-0185 Examination of effect modification of the relationship between PM2.5 and cardiovascular mortality by particle oxidative potential within two Canadian cities

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BACKGROUND AND AIM: There is evidence that particle oxidative potential modifies effects of fine particulate matter air pollution (PM2.5) on health outcomes in between-cities studies in Canada. Additionally, previous work shows that oxidative potential of PM2.5 varies considerably at the within-city spatial scale. The aim of the present study was to determine if differences in the oxidative potential of PM2.5 at the within-city spatial scale modify the relationship between PM2.5 and cardiovascular mortality.
METHODS: We conducted a cohort study in the Canadian Census Health and Environment Cohort, a population-based cohort based on the Canadian longform Census. We followed participants who lived in the cities of Toronto or Montreal, Canada, at least 2 years in the period 2001-2016 (approximately 12 271 100 person-years in 1 101 000 individuals, rounded for confidentiality). Annual estimates of PM2.5 exposures were assigned from satellite data calibrated with ground-based observations, and oxidative potential was measured on samples of PM2.5 taken at 234 sites across the study area. We used time-varying Cox proportional hazards models to estimate hazard ratios for the effect of PM2.5 on cardiovascular mortality within strata of PM2.5 oxidative potential. Additionally, we estimated hazard ratios for oxidative burden (the product of oxidative potential and PM2.5 exposures).
RESULTS: We did not find evidence that oxidative potential modifies the effect of PM2.5 on mortality from cardiovascular causes (N = approximately 6100 events). The overall relationship between PM2.5 exposures and cardiovascular mortality was not significantly different from the null, and the same was true for oxidative burden measures.
CONCLUSIONS: Spatial variability in PM2.5 and the oxidative potential of PM2.5 may be insufficient for OP to act as a modifier of the effect of PM2.5 on cardiovascular mortality within the cities of Toronto and Montreal.

KEYWORDS: fine particulate matter, oxidative potential, outdoor air pollution, cardiovascular disease

P-0186 Association between long-term exposure to ultrafine particles and ischemic heart disease mortality in Montreal, Canada: an open cohort study

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BACKGROUND AND AIM: Ischemic heart disease (IHD) is the leading cause of death globally and its incidence is expected to increase worldwide due to the ongoing epidemiological transition observed worldwide and aging populations. Long-term exposure to ambient fine particles is associated with cardiovascular mortality. Exposure to ultrafine particles (UFPs) may explain part of this association, but evidence remains scarce. We investigated the association between long-term exposure to UFPs and IHD mortality using a population-based cohort in Montreal, Canada.

METHODS: The open cohort was constructed from health administrative databases and included all adults 45 years and older who were residents of Montreal between 2001-2015. IHD deaths were identified with codes from the International Classification of Diseases nine and tenth revisions. Annual UFP concentrations were estimated with a land use regression model developed for Montreal. Time-varying exposure was assigned to participants using their residential postal codes throughout the follow-up. The association between annual mean concentration of UFPs and IHD mortality was estimated with a Cox proportional hazard model stratified for sex, calendar year and material deprivation.

RESULTS: The cohort included 572,883 adults, with 52,327 IHD mortality cases over the follow-up. Annual average UFP exposure was 24,388 particles/cm3 with an interquartile range (IQR) of 3,448 particles/cm3. Annual mean UFP exposure was positively associated with IHD mortality in both the crude model (HR per IQR: 1.03, 95% CI: 1.03-1.04) and the fully adjusted model (HR per IQR: 1.02, 95% CI: 1.01-1.02).

CONCLUSIONS: In this population-based cohort, we found a small positive association between annual UFP exposure and IHD mortality. Further studies with additional adjustments are needed to improve the current evidence.

KEYWORDS: Air pollution, Particulate matter, Ultrafine particles, Cardiovascular mortality, Ischemic heart disease

P-0189 Short-term exposure to ultrafine particles and mortality in Copenhagen, Denmark

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BACKGROUND&AIM: Ultrafine particles (UFP; particulate matter <100 nm in diameter) may be more harmful to human health than larger particles, but epidemiological evidence on their health effects is still limited. In this study, we examined the association between short-term exposure to UFP and mortality in Copenhagen, Denmark.

METHODS: Daily levels of size-aggregated ultrafine, accumulation mode and combined ultrafine and accumulation mode particles (10-110, 110-700, 10-700 nm), expressed as particle number (PNC), surface area (PSC) and volume concentration (PVC) together with meteorological factors were monitored at an urban background station in central Copenhagen during 2004 - 2015. Daily counts of all-cause natural, cardiovascular, and respiratory mortality in Copenhagen were obtained from the Danish Register of Causes of Death. Odds ratios (OR) with 95% confidence intervals (CI) of mortality associated with interquartile range (IQR) increases in exposure on the day of death and up to four days before were estimated using case-crossover design, accounting for temperature and relative humidity.

RESULTS: We observed 98,929 all-cause natural, 28,876 cardiovascular, and 11,642 respiratory deaths. for all-cause natural mortality, we found significant associations mainly with exposure to larger, accumulation mode particles, lagged by one day: an IQR increase in PNC (110-700 nm) was associated with an increase in mortality [OR: 1.02 (95% CI: 1.00, 1.03)]. The strongest association was observed with respiratory mortality, with an OR of 1.08 (95% CI: 1.02, 1.14) per IQR increase in PNC in the ultrafine range (10-110 nm) on the same day. We detected null associations with cardiovascular mortality.
CONCLUSION: We present novel findings that short-term exposure to UFP may be associated with mortality in Copenhagen. Particles in the accumulation mode were most strongly associated with all-cause natural mortality, while particles in the ultrafine size range seemed most relevant for respiratory mortality.

KEYWORDS: Air pollution, Epidemiology, Mortality, Particulate Matter

P-0190 Characterizing Impacts of Smoke Exposure from Prescribed Burns on Adverse Respiratory Health Outcomes in Georgia, USA, 2015-2018

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As the frequency and intensity of wildfires have been increasing, the use of prescribed fire as a strategy to reduce wildfire risk and keep the forest ecosystems healthier has also increased. Our objective was to evaluate associations between fine particulate matter concentrations from prescribed fires (fire PM2.5) and adverse respiratory health outcomes, using spatiotemporal exposure models and regression techniques.

Our assessment examined employer-based health insurance claims for adverse respiratory health outcomes for a period between January 1 and April 30 2015-2018, in the state of Georgia, USA. We examined medication fills, emergency room (ER) visits, and hospitalizations for asthma and other respiratory health conditions. We linked these outcomes with fire and non-fire-related concentrations of air pollutants, using a data fusion approach combining source-apportioned chemical transport model output with measurements. A conditional quasi-Poisson regression with year/month/day/place strata, in combination with a distributed lag non-linear model, was used to measure the effect of fire PM2.5 exposure on adverse health outcomes. This regression framework accounted for a multi-day lag period and included additional predictors, such as nitrogen dioxide, non-fire related PM2.5, temperature, and an index for influenza-like illness activity levels.

Health risks associated with fire PM2.5 exposure for adverse respiratory hospitalizations and ER visits were not statistically significant. However, the estimated risk ratio associated with a 10 µg/m3 increase in fire PM2.5 exposure for asthma medication fills was 1.077 (95% confidence interval: 1.030–1.127). Delayed effects of initial fire PM2.5 exposure persisted for 3-5 days, and effect sizes varied depending on the type of medication (quick-relief vs. long-term controller).

Our results increase understanding of health effects associated with prescribed burns. A comprehensive strategy to mitigate adverse health impacts associated with wildland fires should also account for fire PM2.5 exposure resulting from land management practices, particularly for populations residing close to prescribed burn sites.

P-0191 Exploring 50-years of fungal spore counts and GP consultation rates for asthma to explore their potential association

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BACKGROUND AND AIM: High concentrations of outdoor airborne fungal spores have been associated with allergic sensitisation and exacerbation of asthma. In the UK, both fungal spore prevalence and episodic asthma display strong, overlapping seasonal characteristics, yet little research has been performed on their association. Counts for 50-years of UK-based, outdoor fungal spores and general practitioner (GP) consultations for asthmatic episodes will be analysed to investigate their association in a multivariate context.

METHODS: Airborne fungal spore and pollen counts were performed in Derby/Leicester. These counts, along with publicly available data for air quality (DEFRA) and meteorological (Met Office) variables were aggregated to weekly sums or averages to match the resolution of national counts for GP consultations for asthma (Royal College of General Practitioners). Weekly counts for respiratory viral infections (UKHSA) and bank/school-holiday dates were also obtained for consideration as potential confounding effects. Time-series analyses will be used to explore a causal pathway between fungal spore counts and the rate of GP consultations for asthma.

RESULTS: Descriptive analyses reveal varying seasonal trends for all counted variables. Peak asthma consultations in September, commonly known as 'back to school asthma', coincide with high airborne fungal spore concentrations for many allergenic taxa. Sharp peaks for varying fungal taxa are shown to occur at varying points across a year and may be related to spikes in asthma consultations.

CONCLUSIONS: This analysis will utilise perhaps the longest-running aerobiological sampling dataset within the UK. The temporal range of this data may be required to account for long-term fluctuations in fungal spore counts which can span multiple decades. It is hoped this ongoing analysis will help to understand the role of fungal spores in healthcare-seeking behaviour for asthma.

KEYWORDS: Fungi, asthma, outdoor

P-0194 Exposure to Air Pollution and the Nasal Microbiome in Children

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BACKGROUND AND AIM: Pollution induced damage to the respiratory epithelium may shift its resident microbial community. We examined associations of air pollution with the nasal microbiome in children.

METHODS: We collected nasal microbiome samples in early adolescence (mean age 12.9 years) from the anterior nares of 286 participants in Project Viva, a pre-birth cohort. Participants were white (66%), Black (15%), Hispanic (4%), Asian (3%) and more than one race/ethnicity (12%). We considered three PM2.5 exposure windows (mean ± SD, µg/m3) prior to nasal sampling (1 day (7.4± 3.0), 1 week (7.4± 2.0), 1 month (7.3± 1.5)). We sequenced the bacterial microbiome by 16S (V1-V3) and summarized OTUs by genus. We modeled both abundance of individual taxa (log-transformed) and PAM derived cluster states (Jensen-Shannon Distance) as outcomes, using MaAsLin2 linear models and multinomial regression, respectively. We adjusted models for age, race/ethnicity, sex, BMI, maternal education, sine and cosine of season, and household smoking.Effect estimates are for a 1-unit PM2.5 increase.

RESULTS: Past week PM2.5 exposure was nominally associated with increased Propionibacterium (Beta=0.02, p=0.046). Past month PM2.5 was associated with increased Neisseriaceae (unclassified genera) (Beta=0.018, p=0.006) and Porphyromonas (Beta=0.002, p=0.02). Six cluster states were identified in participants (Propionibacterium dominant (N=26%), Neisseriaceae dominant (N=10%), Staphylococcus dominant (N=18%), Streptococcus dominant (N=13%), Corynebacterium dominant (N=28%), and Moraxella dominant (N=5%)). for past month PM2.5, odds of Neisseriaceae cluster membership were increased (OR=1.53, 95% CI 1.19 to 1.99), while odds of Moraxella cluster membership were decreased (OR=0.68, 95% CI 0.58 to 0.78) as compared to the Corynebacterium cluster. Prior day PM2.5 was not associated with the microbiome.

CONCLUSIONS: Short term PM2.5 exposure may alter nasal microbiome community cluster states in children. The potential health implications of air pollution associated changes in the host microbiome have yet to be explored but represent a new avenue for research.

P-0196 Physical and Mental Health Symptoms After a Hydrogen Sulfide Disaster in Southern Los Angeles County, CA, USA

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BACKGROUND: In October 2021, over 4,000 complaints of noxious odor, headaches, and breathing problems were reported among residents living near the Dominguez Channel—a flood control waterway in Southern Los Angeles County. Hydrogen sulfide (H2S), a toxic odorous gas, was measured along the Channel at concentrations up to 230 times the state acute air quality standard. High H2S concentrations lasted for six weeks before returning to below-standard levels. Because residents continue to experience odors and health symptoms, we aimed to assess the acute and intermediate-term physical and mental health symptoms related to this disaster.

METHODS: We partnered with two community organizations to educate residents on H2S and to design a health survey. We used the Impact of Event Scale-Revised to assess post-traumatic stress disorder-related (PTSD) symptoms. We recruited participants in high- and low- exposed areas through social media, door-to-door outreach, community events, and postcards.

RESULTS: of the 86 current respondents, 66% noted that the odor worsened their physical health and 57% indicated worse mental health. Among respondents with asthma, 60% noted that asthma was worse during the event. The proportion of high exposed respondents (<2 km from Dominguez Channel) reporting difficulty breathing, headaches, and anxiety during the first week of the odor was 1.5, 1.3, 1.6 times higher, respectively, than among low exposed (>2 km) residents. Although a smaller percent of high exposed respondents reported burning eyes and runny nose than low exposed respondents, overall, 31% and 42% of respondents reported these symptoms, respectively. The percent of high exposed respondents with a probable PTSD diagnosis was 1.3 times higher than the percent of low exposed residents.

CONCLUSIONS: Malodors are often under-prioritized in environmental justice communities. The Dominguez Channel H2S incident harmed the mental and physical health of nearby residents.

KEYWORDS: respiratory outcomes, asthma, mental health outcomes, environmental justice, community outreach

P-0198 Associations of outdoor fine particulate matter (PM2.5) air pollution and symptoms of depression in the Prospective Urban Rural Epidemiology (PURE) study

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BACKGROUND/AIM: Emerging evidence suggests that outdoor fine particulate matter (PM2.5) exposure may be a risk factor for major depressive disorder (MDD). The Prospective Urban Rural Epidemiology (PURE) study provides the opportunity to assess this association using a large global cohort with comprehensive covariate data. Within this cohort, long-term PM2.5 exposure has been linked to cardiovascular disease, and increased risk of cardiovascular disease has been linked to having depressive symptoms. We built on this work by evaluating associations between outdoor PM2.5 and depressive symptoms at cohort baseline, across countries of different levels of economic development.

METHODS: In the PURE study, adults aged 35-70 from 21 high-, middle-, and low-income countries were assigned 3-year rolling mean outdoor PM2.5 estimates, based on their community of residence. Estimates were derived from ground monitoring, satellite retrievals, and chemical transport models. Participants completed the Short-Form Composite International Diagnostic Interview (CIDI-SF), for which validation studies indicate that reporting ≥ 4 of 7 symptoms is predictive of MDD. Multivariate regression models will be used to estimate associations between PM2.5 concentrations and CIDI-SF scores.

RESULTS: of 202,131 participants that enrolled in the PURE study (01/2003 – 07/2018), 155,447 had complete information on exposures, covariates, and depressive symptoms. The mean (SD) age was 50.9 (9.7) years, and 59.1% participants were female. The mean (SD) 3-year outdoor PM2.5 concentration at baseline was 47.5 µg/m³ (32.6), ranging from 6 µg/m³ in Vancouver, Canada to 140 µg/m³ in Jaipur, India. 19.5% of participants reported feeling sad, blue, or depressed for two weeks or longer in the past year, and 12.2% reported ≥ 4 depressive symptoms.

CONCLUSIONS: The findings of this project can help evaluate the association between outdoor PM2.5 exposure and MDD on a multinational scale, and further establish the roles of related risk factors.

KEYWORDS: Ambient air pollution, mental health, depression

P-0199 Long-term exposure to air pollution and incidence of 922 health outcomes in a phenome-wide association study: Danish nationwide administrative cohort

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BACKGROUND: Air pollution poses substantial burden on human health, but typically, epidemiological studies address only a single, or several related diseases at the time. The aim of this study was to investigate the associations of long-term exposure to PM2.5 and NO2 with incidence of all health conditions among adults aged 30 years or older in Denmark 2000-2017.

METHODS: We included 3,323,612 Danish residents aged ≥30 years on 1.1.2000. Annual average for PM2.5 and NO2 in 2010 were estimated from European-wide hybrid LUR models (100x100m resolution) at the individuals' baseline residential address. Incidence of 922 health outcomes defined using entire ICD-10 chapter were extracted from the Danish National Patient Register and the Register of Causes of Death until 31.12.2017. The associations of PM2.5 and NO2 with health were estimated by use of Cox regression models accounting for age, sex, country of origin, cohabitation status, education, occupational status, income, and municipality.

RESULTS: Long-term exposure to PM2.5 and NO2 were positively associated with >700 (>80%) and inversely with 12-19% of the 922 health conditions. Considering the most common diseases, strongest associations were detected with chronic obstructive pulmonary disease, type 2 diabetes mellitus, ischaemic heart disease, heart failure, pneumonia, and myocardial infarction, and strongest inverse association with inguinal hernia. We also detected associations with a number of novel outcomes, such as cough, abnormal findings in specimen from respiratory organs and thorax and imaging of the lung, anaemia, tuberculosis, diseases of the liver and eye, mental and behavioural problems, among others.
CONCLUSONS: Using a novel, nationwide phenome-wide association type of approach, we showed that long-term exposure to PM2.5 and NO2 have adverse effects on more than 80% (>700) of all health conditions defined by ICD-10 chapter, illustrating the profound adverse effects of air pollution may have on human health.

KEYWORDS: Air pollution; PM2.5; NO2; PheWAS

P-0201 Short-term effects of exposure to particulate matter concentrations originating from desert dust on mortality in Athens, Greece

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BACKGROUND & AIM: Evidence on the independent associations of source-specific particulate matter (PM) exposures with health outcomes is limited. Our aim was to investigate the effects of short-term exposure to PM≤ 10μm (PM10) concentrations originating from windblown desert dust and local sources on mortality.

METHODS: We investigated the effect of exposure to total PM10 concentrations, as well as estimated concentrations originating from desert dust and other sources on total mortality, between the years 2010-2019. We used Poisson regression models to estimate the association between PM10 from different sources, also controlling for possible confounding by season, meteorology, day of the week and holiday effect.

RESULTS: During the 10-year study period, 35% of days were affected by desert dust (desert dust PM10> 0μg/m3). An increment of 10μg/m3 in total PM10 concentrations was associated with a 0.52% (lag 0–1, 95% confidence interval (CI): 0.21, 0.83%) increase in natural mortality. When mutually adjusting non-desert and desert dust PM10 concentrations, a 10μg/m3 increase in non-desert was associated with a 0.45% (95% CI: 0.07% to 0.84%) increase in natural mortality. On the other hand, the effect of desert PM10 (lag 0-1 days) concentrations was non-significant (0.59%; 95% CI: -0.53% to 1.72%).

CONCLUSIONS: Our findings support the hypothesis that daily exposure to traffic-related particles have more toxic effects, compared to ones originating from windblown desert dust, in Athens, Greece leading to increased mortality.

P-0204 The Association of Visibility and Adenocarcinoma Lung Cancer in Southern Taiwan

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BACKGROUND/AIM:
Studies on association between lung cancer and long-term exposure to air pollution are limited due to the unavailability of air pollution data. The study aims to assess association of visibility, a proxy indicator of long-term air pollution exposure, with adenocarcinoma lung cancer.

METHODS: Our study area is in southern Taiwan, an industrial area with 2.7 million people in 5.7 thousand km². Annual lung cancer incidence data with the ICD-O-3 codes from C34.0-C34.9 were obtained from Taiwan Cancer Registry (TCR) from 1997 to 2018. Age-adjusted incidence of lung cancers were standardized by the WHO 2000 world standard population. Hourly atmospheric visibility data from 1961 to 2022 were obtained from Taiwan Central Weather Bureau. 30-years moving averages were then calculated from 1967 onward to represent long-term visibility in the study area. Linear regression models were employed to estimate associations of 30-years averaging visibility annual age-adjusted lung cancers incidence for both adenocarcinoma and non-adenocarcinoma from 1997 to 2018.

RESULTS: From 1997 to 2018, southern Taiwan's adenocarcinoma lung cancer incidence increased from 8.93 to 25.81 per 100,000 population, while non-adenocarcinoma incidence decreased from 14.61 to 10.41 per 100,000 population. The 30-years averaged visibility in the study area declined from 14.90 km to 7.65 km in the same period. Reducing visibility is significantly associated adenocarcinoma lung cancer, with a 2.43% (95% confidence interval [CI]: 2.77-2.11, adjusted R2 value: 0.92) increase in incidence by 1 km decrease in visibility during this period. Such associations exist for both females and males with increasing incidence of 2.57% (95% CI: 2.92-2.22, adj R2: 0.92) and 2.32% (95% CI: 2.69-1.95, adj R2: 0.89) by 1 km visibility reduction, respectively. By contrast, visibility reduction was not associated with increased in non-adenocarcinoma incidence.

CONCLUSIONS: Long-term visibility reduction is associated with increase in adenocarcinoma lung cancer incidence but not with non-adnocarcinoma.

P-0205 Association between short-term exposure to fine particulate matter components and cause-specific mortality in Korea: a multi-city time-series study

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BACKGROUND/AIM:
Many studies have reported fine particulate matter (PM2.5) has various health effects. The effects of PM2.5 have been shown to vary in space and time. One of the underlying explanations was the variability in the distribution of chemical components in PM2.5. Therefore, identifying whether the health effects of each component of PM2.5 differ can provide evidence for the heterogeneous mortality risk of PM2.5. Our study aims to estimate the associations between short-term exposure to components and cause-specific mortality across six major cities in Korea.

METHODS: Daily mass concentration of PM2.5 and 25 components of PM2.5 were obtained from the National Institute of Environmental Research for 2012-2019. We used six intensive air monitoring stations in each of the six major cities: Seoul, Incheon, Daejeon, Gwangju, Ulsan, and Jeju. We employed a two-stage analysis. In the first stage, we conducted generalized additive model with quasi-Poisson regression to estimate city-specific associations of mortality with PM2.5 and its components on the same day. We excluded Asian dust days and adjusted the model for temperature, relative humidity, and time trend. In the second stage, we used fixed-effects meta-analysis to pool the city-specific estimates.

RESULTS: We could not find statistically significant association of PM2.5 and all components with all-cause mortality. Potassium was associated with 2.2% increment (95% CI:0.4%, 4.0%) in cardiovascular mortality per IQR increase (0.24μg/m3). Magnesium ion was associated with 0.7% increment (95% CI: 0.1%, 1.4%) in respiratory mortality per IQR increase (0.01μg/m3).
CONCLUSION: This study suggests potential adverse health effects of particles produced by dust, salt, or traffic. In contrast to previous studies, our results showed no association of elemental carbon or nitrate with any mortality. Further study would be needed to account for the joint and lagged effect of components and meteorological variables.
KEYWORD: fine particulate matter, components, multi-city analysis, epidemiology, health

P-0208 A randomized crossover trial of portable in-home air purifiers for highway PM and cardiovascular risk: HAFTRAP study update

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BACKGROUND AND AIM: We have shown previously that cardiovascular biomarkers are associated with traffic-related air pollution (TRAP) near highways and that reducing particulate exposure improves blood pressure (BP) in controlled settings. Our aim here is to assess the efficacy of portable in-home high-efficiency particle arrestance (HEPA) air purifiers to reduce indoor concentrations of TRAP and therefore reduce BP and systemic inflammation in a real world, lived-in setting.

METHODS: We are conducting a randomized crossover trial of air purifiers in homes <200m from a major highway. Participants receive real or sham filtration for one month each separated by a one-month wash out period. We collect peripheral and central BP, as well as blood samples for inflammatory biomarker analysis before and after each one-month period. We also conduct air monitoring and satisfaction interviews with a subset of homes and participants.

RESULTS: A sample of 57 participants has been enrolled with recruitment ongoing. Thirty-three percent live within 100m of the highway. The average age of participants is 44 years (range: 30-78 years), 68% are female, and 37% are racial/ethnic minorities. The mean (SD) baseline peripheral and central systolic BP are 123 (14) mmHg and 113 (13) mmHg, respectively. Indoor and outdoor PNC measurements indicate that median concentrations were 40-60% lower during HEPA than SHAM and during HEPA use indoor concentrations were 60-70% lower than outdoors. Data on electricity use and quantitative and qualitative feedback suggest air purifiers were on the medium setting most of the time.

CONCLUSIONS: Approximately one-third of the way to our recruitment goal we have good acceptance and compliance with the intervention, quality data and indications that the air purifiers are reducing TRAP as intended. An interim analysis of health outcomes should be possible in a year.

P-0209 Demand for environmental health technologies: a clean cookstove experiment in Northern Ghana to investigate effects of prices and peers

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BACKGROUND AND AIMS: Across a wide range of environmental health issues, understanding the drivers of technology adoption and behavior change is key to achieving exposure reductions. In areas reliant on biomass for cooking, reducing exposure to household air pollution requires shifts toward cleaner cooking technologies. We conducted an experiment in Northern Ghana to assess how prices and peer effects shape demand for two models of improved cookstoves.

METHODS: Our experiment involved offering stoves at randomized prices to peers and non-peers of households who received free stoves during a prior study. This experimental design allows us fully estimate a two-good demand system for the high- and low-end stoves, and to econometrically identify complex changes in demand for these goods owing to peers' adoption of the stoves.

RESULTS: The peer treatment only affected demand for the less familiar and more expensive stove, making users less price-sensitive while leaving aggregate willingness to pay unchanged. We also find evidence that users found the two stoves offered to be complements: users preferred purchasing one of each stove over purchasing two of either stove. Estimated price elasticity effects translate into substantial positive or negative impacts to the predicted cost-effectiveness of subsidies for these technologies, depending on marketing costs and the relative performance of the two stoves.

CONCLUSIONS: Programs and policies that seek to expand use of health-improving technologies must examine how social context and prior experiences with similar technologies among peers shape households' decision. "Market spoilage" is a risk when low-quality products are distributed in free trials, and these risks should be considered in the design of environmental health promotion strategies.

KEYWORDS: Peer effects, social learning, environmental health, cookstoves, demand modeling

P-0210 Acceptability of air purifiers to reduce traffic-related particulate exposure near a highway

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BACKGROUND AND AIM: Traffic-related ultrafine particle pollution near highways has been associated with adverse health. Reducing exposure by use of portable air purifiers in homes is one way to try to reduce this risk. However, acceptability of having air purifiers in homes is not well studied.

METHODS: We collected data via questionnaires (N=43 surveys at the end of the first month of the intervention), interviews (N=19) and HOBO monitors on air purifiers (N=14) from participants in our randomized crossover trial of air purifiers in homes near a major highway.

RESULTS: From survey questions, only 17% and 12% were bothered by noise of the air purifier in the living room and bedroom, respectively. Most survey respondents, 75% and 68%, again for living room and bedroom, reported they set the air purifier to medium air flow. In qualitative interviews, Seventy-four percent (74%) reported that they did not move their air purifiers, but 63% changed the fan speed, many to reduce noise or air flow. Only 21% said that they ever turned it off. Space, noise, airflow and energy consumption were the main concerns from interviews, while cleaner air, improved symptoms and white noise were positives. Data on electricity use indicates >95% compliance of use on a consistent setting (majority choose medium) during our intervention. We have had few participants drop out after their first home data collection visit, with 36 completing the entire intervention, 20 still actively in the intervention and only one lost to follow-up.

CONCLUSIONS: Evidence from surveys, interviews and HOBO monitors suggests that a small minority of participants were bothered by noise, space issues or air movement from the air purifiers and that they are largely accepted and used by residents near a highway, albeit on settings below maximal air flow.

P-0211 Historical Concentration Estimates for Air Pollutants for the Purpose of Health RiskAssessment and Epidemiological Studies of Chronic Diseases in Relation to Long-Term orLifetime Exposures

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BACKGROUND AND AIM: Estimates of historical concentrations are necessary when epidemiological studies on chronic
diseases, especially oncological diseases, need to relate to lifetime exposure to air pollutants. The aim was to develop a methodology to obtain the most reliable estimates of annual average historical pollutant concentrations, which are further applied to the evaluation of long-term exposure.
METHODS: A combination of air quality monitoring data, a modelled of five-year average pollutant concentrations in a grid 1x1 km and a number of spatial and time correlations of PM10, PM2.5, NO2, SO2, benzene, and B(a)P concentrations have been used. Subsequently, the data were corrected for residential areas and for emissions balances.
RESULTS: In the period 1997-2019, the result accuracy is mainly influenced by the number and territorial distribution of air quality monitoring stations in the respective district. for the period 1980-1995 concentration estimates are directly related to the 1997 and uses correlations with emission balance data, so is burdened with more uncertainty. The resulting annual concentration data represents six pollutants for 13 evaluated districts for the period 1980 - 2019.
CONCLUSIONS: This work is an original contribution to the interdisciplinary field of environmental epidemiology, dealing with the relationship between long-term or lifetime exposure to air pollutants and the incidence of chronic diseases. The methodology tries to solve the insufficient or different availability of historical input data from pollutant monitoring as effectively as possible.

KEYWORDS:
air pollution; pollutant concentration; air quality monitoring; temporal and spatial pollutant correlation; historical concentrations; geographic information system; long-term exposures.

P-0215 Incidence of medication related to emissions from a large steel plant

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BACKGROUND AND AIM: This study was initiated in 2011 in response to concerns about the risks of emissions from a large steel plant in the Netherlands, as follow-up of a study into lung cancer (Breugelmans et al., 2013). The aim of the study was to assess the relation between the contribution of the steel plant site to local air pollution levels and the incidence of medication in the period 2008-2019.

METHODS: The administrative cohort study included all residents of 18 municipalities around the industrial site (~0.75 million inhabitants). We collected information about the annually incidence of medication for heart diseases, high blood pressure, diabetes, Parkinson's disease in adults and for respiratory diseases in children and adults. The contribution of the site to the concentration of primary PM2.5 (PPM2.5) was modelled annually for the period 2005-2019. We carried out discrete survival analyses with a random effect for district. Effect estimates were adjusted for individual and neighborhood-level covariates and the air pollution from other sources (PM2.5 and nitrogen oxides) and expressed as percentage increase per 0.84 μg/m³ (corresponding to the contrast between low and high exposed areas over time).

RESULTS: The increase in RR for the PPM2.5 contribution from the site was for women and men 13% [6-20] and 11% [5-17] for hypertension medication, 16% [6-28] and 15% [4-27] for diabetes medication, 16% [7-26] and 14% 14 [7-22] for heart disease medication, and 5% [-4 ; 14] and 10% [2 ; 19] for respiratory disease medication, respectively. No positive associations were found for medication for respiratory diseases in persons under the age of 20 and for Parkinson's disease.

CONCLUSIONS: Exposure to airborne emissions from a large steel plant site was associated with the incidence of medication for cardiovascular, metabolic and respiratory diseases in adults.

KEYWORDS: air pollution, medication, steel plant

P-0219 Satellite-derived local air pollution impacts of the household 'coal-to-clean energy' program in Beijing

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BACKGROUND:
In 2015 Beijing started a coal-to-clean energy program that banned coal stoves and subsidized electric- or gas-powered heaters and electricity costs in thousands of peri-urban villages. Our objective was to estimate the effect of this program on satellite-derived $PM_{2.5}$.
METHOD:
We geolocated villages in Beijing and assigned participation status in the program between 2015 and 2018. Average monthly outdoor $PM_{2.5}$ data at a spatial resolution of 0.01°x0.01° grid cell were obtained for heating months (Dec-Feb) from Dec. 2014 to Dec. 2018. We estimated the number of households in each grid cell participating in the program ('treated') for each study month. We used a Bayesian spatiotemporal model to estimate the local effect of household participation in the program on satellite-derived $PM_{2.5}$, adjusting for meteorological conditions (temperature/RH, precipitation, and wind vectors), elevation, imperious surface, presence of villages, and eligibility to participate in the program. We assessed linearity using linear splines.

RESULTS: In the 1768 grid cells with at least one village participating in the program by the end of 2018 (out of 17353 grid cells total), the number of treated households ranged from 1-5290 (median: 155). We observed a small but consistent effect of participating in the coal-to-clean energy program on decreases in local $PM_{2.5}$ whereby for every 10 households treated there was an accompanying 0.03μg/m³ decrease [95%CI:-0.04,-0.02] in grid-cell $PM_{2.5}$ up to 155 households. There was no effect of treatment on $PM_{2.5}$ in grid cells with over 155 treated households.
CONCLUSION: In less-populated areas, we observed modest reductions in satellite-derived outdoor $PM_{2.5}$ at the grid cell level in Beijing after participation in the program. The lack of effect in areas with households is likely due to the presence of other sources of local outdoor $PM_{2.5}$ that masks any $PM_{2.5}$ benefit of the program.

KEYWORDS: Outdoor air pollution; residential coal burning

P-0223 The impact of coal and oil power plants retirements on air pollution and cardiorespiratory health in California: an application of generalized synthetic control design

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BACKGROUND AND AIM: Evidence documenting the harmful consequences of ambient air pollution can be advanced by examining the effect of well-defined interventions on air pollution and possible benefits on health outcomes. This study aims to evaluate the effect of coal and oil facility retirements, on fine particulate matter (PM2.5) and cardiorespiratory hospitalizations in California.

METHODS: We identified 15 coal and oil facilities in California that retired between January 1st, 2006 and December 31st, 2013 and estimated the effect of facility retirements with a generalized synthetic control design. We classified California zip codes as exposed or unexposed to a facility retirement using emissions information and a dispersion model. We then estimated the difference in weekly average PM2.5 concentrations and cardiorespiratory hospitalization rate after each facility retirement between the exposed zip codes and the synthetic control generated based on all unexposed zip codes (i.e., the average treatment effect among the exposed [ATE]). Time-fixed (e.g., age distribution) confounding are controlled by study design while time-varying confounders like temperature were adjusted for in the model. We pooled ATEs across facilities using meta-regressions.

RESULTS: The generalized synthetic control performed well with overlapping trends pre-retirement between the exposed zip codes and synthetic controls. The pooled ATE was 0.02 µg/m3 (95% confidence interval (CI): -0.25 to 0.29 µg/m3) for weekly PM2.5. The pooled ATE across all facility retirements was 0.34 per 10,000 person-time (95% CI: -0.08 to 0.75 per 10,000 person-time) for weekly cardiorespiratory hospitalization rates.

CONCLUSIONS: We did not identify reductions in PM2.5 or cardiorespiratory hospitalization rates after oil and coal facility closures in California. The declining contribution of industrial emissions to ambient air pollution in California may explain this observation. We encourage future research to replicate this work in regions with different amounts of industrial activity.

KEYWORDS: Quasi-experimental, natural experiment, air pollution, industrial facility

P-0225 Effect of historical redlining and current-day segregation on air pollution disparities across 143 cities in the USA

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BACKGROUND AND AIM: Systematic racial/ethnic segregation via historical redlining has been identified as a potential contributor to environmental injustices in the US today, particularly air pollution. However, no studies have examined how the effect of current-day racial/ethnic segregation has modified this association. This study examined this hypothesized effect modification on current levels of air pollution (i.e., PM2.5 and diesel PM) across the USA.

METHODS: Current-day demographics and air pollution levels were estimated for USA census tracts using the EPA EJSCREEN. Census-tract-level HOLC grade was assessed using 2010 Historical Redlining Scores, and current-day segregation from the dissimilarity index. We examined differences in air pollution by HOLC grades using city-adjusted, intra-urban air pollution levels from mixed-effects linear regression models using cities as a random intercept to account for city-to-city differences in air pollution levels. We examined our hypothesized effect by investigating the joint effects of redlining (comparing A- and D-grade census tracts) and current-day segregation (comparing low and moderate/high levels of dissimilarity) on log-transformed, population-weighted average diesel PM and PM2.5 levels.

RESULTS: Overall, D-grade air pollution levels are 28% (95% CI: 25% to 31%) and 1.2% (1% to 1.4%) higher than A-grade census tracts for diesel PM and PM2.5, respectively. Moderately/highly segregated, D-grade census tracts have 70% (49% to 95%) times higher diesel PM levels and 5% (0%, 11%) times higher PM2.5 levels compared to lowly segregated, A-grade census tracts. Estimates indicate significant departures from additive (RERI: 24%; 14% to 34%) and multiplicative joint effects (percent change of interaction term: 10%; 3% to 17%) for diesel PM, and similarly for PM2.5 (RERI: 1%, 1% to 2%; percent change of interaction term: 1%, 1% to 2%).

CONCLUSIONS: Current-day segregation modifies the association between historical redlining and air pollution in the USA.

KEYWORDS: environmental justice; redlining; air pollution; effect modification; RERI

P-0227 Air Pollution Exposure and Public Transport in Addis Ababa: Vulnerability Scoping Study

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The effects of air pollution on human health are well documented in a range of epidemiological studies; exposure increases the risk of lung cancer, heart disease, bronchitis and other cardiorespiratory conditions. Whilst, air pollution is considered to impact on all groups, particularly when exposed over prolonged periods of time, some groups are considered to be more susceptible than others. This scoping study explores the vulnerability of commuters, bus drivers and street vendors who are exposed to poor air quality on buses or at bus stations via the deployment of low-cost PM sensors in both indoor and outdoor settings. The study also probed perceptions of commuters, street vendors and bus drivers regarding air pollution. Findings underscore the vulnerability of these groups to air pollution and suggest that those from low socioeconomic backgrounds are likely to face a triple burden of exposure both at home, in work or during commutes. The air pollution levels at both bus station (outdoor) and bus (indoor) settings regularly exceed World Health Organization (WHO) guideline amounts. Bus station PM2.5 were measured to be on average 113 ± 99 µg/m3 and peaked at 323 ± 203 µg/m31. Further to this, air pollution levels tend to peak during early morning and late evening hours, consistently reaching unhealthy levels throughout the day. Measured levels of PM2.5 on buses ranged between PM2.5 49 ± 19 µg/m3 and 105 ± 45 µg/m3 on journeys measured. Survey findings suggest that survey respondents are relatively cognizant of their inherent vulnerability to air pollution, perceiving their vulnerability on a scale of 1-5 at an average of 3.87/5 (five indicating extreme levels of vulnerability). Respondents demonstrated a mixed understanding of the potential sources of air pollution, though this is to be expected given the relative lack of knowledge regarding air pollution in many societies.

P-0232 Particle surface area, ultrafine particle number concentration, and cardiovascular hospitalizations

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BACKGROUND AND AIM: While the human health impacts of larger particulate matter, such as PM10 and PM2.5, have been studied extensively, research regarding ultrafine particles (UFPs or PM0.1) and particle surface area is lacking. This case-crossover study assessed the associations between exposure to particle surface area concentration (PSC) and UFP particle number concentration (UFPnc) and hospital admissions for cardiovascular diseases (CVDs) in New York State (NYS), 2013-2018.

METHODS: We used a time-stratified case-crossover design to compare the PSC and UFPnc levels between hospitalization days and control days (similar days without admissions) for each CVD case. We utilized NYS hospital discharge data to identify all CVD cases who resided in NYS. We used UFP simulation data from GEOS-Chem, a state-of-the-art chemical transport model, to define PSC and UFPnc. Using a multi-pollutant model and conditional logistic regression, we assessed CVD risk per inter-quartile change of PSC and UFPnc after controlling for meteorological factors, co-pollutants, and time-varying variables.

RESULTS: Our results indicate an immediate and robust positive association between PSC and overall CVDs (lag0–lag0-1: 1.0%) and a delayed, lasting effect between UFPnc and CVDs (lag0-3–lag0-6: 0.4%). Exposure to larger PSC was associated with immediate increases in stroke, hypertension, and ischemic heart diseases (0.7%, 0.8%, 0.8%, respectively). The adverse effects of PSC on CVDs were highest among youngest children (0-4 years old), in fall and winter, and during cold temperature days (2.0%, 1.4%, 1.3%, 1.5%, respectively) compared to those on other days.
CONCLUSION: We found an immediate, positive effect of PSC on overall CVDs and a delayed, lasting impact of UFPnc. PSC was a more sensitive indicator than UFPnc. The PSC-related effects were higher among certain CVD subtypes, in the youngest children, in certain seasons, and during cold days.

KEYWORDS: ultrafine particles, particle surface area, air pollutants, cardiovascular admission, vulnerability, seasonality

P-0235 Association between long-term and short-term PM2.5 exposure and hospitalizations among a cohort of COPD patients, North Carolina, 2002-2015

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BACKGROUND: Approximately nine million adults in the USA are living with Chronic Obstructive Pulmonary Disease (COPD). Previous research has reported associations between short-term air pollution exposures and increased risk of hospitalization for COPD in older adults. This study examined associations individually between short-term and long-term PM2.5 exposure and hospitalizations, and whether the association between short-term PM2.5 exposure is modified by long-term PM2.5 exposure in a cohort of individuals with COPD.

METHODS: The study population consists of a cohort of randomly selected individuals with electronic health records from the University of North Carolina Healthcare System that had a COPD diagnosis from 2002-2015 (n=1,429). Estimated ambient PM2.5 concentrations are from a previously validated ensemble model. Poisson regression was used to estimate the Risk Ratios (RR (95%CI)) of cardiovascular disease (CVD) and all-cause hospitalizations with 0-2 day lags of PM2.5, annual average PM2.5 concentrations, and their interactions. Models were adjusted for individual race, and area-level urbanicity, education, unemployment, and proportion on public assistance.

RESULTS: Among the 1,429 COPD patients in our cohort there were 4,302 inpatient hospital visits recorded, including 3,559 CVD-related visits. The mean short-term PM2.5 concentration was 9.62 µg/m3 (IQR 6.77-11.45); the mean long-term PM2.5 concentration was 9.83 µg/m3 (IQR 8.73-10.34). We observed a null association with CVD (RR=1.01 (1.00, 1.02) and a small association with all-cause (RR=1.03 (1.02, 1.04)) hospitalizations per unit increase of short-term PM2.5. There were positive associations between long-term exposure and CVD hospitalizations (RR=1.12 (1.09, 1.16) and all-cause hospitalizations (RR=1.20 (1.17, 1.23)). There was no evidence of interaction between long- and short-term PM2.5 exposures with CVD hospitalizations (RR=1.19 (1.07, 1.32), ICR 0.06) and all-cause hospitalizations (RR=1.21 (1.14, 1.29), ICR -0.02)

CONCLUSIONS: Our preliminary results show associations between short- and long-term PM2.5 and CVD and all-cause hospitalizations among COPD patients, but no evidence of interaction between exposure periods.

P-0236 Chronic Exposure to Fine Particles and Mortality in Chile

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BACKGROUND and AIM: Cities in the center-south of Chile have high air pollution from industrial, mobile, and residential wood burning sources. Several studies have linked PM2.5 air pollution exposure to higher mortality risk due to cardiovascular, pulmonary, and lung cancer causes. Due to the ambient PM2.5 standard, Chile has developed an extensive monitoring that, along with public access databases for population characteristics and socioeconomic conditions, allows this relationship to be studied. Confirming this relationship in a Latin-American country is important for supporting public policies for pollution abatement.

METHODS: a negative binomial regression model, with data at the municipality level, was used to study the impact of 3-year average PM2.5 exposures on age-adjusted mortality rates, controlling by multiple confounding variables. Models were adjusted for all, cardiopulmonary, cardiovascular, pulmonary, cancer, and lung cancer causes of death.

RESULTS: We found evidence of higher mortality risk for cardiopulmonary (1.06; 95% CI: 1.00, 1.13), pulmonary (1.11; 95% CI: 1.02, 1.20) and cardiovascular (1.06; 95% CI: 0.99, 1.13) causes of death (all for an increase of 10 µg/m3 of PM2.5). The positive associations remained even when controlling for multiple confounding factors, and when considering different methods for exposure characterization. These estimates are in line with previous results from US and European studies.

CONCLUSIONS: PM2.5 pollution exposure, as well as demographic and socioeconomic factors, are associated with age-adjusted mortality rates in Chile, for cardiovascular and pulmonary causes. This result reinforces the need to reduce fine particulate matter air pollution in Chile and other Latin-American countries

KEYWORDS: fine particulate matter; PM2.5; Latinamerica; Cardiopulmonary disease; Age-adjusted mortality rates; Ecological study; negative binomial

P-0238 Prediction of health effects of Asian dust in Japan

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BACKGROUND AND AIM: The health effects of cross-border air pollutants and Asian dust are of significant concern in Japan. Currently, models predicting the arrival of aerosols have not investigated the association between arrival predictions and health effects. We investigated the association between subjective health symptoms and data acquired from the Japan Meteorological Agency's (JMA's) Model of Aerosol Species in the Global Atmosphere (MASINGAR) aerosol model with the objective of ascertaining if the data could be applied for predicting health effects.

METHODS: Subjective symptom scores were collected using self-administered questionnaires and used with the JMA model's surface concentration data to conduct a risk evaluation using a multiple linear mixed model, from 2013 to 2015. Altogether, 160 individuals provided 16226 responses. Data regarding climate (temperature, humidity, and atmospheric pressure) and environmental factors (NO2, SO2, and Ox) were used as covariates. We calculated the association between the surface dust concentration and symptoms.

RESULTS: A strong association was also observed for nasal and cough symptoms (P for trend < 0.001). The differences in scores of nasal symptoms (sneezing and runny) of the highest quartile [Q4] vs. the lowest [Q1] were 0.039 (95% confidence interval (CI): 0.02–0.01, $p < 0.05$) and 0.046 (95% CI: 0.002–0.02, $p < 0.05$), respectively. The differences in scores of cough symptoms were 0.036 (95% confidence interval (CI): 0.002–0.01, $p < 0.05$).

CONCLUSIONS: This study suggests that predictive models for pollutants' arrival can be used to capability to foresee and possibly prevent the health impact of long-range transport of air pollutants, recommending the potential role of aerosol forecast models in health care. MASINGAR is the Global Spectral Model (GSM), this has the potential that can contribute to health predictions all over the world.

KEYWORDS:
Asian dust, Health forecast, Allergic symptoms, Air pollution

P-0241 Use of wildfire smoke indicators in health exposure research: high spatial resolution mapping of wildfire-related PM2.5 in California

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BACKGROUND: Wildfire smoke is a leading driver of acute exposure to PM2.5 in the American West and a significant contributor to chronic pollution exposure in immediately impacted and further downwind areas. Exposure to wildfire smoke is linked to acute respiratory morbidity and all-cause mortality, yet little is known about chronic effects of repeated, elevated exposures. Inclusion of wildfire smoke in air quality models for health effects research is important for improving accuracy of the overall models and understanding the specific and independent effects of wildfire smoke relative to the entire pollution mixture. However, the nature of smoke, including high spatial variability and the three-dimensional structure of smoke plumes, presents challenges for the accurate representation of wildfire smoke in health research applications. In this presentation, we will discuss exposure and health research applications that use explicit representations of wildfire smoke to improve exposure estimates.

METHODS: We used dispersion modeling of wildfire smoke to predict ground-level concentrations and support a deep learning ensemble model of PM2.5 over California for 2008-2017. Smoke emissions were modeled using satellite detections of wildfires and a database of emissions related to fire radiative energy. Emissions were dispersed using a fine-scale meteorological data set. We assessed the ability of the model to reproduce spatial and temporal patterns of wildfire smoke using visual satellite imagery of smoke and correlations with ground-based monitoring, respectively.

RESULTS: Our results show that the inclusion of smoke dispersion surfaces produces accurate predictions of PM2.5 concentrations in wildfire smoke conditions.

CONCLUSIONS: This work highlights the importance of incorporating wildfire smoke data sources into exposure assessments, and it indicates new directions for use of wildfire smoke data in health research. The extension of our smoke modeling through the high-smoke years between 2018 and 2021 will support important additional research on wildfire smoke exposure health impacts.

KEYWORDS: Wildfire

P-0243 The NASA TEMPO Mission: Revolutionary Satellite Observations for Community-Scale Air Quality Monitoring and Improved Health Studies

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In December 2022, NASA plans to launch the Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument, a geostationary ultraviolet/visible grating spectrometer, which will observe trace gases and aerosols, including nitrogen dioxide (NO2), sulfur dioxide (SO2), formaldehyde (HCHO), ozone (O3), and aerosol optical depth (AOD), at high spatial resolution (~2 x 4.75 km2) every daylight hour over a Field of Regard (FoR) covering greater North America. An O3 profile product from TEMPO will provide information on O3 in the 0-2 km layer where people live and breathe. TEMPO will also enable observations at even higher frequency (e.g., <= 10 minutes) over smaller regions during special non-standard scan operations. During the pre-launch era of the TEMPO mission, a large diversity of stakeholders and end-users have participated in workshops, data tutorials, and focus sessions hosted by the TEMPO Early Adopters Program, supported by the NASA Applied Sciences Program (ASP), which aims to maximize the societal benefit of the mission data after launch. These user engagement activities have led to a comprehensive understanding of the unprecedented air quality and health applications that can be achieved through use of the highly anticipated data products. In particular, the TEMPO mission will provide multi-pollutant data at high spatiotemporal resolution for enabling more robust and accurate health studies and exposure assessments. This presentation will provide details on the current status of the TEMPO mission, Early Adopter Program activities, and science applications and demonstrations relevant to the epidemiology community.

KEYWORDS: air quality, health, satellites

P-0245 Evaluation of the effects of particulate matter forecasting system on behavior patterns in Seoul, Korea

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BACKGROUND AND AIM: The particulate matter (PM) forecasting system is one of the most prominent political options that can help to reduce the risk of PM. Its goal is to urge people to take avoidance behaviors for upcoming pollution by issuing warnings. In Korea, the national PM10 forecasting system was launched on February 6, 2014. We aimed to estimate the effectiveness of the PM forecasting system in relation to the number of visitors to the Children's Grand Park in Seoul, Korea.

METHODS: We used regression discontinuity design to estimate the effectiveness of the policy from 2014 to 2019. Since the PM forecasting results were not available, the measured PM10 concentration of Seoul was used as a proxy for treatment variable. The cut-off point of the intervention was set to 80ug/m3, the starting point for a "Bad" rating, and the bandwidth was set to 10ug/m3. We further adjusted the daily mean temperature.

RESULTS: When the PM10 concentration exceeds 80ug/m3, the number of visitors to the park decreased by about 15,000. In addition, there was a negative relationship between PM10 concentration and the number of park visitors where pollution levels were over 80ug/m3. The results were statistically significant at the 10% significance level.

CONCLUSIONS: Our result indicates that the PM10 forecasting system seems effective in Korea. According to previous studies in Korea, the risk of PM10 on various health outcomes decreased in recent years. The introduction of the forecasting system and increment in awareness of PM might be possible causes for that change in the PM10 risk.

P-0246 Impact of traffic congestion on near-road black carbon particulate matter and nitric oxide levels

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BACKGROUND AND AIM: Most health studies related to traffic-related air pollution (TRAP) link proxies of traffic levels (annual average daily traffic (AADT), distance from roadway, etc.) to health outcomes. These proxies overlook intermittent elevated pollution emissions arising from congested traffic periods. With data from under-pavement vehicle sensor systems, we developed models of traffic behavior and near road air pollution.

METHODS: A suite of air pollutants and meteorological parameters were monitored nearly continuously for one year, between October, 2020-September, 2021, 15 meters from a heavily trafficked freeway. Vehicle speed, % heavy-duty vehicle and vehicle counts were monitored by under pavement sensors near the monitoring station. These data were used to predict black carbon (BC) and nitric oxide (NO) concentrations as a function of the traffic and meteorological parameters using Generalized Additive Models (GAM) with the default convergence criteria. We also compared our NO measurements with C-Line, an emission and dispersion roadway pollution model supported by EPA.

RESULTS: As expected, TRAP levels increased with greater traffic volume and speeds, with an additional super-linear increase observed under high volume, low speed congestive conditions. Fifteen-minute averaged BC data (n=1739) was split into 80% training/20 % test datasets. The BC model using the training dataset explained 43% of the variation in the test data with all predictors significant. GAM predictions of near road NO concentrations were within 20% of the monitored levels while C-Line overpredicted NO by two-fold.
CONCLUSION: Exposure to roadway air pollution can be significantly impacted by traffic behavior, compared with annual averages and/or models based upon proxy roadway variables. U.S. Blacks and Hispanics are twice as likely to live in high traffic density census tracts. Linked to health outcomes, these data may help identify further causes of health disparities, and provide future paths towards the attainment of U.S. environmental justice.

KEYWORDS: Traffic-related air pollution; TRAP; black carbon exposure; nitric oxide exposure; congestion emissions; air pollution modeling; environmental justice
Topics: Air pollution (ambient & indoor) and Sources, Environment and health in low and medium income areas, Environmental Equity, Exposure assessment

THEMATIC 05: Chemical Exposures

P-0319 Ecological and health risks assessment of lead in environmental and plants in an artisanal mining area in Nigeria

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BACKGROUND AND AIM: The emission of persistent toxic metals into the environment from artisanal mining remains a major challenge to the environment and risk to public health. Thereby causing severe diseases and eventual death amongst adults and children. The study determined the ecological and health risk assessment of lead emission from gold mining in Arufu, Northeast, Nigeria.

METHODS: Fifty-sixty (56) samples, comprising 30 soils, 10 stream sediments, 6 rocks, 5 mine tailings and 5 plants were collected in areas close to mining excavation. All samples were air-dried and pulverized while rock samples was crushed and pulverized. Samples were analysed for Lead (Pb) using High Performance Liquid Chromatography-Inductively Coupled Plasma-Mass Spectrometry. Statistical evaluations of rate of bioaccumulation of metals in plant and health risk assessment for carcinogenic and non-carcinogenic effect were also assessed.

RESULTS: Mean concentration of Pb in soils, sediments, tailings, rocks and plants are: 1,100 mg/kg, 15,800 mg/kg, 110 mg/kg, 12,756 mg/kg, 7,105 mg/kg and 50 mg/kg, respectively. Bioaccumulation factor showed metal mobility from soil to plant. Ecological risk assessment revealed that Pb poses threat to the environment and metals in all the media pose high carcinogenic and non-carcinogenic health risk especially in children. Pollution load index (PLI) revealed all samples to be highly polluted with Pb due to mining.
CONCLUSION: Mining and geogenic activities contributes significantly to the contamination of media in the area. Lead in the samples poses both carcinogenic and non-carcinogenic health diseases. It is recommended from this study that artisanal mining in the area should be regularly monitored to forestall future epidemic.

KEYWORDS: Artisanal, Bioaccumulation factor, Ecological risk, Diseases, Mining

P-0322 Systematic Evidence Map of the Epidemiological Evidence for Health Effects of Ethylbenzene

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BACKGROUND & AIM: Ethylbenzene is an aromatic hydrocarbon widely used in consumer and industrial applications, including as styrene feedstock and in paints, glues, and fuels. Given that ethylbenzene is one of the most highly emitted hazardous air pollutants, it is relevant to survey the available literature to understand potential adverse health effects. Here, we utilize a systematic evidence map (SEM) approach to identify epidemiological studies of ethylbenzene exposure and characterize aspects of the evidence base that may support human health hazard identification.

METHODS: We developed a Populations, Exposures, Comparators, and Outcomes (PECO) statement to guide our SEM. Searches were conducted in PubMed, Web of Science, and selected grey literature sources. DistillerSR was used to identify PECO-relevant human studies and extract study details. The results are displayed in interactive Tableau® dashboards.

RESULTS: Over 40 epidemiological studies, including cross-sectional, case-control, cohort, and controlled trials, met the PECO criteria. Study participants included samples of the general population (adults), occupational populations, and children/infants. Most studies evaluated exposure to ethylbenzene through air monitoring or modeling, while fewer studies characterized exposure using biomarkers. Immune and respiratory outcomes were the two most commonly evaluated health effects across all study types. Other commonly assessed health effects included sensory, ocular, hematology, and developmental effects.

CONCLUSIONS: Through the SEM, we identified and categorized numerous studies documenting a total of >10 organ systems potentially adversely affected by ethylbenzene exposure. The epidemiological data for ethylbenzene are suitable to inform human health hazard identification. Data gaps can be used to prioritize future research needs.

KEYWORDS: ethylbenzene; systematic evidence map
*Disclaimer: The views expressed in this abstract are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.

P-0323 Mixture Toxicity of Perfluoroalkyl Substances to the Kidney in the Elderly: the Application of the Bayesian Kernel Machine Regression to the 2003-2018 US National Health and Nutrition Examination Survey Datasets

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INTRODUCTION: Previous studies focused on the independent toxicity of each Perfluoroalkyl Substance (PFAS) on the kidney and did not consider the mixture toxicity of PFASs. In a mixture toxicity study, complex interaction effects among multiple PFASs and a non-linear relationship between PFAS mixture exposure and kidney damage should be considered sufficiently. This study will analyze the mixture toxicity of PFASs for the aging kidney at ≥ 65 years of age, using the Bayesian Kernel Machine Regression (BKMR) method.

METHODS: The 2003-2018 US National Health and Nutrition Examination Survey (NHANES) datasets were used.

RESULTS: A total of 2832 subjects ≥ 65 years of age were included. for the univariate exposure-response relationship, the estimated glomerular filtration rate (eGFR) decreased about -15, -10, -5, and -2 ml/min/1.73 m² when ln PFOA, ln PFOS, ln PFHxS, and ln PFNA increased from 1.0 to 4.3, from 0 to 6.0, from 1.5 to 3.9, and from -2.8 to 3.0 ng/mL respectively. for the bivariate exposure-response relationship, PFHxS showed a protective interaction effect (by about 5-10 mL/min/1.73 m² of eGFR change) when independently mixed with each of the other 3 PFASs. PFOS showed an aggravating interaction effect (by about 7-10 mL/min/1.73 m² of eGFR change) when independently mixed with each of the other 3 PFASs. for the interaction effects, when the serum concentrations of other 3 PFASs were increased from the 25 th percentile to the 75 th percentile, the eGFR decrease for PFOA, PFOS, PFHxS, and PFNA (the 99 th percentile vs. the 50 th percentile) was alleviated by 0.29, 0.77, 2.57, and 0.05 ml/min/1.73 m², respectively.
DISCUSSION: Several interesting conclusions can be inferred from the study results. Biologic plausibility and the possibility of reverse causation were discussed based on previous literature.

P-0325 Prenatal exposure to POPs mixtures and DNA methylation alterations in multiple tissues at birth

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BACKGROUND/AIM: Prenatal exposure to persistent organic pollutants (POPs) has been linked to adverse health conditions in the offspring. However, little is known about the underlying mechanisms. Growing literature suggests epigenetics may play a role. We aimed to evaluate the associations of prenatal exposure to individual POPs exposure and POP mixtures with global and site-specific DNA methylation (DNAm) changes in cord blood and placenta in the Early Autism Risk Longitudinal Investigation (EARLI) study.

METHODS: We leveraged existing data on maternal serum POPs collected during early pregnancy and cord blood (n=122) and placenta DNAm (n=80) measured on the Illumina 450K platform at birth. Concentrations of 11 polychlorinated biphenyls (PCBs), 4 polybrominated diphenyls (PBDEs), and 2 persistent pesticides were measured. We examined global DNAm in 5 genomic regions (genome wide, open sea, shelf, shore, and island regions) and site-specific DNAm at 261 loci previously identified to be associated with POPs. Linear regression and quantile g-computation models were performed to evaluate the single pollutant effect and joint effect of POP mixtures on DNAm adjusted for surrogate variables and confounders.

RESULTS: Prenatal exposure to PCB 28 was associated with decreased placental DNAm levels at sites located in shelf regions (p=0.04). There was an inverse linear relationship observed between POP mixtures and placental DNAm in open sea regions. POP mixtures were associated with a decrease in methylation levels at 5 sites in cord blood and 14 sites in placenta and an increase in methylation levels at 4 sites in cord blood at nominal level. None of these associations was significant after FDR adjustment.

CONCLUSIONS: We observed global DNAm changes in placenta associated with prenatal exposure to PCB 28 and POP mixtures. The findings suggest DNAm involvement in response to prenatal environmental exposures in developmentally relevant tissues.

KEYWORDS: Persistent organic pollutants, chemical mixtures, DNA methylation, quantile g-computation

P-0327 Sources of children's exposure to phthalates and phthalate replacements

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BACKGROUND AND AIM: Phthalates and their replacements are endocrine disrupting chemicals; children may be exposed when using personal care products (PCPs). Our aim was to identify PCPs associated with phthalates/replacements exposure in children.

METHODS: Children (4-8 years) enrolled in the ECHO-FGS study provided urine from 2017-2019 (n=951). We queried parents about children's PCP-use during the preceding 24-hours. Concentrations of 16 urinary phthalate/replacement metabolites were determined by liquid chromatography tandem-mass spectrometry (n=630). Based on reported product use, we operationalized 15 PCP-use variables by product type (e.g., lotions, oils) and 4 PCP-use variables by product ingredients (e.g., "phthalate-free," "organic"). Multiple linear regression models estimated PCP-use variables as individual predictors of natural log-transformed urinary phthalates/replacements, adjusted for specific gravity, age, gender, BMI, race/ethnicity, maternal education, and season as confounders. We also used self-organizing maps (SOM) to identify 8 exposure "profiles" that classified joint patterns of the 19 PCP-use variables, and were employed as predictors of natural log-transformed urinary phthalates/replacements.

RESULTS: Children applied lotions (45.2%) frequently, but "2-in-1" hair-care products (7.2%), sunscreens (6.4%), and hair/skin oils (4.3%) infrequently. Lotions predicted higher MBzP (β=0.17, 95%CI: 0.03,0.31), oils predicted higher MEP (β=1.03, 95%CI: 0.62,1.45) and MBP (β=0.35, 95%CI: 0.07,0.63), and sunscreens predicted higher MCPP (β=0.15, 95%CI: 0.01,0.29) and MiBP (β=0.26, 95%CI: 0.02,0.49). However, 2-in-1s predicted lower MCPP (β=-0.15, 95%CI: -0.29,-0.01). Race/ethnicity modified the association of lotions with the sum of MEP, MBP, and MiBP. SOM exposure profiles predicted greater MBzP (β=0.35, 95%CI: 0.08,0.61) and MCiNP (β=0.08, 95%CI: 0.02,0.15 and β=0.07, 95%CI: 0.01,0.14), but lower MCOCH (β=-0.15, 95%CI: -0.29,-0.01), MCPP (β=-0.24, 95%CI: -0.45,-0.02; β=-0.13, 95%CI:-0.26,-0.005; and β=-0.13, 95%CI: -0.26,-0.01), and DINCH (β=-0.01, 95%CI: -0.01,-0.0001) relative to a reference profile.

CONCLUSIONS: Recent PCP-use was associated with urinary phthalate/replacement metabolites among children. These results may inform stakeholders to help limit children's exposure to endocrine disrupting chemicals.

KEYWORDS: Exposure, Phthalates

P-0328 Per- and polyfluoroalkyl substances (PFAS) in serum of 2- to 5-year-old children: temporal trends, determinants, and correlations with maternal PFAS concentrations

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BACKGROUND/AIM: Early-life exposure to per- and polyfluoroalkyl substances (PFAS) occurs through placental and lactational transfers and ingestion of contaminated food, drinking water, and dust. However, little is known about temporal trends of PFAS in children's serum, especially since the phase-out of certain long-chain PFAS in the early 2000s. We investigated temporal trends and determinants of child serum PFAS concentrations and assessed their correlations with maternal PFAS concentrations.

METHODS: We included 551 children age 2 to 5 years from the CHildhood Autism Risks from Genetics and Environment (CHARGE) study. We quantified 14 PFAS in their serum samples collected during 2009-2017. for 9 PFAS detected in greater than 74% of the samples, we performed multiple regression with adjustment of potential determinants to calculate least square geometric means of PFAS concentrations for each sampling year and to estimate their average annual percent changes. for a subset of 354 children, we quantified 9 PFAS in their mother's serum collected at the same study visit and computed Spearman's correlation coefficients between maternal and child PFAS concentrations.

RESULTS: During the study period, child serum concentrations of 9 PFAS significantly decreased (range of annual percent changes: 6-12%). Child PFAS concentrations were positively associated with longer breastfeeding duration. Non-Hispanic white children had higher PFAS concentrations compared to Black, Asian, and multiracial children. for 354 mother-child pairs, the correlation coefficients between maternal and child PFAS concentrations ranged from 0.15 to 0.36, depending on the compound.

CONCLUSIONS: Our results showed that childhood body burdens of PFAS decreased from 2009 to 2017. Breastfeeding appears to contribute to higher child PFAS concentrations and lower maternal PFAS concentrations, resulting in relatively low correlation coefficients between maternal and child PFAS concentrations for samples collected in early childhood.

KEYWORDS: PFAS, child serum, temporal trends, determinants, breastfeeding

P-0334 Determinants of urinary phthalate biomarker concentrations in pre- and perimenopausal women with consideration for race

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BACKGROUND: Phthalates are endocrine disruptors in consumer plastics and personal care products. Our objectives were to identify determinants of phthalate biomarkers in women during the hormonally-sensitive midlife period, and to consider differences between non-Hispanic white and black women.

METHODS: We used information from the Midlife Women's Health Study of pre- and peri-menopausal women from Baltimore, Maryland (enrolled 2006-2015). We collected sociodemographic/health information via baseline questionnaires or during clinic visits and measured nine phthalate metabolites in pools of 2-4 urines collected across one menstrual cycle. We calculated molar sums of metabolites to approximate exposure to di(2-ethylhexyl) phthalate (ΣDEHP), personal care product phthalates (ΣPCPs), and phthalates in plastics (ΣPlastics). Accounting for meaningful predictors from bivariable analyses, our multivariable linear regression models evaluated determinants of phthalate biomarkers in all women (n=689), non-Hispanic white women only (n=467), or non-Hispanic black women only (n=195).

RESULTS: In multivariable analyses of all women, those who were perimenopausal, widowed/divorced, non-Hispanic black, with higher family income, with lower BMI, or who reported more frequent nausea had higher monoethyl phthalate (MEP) and ΣPCP. Non-Hispanic white women who were perimenopausal had lower mono-(3-carboxypropyl) phthalate (MCPP) and monobutyl phthalate (MBP), those who consume alcohol had higher mono-isobutyl phthalate (MiBP), and those with higher BMI had lower MEP and higher MCPP. Alternatively, widowed/divorced black women had higher ΣDEHP, monobenzyl phthalate (MBzP), and ΣPlastics, whereas black women with higher income had higher MEP and ΣPCP. Black women who described themselves as having "as much" physical activity as others or who reported a skin condition had lower MBzP and MCPP, respectively.
CONCLUSION: We identified important determinants of phthalate biomarkers in midlife women and observed some differences by race. Future studies could consider reasons for these differences when considering interventions to reduce phthalate disparities and related health effects.

KEYWORDS: phthalates, determinants, menopause

P-0337 Aerosols in 3D Printing - Measurement of Emissions and Estimation of Body Deposition

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As 3d printers become more and more popular, there have been many concerns about the hazards. We aimed to evaluate the emission of ultrafine particles (UFP) during fused deposition modeling (FDM) 3D printing according to the filament types and temperature and to estimate the dose of UFP in the respiratory tract.

The emission rates of UFP during 3D printing was evaluated using a direct-reading instrument (scanning mobility particle sizers and optical particle spectrometer) in a well-designed dynamic chamber. A total of six filament materials (ABS, PLA, PVA, Laywood, HIPS, and Nylon) were tested at the manufacturer-recommended temperature and gradual increasing conditions. The deposited dose at the head air way (HA), the tracheobronchial region (TB), and the alveolar region (AL), was estimated using the International Commission on Radiological Protection (ICRP) model

The filaments were classified as high emitter (>1011 #/min) which included HIPS and nylon, medium emitters (109#/min −1011 #/min) included ABS 1 and ABS2, and low emitters (<109 #/min) included PVA and PLA based on UFP emissions. The emission rate increased gradually as the temperature increased. Both filament type and temperature were the key factors affecting the emission rate.

For all filament types, the particles between 10 nm and 1um occupied a large portion and the proportion of UFP was dominated. The deposited particles in the alveolar region had larger proportions from 23 to 44% to total inhaled doses than in other regions. More than 5.8x108 particles/kgbw/g (about 40%) released from the high emitter were estimated to be deposited, while about 2.0x106 particles/kgbw/g (27% of inhaled dose) from the low emitter can be deposited at alveolar region. The emission rate of UFP were different between printing materials and temperature. Modeled estimates of UFP smaller than 1 μm had a large proportion to deposited dose at each respiratory region.

KEYWORDS: 3D printer

P-0338 Associations between per- and polyfluoroalkyl substances (PFAS) and diabetes in two population-based cohort studies from Sweden

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) have been put forward as metabolism disrupting chemicals with the potential to contribute to the development of many metabolic diseases such as obesity and diabetes. However, evidence from epidemiological studies remain divergent. The aim was to investigate associations between PFAS concentrations and prevalent diabetes in a cross-sectional analysis and fasting glucose in a longitudinal analysis in two population-based cohort studies in Sweden.

METHODS: In 2,373 subjects aged 45-75 years from the EpiHealth study, three PFAS; PFHxS, PFOA and PFOS were analyzed in plasma together with information on prevalent diabetes. Participants in the PIVUS study (n=1016 at baseline, all aged 70 years) were followed over 10 years regarding changes in plasma levels of six PFAS; PFHxS, PFOA, PFOS, PFNA, PFDA, and PFUnDA and changes in plasma levels of fasting glucose.

RESULTS: In the EpiHealth study, no overall associations could be observed between the levels of PFOA, PFOS or PFHxS and prevalent diabetes. However, there was a significant sex-interaction for PFOA, and an inverse association could be seen between PFOA and prevalent diabetes in women only (β: -0.40, p = 0.02). This association showed a non-monotonic dose-response curve. In the PIVUS study, inverse relationships could be observed between the changes in levels of PFOA and PFUnDA vs the change in fasting glucose levels over 10 years (p = 0.04 and p = 0.02). As in EpiHealth, these inverse associations were only significant in women (PFOA: β: -0.03, p = 0.02, PFUnDA: β: -0.03, p = 0.03).

CONCLUSIONS: Some PFAS were inversely related to prevalent diabetes and fasting glucose levels. These associations were observed in women only, clearly demonstrating a sex-difference regarding the relationship between PFAS exposure and diabetes outcomes.

KEYWORDS: Per-and polyfluoroalkyl substances (PFAS), diabetes, glucose levels, cross sectional, longitudinal

P-0339 Changes in adipose tissue and circulating concentrations of persistent organic pollutants: the Study of Women's Health Across the Nation

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BACKGROUND: Polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) are persistent organic pollutants (POPs) that bioaccumulate in adipose tissue and can negatively impact health often via endocrine system disruption. In the U.S., regulations on the industrial production or commercial use of POPs have reduced external exposure. Nevertheless, POPs can be released from adipose tissue and constitute a continued internal source of exposure.
Objective: We investigated the relationship between a change in central adiposity and changes in circulating concentrations of POPs.

METHODS: We measured serum concentrations of 34 PCBs and 19 OCPs at four timepoints in a longitudinal cohort of midlife women within the Study of Women's Health Across the Nation. for PCBs, 65 women with at least two serum measurements were included, for a total of 181 observations. for OCPs, 59 women with at least two serum measurements were included, for a total of 151 observations. Linear mixed models were used to test the association between an increase in waist circumference and a change in serum POPs concentrations.

RESULTS: After adjustment for confounding variables, as the difference in waist circumference between visits increased by one inch, the difference in the serum concentration of PCB-194 decreased by 4.8% (95% CI: -7.9, -1.6). No significant associations were found for other PCB congeners or OCPs. of all the POPs analyzed, PCB-194 has the greatest lipophilicity.

CONCLUSIONS: POPs may be released from adipose tissue into the blood or conversely sequestered in adipose tissue following adiposity loss or gain, respectively. The dynamics and distribution of POPs may be influenced by a compound's lipophilicity. Further research is warranted on intra-person variation in serum POPs concentrations as well as other factors that may affect trends in serum concentrations.

P-0341 Associations between co-exposure of metals and the renal tubular damage of the residents in the metal contaminated smelter area

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BACKGROUND AND AIM: The effects of metals to renal tubular damage have been mostly reported for individual metals. We investigated non-linear effects of multiple metals for renal tubular damage and interactions among metals of the real population living near the metal contaminated smelter area.

METHODS: A total of 120 individuals were included for urine sampling and survey in the Forensic Research via Omics Markers(FROM) study. Nine metals(V, Cr, Mn, Ni, Mo, Cd, Sb, Pb, and Hg) in urine were analyzed by inductively coupled plasma-mass spectroscopy and mercury analyzer. Beta-2-microglobulin(β2-MG) and N-acetyl-β-D-glucosaminidase(NAG) were applied as renal tubular damage markers. We compared the difference between the single-metal models and the multiple-metal models. and Bayesian kernel machine regression(BKMR) was conducted to examine the joint effects of multiple metals on renal tubular damage, interactions among metals and non-linear dose-response effects.

RESULTS: V for β2-MG, and Hg and Cd for NAG were consistently significant in both simple and multiple linear regression, though Ni for β2-MG was significant only in the multiple linear regression model. Mn for NAG was significant only in the single linear regression model. The BKMR analysis showed that the co-exposure of metals was significantly increased only NAG and Hg contributed the most to the NAG(PIP, posterior inclusion probability=0.608). β2-MG was increased by co-exposure of metals but not statistically significant and V contributed the most to the β2-MG(PIP=0.704).

CONCLUSIONS: This study suggests that co-exposure of metals was significantly associated with NAG. The interaction among metals for renal tubular damage was not shown but further study is needed.

KEYWORDS: Metals, Co-exposure, Kidney damage, BKMR, Metal exposure
The Korea Environment Industry and Technology Institute through the Core Technology Development Project for Environmental Disease Prevention and Management, funded by the Korea Ministry of Environment (grant number 2021003320003).

P-0342 The chemical exposome in brain cancer: an exploratory study

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Diffuse gliomas are a highly heterogeneous and aggressive brain tumours with poor prognosis and survival and few established risk factors. Environmental exposures are suspected in the pathogenesis of these tumours; however, results of existing studies are limited and inconsistent, particularly for exogenous organic chemicals, with no available characterization of the chemical exposome of these tumours. Also, better understanding of phenotypic differences in tumour types is needed in order to improve clinical decision making and provision of personalised treatment recommendations. In this proof of concept study we analysed 33 glioblastoma samples (Bellvitge Glioma Cohort (BGC), Spain, 2005-present), including 16 methylated and 17 non-methylated tumours combining HRMS-based wide-scope target and suspect strategies. Forty-six exogenous chemicals were identified in the tumour tissue samples (31 confirmed with standard) including a variety of industrial chemicals (e.g. plastic additives or perfluorinated compounds), personal care products and pharmaceuticals. Our findings provide novel evidence on the presence of these chemicals in brain tissue, highlighting the need for comprehensive evaluations of their potential effects in the tumour pathogenesis. Finally, after applying metabolomics methods we observed clear differences in the profiles of endogenous chemicals among the studied glioma subtypes, and identified possible biomarkers. These chemicals have potential to be determined in a non-invasive manner, either by LC-HRMS-based blood analysis or using complementary techniques (proton magnetic resonance (1H-MRS)). These are inspiring results since methylation is a strong independent predictor of survival as well as tumour response to chemotherapy for glioblastoma. Indeed, its non-invasive and pre-surgical determination would have a major impact on patient management. Our preliminary data is suggestive for the potential of nontargeted exposome methods to find new valuable biomarkers for diffuse gliomas diagnostic and prognostic stratification.

KEYWORDS: Glioma, brain cancer, environmental exposure, high resolution mass spectrometry, organic chemicals, non-target analysis.

P-0343 Evaluation of the human exposure to a broad spectrum of organic chemicals and the potential use of sewage sludge to prioritize hazardous substances

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Chemicals are part of our daily lives and we are exposed to numerous chemicals through multiple pathways. Relevant scientific evidence contributing to the regulation of hazardous chemicals require a holistic approach to assess simultaneous exposure to multiple compounds. Currently, the main way to obtain data on the exposure to organic chemicals is through human biomonitoring, that requires very complex and costly sampling campaigns. Finding efficient proxies to predict the risk of chemical exposure in humans is an urgent need to cover large areas and populations at a reasonable cost. We conducted an exploratory study to characterize the human chemical exposome in maternal blood and placenta samples of a population-based birth cohort in Barcelona (2018-2021). Ultimate HRMS-based approaches were applied including wide-scope target, suspect (for >2300 and >10000 chemicals, respectively) and non-target screening. Forty-two chemicals were identified including pesticides, personal care products or industrial compounds, among others, in the range of ng/mL and ng/g. In parallel, sewage sludge from the wastewater treatment plants serving the residence areas of the studied population were also screened, showing correlations with the type and concentrations of chemicals found in humans. Our findings were suggestive for the potential use of sewage sludge as a proxy of the human exposure and its application in early-warning systems to prevent chemical threats.

KEYWORDS: chemical exposome; non-target screening; high-resolution mass spectrometry (HRMS); human biomonitoring; sewage epidemiology; emerging organic contaminants

P-0344 Demographic differences in chemical mixture exposure and associated determinants among Swedish adolescents

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BACKGROUND AND AIM: Few population-based studies of adolescents have investigated the relation between socio-demographic factors and the wider chemical exposome. Adolescents are likely going through a sensitive developmental window were negative exposure-induced health effects can manifest into adulthood. We aim to identify associations of social demographic factors with the chemical exposome of Swedish adolescents as well as to identify demographic groups more at risk of higher exposure to specific substances.

METHODS: Using the Riksmaten Adolescents 2016-17 cohort (RMU) we analysed several social-demographic factors: gender, participant/maternal (P/M) birth country income level, parental education levels, and geographic location (longitude/latitude), and their relation to blood/serum/urine concentrations of a large range of toxic substances (N=64) across multiple chemical groups (heavy metals, chlorinated pesticides, PCBs, BFRs, PFASs, phthalates, phenols, pesticides, PAHs). Association analysis was conducted using ordinal regression models due to its robustness to handle highly skewed data.

RESULTS: P/M birth country was the most frequent determinant of toxic substance concentrations, being significantly associated with concentrations of 45 substances, followed by gender (N=41), and longitude (N=37). P/M birth country also showed the largest fold-differences in concentrations, with subjects born in high-income countries having several-fold higher estimated adjusted mean (EAM) concentrations of PCBs, BFRs and PFASs than those born in low-income countries. In contrast, adolescents born in low-income countries had higher EAM levels of heavy metals, chlorinated pesticides, and phthalates. Substances belonging to the same chemical group tended to have the same determinants. Interesting north to south or west to east gradients of substance concentrations were identified in Sweden, suggesting geographical inequalities of exposure.

CONCLUSIONS: P/M birth country is an important confounder and should be included in future toxicology population-based studies. Exposure associations with latitude/longitude should be further investigated.

KEYWORDS: Adolescents, RMU, ordinal regression, exposome, metals, PCB, BFR, PFAS, pesticides, phthalates, phenols, epidemiology, birth country income

P-0345 Endocrine disruptors and Gestational Diabetes Mellitus: A pilot study of INSULIN cohort (Catalonia, Spain)

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BACKGROUND AND AIM: The incidence of Gestational Diabetes Mellitus (GDM) has increased in the past 20 years, and it is now diagnosed in up to 10% of all pregnancies. GDM is associated with adverse consequences like preeclampsia, birth complications, as well as with cardiometabolic diseases for both the mother and child. Many environmental factors can cause beta-cell stress, including the developmental exposure to Endocrine-Disrupting Chemicals (EDCs). The present pilot study was aimed at assessing the exposure to EDCs of pregnant women of INSULIN, a cohort of GDM built at Hospital Joan XXIII (Tarragona, Spain).

METHODS: Sociodemographic, dietary and life-style determinants were linked to the occurrence of the EDCs and clinical data, including the development of GDM during pregnancy. The occurrence of BPA and 10 BPA analogues (BPF, BPS, BPAF, BPAP, BPB, BPE, BPG, BPM, BPP, BPZ), phthalates metabolites (mono-ethyl, mono-butyl and mono-methyl); parabens and their metabolites (methyl-, ethyl-, propyl- and butyl-); and flame-retardants (HBCD, TBBPA, TBP) were assessed in urine (12-week and delivery), mother serum (delivery), cord serum and/or placenta of 25 pregnant women by means of LC-QTOF.

RESULTS: High detection rates of BPs, phthalate and parabens were found in urine and mother serum, but also their detection in placenta and cord serum, might be slightly related to the use of plastic and personal care products, along with the consumption of canned foodstuffs according to the results of the individual questionnaire.

CONCLUSIONS: The premature state of the results does not allow identifying a potential role of a target EDC (or a mixture of EDCs) on the development of GDM. However, we can confirm the widespread presence of these EDCs in our daily life, which might become a hazard for the health of vulnerable population groups, such as pregnant women and their newborns.

KEYWORDS: Endocrine disruptors, pregnancy, gestational diabetes mellitus, exposome

P-0347 Metabolic signatures of youth exposure to mixtures of lipophilic persistent organic pollutants

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BACKGROUND AND AIM: Exposure to lipophilic persistent organic pollutants (POPs), including organochlorine compounds (OCs), polychlorinated biphenyls (PCBs), and polybrominated diphenyl ethers (PBDEs), is ubiquitous and may increase risk of metabolic disorders in children. We examined the associations of OC, PCB, and PBDE mixtures with metabolic pathways in two independent cohorts.

METHODS: 301 overweight/obese adolescents from the Study of Latino Adolescents at Risk (SOLAR, 2001-2012; age: 8-15 years) and 135 young adults from the Southern California Children's Health Study (CHS, 2014-2018; age 17-22 years) were included in analysis. Measurements of the metabolome along with 11 lipophilic POPs, including 2 OCs (4,4'-dichlorodiphenyldichloroethylene, hexachlorobenzene), 4 PCBs (PCBs-153, 138, 118, 180) and 5 PBDEs (PBDEs-154, 153, 100, 85, 47) were determined in plasma. for each chemical class, we performed a metabolome wide association study using quantile g-computation to assess the associations of exposure to the chemical mixture with each of the 23,166 untargeted metabolite features. Pathway enrichment analysis was performed using mummichog. Significant pathways were determined with an α=0.05.

RESULTS: In the SOLAR cohort, OCs, PCBs, and PBDEs were associated with 12%, 6%, and 14% of metabolites, respectively. for the CHS cohort, OCs, PCBs, and PBDEs were associated with 4%, 5%, and 4% of metabolites, respectively. for the OC and PCB mixtures, 9 and 12 metabolic pathways were enriched in both cohorts, respectively. for OCs, 7 pathways were related to amino acid metabolism, including alanine, aspartate, and asparagine metabolism. for PCBs, 8 pathways were related to amino acid metabolism, including valine, leucine, and isoleucine metabolism. for PBDEs, only 1 pathway (linoleate metabolism) was enriched in both cohorts.

CONCLUSIONS: Exposure to chlorinated lipophilic POPs is associated with alterations in amino acid metabolism in children and young adults. These associations may link exposure to POPs with risk of metabolic disease.

KEYWORDS: Metabolomics, Exposome, Metabolism Disrupting Chemicals

P-0351 The combined associations of mercury exposure and DNA methylation with sustained attention in children

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BACKGROUND AND AIM: Attention deficit disorder (ADHD) is one of the world's most common neurodevelopmental disorders, yet the etiology is not well-understood. Childhood DNA methylation (DNAm) patterns and exposure to methylmercury have both been implicated in the development of ADHD, though simultaneous assessments of these factors are rare. This study leverages the ELEMENT (Early Life Exposures in Mexico to Environmental Toxicants) cohort to identify the associations of childhood mercury exposure and DNAm with sustained attention in adolescence, and how these associations differ by sex.

METHODS: Total mercury was measured in hair and urine from ELEMENT participants aged 6-12, reflecting organic and inorganic sources respectively. Children were followed on average 5.6 years, when adolescent DNAm was quantified in blood leukocytes via the Infinium EPIC array. Conners Continuous Performance Test (CPT3) was used to quantify measures of inattention, impulsivity, sustained attention, and vigilance. Linear regression was used to assess relationships between mercury biomarkers and CPT3 outcomes (N=399). In an epigenome-wide association study, we examined associations between adolescent DNAm and CPT3 performance (N=517). All analyses were adjusted for age, sex, socioeconomic status, and response style in adolescence.

RESULTS: Childhood hair and specific gravity-adjusted urine mercury averaged 0.62±0.03 µg/g and 1.09±0.14 µg/L, respectively. Relationships between mercury levels and attention varied by mercury biomarker and CPT3 variable. Hair mercury, for instance, was associated with reduced inattentiveness (β=-0.021(SE=0.0095), p=0.027); urine mercury was not (β=-0.0045(SE=0.0078), p=0.57). Sex modified associations; for instance, urine mercury exposure was related to decreased vigilance in males (β=1.31(SE=0.65), p=0.045), but not in females (β=-0.20(SE=0.81), p=0.80). Lastly, DNAm at certain genes was associated with CPT3 scores. for example, DNAm at a loci in ZNF814 (Zinc Finger Protein-814) was related to increased sustained attention (β=0.97(SE=0.17), q=0.012).

CONCLUSIONS: Both DNAm and mercury exposure are associated with adolescent CPT3 performance.

KEYWORDS: mercury, sustained attention, DNA methylation, ADHD

P-0355 Exposure to melamine and its derivatives and aromatic amines among pregnant women in the USA: The ECHO Program

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BACKGROUND: Melamine, melamine derivatives, and aromatic amines are nitrogen-containing compounds with known toxicity and widespread commercial uses. Nevertheless, biomonitoring of these chemicals is lacking, particularly during pregnancy, a period of increased susceptibility to adverse health effects. We aimed to measure melamine, melamine derivatives, and aromatic amine exposure in pregnant women across the USA (U.S.) and evaluate associations with participant and urine sample collection characteristics.

METHODS: We measured melamine, cyanuric acid, ammelide, ammeline, and 41 aromatic amines in urine from pregnant women in nine diverse ECHO cohorts during 2008-2020 (N=171). To assess relations with participant and urine sample collection characteristics, we used generalized estimating equations to estimate prevalence ratios (PRs) for biomarkers dichotomized at the detection limit, % differences (%Δ) for continuous biomarkers, and 95% confidence intervals. Multivariable models included age, race/ethnicity, marital status, cotinine, and year of sample collection.

RESULTS: Twelve chemicals were detected in >60% of samples, with near ubiquitous detection of cyanuric acid, melamine, aniline, 4,4'-methylenedianiline, and a composite of o-toluidine and m-toluidine. In multivariable models, concentrations of 3,4-dichloroaniline were higher among Hispanic (%Δ: 149, 95% CI: 17, 431) and non-Hispanic Black (%Δ: 136, 95% CI: 35, 311) women compared with non-Hispanic White women. We observed similar results for ammelide, o-/m-toluidine, 4,4'-methylenedianiline, and 4-chloroaniline. Most chemicals were positively associated with the tobacco biomarker cotinine, with strongest associations observed for o-/m-toluidine (%Δ: 23; 95% CI: 16, 31) and 3,4-dichloroaniline (%Δ: 25; 95% CI: 17, 33). Some chemicals exhibited annual trends (e.g., %Δ in melamine per year: -11; 95% CI: -19, -1) or within-day, seasonal, and geographic variability.

DISCUSSION: Exposure to melamine, cyanuric acid, and some aromatic amines was ubiquitous in this first investigation of these analytes in pregnant women. Future research should expand biomonitoring, identify sources of exposure disparities by race/ethnicity, and evaluate potential adverse health effects.

P-0356 Associations between prenatal exposure to endocrine disrupting chemicals and play behavior in 7-year-old children in the SELMA study

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BACKGROUND AND AIM: A growing body of evidence shows that exposure to some commonly used chemicals affects child development through altered endocrine function. These so-called endocrine disrupting chemicals (EDCs) include a spectrum of substances; since many EDCs have been shown to affect sex hormone signaling, they may affect sexual development of the brain. Indeed, a few studies report the effects of prenatal EDC exposure and sex-atypical play behavior. However, these were conducted on single chemicals while human exposure entails mixtures of EDCs. In this study, we aimed to investigate the associations between prenatal exposure to single chemicals as well as chemical mixtures and play behavior.

METHODS: A total of 618 mother-child pairs from the Swedish Environmental Longitudinal, Mother and Child, Asthma and Allergy (SELMA) study were included. In the median week 10 of pregnancy, prenatal exposure to 26 EDCs was measured in urine and blood samples. Play behavior was measured with Preschool Activities Inventory at the age of 7 years. Linear and weighted quantile sum (WQS) regressions were used for single compound and mixture analyses, respectively; data stratification by sex was performed. Models were adjusted for child and maternal age, maternal education, parental attitudes towards play behavior and urinary creatinine concentration.

RESULTS: Higher urinary concentrations of diisononyl phthalate (DINP) metabolites were shown to be associated with decreased masculinity among boys (β=-1.35; 95%CI=-2.62,-0.08). Also, higher prenatal exposure to a mixture of 7 chemicals - among the 26 compounds measured - was demonstrated to be associated with decreased masculinity among boys (β=-0.91; 95%CI=-1.45,-0.36).

CONCLUSIONS: Our findings indicate an association between prenatal EDCs exposure and alterations in play behavior, in part confirming earlier findings.

KEYWORDS: Prenatal exposure, endocrine disrupting chemicals, phthalates, chemical mixture, play behavior

P-0361 Fluoride exposure via public drinking water supplies and associated health outcomes: an ecological study in England

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BACKGROUND AND AIM: The protective effect of drinking water fluoridation on dental caries is established. While adverse effects are known for fluoride concentrations above 1.5mg/L, the evidence is less clear for effects at lower concentrations. In new updated analyses, we aimed to estimate the association between fluoride exposure and dental health outcomes and hip fractures.
METHODS: Exposure was defined as mean public drinking water fluoride concentrations, assigned to geographical areas, over time periods of interest. Concentrations were categorised: <0.1, 0.1-<0.2, 0.2-<0.4, 0.4-<0.7, ≥0.7mg/L. Area-level health outcomes, deprivation scores, and age- and sex-specific denominators were obtained from hospital data, oral health surveys, and routine data sources. Binomial models with logit link were used to determine the association (adjusted odds ratios) between fluoride and dental caries prevalence. Negative binomial models were used to determine the association (adjusted incidence rate ratios) with dental extractions and hip fractures.
RESULTS: The association between fluoride and dental outcomes varied by deprivation. Odds of caries decreased in each fluoride concentration category relative to the lowest, with the greatest reduction in the most deprived quintile (ORs 0.61-0.80, composite p<0.001). Incidence of hospital admissions for carious tooth extractions decreased similarly (IRRs 0.37-0.66, composite p<0.001). The association with hip fracture varied by age (p<0.001), with evidence of a protective association in those aged under 50 (IRRs 0.83-0.97, composite p<0.001) and an adverse association in those aged over 80 (IRRs 0.98-1.08, composite p<0.01) at some individual concentration categories. There was no evidence of a dose response.
CONCLUSION:
Exposure to fluoride in drinking water, at concentrations <1.5mg/L, was associated with reduced dental caries and extractions. The most deprived populations benefited the most. There was no clear evidence of an association with hip fractures. The findings support adoption of water fluoridation as an equitable dental public health intervention.

KEYWORDS:
Fluoride; oral health; fractures

P-0363 Perfluoroalkyl chemicals and mortality: an exploratory analysis using NHANES 1999-2014

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BACKGROUND: Per- and Polyfluoroalkyl Substances (PFAS) are ubiquitous synthetic chemicals that have been widely used in industrial and consumer products, and are detected in the blood of more than 98% of Americans. PFAS have been linked to increased risks of multiple health outcomes such as cardiovascular disease (CVD) and cancer.
Aim: To examine the associations of PFAS exposures with all-cause, CVD, and cancer mortality in the general US population using the most up-to-date publicly available data.

METHODS: The current study included participant-level data for 5,839 adults aged 45 years or older from the National Health and Nutrition Examination Survey (NHANES) 1999-2000 and 2003-2014 that were eligible for linkage to the public-use National Death Index (NDI) Mortality Files. The associations between 5 individual PFAS, including perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), perfluorononanoic acid (PFNA), perfluorohexane sulfonic acid (PFHxS), and perfluorodecanoic acid (PFDA) and mortality were examined using survey-weighted Cox-Proportional Hazards model with the age as the time scale. Hazard ratios (HR) were calculated to compare the mortality HR of participants per interquartile range (IQR) increase in log-transformed serum PFAS concentrations.

RESULTS: After adjusting for sex, race, education, BMI, hypertension, cholesterol level, and survey cycle, most PFAS were not statistically significantly associated with increased risk of CVD or cancer mortality. While higher PFOS and all PFAS were inversely associated with CVD and all-cause mortality risks, respectively ($p < 0.05$), the observed associations became null when analyses were restricted to participants without chronic kidney disease (CKD).

CONCLUSIONS: Based on the most available data from NHANES, there was no evidence of increased risks of CVD or cancer mortality due to elevated PFAS concentrations. Further studies are needed to fully understand the inverse associations observed in this study as well as the role of CKD in PFAS related health effects.

KEYWORDS: Perfluoroalkyls, mortality, NHANES

P-0364 Relations of urinary volatile organic compound metabolites with inflammation and immune response

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BACKGROUND AND AIM: Volatile organic compounds (VOCs) are ubiquitous environmental pollutants that are generated by combustion, industrial solvents, and household items. VOCs are also detected at several hazardous waste sites. Exposure to VOCs is associated with insulin resistance, diabetes, and cardiovascular disease. However, the effects of VOCs on systemic inflammation are unclear. We evaluated the relation of urinary VOC metabolites, individually and in mixtures, with circulating cytokines and immune cells in a cross-sectional study of 625 participants (ages 25-70 years) from Louisville, Kentucky, USA.

METHODS: We quantified a) concentrations of 16 urinary metabolites corresponding to 12 parent VOCs by liquid chromatography-mass spectrometry; b) blood immune cells by blood analyzer; and c) plasma cytokines by multiplex array. Using linear regression models, we estimated covariate-adjusted relations of individual VOC metabolites with ln-transformed cytokine concentrations and immune cells. We used quantile-based g-computation to estimate covariate-adjusted relations of urinary VOC metabolite mixtures with inflammation biomarkers.

RESULTS: We found weak to moderate positive correlations between cytokines, correlation coefficients ranged from 0.03 to 0.59. In separate models, interquartile range (IQR) increases in the urinary metabolites of crotonaldehyde, acrylonitrile, 1,3-butadiene, and acrolein were associated with 4.0 to 10% higher concentrations of several pro-inflammatory cytokines, including IL-6, IL-8, or MCP1. Higher concentrations of the propylene oxide metabolite were associated with lower IL-9 (-1.0% per IQR; 95%CI=-1.1, -0.1). In mixture analyses, a quartile increase in all VOC metabolites was associated with 8.6% (-15, -2.0%) lower IL-10, an anti-inflammatory cytokine, and 5.1% (95% CI= 1.0, 11%) higher white blood cell count. These associations were largely driven by acrylonitrile and 1,3 butadiene, respectively. We did not find strong evidence of a joint VOC mixture effect on IL-6, IL-8, or MCP1.

CONCLUSIONS: VOC exposure could promote systemic inflammation thereby increasing susceptibility to cardiometabolic disease.

KEYWORDS: volatile organic compounds, chemical mixtures, inflammation, cytokines

P-0367 Breast Cancer Incidence is Associated with Uranium Exposure in a Population Living Near a Uranium Refinery

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BACKGROUND AND AIM: s: Ionizing radiation is recognized as a risk factor for breast cancer in humans, but recent studies of rodents and mammary cell lines have noted that the heavy metal uranium exhibits estrogenic activity. We examined data from a large longitudinal cohort to determine if breast cancer incidence was related to exposure to uranium and radiation in a population residing around the Feed Materials Production Center, a uranium refinery in Fernald, Ohio. The FMPC was part of the US Department of Energy nuclear weapons complex, and produced uranium metal products from 1952-1989, with releases of soluble and insoluble uranium dusts. The US Centers for Disease Control and Prevention (CDC) developed dose estimation models for exposures to individuals who lived within a 5-mile radius from the perimeter of the plant.

METHODS: We used the CDC algorithms to estimate exposure for 4832 women enrolled in the Fernald Community Cohort, of whom 324 were diagnosed with breast cancer during 31 years of follow-up (1990–2021), and conducted proportional hazards analyses, with appropriate covariates (age, family history of breast cancer, alcohol consumption, age at menarche, parity), to determine the association of uranium/radiation exposure and breast cancer incidence.

RESULTS: The mean value of the uranium particulate exposure (ug/m3-years) for women in the three exposure groups was 0.086, 0.354, 1.596, and for cases was 0.35 vs. 0.19 for controls. The risk of breast cancer in the highest exposure group compared to baseline was significantly elevated (HR=1.53, 95% CI 1.20, 1.95). In the subgroup with age at first exposure ≤13.75 years the HR for the highest exposure group compared to baseline was higher.

CONCLUSIONS: for women living within five miles of a uranium processing plant, degree of exposure to uranium particulates was related to risk of incident breast cancer.

KEYWORDS: uranium, breast cancer

P-0371 Prenatal Exposure to organochlorine compounds (OCs) and puberty-related hormones in boys and girls at 11 years of age; findings from the Rhea birth cohort, Crete, Greece

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BACKGROUND AND AIM: Puberty is a period of major hormonal changes and prenatal exposure to endocrine disruptors such as organochlorine compounds (OCs) might impair normal development. However, only a few studies have investigated relationships between OCs and pubertal development with mixed findings. The aim of the current study was to examine the role of in utero exposure to OCs on pubertal development in 11-years old children (n=137 boys and n=107 girls) from the Rhea birth cohort in Greece.

METHODS: Concentrations of 6 polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethene (DDE), and hexachlorobenzene (HCB) were determined in 1st trimester maternal serum. at 11 years of age, we measured dehydroepiandrosterone sulfate (DHEA-S), luteinizing hormone (LH) and follicle-stimulating hormone (FSH). Associations between OCs and puberty-related hormones were assessed using multivariable linear regression separately in boys and girls. Further, the hierarchical version of Bayesian Kernel Machine Regression (BKMR) was employed to investigate exposure mixtures as well as possible interactions between exposures.

RESULTS: In boys, the sum of prenatal PCBs was positively associated with DHEA-S (for a doubling of exposure, β= 25.5 μg/mL, 95% CI: 1.5, 48.5) and HCB was positively associated with FSH (β= 0.2 mUI/mL, 95% CI: 0.1, 0.5). In BKMR the OCs mixture showed a trend for a positive association with DHEA-S and the PCBs ranked higher according to their group Posterior Inclusion Probabilities (PIPs) with PCB-170 and PCB-180 ranking higher according to their conditional PIPs. Also, the OCs mixture showed a positive association with FSH with HCB ranking higher according to the conditional PIPs. No sign for an interaction between compounds was detected. Among girls the associations were null.
CONCLUSION: Prenatal exposure to OCs was associated with puberty-related hormones in boys but not in girls. The implications on future reproductive function in puberty and adulthood should be determined.

KEYWORDS: endocrine disruptors, puberty, prenatal

P-0372 Transfer of perfluoroalkyl substances (PFAS) from serum to breastmilk and breastmilk concentrations over the course of lactation: a study in the highly-exposed Ronneby Mother-Child Cohort

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BACKGROUND: PFAS are detectable in human breastmilk, and breastfeeding may be a significant source of infancy exposures. The magnitude of exposure is determined by the transfer efficiency (TE) of PFAS from maternal serum into breastmilk. However, there are no studies of PFAS concentrations in the breastmilk of highly-exposed mothers.
OBJECTIVES: To estimate the transfer of PFAS from maternal serum into breastmilk and changes in concentrations over the course of lactation in a cohort of women with a wide range of PFAS exposures.

METHODS: We conducted this study in the prospective Ronneby Mother-Child birth cohort, which was established in 2015 after PFAS contamination was discovered in the public drinking water of Ronneby, Sweden. We measured seven PFAS in matched samples of colostrum, breastmilk, and maternal serum at delivery. We calculated the TE (%) as the ratio of PFAS in colostrum or breastmilk to serum and evaluated whether TE varied by PFAS, lactation stage, or exposure level using linear mixed-effects models. We also measured PFAS in repeated breastmilk samples collected over a period of nine months from a subset of 15 mothers.

RESULTS: This study included 126 women. While all seven PFAS were quantifiable in serum, only PFNA, PFHxS, PFOA and PFOS were above the LOQ in >50% of colostrum and breastmilk samples. Median overall TE varied from 0.8% to 2.7%. TEs were generally higher for PFNA and PFOA than PFOS and PFHxS, and were of a similar magnitude across exposure categories. While PFOA concentrations decreased over the course of lactation, PFOS and PFHxS concentrations remained relatively consistent.
DISCUSSION: PFAS concentrations in colostrum and breastmilk of highly-exposed women were higher than concentrations in background-exposed women. This suggests that breastfeeding may be an important route of PFAS exposure for breastfeeding infants with highly-exposed mothers.

KEYWORDS: PFAS; perfluoroalkyl substances; breastfeeding; exposure assessment; breastmilk; lactation

P-0374 Do nutrients modify the risk of cadmium on acute myocardial infarction among never smokers in the Danish Diet, Cancer and Health cohort?

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BACKGROUND/AIM: Urine cadmium (U-Cd) is an established biomarker of long-term Cd exposure. U-Cd may be associated with risk of acute myocardial infarction (AMI), but results are equivocal at low biomarker levels. Nutrients including calcium (Ca), magnesium (Mg), and potassium (K) may play an important role in slowing atherosclerosis progression, though research findings with AMI have been inconsistent, and studies are limited in examining whether Cd-AMI associations are modified by these nutrients.

METHODS: We analyzed data from a never smoking subgroup of the Danish Diet, Cancer, and Health (DCH) cohort, a prospective study of 50–64-year-old participants recruited between 1993-1997. Using a case-cohort design, with complete case analysis, we identified 1135 members of the randomly selected subcohort and 776 AMI cases through 2015. We quantified Cd (µg/g) and Ca (mg/g) concentrations in baseline urine samples. We calculated combined nutrient dietary intake scores (3-12 points) from Ca, K, and Mg food frequency questionnaires. We estimated adjusted hazard ratios (HRs) and 95% confidence intervals (95% CIs) using Cox proportional hazard models, adjusted for sex, education, passive smoking, alcohol, waist circumference, exercise and healthy diet. We stratified by median cutpoints and defined as high and low urine Ca (U-Ca) concentrations (median: 117.5 µg/g) or dietary intake scores (median: 8 points).

RESULTS: Results were not materially different when stratified. Among high and low U-Ca groups, HRs for AMI were 1.27 (95% CI: 0.81, 1.98) and 0.93 (95% CI: 0.62, 1.41), respectively, when comparing highest vs. lowest U-Cd quartiles. HRs among high and low dietary intake scores were 0.96 (95% CI: 0.62, 1.49) and 1.25 (95% CI: 0.80, 1.95), respectively, when comparing highest vs. lowest U-Cd quartiles.

CONCLUSIONS: We did not find evidence that nutrient levels modified the association between low-level Cd and AMI among never smokers.

KEYWORDS: metals, nutrients, cadmium, myocardial infarction, cardiovascular health

P-0375 Tampons as a source of exposure to metals among reproductive-aged Black women

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BACKGROUND/AIM: Tampons are cotton/rayon plugs commonly used to manage menstrual bleeding. Tampons may become contaminated by environmental chemicals during manufacturing and through cotton production; cotton is a high-pesticide crop and can uptake metals. Retention of the tampon in the vagina for several hours and saturation with menstrual fluid may allow for chemicals to be released from the tampon and efficiently absorbed through the vaginal mucosa into systemic circulation. We evaluated whether tampon use was associated with blood metal concentrations in menstruators.

METHODS: We performed a cross-sectional analysis of baseline data from the Study of Environment, Lifestyle and Fibroids (SELF) in Detroit, Michigan (2010-2012; n=1,664 participants). Tampon use was defined as reporting use of ≥1 tampon on the day of heaviest bleeding during the participant's last menstrual period. We analyzed whole blood metal concentrations using ICP-MS (Al, As, Ba, Cd, Co, Cr, Cs, Cu, Mg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V, Zn) and Direct Mercury Analysis (Hg). We used linear regression models to calculate mean differences and 95% confidence intervals (CIs) for associations between tampon use and log-transformed metal concentrations, adjusting for potential confounders.

RESULTS: Tampon use was associated with lower concentrations of Zn (-0.02 µg/L, 95% CI: -0.04, -0.00) and Co (-0.06 µg/L, 95% CI: -0.10, -0.01). Associations with other metals were null. In a sensitivity analysis restricted to participants currently menstruating during biospecimen collection (n=401), tampon use was associated with greater Cr concentrations (0.15 µg/L, 95% CI: 0.01, 0.29)

CONCLUSIONS: We observed weak and inverse associations of Zn and Co with tampon use, and a positive association of Cr with tampon use among participants currently menstruating. Future research is needed to evaluate the presence of contaminants in tampons and determine absorption rates of such chemicals across vaginal mucosa.

KEYWORDS: tampons; metals; menstruation; environmental chemicals; women's health

P-0376 Assessing the role of the Gut Microbiome in the interface between Environmental Chemicals Exposure and Human Health

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BACKGROUND:
Since the explosion of microbiome research over the last ten years, findings have shed light on multiple ways through which factors can interact with the human microbiome and drive health and disease. Evidence showed that the microbiome may be an early response system to environmental toxins and a biological mediator of their adverse effects on human health. However, only a few reviews provided a framework for research and translation on the role of the gut microbiome in environmental health science.

METHODS: We summarized the up-to-date published evidence on environmental compounds and their effect on the gut microbiome, the subsequent metabolic pathways, and the long-term outcomes on host health. The PubMed database was queried for the following keywords: “gut microbiota”, “microbiome”, “chemicals”, “xenobiotics”, “human diseases”, “obesity”, “diabetes”, “cardiovascular diseases”, “neurologic disorders”, “biological pathways”, “metabolomics”, and “metagenomics”. Studies related to the subject of our review and written in English, which were published between 2004 and 2022 and available in the English language were included.

RESULTS: We concluded that the evidence supports the gut microbiota as a crucial factor that may mediate and modulate the human health effects of environmental chemicals. However, there are still challenges in understanding the microbiome’s role in pollutants’ toxicity. for example, since environmental chemicals are omnipresent contaminants, they can act consecutively or synchronously as a mixture. It is also critical to elucidate the dynamic interactions between the heterogeneous and individual “omics” datasets. Lastly, more shotgun metagenomics-oriented approaches would help in exploring a larger range of microorganisms present in the human gut microbiome ecosystem like fungi, viruses, and small eukaryotes.
CONCLUSION: Future research in this field is required to build on our limited knowledge of interactions between the intestinal microbiota and environmental pollutants and further elucidate the human health effects.

P-0378 Childhood exposure to non-persistent endocrine disrupting chemicals and multi-omic markers in a population-based child cohort

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BACKGROUND AND AIM: Individuals are exposed to multiple environmental pollutants with endocrine disrupting activity (endocrine disruptors, EDCs). The early stages of life are recognized to be particularly susceptible to these stressors. Previous studies have focused on identifying molecular signatures associated with EDCs to elucidate potential mechanisms, however few have integrated multiple omics layers. We aimed to identify multi-omic signatures associated with childhood exposure to non-persistent EDCs using an integrative network approach.

METHODS: We relied on the HELIX Child Panel, which includes roughly 150 children aged 6 to 11 and with no serious health problems. Multi-omic profiles (serum and urinary metabolome, proteome, methylome) were measured in blood and urine samples collected at two time points, 6 months apart. Similarly, 22 non-persistent EDCs (10 phenols, 5 phthalate metabolites, 7 organophosphate pesticide metabolites) were measured at each time point in weekly pooled urine samples, to account for their intra-individual variability. We used Gaussian Graphical Models (GGMs) based on shrinkage estimates of pairwise partial correlations between covariates-adjusted molecular features and EDCs. The networks for the two time points were merged based on the intersection of their significant edges in order to identify reproducible associations.

RESULTS: The time-specific networks included associations of comparable strength and statistical significance. The merged network consisted of 950 edges, 462 nodes, 7 connected components, and included less than 3% of mixed omics-exposure edges. Inter-omic connections represented known biochemical pathways such as insulin, blood hexose and citrate. The reproducible inter-layer associations were corroborated with data from the literature. Among the most significant, we found associations between mono benzyl phthalate and N-acetyl neuraminic, triclosan and serotonin, and diethyl phosphate and serotonin.

CONCLUSIONS: Through partial correlation network analyses, repeat time points and weekly EDC exposure assessment, we identified several biologically relevant molecular signatures related to EDC exposure in childhood.

KEYWORDS:
Multi-omics, EDCs, Networks

P-0381 PFAS exposures and the human metabolome: a systematic review of epidemiological studies

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BACKGROUND/AIM:
There is growing interest in understanding the health effects of exposure to per-/polyfluoroalkyl substances (PFAS) through the study of the human metabolome. We conducted a systematic review of epidemiologic studies evaluating the association between PFAS and metabolomics.

METHODS: Following PRISMA guidelines, we searched two databases (EMBASE/PubMed) through February 28, 2022 and identified 27 eligible observational studies. We summarized the evidence for PFAS associations reported with individual metabolites or metabolic pathways to identify consistent findings and research gaps.

RESULTS: Effects of twenty-six PFAS exposures have been evaluated using human metabolomic studies, with the most common exposure being legacy long-chain PFAS. Most studies measured exposures during adulthood (n=15), followed by prenatally/perinatally (n=9) and/or in childhood (n=6). Sample sizes ranged from 40 to 1,105 participants. A total of 18 studies used a non-targeted metabolomics approach, 7 studies used targeted approaches, and 2 studies included both. Metabolomics were measured in serum (n=16), plasma (n=9), urine (n=2), or semen samples (n=1). Only two studies integrated repeated metabolomics measures in plasma or urine. The majority of studies were cross-sectional (n=24), including four with prospective analyses of PFAS measured prior to metabolomics. Consistent associations (either up- or down-regulated) were reported between PFAS and amino acids, fatty acids, glycerophosphocholines, glycerolipids, sphingomyelins, bile acids, ceramides, and carnitines. Common enriched metabolic pathways included lipid metabolism, amino acid metabolism, carbohydrate metabolism, purine and urea cycle metabolism. Results for other pathways were less consistent across studies.
CONCLUSION:
A growing body of literature has identified alterations in several metabolites and metabolic pathways that could underlie PFAS-associated metabolic disease in humans. Future studies should consider prospective designs optimizing methods for exposure-metabolomics analyses with longitudinal measures, tissue-specific effects, additional confounder adjustment, or assessment of emerging PFAS and mixture effects to address existing limitations in this field.

KEYWORDS: PFAS, metabolomics, endocrine disrupting chemicals, systematic review.

P-0382 Liver and Plasma concentrations of Per- and Polyfluoroalkyl Substances in Adolescents from the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Study

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BACKGROUND AND AIM: Exposure to per- and poly-fluoroalkyl substances (PFAS) is ubiquitous due to their persistence in the environment and in humans. Extreme weight loss has been shown to influence concentrations of circulating persistent organic pollutants (POPs). Using data from the multi-center perspective Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) cohort, we compared concentrations of liver and plasma-PFAS and investigated changes in plasma-PFAS in adolescents after bariatric surgery.

METHODS: Adolescents (Mean age = 17.1 years, SD = 1.5 years) undergoing bariatric surgery were enrolled in the Teen-LABS study. Plasma-PFAS were measured at the time of surgery and then 6-, 12-, and 36 months post-surgery. PFAS was measured in liver tissue from biopsies collected at the time of bariatric surgery. Concentrations of liver and plasma-PFAS were compared using Spearman's rank correlation coefficients. Linear mixed effect models were used to evaluate longitudinal changes in plasma-PFAS after the time of bariatric surgery.

RESULTS: This study included 186 adolescents at baseline with severe obesity who underwent bariatric surgery between 2007 and 2012. Baseline plasma and liver-PFAS concentrations were found to be strongly positively correlated (ρ = 0.76-0.91). Models of longitudinal changes in plasma-PFAS after bariatric surgery revealed an increase in plasma-PFAS concentrations from the time of surgery to 6 months ($p<0.05$ for all plasma-PFAS except PFHxS) and a decline in PFAS concentrations from 6 months to 36 months ($p<0.05$ for all plasma-PFAS).

CONCLUSIONS: Bariatric surgery in adolescents was associated with an initial increase in circulating PFAS at 6 months following surgery, followed by continuing decline in concentration to 36 months following bariatric surgery. High correlations between liver and plasma-PFAS concentrations suggest that measurements in plasma are a good proxy for PFAS accumulation in the liver and potential liver-specific PFAS effects.

KEYWORDS: PFAS, children, environmental health, weight loss

P-0383 Replacement Phthalates are Associated with Adverse Pregnancy Outcomes in an Ethnically Diverse Nulliparous Pregnancy Cohort in the USA, 2010-2015

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BACKGROUND: Preterm birth and preeclampsia are leading causes of pregnancy-related morbidity and mortality. We examined associations between prenatal exposure to phthalate metabolites (PMs) and the risk of these outcomes in an ethnically diverse cohort.

METHODS: 1,020 cases of preeclampsia (PE), new-onset antenatal hypertension (aHTN), or spontaneous preterm birth (sPTB) and 1,020 matched controls from the Nulliparous Mothers To Be Study cohort were included. Urine specimens in each trimester (total = 5,789) were analyzed for 14 PMs including four di-2-ethylhexyl (DEHP) PPMs with concentrations below the limit of detection (LOD) values were replaced with LOD/√2 and PMs with under 70% detection were not analyzed. Exposure was defined as the geometric mean of each PM in each trimester, adjusted for specific gravity, and divided into quartiles. Multivariate conditional logistic regression analyses were performed to examine associations between PMs and outcomes, adjusting for confounders. Race and infant sex were considered a priori effect modifiers.

RESULTS: 59.1% of women were white, and 40.9% were non-white. PE: Overall odds of PE were increased two-fold for 2 PMs of di-2-ethylhexyl terephthalate (DEHTP), a replacement plasticizer for DEHP. These associations were held for both white and non-white mothers and for mothers of girls. Several non-DEHP PMs were also associated with increased odds of PE. aHTN: Odds of aHTN were increased at lower concentrations of several DEHP metabolites. These associations were held for mothers of boys and girls, but only for non-white mothers. sPTB: Overall, the odds of sPTB were decreased for DEHP PMs, regardless of infant sex. for boys and non-white mothers, non-DEHP PMs were associated with increased odds of sPTB.
CONCLUSION: Associations between PMs and adverse pregnancy outcomes differed by infant sex and maternal race, suggesting that interventions to reduce exposure be tailored to specific groups.

P-0384 Exposure to PFAS in Australian communities impacted by environmental contamination; the PFAS Health Study, 2016-2020

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BACKGROUND:
Communities impacted by environmental contamination may have higher exposure to per- and polyfluoroalkyl substances (PFAS), which has the potential for both immediate and latent impacts on human health. We investigated PFAS exposure in children and adults who had lived or worked in three Australian communities affected by environmental contamination associated with the historic use of Aqueous Film Forming Foams (AFFF) at military bases.

METHODS: From 2016 to 2019, the Australian Government conducted the Voluntary Blood Testing Program for PFAS. We recruited 2,587 participants into the PFAS Health Study, in addition to 702 randomly sampled residents of three comparison communities not known to be affected by environmental contamination. Comparison communities were selected based on area-level sociodemographic characteristics, in accordance with the three exposed communities. We measured concentrations of nine PFAS blood serum samples from each participant using Liquid Chromatography Tandem Mass Spectrometry.

RESULTS: Geometric means of serum PFAS concentrations across exposed communities ranged from 4.9–6.6 nanograms per millilitre (ng/mL) for perfluorooctane sulfonic acid (PFOS), from 2.9–3.7 ng/mL for perfluorohexane sulfonic acid (PFHxS) and from 1.3–1.8 ng/mL for perfluorooctanoic acid (PFOA). Geometric means of PFAS concentrations were higher in older participants and males. In total, 29–42% of participants from exposed communities had an elevated serum PFOS concentration (above the 95th percentile of the comparison population) and 48–55% had an elevated serum PFHxS concentration.

CONCLUSIONS: Evidence of higher serum PFOS and PFHxS concentrations in these Australian communities is consistent with the nature of the environmental contamination and the main constituents of the AFFF used in the areas. Serum PFAS concentrations across the exposed communities were comparable to those reported for communities in the USA affected by environmental PFAS contamination from firefighting foam use on military bases, though lower than in a community in Sweden.

P-0387 Current exposure levels and endocrine related outcomes of five non-phthalate plasticizers in humans: A systematic review

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Several substitutes such as DEHA, DINCH, DEHTP, ATBC, and TOTM are widelyused in commercial products in replacement of phthalates. Consequently, their human exposure and related health outcomes are increasingly reported. In the present study, we reviewed and synthesized the current knowledge on biomonitoring and endocrine related epidemiological studies on the five alternative plasticizers. A systematic literature search was conducted on PubMed and Scopus, for the articles published since January 2000 up to November 2021. The total number of literatures identified was 56 and 11 for biomonitoring and epidemiological studies, respectively. Major metabolites of the alternative plasticizers were reported in human urines of 17 countries, and the detection frequency was the highest in Europe, and the lowest in Asia. Among the substances detected over 60%, DINCH metabolites were most frequently detected, followed by those of DEHTP, DEHA, and TOTM. ATBC exposure has not been evaluated in urine but in plasma. Urinary DINCH and DEHTP metabolites showed androgenic associations in the US women. Both chemicals were associated with increased uterine fibroid prevalence in premenopausal women of Korea. Urinary DINCH metabolites increased the risk of preterm birth in the US infants and mothers, and thyroid hormones in Swedish pregnant women. ATBC in plasma showed positive association with breast cancer risk in French women. Positive associations between urinary DINCH metabolites and sperm DMRs were observed in the US men, suggesting potential epigenetic changes on the male gamete. Lack of reliable urinary biomarkers of exposure and limited observations on the association on susceptible populations were identified as research gaps that require further investigations.

KEYWORDS: Alternative plasticizers, urinary phthalate metabolites, endocrine disruption, systematic review
[Acknowledgement] This work was supported by grants from the Ministry of Food and Drug Safety of Korea (21162 위해평 074).

P-0389 Hypothetical interventions on dietary intakes to mitigate lead and cadmium induced mortality in US adults

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CONTEXT: In the recent decades, lead and cadmium exposure have declined sharply, although they are ranked second and seventh most significant potential threat to human health through increasing oxidative stress and inflammation. In parallel, high diet quality may prevent from chronic inflammation. Therefore, we sought to estimate the effects of a joint hypothetical intervention on metals exposures levels and adherence to an anti-inflammatory diet or fruits and vegetables (FV) intake on the expected all-cause and specific causes of mortality distributions.

METHODS: We used data on 14,311 adults aged ≥20 years enrolled in the NHANES-III between 1988 and 1994 and followed up through Dec 31, 2015. at baseline, daily FV servings and adherence to the dietary inflammatory index (DII) were assessed using 24-hour dietary recalls. Mortality was determined from the National Death Index records. We used the parametric g-formula with pooled logistic regression models to estimate the absolute risk of all-cause, cardiovascular, and cancer mortality under the different interventions while controlling for risk factors.

RESULTS: Median follow-up was 22.5 years, 5,167 (36%) participants died; 1,550 were attributable to cardiovascular disease and 1,135 to cancer. Compared to the natural course (no intervention), the joint intervention to lower BLLs and increase the adherence to the DII had the strongest impact on cancer mortality risk with a RD of -1.77% (-2.73% to -1.01%). for UCd, the corresponding RD was -3.10% (-9.50 to -0.47) for cancer and -6.97% (-12.39 to -1.52) for all-cause mortality. Intervening on BLLs and FV servings/days was associated to lower risk of all-cause and cancer mortality. Any of the joint intervention was associated to cardiovascular disease mortality.
CONCLUSION: These results suggest that higher diet quality may constitute an complementary approach to the interventions to reduce exposures to cadmium and lead to further minimize their effects on mortality, specially from cancer.

P-0391 Psychological distress in three Australian communities living with chronic environmental per- and polyfluoroalkyl substances contamination

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BACKGROUND AND AIM: Chronic environmental contamination is a recognised risk factor for psychological distress. Psychological distress has been seldom studied in the context of per- and polyfluoroalkyl substances (PFAS) contamination, despite the existence of numerous and widespread contamination sites globally. We examined psychological distress in Australian communities exposed to PFAS from the historical use of aqueous film-forming foam in firefighting activities.

METHODS: We conducted a cross-sectional study of 881 adults in three exposed communities and 801 adults in three comparison communities. Participants provided blood samples and completed a survey on their exposure history, sociodemographic characteristics, and measures of psychological distress (Kessler-6, Distress Questionnaire-5), somatisation (Patient Health Questionnaire-15), and anxiety (Generalised Anxiety Disorder-7). We estimated prevalence ratios (PR) of clinically-significant psychological distress scores and differences in mean scores: (1) between exposed and comparison communities; (2) per doubling in PFAS serum concentrations in exposed communities; (3) for factors that affect the perceived risk of living or working in a community exposed to PFAS; and (4) in relation to self-reported concerns about health.

RESULTS: We observed higher levels of self-reported psychological distress in exposed communities than in comparison communities (e.g., in Katherine compared to Alice Springs, Northern Territory: clinically-significant anxiety scores, adjusted PR=2.82, 95%CI 1.16–6.89). We found little evidence to suggest that psychological distress was associated with PFAS serum concentrations (e.g., in Katherine, PFOS and anxiety, adjusted PR=0.85, 95%CI 0.65–1.10). Psychological distress was higher among participants who were occupationally exposed to firefighting foam, used bore water on their properties, or were concerned about their health.
CONCLUSION: Psychological distress was substantially more prevalent in exposed communities than in comparison communities. Our findings suggest that the perception of risks to health, rather than direct PFAS exposure, contribute to psychological distress in communities with PFAS contamination.

KEYWORDS: Distress, somatisation, anxiety, perfluoroalkyl and polyfluoroalkyl substances, environmental contamination

P-0393 Lipid Metabolites and Arsenic Methylation in the Strong Heart Family Study: An Untargeted Metabolomics Approach

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BACKGROUND AND AIM: There are no safe levels of arsenic (As) exposure. Inorganic As (iAs) is methylated into mono-methyl (MMA) and dimethyl (DMA) arsenicals; methylation to DMA facilitates urinary As elimination and potentially reduces As-related toxicity. Our goal is to identify metabolites associated with As methylation patterns, as measured by the As species (iAs%, MMA%, and DMA%), and As methylation indices (primary methylation index (PMI:MMA/iAs) and secondary methylation index (SMI:DMA/MMA) which are less influenced by As exposure levels.

METHODS: This study leveraged urinary As and untargeted lipid metabolite data from 1,838 participants in the Strong Heart Family Study, which recruited adult participants from 12 American Indian communities in Arizona, Oklahoma, and North/South Dakota in 2001–2003. Metabolite data was performed on plasma samples using a quadrupole time-of-flight mass spectrometer. We used linear regression models to evaluate the cross-sectional associations between lipid metabolites and As methylation patterns and Mummichog for metabolic pathways analysis.

RESULTS: 1543 (543 identified, 1000 unidentified) lipid metabolic features were included. From 1,088 lipid metabolites that were significantly associated (pFDR<0.05) with at least one As species in linear regression models, 531 were associated with all three species, and 541 overlapped with MMA%, DMA% and SMI. Pathway enrichment analyses of associated metabolites (p<0.1) with ≥3 significant lipid metabolites in the pathway showed effects in 12 pathways that were associated with As methylation markers. Although there were only 3 pathways that were associated with PMI, (lineolate, fatty acid activation, and carnitine shuttle metabolism), these same pathways were associated with all 5 measures of As methylation.

CONCLUSIONS: We found that associations between As methylation indices and lipid metabolites predominantly affect the secondary methylation of As, from MMA to DMA along fatty acid metabolism pathways. Future work will investigate if these metabolites are also associated with adverse health outcomes.

KEYWORDS: Arsenic methylation, metabolomics

P-0394 Using geographic information systems to estimate potential pesticide exposure in Belgium

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BACKGROUND AND AIM: The assessment of residential exposure to agricultural pesticides is a major issue for public health, regulatory and management purposes. In that context, geographic information systems (GIS) approaches for mapping estimates of agricultural pesticide exposure were developed in this study.
METHODS: Data on pesticide application rates, high-resolution annual datasets of the geographic distribution of crops, and the 100x100m grid population dataset were used to complete this analysis in Wallonia (Belgium) over the period 2015-2019. Pesticide exposure metrics were estimated using a buffer-based exposure model by neighborhood analysis in ArcGIS. The model takes into account both proximity to crops, estimated amount of pesticides and acreage treated. The weighting factors established for Harmonized Risk Indicators under Directive 2009/128/EC were applied to the estimated amounts of actives ingredients in order to align with the European approach. Then, a population weighted method was used to 'up-scale' the exposure data to administrative levels to match up with public health datasets.
RESULTS: The results provide the first map of modeling residential exposure to agricultural pesticides for the entire region of Wallonia. The northern part of the Sambre-Meuse axis shows more intensive agriculture and the highest pesticide weighted exposure indices. Such GIS approaches help to characterize pesticide exposure for residents living close to agricultural lands but also in non-domestic environments such as schools, nurseries, etc.
CONCLUSIONS: This research work on exposure characterization to agricultural pesticides using GIS models gives a valuable basis for research and environmental health actions in Belgium. Maps highlight areas where human biomonitoring and epidemiological studies should be implemented to investigate the impact of potential environmental exposure to pesticides. Using this information, policymakers will able to detect potential priority zones and take action to check and reduce agricultural pesticide loads in the environment.

KEYWORDS:
Pesticide exposure, Agriculture, GIS, Environmental health

P-0396 Dose reconstruction of four alternative plasticizers from urinary biomarkers of exposure

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BACKGROUND AND AIM: As alternative plasticizers (APs) are widely being used, more and more studies reported detection of urinary metabolites of APs including Di-2-ethylhexyl terephthalate (DEHTP), disononyl phthalate (DiNP), di(2-ehtylhexyl) adipate(DEHA), diisononyl-cyclohexane-1,2-dicarboxylate (DINCH). This study aimed to estimate the external exposure of above four APs using urinary excretion fraction (Fue)s and simple pharmacokinetic (PK) models for humans.

METHODS: The Fue and time-concentration profiles (PK-profiles) were obtained from the published articles, where the study APs were administered in humans. Three metabolites, mainly monoesters and secondary oxidative metabolites were selected for each APs. A compartment-model for each APs was constructed to describe the elimination of parent compound and the metabolites. Then, exposure-conversion factors (ECFs) were calculated from PK model simulation showing the relationship between daily intake and urinary biomarkers. Regarding dose-reconstruction, synthetic biomarker measurements were used for typical body weight, urinary creatinine values in Korean children, adolescents and adults.

RESULTS: The exposure estimates from PK/ECF corresponding to 10 ug/L were as follow: 5OH-MEHTP (4.8 ~ 5.5 μg/kg/d) for DEHTP; 5OH-MEHA (127 ~ 166 μg/kg/d) for DEHA; 5OH-MINCH (0.67 ~ 0.87 μg/kg/d) for DINCH; OH-MINP (0.43 ~ 0.56 μg/kg/d) for DiNP. Those from Fues were comparable with 1.1 to 4 folds.

CONCLUSIONS: Reverse dosimetry was successfully performed with simple human PK models for urinary biomarkers of exposure to APs, which were close or comparable to those from popular Fue methods. for future investigations, we believe the PK technique will be more effective in exposure modeling.

KEYWORDS:
Alternative plasticizers, Biomarkers of exposure, Reverse dosimetry, PK modeling

P-0397 Association between prenatal exposure to organophosphate flame retardants and thyroid hormone levels in diverse pregnancy cohorts

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BACKGROUND: Organophosphate flame retardants (OPFR) are rarely measured in pregnant people. Prenatal exposure to organophosphate pesticides (structurally similar to OPFRs) is linked to thyroid hormone (TH) disruption. Prenatal TH disruption has been associated with adverse pregnancy-related outcomes and poor neurodevelopment in the offspring. We aim to characterize prenatal OPFR exposures and assess their relationship with thyroid-stimulating hormone (TSH), thyroxine in free and total forms (TT4 and fT4, respectively).

METHODS: We analyzed nine OPFR metabolites in 2nd-trimester urine, as well as fT4, TT4, and TSH in 2nd-trimester blood collected from 287 pregnant participants from a combined and demographically diverse pregnancy cohort from the University of California San Francisco and the University of Illinois Urbana-Champaign (N= 110 and N = 177 respectively). We used linear regression models to assess relationships between prenatal OPFR levels and each of the measured thyroid hormones. Linear models were adjusted for gestational age at sample collection, maternal age, and cohort. We calculated the percent change in TH for a 10-fold increase in OPFR level.

RESULTS: OPFRs were modestly associated with TH disruption, however, confidence intervals were imprecise. DBUP was associated with 8% decrease in TSH (95% CI: (-24.5, 11.0), while BCPP with a 10% increase in TSH levels (0.9, 21.0), neither chemical was associated with changes in TT4 or fT4. DPHP and BDCPP were associated with changes in fT4 (2% (-4.7, 1.2) decrease and 1% (-1.4,2.7) increase, respectively). BCETP was associated with an increase in both fT4 (1% (-0.7, 2.5)) and TT4 (1.5% (-0.4, 3.6)). BBOEP showed a 3% (-0.9, 7.7) increase in TT4. The remaining OPFRs did not have evidence for change in TSH, fT4 or TT4 levels.

CONCLUSIONS: Prenatal OPFR exposures may influence levels of TSH, free and total T4 in pregnant women.

KEYWORDS: Thyroid hormone, flame retardants, infant neurodevelopment, prenatal exposures

P-0398 Human health risks of gadolinium contamination in urban and rural soils across Leicestershire (UK)

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BACKGROUND AND AIM: Gadolinium (Gd) is widely used in industrial and household applications, including compact discs, microwaves, fibre optics and flat screen displays. The aim was to determine the presence, distribution and risks to this element in urban/rural topsoils from Leicestershire (UK).

METHODS: A total of 850 soil samples were collected (2017-18); 26 composite samples were appropriately prepared after mixing topsoil samples collected per park/location (18 urban, 8 rural), which were further processed in duplicate. Gd was measured in triplicates in each of the 52 composite samples by ICP-MS. Noncarcinogenic risks were characterised following US EPA methodologies.

RESULTS: Slightly higher levels of Gd were found in rural area, although without significance (data presented as median and interquartile ranges, in mg/kg): 3.312 (2.174, 3.862) vs. 3.094 (2.763, 3.418). Fertilisers, a major diffuse source of rare earth elements in topsoils, might explain the lack of statistical significance between both main areas. The urban/rural regions were subdivided into the four ordinal directions to study the Gd distribution. Significant differences were detected for the Gd monitored in the composite samples monitored throughout Leicester city ($p=0.017$) and rural areas ($p=0.007$), which revealed different concentration patterns NE>SW>SE>NW and SE>NE>SW>NW for each area, respectively, reflecting the Gd wide distribution. Noncarcinogenic risks quotients for ingestion (2.98E-03) and dermal contact (1.06E-04) were lower than the threshold.

CONCLUSIONS: Our results would suggest a minimal risk through the ingestion/dermal contact of Gd present in topsoils in Leicester city. However, the risk characterisation is incomplete as the specific risks derived through the inhalation of resuspended soils would require for further and unknown toxicological data. Moreover, understanding the fate processes Gd undergoes in the environment is critical to perform environmental risk assessments, which is increasing in relevance owing to the myriad of anthropic applications of Gd.

KEYWORDS: Gadolinium, HREEs, Leicester, topsoils, distribution, risks.

P-0399 Calcium and body mass index modify the associations between prenatal phthalate exposure and ultrasound measures of bone metabolism among pregnant women in Mexico City

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BACKGROUND AND AIM: Phthalates are used in numerous consumer products, resulting in ubiquitous human exposure. As phthalates have demonstrated endocrine and peroxisome proliferator-activated receptor activity, we hypothesize that exposure may interfere with bone remodeling, particularly if exposure occurs during periods of increased bone activity, like pregnancy. We evaluated associations between prenatal phthalate exposure and bone remodeling during pregnancy and one year postpartum among 289 mothers from the ELEMENT birth cohort.

METHODS: Urine samples were collected at up to three points during pregnancy (3, 6, 8 months) and assayed for 9 phthalate metabolites. Geometric means of specific gravity-corrected phthalate concentrations were used as overall measures of prenatal phthalate exposure. Bone remodeling was assessed utilizing quantitative ultrasound speed of sound (SOS) of the phalange (cortical bone) and distal radius (trabecular bone) at each prenatal visit and 1, 3, 7, and 12 months postpartum. Participants were randomized to receive calcium supplementation or placebo throughout pregnancy. Linear mixed effect models were used to estimate associations between phthalate exposure and repeated SOS z-scores, with separate models for prenatal and postnatal measurements. Final models adjusted for maternal age, pre-pregnancy BMI, education, parity, calcium supplementation, and study visit. We also explored effect modification by calcium supplementation and BMI.

RESULTS: We observed higher prenatal phalange SOS z-scores with interquartile range increases in MEP (β=0.11; 95%CI: 0.003,0.31) and MiBP (β=0.15; 95%CI: 0,0.42). Several phthalates were associated with lower SOS among women who received calcium compared to the placebo group, particularly for postpartum phalange measures. Prenatal and postpartum phalange SOS measures were positively associated with phthalate exposure among women with a BMI≥25 compared to those with a BMI<25.

CONCLUSIONS: Our findings suggest that phthalate exposure may interfere with bone remodeling during pregnancy, and that consideration of effect modifiers is paramount to understand the effects of environmental exposures on bone health.

P-0406 Prenatal Exposure to Organophosphate Insecticides and Measurements of Fetal Growth and Length of Gestation in the Study of Asian Women and their Offspring's Development and Environmental Exposures (SAWASDEE)

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BACKGROUND AND AIM: Experimental studies have shown associations between organophosphate pesticides (OPs) and fetal growth measurements, but these associations have been inconsistent in epidemiological studies. We aimed to evaluate associations between prenatal exposure to OPs and birth outcomes by including trimester specific measures of OPs.

METHODS: We recruited pregnant farmworker women in Chom Thong and Fang, two districts of Chiang Mai province in Thailand (N = 330) into the Study of Asian Women and their Offspring's Development and Environmental Exposures (SAWASDEE). We collected up to 6 serial urine samples per participant during gestation and composited the samples to represent early, mid, and late pregnancy. Spearman correlation coefficients of concentrations of dialkyl phosphates (DAPs) across pregnancy were calculated. Windows of vulnerability to OP exposure were assessed by modeling urinary DAPs measured in early, middle, and late pregnancy with outcomes of growth measurements at birth.

RESULTS: DAP metabolite concentrations in serial composite samples were weakly to moderately correlated. We observed significant differences between participants from Fang compared to Chom Thong, both in demographic and exposure characteristics. We were unable to demonstrate an adverse relationship between in utero exposure to OPs and measurement of fetal growth (birth length, weight, and head circumference). Among participants from Fang, we observed increases in gestational duration associated with early pregnancy exposure to ∑DEAP (βadjusted = 0.80 weeks per log10 unit increase; 95% CI (0.34, 1.2), $p<0.01$) and its individual metabolites (DETP, DEDTP, DEP) as well as with late pregnancy exposure to ∑DEAP (βadjusted = 0.69 weeks per log10 unit increase; 95% CI (0.18, 1.2), $p<0.01$) and its individual metabolites (DETP, DEDTP, DEP).

CONCLUSIONS: Maternal concentrations of urinary DAPs were not associated with fetal growth measurements at birth; however, we did observe associations with length of gestation.

KEYWORDS: pesticides, birth outcomes, exposure assessment

P-0408 Urinary Concentrations of Oxidative Stress Biomarkers Across Pregnancy: Variability of Measures in Two Birth Cohorts

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BACKGROUND AND AIM: Measurement of urinary levels of oxidative stress biomarkers (OSB) is often used to infer about the biological mechanisms associated with exogenous environmental exposures, particularly in pregnancy. Yet, it is unclear if a single measure of OBS in pregnancy can be used an indicator of oxidative status in pregnant women. Here, we examined the stability of repeated measures of OSBs across pregnancy, accounting for sociodemographic, health-related and life style factors, and identified patterns in variability in urinary OSBs.

METHODS: Seven Oxidative stress biomarkers including MDA, F2-isoprostanes, 8-OHdG, and diY were analyzed using urine samples that were collected at <18, 18-25 and >25 weeks of gestation in two birth cohorts, NYU CHES (n=679) and TIDES (n=240) using Solid Phase Extraction and High-Performance Liquid Chromatography coupled with Tandem Mass Spectrometry. After replacing values below levels of detection(LOD)with LOD/√2, urinary levels were divided by creatinine to account for dilution and log-transformed for normality. We estimated the intraclass correlation coefficients (ICCs) of repeatedly measured OSBs using a 2-way mixed-effects model with absolute agreement, adjusted for covariates. We used latent class linear mixed model (LCLMM) to identify classes of women with similar patterns in variability of biomarkers.

RESULTS: OSBs were detected in more than 80% of samples, except F2-isoprostanes, for which percent below LOD was close to 30%. ICCs varied between 0.17 and 0.40 for a single measurement and 0.43 and 0.67 for average measurements. The results of LCLMM suggested that, for most OSBs, three latent classes well characterize distinct variability patterns of repeated measured biomarkers in pregnant women.

CONCLUSIONS: Urinary measures of OSB showed within-individual variability across the course of pregnancy. Future studies of OSB measures in pregnant women are recommended to rely on more than one measurement to infer about oxidative status in pregnancy.

KEYWORDS: Pregnancy, Environmental Exposure, Oxidative Stress

P-0409 Why Indoor Chemistry Matters: A National Academies Consensus Study

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BACKGROUND AND AIM: The indoor environment is a significant contributor to human chemical exposures and health risks, and indoor chemistry plays an important role in driving and modifying exposure to many indoor pollutants. Despite recent developments, much of the chemical complexity and variability of indoor environments remains poorly understood.

METHODS: The National Academies of Sciences, Engineering, and Medicine (the National Academies) convened an ad hoc committee of 16 experts to conduct a consensus study examining the state of the science regarding chemicals in non-industrial indoor environments.

RESULTS: This presentation will summarize findings and emerging discoveries related to indoor chemistry and sources, chemical partitioning and reactions, and links between chemical exposure, air quality, and human health. Briefly, thousands of chemicals are found indoors in air, particles, dust, and surfaces, and they partition across phases. Humans can modify indoor chemistry and act as primary sources. Indoor chemicals undergo oxidation, photolysis, hydrolysis, acid-base, and other reactions and can form reaction products with differing properties. Improved knowledge of molecular reaction rates, kinetics, emission rates, building and environmental factors, and human behaviors and time activity patterns along with their uncertainties are needed to refine exposure and health risk models. This presentation will also summarize recommendations regarding: 1) key implications of recent scientific research, including potential near-term opportunities for translating research findings into practice, and 2) opportunities for new scientific research in several priority areas critical to achieving a better understanding of the chemistry of the indoor environment and resulting adverse exposures and health risks.

CONCLUSIONS: The committee noted opportunities for advancing this field of study by enhancing interdisciplinary collaboration and addressing methodological or technological barriers to research. This scientific foundation will further our understanding of indoor chemistry and its impacts on health and the environment and support regulatory action and guidelines.

THEMATIC 17: Non-communicable diseases including cancer, cardio-metabolic and neurological

P-1036 Prevalence of overweight and obesity and associated risk factors among pupils in primary schools in northern Iraq: a cross-sectional study

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BACKGROUND:
The prevalence of overweight and obesity among school children in the Eastern Mediterranean region is increasing. Childhood obesity can cause several health problems. The aim of this study is to find the prevalence and the associated risk factors of increasing weight among primary school pupils.

METHODS: This is cross-sectional descriptive study was carried out during the school year 2019. A total of 450 pupils primary school children of both sexes (222 male and 228 female) were involved in this study aged 7 to 13 years old. Children were categorized into 4 BMI categories: Thin < 5th percentile or normal ≥ 5-84th percentile or overweight 85-97th percentile or obese ≥ 97th. All students were weighted with light clothes and were barefooted.

RESULTS: The prevalence of obese in this study was 12%, and overweight was 18.4%. It was found that most food taken to school were sugar and carbohydrates (Chips and Juice were 25%, Biscuit and Nestle were 28.1%). Class level (second and third) of pupils (p value=0.0001) of schoolchildren and mother education risk factors (p value=0.025) shows significant difference with BMI percentile. Other risk factors such as father education, family monthly income, type of feeding and time of weaning show no significant difference. Also our results show significant difference with BMI percentile and risk factors (type of food taken to school (p value: 0.048), taking money to buy from school canteen (0.005), soft drinking (0.038), and eating snacks (0.001).
CONCLUSION: In this survey an increase of prevalence of weight among primary schoolchildren was found. Several factors contribute in this epidemiological result including absence of health educated programs delivered to the pupils by schools. A mandatory education program should established to both the pupils and their families to prevent obesity among pupils.

KEYWORDS: Obesity, prevalence, risk factors, primary school, Iraq

P-1037 Clinical-environment characteristics among Brazilian women diagnosed with benign breast disease

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INTRODUCTION: Although benign breast disease (BBD) is one of the main breast cancer risk factors, its natural history is still unclear. The breast development, maturation, and differentiation suffer hormones and growth factors influence that may modulate BBD development. Thus, clinical-environment risk factors could influence BBD histological type. Aim: To evaluate the distribution of selected environmental, clinical, sociodemographic, and reproductive factors in cohorts of Brazilian women diagnosed with benign breast disease, according to histopathology group. Methodology: Cross-sectional study conducted with women with BBD diagnose referred to two hospitals in Rio de Janeiro (IFF/Fiocruz and HFL/Ministry of Health) from 2013 and 2018. A standardized questionnaire was applied by trained interviewers. Crude and adjusted odds ratios and 95% respective confidence interval were estimated using multinomial logistic regression.

RESULTS: From 353 women included, 62.9% had non-proliferative diseases, 27.8% had proliferative diseases without atypia, and 9.3% had proliferative diseases with atypia or lobular carcinoma in situ. About 30% were either current or former smokers, and reported alcohol consumption. Women exposed to hair dyes and hair straightening products (81.8%) were statistically higher in the proliferative lesion with atypia/lobular carcinoma in situ compared with non-proliferative and proliferative without atypia lesions. Compared to women with non-proliferative diseases, those with proliferative diseases with atypia or lobular carcinoma in situ were more likely to be older at diagnosis (OR =1.05;95%CI:1.01-1.09); to have 3+ histological types in biopsied lesion (OR=26.74;95%CI: 9.79-73.01); and to have regular menstrual cycles (OR=2.98; 95%CI: 1.03-8.66).
CONCLUSION: Findings suggest that age at diagnosis, increased histological types found in biopsied tissue, and having presented regular menstrual cycles throughout the reproductive period may be associated with benign lesions with a high risk of breast cancer.

KEYWORDS: breast diseases; epidemiology; breast neoplasms.

P-1039 Phthalates/replacements are associated with maternal second-trimester glucose homeostasis and lipid-related metabolic factors

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BACKGROUND AND AIM: Pregnant women are widely exposed to metabolic disruptors, including phthalates and their replacements, but their metabolic targets are not well-characterized. We evaluated associations of phthalates/replacements with a broad panel of maternal metabolic biomarkers.

METHODS: Illinois women (n=300) provided five first-morning urines (median 13, 17, 23, 28, 34 weeks gestation), which we pooled to quantify 19 phthalate/replacement metabolites. Women provided a fasting blood sample at median 17 weeks gestation, in which we quantified plasma total and high-density lipoprotein (HDL) cholesterols, glucose, insulin, C-peptide, leptin, triglycerides, and free fatty acids. We calculated low-density lipoprotein (LDL) and very-low-density lipoprotein (VLDL) using published equations. Using principal component analysis (PCA), we reduced ten maternal metabolic factors into three uncorrelated principal components (PCs), which we evaluated in relation to phthalates/replacements using multivariable linear regression.

RESULTS: These predominately non-Hispanic white, high-income, college-educated women had similar phthalate/replacement concentrations to U.S. women. Using PCA, three PCs explained 73% of the variability in metabolic factors (each $r > 0.40$): cholesterol PC (loaded strongly on total, HDL, and LDL cholesterols); glucose homeostasis PC (loaded strongly on glucose, insulin, C-peptide, leptin); and lipids PC (loaded strongly on triglycerides, VLDL, free fatty acids). Using linear regression models, two-fold increases in molar sums of metabolites of di-isononyl phthalate and of di(2-ethylhexyl) terephthalate (DEHTP) were associated with 0.08 (95%CI: -0.01, 0.17) and 0.10 (95%CI: 0.03, 0.17) higher glucose homeostasis PC scores, respectively. Additionally, each two-fold increase in the molar sum of di(2-ethylhexyl) phthalate metabolites was associated with higher lipids PC scores (β: 0.14; 95%CI: 0.02, 0.26), whereas monoethyl phthalate was associated with lower lipids PC scores (β: -0.13; 95%CI: -0.22, -0.04).

CONCLUSIONS: Our results suggest concentrations of select phthalate biomarkers measured across pregnancy, including plasticizer replacement DEHTP, are associated with disrupted second-trimester maternal glucose and lipid homeostasis.

KEYWORDS: phthalates/replacements, cardiometabolic markers, pregnancy

P-1040 A Nested Case-Control Study of Serum Per- and Polyfluoroalkyl Substances and Testicular Germ Cell Tumor Risk in U.S. Air Force Personnel

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are a component of aqueous-film-forming-foam fire suppressants used at military installations. However, PFAS-related cancer risks among military personnel are unclear. We investigated serum PFAS associations with testicular germ cell tumors (TGCTs) among U.S. Air Force servicemen within the Department of Defense Serum Repository (DoDSR).

METHODS: We conducted a nested case-control study involving 530 cases and 530 controls individually matched to cases on date of birth, race/ethnicity, year entered the service and year of sample collection, selected from among active-duty personnel with pre-diagnostic DoDSR sera collected between 1988 and 2017. A subset of 187 case-control pairs had a second pre-diagnostic sample collected on average five years after the baseline sample. Perfluorooctanesulfonate (PFOS), perfluorooctanoate, perfluorohexanesulfonate and other PFAS were quantified using isotope-dilution tandem mass spectrometry. Odds ratios (ORs) and 95% confidence intervals (CIs) relating PFAS concentrations (categorized using quartiles among controls) and TGCT were computed using conditional logistic regression adjusting for rank, with tests of trend across exposure categories.

RESULTS: Case-control analyses of the baseline PFAS concentrations were null. In the later samples, however, increasing PFOS concentrations were associated with TGCT (Q2: OR 1.1, 95% CI 0.6-2.0; Q3: OR 1.8, 95% CI 0.9-3.8; Q4: OR 2.7, 95% CI 1.1-6.4; p-trend = 0.02).

CONCLUSIONS: Our findings provide limited evidence of an association between serum PFOS concentrations and TGCT risk which warrants further investigation.
Disclaimer: The views presented here are those of the authors and are not to be construed as official or reflecting the views of the Uniformed University of the Health Sciences, the Centers for Disease Control and Prevention, the Department of Defense or the National Institutes of Health.

KEYWORDS: PFAS, testicular cancer, serum, military, nested case-control study

P-1041 Associations Between First Trimester Particulate Matter Exposure and Blood Pressure During Pregnancy

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BACKGROUND AND AIM: Higher blood pressure (BP) is a risk factor for hypertensive disorders of pregnancy (HDP), a major cause of adverse maternal outcomes. Air pollution is associated with severe forms of HDP including preeclampsia; therefore, examining associations between air pollution and BP during early pregnancy may be helpful for understanding pathways. We evaluated associations between first trimester particulate matter (PM) less than 2.5 and 10 microns (PM2.5 and PM10) exposure and systolic (SBP) and diastolic (DBP) blood pressure at points during pregnancy.
METHODS: We utilized data from 814 women enrolled in the Pregnancy Research on Inflammation, Nutrition, & City Environment: Systematic Analyses (PRINCESA) Study in Mexico City, 2009-2014. Generalized linear models controlling for age, secondhand smoke exposure, gestational age at enrollment and pre-pregnancy body mass index were used to evaluate associations.
RESULTS: The mean age of participants was 25.2 years, and mean gestational age at enrollment was 14.6 weeks, range 2.6 – 26.3 weeks. Mean PM2.5 concentration was 25.1 µg/m3, range 12.5 – 36.1 while mean PM10 was 57.3 µg/m3 (range 29.8 – 105.6). Marginally significant associations were found between PM2.5 and SBP at visit 1 (β = 0.22, p-value = 0.1) and visit 2 (β = 0.20, p-value = 0.1), while PM2.5 was marginally and significantly associated with DBP at visit 1(β = 0.22, p-value = 0.1) and visit 2 (β = 0.42 p-value = 0.0006), respectively. for PM10, significant associations were found only for DBP for visit 1 (β = 0.08, p-value = 0.04) and visit 2 (β = 0.13, p-value = 0.007).
CONCLUSIONS: PM2.5 and PM10 exposure in early pregnancy was associated with higher SBP and DBP. This work provides additional support for PM's role in HDP and suggests minimizing prenatal exposure may reduce risk of adverse outcomes.

KEYWORDS: Air pollution, pregnancy, blood pressure, cardio-metabolic health

P-1042 Lung cancer and annual mean exposure to outdoor air pollution in Crete, Greece. Reflections from a two decades big-database

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BACKGROUND: The increasing burden of lung cancer (LC) in Crete, Greece, has raised certain concerns about the potential association of environmental risk factors with LC.
Aim: The aim of this study was to assess outdoor air pollution (OAP) and the risk for LC mortality for the first time in Crete using LC primary data.

METHODS: 5057 LC cases (diagnosed from 1992 to 2013) were obtained from the Cancer Registry of Crete (http://www.crc.uoc.gr) and followed up until 2014. The age-standardized incidence and mortality rates (ASIR) were calculated. Data on OAP indicators [particulate matter (PM)2.5, between 2.5 and 10 μm (PM2.5-10), PM10, PM2.5 absorbance (black carbon measure), nitrogen dioxide (NO2), and nitrogen oxides (NOx)] were collected. Spatial statistics were calculated and the binary logistic regression model was constructed at α=0.05 in IBM SPSS 24 and ArcMap 10.3.1.

RESULTS: LC in Crete accounts for 40.2 new cases/100 000/year for both sexes (ASIRmales=73.1 new cases/100 000/year; ASIRfemales=11.8 new cases/100 000/year). Annual median estimates of environmental concentrations in Crete were as follows: PM2.5=20.7 (±1.5) μg/m, PM10=38.9 (±2.5) μg/m, PM2.5-10=59.6 (±3.7) μg/m, PM2.5 absorbance=1.2 (±0.3)×10/m, NO2=15.2 (±3.8) μg/m, and NOx=20.1 (±4.9) μg/m. A statistically significant association was observed between OAP and LC mortality (mean correlation coefficient=0.75; P<0.05). The highest risk for 5-year LC mortality was found in the major urban centers and several south-east and north-west rural regions of Crete (relative risk=3.2, 95% confidence interval=1.6-4.7).

CONCLUSIONS: OAP seems to be an important determinant of LC mortality. Targeted interventions should be performed in the high-risk areas.

P-1043 Environmental Exposures Associated with Amyotrophic Lateral Sclerosis (ALS)

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BACKGROUND AND AIM: ALS is a devastating neuromuscular disease with no cure, and most patients only survive 2– 5 years post-diagnosis. Since the etiology of ALS is largely unknown, it has been hypothesized that environmental exposures may increase risk and susceptibility to the disease. Our aim is to examine the role of environmental exposures in ALS from research studies funded by the USA National ALS Registry.

METHODS: To identify possible environmental exposures linked to ALS, the Registry funds academic institutions and conducts intramural research on Registry data. The former has been accomplished by funding investigator initiated R01 grants that allow institutions to explore etiologies. Intermural research explores data from several sources, including survey data collected from patients.

RESULTS: Since 2013, the Registry has funded over 20 grants. Key findings from the program-funded research include statistically increased risks for ALS from exposures to pesticide, lead, mercury, and several polychlorinated biphenyls congeners. Hobbies involving lead were strongly associated with ALS risk as were occupations with potential environmental exposures.
Additional program-study results that can inform additional exposure studies include:
1) Exposures to lead 20 or more years prior to diagnosis had larger effects than those occurring more recently.
2) Estrogen-related factors in women suggest the role of endogenous estrogen exposure and early-onset ALS.
3) Specific metabolism alterations associated with ALS are also impacted by substance exposures.
4) Living near water bodies with blooms of cyanobacteria increases ALS risk, with many blooms being associated with fertilizer runoff.

CONCLUSIONS: Research funded by the National ALS Registry has resulted in increased understanding of the etiologic role of environmental exposures and ALS. This research supports the development of mitigation strategies to limit or reduce risk in the future.

KEYWORDS: Amyotrophic lateral sclerosis, ALS, environmental exposure

P-1044 Effects of low-level environmental mercury on thyroid cancer risk and red blood cell indices among residents living near national industrial complexes in South Korea: A population-based cohort study

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BACKGROUND AND AIM: Previous studies suggested that mercury may be linked to thyroid cancer due to its bioaccumulation in the thyroid gland, but no studies have been evaluated the association between mercury exposure and thyroid cancer. We examined the effect of mercury exposure on the thyroid cancer, and the potential modification of hematological parameters.

METHODS: We conducted a prospective cohort study using data from South Korean “Monitoring Project for Exposure to Environmental Pollutants and Health Effects among Residents Living near Industrial Complexes” survey during 2003 to 2011. The incidence of thyroid cancer cases (C73, ICD-10 code) were identified from the National Cancer Registry and Statistics Korea. Urinary mercury concentrations were measured using thermal decomposition amalgamation atomic absorption spectrometry (TDA-AAS). Cox proportional hazards regression models were used to estimate the hazard ratio (HR) and 95% confidence interval (CI) between mercury exposure and thyroid cancer risk.

RESULTS: During the follow-up (median 8.7 years), we documented 69 cases of thyroid cancer in a total of 5213 participants. The geometric mean of urinary mercury concentration was 1.8 μg/L for thyroid cancer cases and 1.2 μg/L for non-cases. After adjusting for potential confounders, those in the highest tertile of urinary mercury levels had a two-fold higher incidence risk of thyroid cancer (HR=1.97, 95% CI 1.03−3.80 in the highest tertile vs. the lowest tertile, p for trend=0.043). This association was stronger for those with lower mean corpuscular volume and mean corpuscular hemoglobin status.

CONCLUSIONS: Urinary mercury concentration was positively associated with the risk of thyroid cancer among residents living near national industrial complexes, and this association was influenced by red blood cell indices status. These results provide further evidence for the adverse effects of environmental metal pollution in the development of thyroid cancer.

KEYWORDS: Mercury (Hg), Metal pollutant, Environmental pollutant, Thyroid cancer, Red blood cell

P-1045 Machine learning to evaluate mixtures of circulating levels of 42 environmental contaminants to predict incident diabetes

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BACKGROUND AND AIM: Many studies have been published on the relationships between different environmental contaminants and diabetes. In these studies, the environmental contaminants have most often been evaluated one by one, but in real life we are exposed to a mixture of contaminants that interact with each other. The major aim of this study was to see if a mixture of contaminants could improve the prediction of incident diabetes, using machine learning.
METHODS: In the Prospective Investigation of the Vasculature in Uppsala (PIVUS) study (988 men and women aged 70 years), circulating levels of 42 contaminants from several chemical classes were measured at baseline. Incident diabetes was followed for 15 years. Six different machine-learning models were used to predict prevalent diabetes (n=115). The variables with top importance were thereafter used to predict incident diabetes (n=83).
RESULTS: Boosted regression trees performed best regarding prediction of prevalent diabetes (area under the ROC-curve= 0.70). Following removal of correlated contaminants, addition of nine selected contaminants (Cd, Pb, Trans-nonachlor the phthalate MiBP, Hg, Ni, PCB126, PCB169 and PFOS) resulted in a significant improvement of 6.0% of the ROC curve (from 0.66 to 0.72, p=0.018) regarding incident diabetes (n=51) compared with a baseline model including age, sex and BMI when the first 5 years of the follow-up was used. No such improvement in prediction was seen over 15 years follow-up. The single contaminant being most closely related to incident diabetes over 5 years was Nickel (odds ratio 1.44 for a SD change, 95%CI 1.05-1.95, p=0.022).
CONCLUSIONS: This study supports the view that machine learning was useful in finding a mixture of important contaminants that improved prediction of incident diabetes. This improvement in prediction was only seen during the first 5 years of follow-up.

KEYWORDS:
Diabetes, machine learning, contaminants, epidemiology, prediction.

P-1046 Multiple environmental contaminants and diabetes - Results from two population based studies

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BACKGROUND AND AIM: In previous studies on environmental contaminants and diabetes only a limited number of contaminants have been evaluated. The aim with the present study is therefore to obtain a comprehensive picture of the relationships between a large number of environmental contaminants and prevalent diabetes.
METHODS: In 10 examination cycles in The National Health and Nutrition Examination Survey (NHANES) (1999-2017) altogether 116 different environmental contaminants were evaluated in the circulation or urine in relation to prevalent diabetes. Similar analyses were also performed in the Prospective Investigation of Vasculature in Uppsala Seniors (PIVUS) study (n=1016, all aged 70 years, 50% women, 42 contaminants). The logistic regression models were adjusted for age, sex, race, education, BMI, alcohol intake, smoking and lipids.
RESULTS: In a meta-analysis of the 10 NHANES examinations, thirty-six contaminants were significantly related to prevalent diabetes. Those contaminants represent a number of different classes, such as metals, PCBs, dioxins, furans, pesticides, PFAS, phthalates, and phenols.
Some of these relationships were inverse, such as lead, cadmium, mercury, barium, cesium and strontium, some PFAS and furans, as well as benzophenone-3. In the smaller PIVUS study (119 prevalent diabetes cases), significant relationships similar to NHANES were seen for some PCBs, p,p´-DDE and lead. PFHxS and PFOA, showed inverse relationships also in PIVUS. The same was seen for mercury and cadmium.
CONCLUSIONS: Many environmental contaminants were related to diabetes in the NHANES study. Some of these relationships, mainly some metals and PFAS, were negative. Many of these results were similar in the smaller PIVUS study. These findings need be evaluated in prospective studies.

KEYWORDS:
Diabetes, contaminants, epidemiology, metals, organic pollutants.

P-1047 The Causal Relationship Between Radiofrequency-Electromagnetic Radiation from Wireless Phones and Brain Tumor, Part 1: A Systematic Review for Possible Biases and Confounding

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INTRODUCTION: The hypothesis of this study is that RF-EMR exposure from wireless phones causes brain tumors and that this causal relationship can be accurately validated only when accurate exposure assessment methods are applied. As a starting point of this series article, a systematic review of published literature for possible biases and confounding in previous studies will be conducted in the first part.

METHODS: The medical librarian searched MEDLINE: PubMed, EMBASE, and the Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library (until 24 December 2020).

RESULTS: AND DISCUSSION: of the total of 13 studies included, 8 studies concluded that the risk estimates in original studies were underestimated. The other 2 studies concluded that the risk estimates in original studies were underestimated in most scenarios except for a limited number of low possibility scenarios. The other 2 studies concluded the risk estimates might be under- or over-estimated equivocally, and another 1 study concluded the risk estimates might be fair. One study insisted the accurate assessment of RF-EMR exposure should be based on (ⅰ) site-specific, (ⅱ) time integral of (ⅲ) specific absorption rate (SAR). As for the 'site specific' component, the fact that the widespread Bluetooth technology is making the distance between the head and wireless phones farther than before should be considered. As for the 'time-integral' component, almost all people in modern society are using their mobile phones every day, every minute, even when they are sleeping (as a morning-alarm device), for various purposes other than mere calling. As for the 'SAR' component, the fluctuating output power range according to various conditions should be considered in the exposure assessment.

CONCLUSION: Overall, the risk estimates were underestimated in previous literature. However, a more important point is that accurate exposure assessment is required for valid epidemiologic studies.

P-1048 The Causal Relationship Between Radiofrequency-Electromagnetic Radiation From Wireless Phones and Brain Tumor, Part 2: A Meta-Analysis of Current Literature Using Crude Proxies for RF-EMR Exposure Assessment

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INTRODUCTION: Considering the imprecise characteristic of the currently used exposure classification categories discussed in the first part of this series article, in this second part, the authors will conduct a series of meta-analyses and subgroup analyses using various exposure classification categories from crude ones to more precise ones.

METHODS: The medical librarian searched MEDLINE (PubMed), EMBASE, and the Cochrane Library until 16 December 2020.

RESULTS: AND DISCUSSION: As for the separate analysis stratified by each tumor type, the odds ratio for meningioma for regular users was statistically significantly decreased, 0.86 (95% CI 0.77-0.95). for ipsilateral users, the pooled odds ratio for meningioma (1.20 (95% CI 1.04-1.39)), glioma (1.45 (95% CI 1.16-1.82)), and malignant tumors (1.93 (95% CI 1.55-2.39)) showed a statistically significant increased estimate. for years of use, the pooled odds ratio for glioma for > 10 years of use group showed a statistically significant increased estimate (1.32 (95% CI 1.01-1.71)). To sum up, these results stratified by each tumor type, glioma, and malignant tumors were strong candidate tumor types of the possible tumorigenic effect of RF-EMR from wireless phones. In the meta-analysis for the total cumulative hours of use > 867 hours, the pooled odds ratio was 1.56 (95% CI 1.27-1.91). This statistically significant increased pooled odds ratio indicates that a rather moderate amount of cumulative exposure to RF-EMR from wireless phones could induce brain tumors.
CONCLUSION: The study hypothesis, 'the causal relationship between RF-EMR exposure and brain tumor incidence can be clearly validated only when accurate exposure assessment methods are applied,' was validated by the increasing pattern of estimated odds ratios from the use of rather crude exposure categories to more precise exposure categories.

P-1049 The Causal Relationship Between Radiofrequency-Electromagnetic Radiation From Wireless Phones and Brain Tumor, Part 3: The Brain Tumor Incidence Trends in South Korea and a Systematic Review of Nationwide Natural Experiment

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INTRODUCTION: We will (i) briefly look over the incidence trend of various types of brain tumors in South Korea and will (ii) conduct a systematic review of the literature reporting a nationwide or regional brain tumor incidence trend.

METHODS: for the brain tumor incidence trend in South Korea, the brain tumor incidence data from 1999 to 2018 provided by Korea Central Cancer Registry, National Cancer Center were used. for a systematic review, the medical librarian searched MEDLINE (PubMed), EMBASE, and the Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library (until 24 December 2020).

RESULTS: AND DISCUSSION: In South Korea, the subscription rate increased from 0 per 100 persons in 1989 to 135 per 100 persons in 2019. From 1999 to 2018, the average annual percentage change (AAPC) for benign meningioma, benign brain tumors, malignant tumors in the CNS except for the brain, malignant tumors in the frontal lobe, and malignant tumors in the temporal lobe were 3.6 (95% CI 3.3-3.9), 11.3 (95% CI 9.7-12.9), 0.2 (95% CI 0-0.5), 1.5 (95% CI 1.2-1.9), and 0.6 (95% CI 0.5-0.8), respectively. In a systematic review of literature reporting brain tumor incidence trends in each country (or region), 22 articles reporting annual percentage change (APC) (or AAPC) and 15 articles reporting age-standardized incidence rate (ASIR) were analyzed. When the collected data were analyzed using the subscription changes as the independent variable, the results of all 8 analyses were statistically non-significant. These results could be different if a more precise RF-EMR exposure assessment is used in future studies (for example, a site-specific, time-integral of SAR for the brain). Other 4 possible causal factors for the increasing incidence of brain tumors were provided.
CONCLUSION: Future analysis using data with a more precise exposure assessment could indicate a more valid picture for this topic.

P-1051 Systematic review and meta-analysis of studies of exposure to wood smoke from cooking or heating and lung cancer

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BACKGROUND AND AIM: Worldwide, about 2 billion people use biomass fuels for home heating and cooking. In low- and middle-income countries, wood is often burned in open hearths or inefficient stoves, exposing people to hazardous pollutants. Over 2 million U.S. households use wood as their primary source of heating. In the U.S., wood is often perceived as safe because it is a natural substance.
To inform a cancer hazard evaluation for possible listing of wood smoke in the Report on Carcinogens, we conducted a systematic review and meta-analysis of studies of wood use and lung cancer.

METHODS: We searched three bibliographic databases for studies of wood smoke exposure and lung cancer and selected studies providing risk estimates explicitly for wood use. Using a structured protocol, we evaluated study informativeness (risk of bias and study sensitivity) and pooled the least biased, most relevant risk estimates from each study, employing random-effect models to calculate meta-ORs.

RESULTS: Of the ten studies meeting our inclusion criteria, two-thirds were informative based on study evaluation guidelines. All queried wood use for fuel, potentially leading to non-differential exposure misclassification as fuel may be an imperfect surrogate for wood smoke levels. Most studies addressed the major potential confounders (e.g., smoking, socioeconomic status, [SES]/education); however, in some studies, it was unclear if wood users also used coal. Residual confounding by SES is also possible. The meta-ORs and 95% confidence intervals for using wood as fuel were 1.49 (1.22–1.82) for all studies, 1.35 (1.16–1.58) for never smokers, and 1.39 (1.21–1.58) for women. The meta-OR for informative studies was higher than that for less informative studies. Never smoker studies were the least consistent.

CONCLUSIONS: Globally, wood smoke was associated with lung cancer risk and robust in subgroup analyses. Additional analyses are ongoing.

KEYWORDS: Wood smoke, lung cancer, meta-analysis, systematic review

P-1052 Noise-induced hearing loss and obesity: a bidirectional Mendelian randomisation study

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BACKGROUND AND AIM: Exposure to environmental noise causes both auditory and non-auditory health effects. Noise-induced hearing loss (NIHL) might play a vital role in the relationship between noise exposure and obesity. While observational studies have demonstrated an association between hearing loss and obesity, the causal nature of these relationships remains unestablished. We aimed to infer the causality between NIHL and obesity-related traits (obesity-RT) from a genetic perspective and gain insight into the noise-obesity relationship.

METHODS: We used publicly available genetic summary statistics of genome-wide association studies from four consortia (GIANT, UKBB, FINNGEN, and EGG), including data from European-descent men and women aged 15 and older (number of participants: 36160–681275). Genetic variants used as proxies for NIHL and obesity-RT [BMI, waist-hip-ratio (WHR) and childhood obesity] were derived from the consortia, minimising confounding and sample overlap. We conducted a bidirectional and two sample Mendelian randomisation study to investigate the causal relationships between NIHL and obesity-RT.

RESULTS: We found no evidence to support bi-directional causal associations from NIHL to BMI, WHR and childhood obesity [inverse-variance weighted (IVW): 1-unit increase in log odds of NIHL: 0.00 (beta 95% CI: -0.01–0.01), 0.00 (beta 95% CI: 0.00–0.01), 1.00 (OR 95% CI: 0.98–1.01), respectively] and from obesity-RT to the risk of NIHL [IVW: 1-SD increase in BMI: 1.13 (OR 95% CI: 0.78–1.63), 1-SD increase in WHR: 1.19 (OR 95% CI: 0.74–1.92), 1-unit increase in log odds of childhood obesity: 0.93 (OR 95% CI: 0.78–1.10)].

CONCLUSIONS: No clear evidence of a causal effect was seen between NIHL and obesity-RT, in either direction. However, we can still not rule out a modest or non-linear effect of exposures. Future studies may be designed to understand the relationship between them in more detail. NIHL may be a mediator in the noise-obesity relationship.

KEYWORDS: noise-induced hearing loss, obesity-related traits, Mendelian randomisation

P-1053 Exposure to PM2.5 could affect the severity of major depressive disorder: preliminary results from the DeprAir project

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BACKGROUND AND AIM: Exposure to air pollution increases the risk of many diseases and recent evidence supports a relationship with psychiatric disorders such as depression. Major depressive disorder (MDD) is characterized by a complex pattern of biological alterations thought to be caused by genetic, biological, psychological and environmental factors. The DeprAir project aims to assess the effect of air pollution exposure on MDD severity and to clarify potential underlying biological mechanisms.

METHODS: Since September 2020, we have been recruiting patients accessing the Psychiatry Unit of the Policlinico Hospital (Milan, Italy) for mild, moderate, and severe depression. After collecting informed consent, we administered a questionnaire on personal, lifestyle and clinical characteristics, assessed MDD severity and disability through psychiatry rating scales (MADRS, HAM-D, CGI, DISS, GAF) and collected blood samples (lab analyses will be performed after concluding the recruitment). Multivariate linear regression models were performed to verify the association between MDD severity and average PM2.5 concentration in the month preceding recruitment.

RESULTS: Study population so far consists of 256 patients affected by MDD (median age: 56 years, females: 68%). About 50% of subjects reported family history of psychiatric disorders. We observed a positive association between PM2.5 and both the HAM-D score (more focused on anxiety and somatic symptoms: β=0.26, 95%CI: -0.03; 0.55, p=0.076) and the "working life" domain of the DISS scale (evaluating social dysfunction: β=0.084, 95%CI: -0.005; 0.171, p=0.063). When considering the "social support" domain of the DISS scale, family history of depression appeared to modify the association between PM2.5 and MDD severity (p=0.010).

CONCLUSIONS: Although preliminary, our results suggest a potential role of PM2.5 in influencing MDD severity. The ongoing expansion of our study population, together with finer exposure estimates that are becoming available, will likely allow us to further confirm our findings.

KEYWORDS: Air pollution, depression, severity, clinical scales

P-1057 Rail traffic noise-induced nocturnal awakenings might lead to depression and anxiety disorder – Results of the Leipzig LIFE cohort study

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BACKGROUND AND AIM: Recent studies found elevated depression risks for people exposed to traffic noise. In the LIFE cohort-study, we analysed the relationship between “awakenings” induced by maximum railway-traffic noise levels and affective disorders.

METHODS: Based on the 5-year-follow-up of the Leipzig LIFE cohort study (n=5679 participants), we examined the relationship between address-specific rail traffic noise-induced “awakenings” and depression (incidence of 5.3% applying the CES-D scale) as well as anxiety disorder risks (incidence of 4.9% applying the GAD-7 scale). We converted maximum noise pressure levels induced by railroad noise into awakening probabilities according to Möhler et al. (2018), and we summed up the individual awakening probabilities to get the total number of nocturnal awakenings. Thus, for example, if the awakening probability for the passage of a freight train is 5.7%, then approximately 18 train passages would result arithmetically in 1 awakening.

RESULTS: An increase in depression risk for ≥3 nocturnal awakenings was found (incidence rate ratio IRR=1.86; 95% 0.63-5.52, adjusted for gender, age and socioeconomic status) for rail traffic noise. The risk of depression reached statistical significance if people with missing values for depression at baseline were included. The risk of an incident anxiety disorder was increased due to an exposure of ≥3 awakenings due to rail traffic noise (IRR=2.56; 95% CI 1.02-6.43).

CONCLUSIONS: Increased risks for anxiety disorders (and less pronounced for depression) were found for ≥3 nocturnal awakenings due to rail traffic noise. Noise protection measures should take into account the reduction of maximum rail traffic noise levels to in turn reduce nocturnal awakenings.

KEYWORDS: rail traffic noise, maximum noise levels, nocturnal awakenings, depression, anxiety disorder, cohort study

ACKNOWLEDGMENTS: This study was supported by German Environment Agency (UBA).

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P-1059 Prevalence of inattention and hyperactivity symptoms in children from the INMA cohorts of Gipuzkoa, Sabadell, and Valencia

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BACKGROUND AND AIM: Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common childhood neurodevelopmental disorders, characterized by inattention, hyperactivity, and impulsive behavior.
The objective of this study is to estimate the prevalence of ADHD symptoms during childhood in the INMA (INfancia y Medio Ambiente) population-based cohort (www.proyectoinma.org), as well as to identify differences in the distribution of the symptoms based on sociodemographic (cohort, maternal social class, gender) characteristics of the participants.
METHODS: The present study includes participants from the cohorts of Gipuzkoa, Sabadell, and Valencia. ADHD symptoms were measured at three different time points: 4-5 years (n=1181), 7-8 years (n=1341), and 11-13 years (n=1184). ADHD was measured using ADHD-DSM-IV at 4-5 years, while Conner's Rating Scale Revised short form was used at the 7-8 and 11-13 year measurements.
RESULTS: The overall prevalence of ADHD was 5,17%, 20,81%, and 15,71%, respectively for each time point (4-5, 7-8, and 11-13 years). Remarkably, the ADHD trends through the different time points along the three cohorts show that ADHD is more prevalent at 7-8 years and in children from mothers of lower social class. Concerning gender, at the 4-5 year assessment ADHD prevalence is slightly lower in girls, with 97,39% of healthy girls compared to 92,42% of boys, but this percentage gets balanced in the following measurements. Looking closely at the data of each cohort, the difference in the prevalence of ADHD between Gipuzkoa, Sabadell, and Valencia at 4-5 (2,54%, 5,04%, and 7,32%, respectively), 8-7 (16,37%, 22,11% and 23,24%, respectively) and 11-13 years (12,77%, 19,63%, and 14,21%, respectively) show to be mainly distributed attending the social class of each cohort.
CONCLUSIONS: From an epidemiological perspective, the results could help to better understand the real magnitude and dimension of ADHD in children.

KEYWORDS:
ADHD, Childhood, Prevalence

P-1063 Residential exposure to solar ultraviolet radiation and risk of childhood hematological malignancies in Switzerland: a nationwide census-based cohort study

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BACKGROUND: Childhood hematological malignancies (CHM) are the most frequent pediatric cancers yet their environmental drivers remain largely unknown. Solar ultraviolet radiation (UVR) is a known risk factor for skin, lip, and eye cancers. Results from the few studies on CHM risk from UVR exposure suggest a non-linear negative association for acute lymphoblastic leukemia (ALL). We aimed to investigate this association in Switzerland, a country with varying topography and weather conditions.

METHODS: We included all children aged 0-15 years from the Swiss National Cohort during 1990-2015 and identified incident cancer cases through probabilistic record linkage with the Swiss Childhood Cancer Registry. We used a climatological model of the midday (11am-3pm) UV-Index (UVI) with a spatial resolution of 1.5x1.5 km during 2004-2018 and calculated the overall annual mean and mean levels for the month of July at children's homes at diagnosis. We fitted conditional logistic regression models to case-control data matched by birth year obtained by risk-set sampling (odds ratios can be interpreted as hazard ratios). Analyses were adjusted for sex, neighborhood SES, urbanization, air pollution, and background ionizing radiation.

RESULTS: We included 1,446 cases of CHM. Adjusted hazard ratios per unit UVI increase from linear models including July exposure were 0.76 (95% CI 0.59-0.98) for leukemia and 0.74 (0.55-0.98) for ALL. Corresponding point estimates for annual exposure were similar but CIs wider. Linear models showed no evidence of association for lymphoma (1.14, 0.59-2.19 for annual exposure). In the categorical analyses, there was no evidence of an association overall for any of the diagnostic groups with p-values of likelihood ratio (LR) tests >0.2; nor was there any evidence of a departure from linearity (p-values LR test >0.3).

CONCLUSIONS: Our study provides weak evidence that UVR may protect against childhood ALL.

KEYWORDS: Ultraviolet radiation; sun exposure; children; hematological malignancies; cohort study; Switzerland

P-1065 Short-term effects of exposure to ultrafine particles and black carbon on cause-specific morbidities in older adults in New York State

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BACKGROUND AND AIM: Ambient fine particulate matter (PM2.5) is known to have adverse health effects, but less is known about the effects of ultrafine particles (UFP, <100 nm) and black carbon (BC). We examined the associations of short-term exposure to UFP, BC, and PM2.5 with cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD), asthma, depression, and Alzheimer's disease and related dementias (ADRD) among adults aged 65 years and older.

METHODS: We performed a time-stratified case-crossover analysis among Medicare enrollees in New York State (NYS) from 2012 to 2018. Daily air pollution data were obtained from the NYS Department of Environmental Conservation. Cases were limited to those residing in a zip-code within a 30 km-buffer around each monitor site. The control days were chosen bi-directionally and matched on the same day of the week in the same month and year as the case day. We used conditional logistic regression to quantify the associations, adjusting for daily maximum temperature. Effect modification by age, sex, race, and Medicaid eligibility was examined.

RESULTS: Each interquartile range (IQR) increase in UFP exposure was associated with increased odds of overall CVD (OR=1.031, 95% CI: 1.021-1.041), stroke (OR=1.042, 95% CI: 1.026-1.057), ischemic heart disease (IHD, OR=1.034, 95% CI: 1.024-1.045), asthma (OR=1.044, 95% CI: 1.026-1.062), depression (OR=1.037, 95% CI: 1.026-1.048), and ADRD (OR=1.040, 95% CI: 1.027-1.053), but not with COPD. We observed positive associations for BC exposure per IQR change with stroke (OR=1.024, 95% CI: 1.006-1.043), IHD (OR=1.014, 95% CI: 1.001-1.027), and depression (OR=1.014, 95% CI: 1.001-1.028). The associations were stronger among individuals aged 65-75, males, and Non-Whites. No associations for PM2.5 exposure were found.

CONCLUSIONS: Our findings contribute to emerging evidence for positive associations of short-term exposure to UFP and BC with adverse health outcomes among older adults.

KEYWORDS: Black carbon; Ultrafine particles; Short-term exposure; Case-crossover design

P-1067 The influence of air pollution exposure on the association between active mobility and long-term health outcomes: A systematic review

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BACKGROUND: Walking and cycling for transportation, namely active mobility (AM), can improve health through increasing individuals' daily physical activity levels. People using AM increase their breathing rate, however, inhaling harmful air pollutants (AP) along with necessary oxygen. The interaction of these complex combined effects can develop slowly and clinically manifested over time.
Purpose: Our study aimed to synthesize the current knowledge on effect modification of AP exposure with AM on long-term health outcomes.

METHODS: A systematic review was conducted using Medline, Embase, Web of Science and Scopus databases. Searches included a wide range of keywords related to AP and AM to identify original articles published in English or Spanish in peer-reviewed journals until September 2021. Effect modification by AP was examined in studies on healthy adults where an interaction term between AM and AP was included in modelling or that presented stratified analyses by AM or AP levels.

RESULTS: 5725 studies were found and 10 were finally included where AP main indicators studied include particulate matter and nitrogen oxides. Health outcomes studied are wide in range but grouped into cardiovascular and respiratory outcomes. Most studies tested an interaction term within models. High NO2 levels do not attenuate the reductions in risk of all- and cause-specific mortality from AM, however, PM2.5 did attenuate these reductions. No significant effect modification was seen by NO2 levels on the association between cycling or walking and cardiovascular or respiratory outcomes.

CONCLUSIONS: Little evidence of interaction between AP and AM on long-term outcomes was found, but pollutant-specific long-term effects need further investigation. Further consideration on study design, interaction testing, and results reporting is needed to advance understanding of this complex relationship to guide future work and decision-making.

P-1071 Air pollution, risk of neurodegenerative disorders and potential mediation pathways

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BACKGROUND AND AIM: Recent studies revealed an implication of air pollution in neurodegenerative disorders. Still, due to the scarcity of studies testing air pollution in a comprehensive manner, including potential mediation pathways, this link remains controversial. Here, we aimed to investigate these aspects by testing multiple pollutants simultaneously.

METHODS: In the Moli-sani cohort (N=24,325; ≥35 years; 51.9% women, baseline 2005-2010), we estimated yearly levels of exposure to nitrogen oxides (NOX, NO, NO2), ozone (O3), particulate matter (PM10) and BTX hydrocarbons (benzene, toluene and xylene) in the period 2006-2018, applying residence geo-localization of participants and Kriging interpolation algorithm to land measurements of air pollutants. We performed a principal component analysis and tested association of the resulting principal components (PCs) with the incident risk of Parkinson (PD) and Alzheimer disease (AD), through multivariable Cox PH regressions adjusted for age, sex and education level completed.

RESULTS: Over 24,308 subjects with pollution data available (51.9% women, 55.8(12.0) years), we extracted three PCs explaining ≥5% of pollution exposure variance: PC1 (38.2%, tagging PM10 exposure), PC2 (19.5%, O3/CO/SO2), PC3 (8.5%, NOx/BTX hydrocarbons). Over a mean follow-up of 10.9(2.1) years, we observed statistically significant associations of PC1 with an increased risk of PD (HR[CI] = 1.04[1.02-1.05]; 405 incident cases) and AD (1.06[1.04-1.08]; 218 cases). These associations were confirmed when we analyzed PM10 levels averaged over follow-up time, in models further adjusted for professional exposures like working class, compartment and toxic compounds and lifestyles like smoking and drinking habits, physical activity and adherence to Mediterranean diet (PD: 1.27 [1.19-1.37]; AD: 1.22[1.16-1.28] per 1 µg/m3 increase of PM10).

CONCLUSIONS: We found evidence supporting an influence of air pollution – especially PM10 – on increased neurodegenerative risk in the Italian population, independent on concurring risk factors. We are now investigating a potential mediation role of circulating inflammation in this link.

P-1072 Household air pollution, polycyclic aromatic hydrocarbons and esophageal cancer risk in Kenya: ESCCAPE case-control study

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BACKGROUND AND AIM: Esophageal squamous cell carcinoma (ESCC) is highly prevalent in Western Kenya. Established risk factors (e.g. smoking and alcohol consumption) are not common in female patients. Exposure to household air pollution (HAP) from solid fuels used for cooking and heating might be relevant in ESCC aetiology. As such, this study aims to examine the relationship between self-reported indicators of exposure to HAP with risk of ESCC in Western Kenya.

METHODS: Six-hundred and four (604) ESCC cases and six-hundred and thirty-one (631) controls were recruited during three phases of the ESCCAPE Kenya case-control study. Surveys on risk factors were conducted with all participants. Surveys included questions on demographic and socio-economic factors, and fuels used in the home currently and during childhood, and their proximity to heating and cooking sources.

RESULTS: When accounting for confounding demographic factors, odds ratios (OR) derived from binomial regression illustrates a significantly increased risk of esophageal cancer among those who use firewood as their primary cooking fuel (OR: 2.187; CI: 1.368-3.557). Women were almost three times as likely to have esophageal cancer when using firewood as the primary cooking fuel (OR: 2.821; CI: 1.255-6.917). Risk of esophageal cancer was significantly greater among participants who cooked in their living room (OR: 1.954; CI: 1.234-3.107). Findings demonstrate greater wood burning exposure is associated with significantly heightened risk of esophageal cancer.

CONCLUSIONS: Findings from the ESCCAPE case-control study indicate the potential role of exposure to smoke from firewood used in cooking and heating, in the complex aetiology of ESCC. Given the increased lifetime exposure to woodsmoke for women due to traditional domestic roles, and their lower exposure to other known risk factors, reliance on solid fuels for domestic energy could be an important potentially preventable risk factor for women in areas when the occurrence of ESCC is high.

P-1075 An examination of vitamin D levels as a mediator in the association of ambient air pollution and incident type 2 diabetes mellitus in India

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BACKGROUND & AIM:
Recent evidence suggests a role for air pollution and low vitamin D levels in enhancing the risk of diabetes. In India, both air pollution and a high prevalence of vitamin D deficiency exist alongside a high burden of diabetes. Particulate matter also reduces penetration of UVB light into earth's atmosphere resulting in reduced synthesis of cutaneous vitamin D. We hypothesized that air pollution as measured by PM2.5 is associated with vitamin D levels as measured by 25-OHD in the body, which may mediate association between PM2.5 and incident type 2 diabetes mellitus.

METHODS: We used a nested prospective case-control study in the Center for Cardiometabolic Risk Reduction in South Asia cohort study in Delhi and Chennai. Cases (n=506) defined as those with incident diabetes mellitus, were matched with healthy controls/non-diabetics (n=506). Multivariable regression analyses were performed to evaluate the associations between varying lag exposures of PM2.5 and incident diabetes. We estimated the mediating effects of vitamin D levels associated with PM2.5 exposure on incident diabetes through causal mediation analyses and boot strapping.

RESULTS: 92.4% and 89.9% of cases and controls were vitamin D insufficient (< 30 ng/ml), respectively. We observed statistically significant negative correlation [-0.41 95%CI: -0.35, -0.46] between vitamin D levels and PM2.5 for all the lag periods (1-day, 7-day, 30-day, and 90-day) studied. The association between short-term exposure to PM2.5 and incident diabetes were evident among people who were obese, had higher waist-hip-ratio, and elevated triglyceride levels. The mediating role of low vitamin D was not supported by our dataset.

CONCLUSIONS: Air pollution appears to interfere with vitamin D synthesis from natural sources. We, however, did not find evidence to support a mediating role of vitamin D on the association between PM2.5 and incident diabetes.

KEYWORDS: Air pollution, diabetes mellitus, vitamin D, mediation analysis

P-1078 Air pollution and risk of lung cancer within the EAGLE case-control study

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BACKGROUND AND AIM: In 2013 IARC classified air pollution (AP) as group 1 human carcinogen based on studies documenting that long-term exposure to particulate matter (PM) increases the risk of lung cancer (LC). Within the EAGLE case-control study, we previously reported that exposure to PM ≤10 µm (PM10) in a year (2000) close to diagnosis/enrollment was associated with an increased LC risk. We now aim to evaluate this association considering AP exposures further away in time.

METHODS: From 2002 to 2005, 2,099 incident LC cases were recruited from 13 Lombardy (Italy) hospitals belonging to five areas (Milan, Monza, Varese, Pavia, Brescia) and matched by sex, age, and area to 2,101 controls. Subjects underwent a computer assisted personal interview (CAPI), filled in a self-administrated questionnaire and donated blood samples. Annual means of PM10 for the year 1990 were estimated with a resolution of 3x3 km through an Eulerian chemical transport model. Association between PM10 and LC was assessed applying multivariable unconditional logistic regression models to the entire sample and stratifying by area.

RESULTS: Study sample consists of 3,473 subjects (1,665 cases and 1,808 controls, males: 77%, smokers: 37%) who did not change residence since 1980 and mainly lived in Milan (69.4%). Adenocarcinoma was the most common morphology (males: 38%, females: 55%). In the entire population, we did not observe an association between AP and LC (OR=0.96 per 10 µg/m³ of PM10, 95%CI: 0.86;1.06). When stratifying by area, a positive association was found in Pavia (OR=1.89, 95%CI: 0.66;5.45) and Varese (OR=2.27, 95%CI: 0.77;6.68).

CONCLUSIONS: These preliminary results partially confirm an increased LC risk using AP measured 12-15 years before. Further analyses will aim to assess non-linear associations, analyze gaseous pollutants, evaluate the interplay between different pollutants, and improve the spatial resolution of our exposure data.

KEYWORDS: particulate matter, lung cancer, case-control study

P-1080 Prevalence and determinants of sunburns and sun protection behaviors among children: A nationwide cross-sectional survey in Switzerland

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BACKGROUND: High exposure to solar ultraviolet radiation in early life increases the risk of developing skin cancer later, with increasing risk related to an increasing number of sunburns. Switzerland has high incidence rates of skin cancer compared to surrounding countries. We aimed to estimate the prevalence of sunburns and sun protection behaviors and their potential determinants among children in Switzerland.

METHODS: In February 2019, we sent questionnaires to the parents of a random sample of 8,221 Swiss resident children. The questionnaires of 2,841 children were returned (response rate 35%). In spring and summer of the same year, follow-up questionnaires were sent to these children (response rate ~50%). Parents were asked about their child regarding protection measures, number of sunburns in the previous year, and skin phototype. We calculated the prevalence of sunburns and sun-protective behaviors (wearing a hat, seeking for shade, and use of sunscreen) by season, sociodemographic characteristics and skin phototype.

RESULTS: Among participating children, 39.9% had at least one sunburn in the previous year, of whom 20.5% had a severe sunburn. When outside on a sunny day, 50.3% of the children wore a hat in summer (46.8% in spring), 21.1% (19.8%) sought shade more than half of the time, and 53.6% (43.5%) wore sunscreen. Prevalence of sunburns and of severe sunburns was higher among older children, boys, and children with sensitive skin. Protective measures were more frequent among younger children, girls, and children with sensitive skin. Prevalence of both outcomes varied substantially between regions. Sunburn prevalence was associated with lower use of sun protection.

CONCLUSIONS: Compared to previous regional studies in Switzerland, we found a lower prevalence of sunburns and of protection behaviors, with important regional heterogeneity. Our results should help tailor sun exposure prevention measures to specific age groups and regions.

KEYWORDS: sunburn, children, skin cancer

P-1083 Association between selenium species and hippocampal volume in subjects with mild cognitive impairment

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BACKGROUND AND AIM: Selenium is a trace element with nutritional and toxicological properties. Its influence on human health is thought to depend on exposure dose and chemical form. The effects of selenium exposure on medical conditions that involve the central nervous system have been understudied. In a cohort of individuals with mild cognitive impairment, we have previously documented a positive relation between cerebrospinal fluid (CSF) levels of inorganic hexavalent selenium (selenate) and risk of dementia.

METHODS: We assessed the relation between CSF levels of selenium species and volume of the hippocampus among the 33 cohort members aged 43-82 years who had undergone magnetic resonance imaging at baseline (2008-2014) using both linear and spline regression analyses. We also performed a surface-based analysis using SPHARM-PDM to evaluate differences in shape of the hippocampus in addition to its volume in relation to CSF levels of selenium species.

RESULTS: We found an inverse association between selenate and total hippocampal volume (β regression coefficient in multivariable linear regression analysis -3.05, 95% confidence interval -5.74 to -0.37), which was similar for the right and left hippocampus and emerged mainly at the highest exposure levels. We found little association between the other selenium forms and hippocampal volume. In the surface-based analysis, the left hippocampus showed considerably more pronounced shape differences in the ventro-medial region of the head.

CONCLUSIONS: This is the first study to analyze selenium species in relation to hippocampal volume and structure, suggesting that a selenium form with high toxicological potential may adversely affect a key structure involved in dementia onset and progression as the hippocampus, possibly the left one in particular. However, we cannot entirely rule out the influence of reverse causation or unmeasured confounding on these results.

KEYWORDS: Mild cognitive impairment; Dementia; Alzheimer's dementia; Hippocampus; Magnetic resonance imaging; Cerebrospinal fluid; Selenium; selenate

P-1088 Association between long-term ambient air pollution exposure and handgrip strength change in the French CONSTANCES cohort

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BACKGROUND AND AIM: Literature is scarce regarding the effect of exposure to outdoor air pollution on frailty. In this longitudinal study, we aimed to assess the association between long-term air pollution exposure and handgrip muscle strength (HGS) change, a marker of frailty.

METHODS: Data from the 45-69 years-old population of the French CONSTANCES cohort with two HGS measurements were used. Annual mean concentrations of PM2.5, black carbon (BC), and NO2 were estimated using 2010 land-use regression models at the residential addresses of the participants at enrolment (2014-2016). Absolute change in maximum HGS (HGSmax) between enrolment and follow-up (around 4.5yrs after) was used as the outcome and decline was defined as a negative absolute change in HGSmax. Sex-stratified multilevel adjusted (including length of follow-up) linear regressions with the center of recruitment as a random effect and sandwich robust error were used (reported as adjusted β, and 95% confidence interval [CI] for an interquartile range increase in exposure).

RESULTS: Among the 4655 included participants, 50% (N=2331) were women, mean age was 57 years old, and 54% had a high educational level. Average HGSmax at baseline was higher among men than women (45.1 vs 27.6 kg). Around 60% had a decline in HGSmax between the two measurements and decline was higher in men (median[Q1;Q3]=-2[-5;2]) than in women (-1[-3.5;1]). Preliminary results showed that exposure to BC was associated with HGS decline in women (β[95%CI]: -0.33[-0.62;-0.05]), but not in men (-0.17[-0.60;0.25]). Further adjusting on urbanity led to similar effect sizes, but results among women were no longer statistically significant. Results for PM2.5 and NO2 were similar to the ones for BC.

CONCLUSIONS: Long-term exposure to ambient air pollution is associated with HGS decline in women, with urbanity as a possible confounding factor.

KEYWORDS: Handgrip strength, aging, air pollution, particulate matter, frailty

P-1089 Associations between per- and polyfluoroalkyl substances and liver transient elastography measures in U.S. adults

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BACKGROUND AND AIM: Non-alcoholic fatty liver disease (NAFLD) is increasingly diagnosed in the U.S. and elsewhere and affects approximately one billion individuals worldwide. In the U.S., almost 1 in every 3 adults are estimated to have NAFLD. Exposure to per- and polyfluoroalkyl substances (PFAS) has been linked to liver steatosis and hepatocyte apoptosis in animal studies, but evidence in humans for a link between PFAS and NAFLD is sparse. We investigated the associations between PFAS and liver steatosis and fibrosis using transient elastography (TE) in U.S. adults.

METHODS: We studied 1700 adult participants from the 2017-2018 National Health and Nutrition Examination Survey (NHANES) with available serum PFAS measurements and valid vibration-controlled TE measures of liver steatosis (median controlled attenuation parameter [CAP] in decibels per meter [dB/m]) and liver fibrosis (median stiffness in kilopascals [kPa]). Participants with viral and autoimmune hepatitis and liver cancer were excluded from analyses. We used multivariable regressions to assess the covariate-adjusted associations between six PFAS and median CAP and liver stiffness. We also investigated effect modification by sex and age.

RESULTS: Average CAP was 263.0 dB/m (SD: 62.6) and average median stiffness was 5.7 kPa (SD: 4.3). Concentrations of perfluorooctanoic (PFOA), perfluorodecanoic (PFDA), perfluoroundecanoic (PFUA) acids, perfluorohexane (PFHxS) and perfluorooctane (PFOS) sulfonic acids were significantly negatively associated with CAP and liver stiffness measures. for instance, a twofold increase in PFDA was associated with a decrease of 0.11 SD (95% CI: -0.16, -0.05) and 0.08 SD (95% CI: -0.14, -0.02) in CAP and stiffness measures, respectively. Associations of PFNA and PFUA with both outcomes were modified by sex, whereas associations of PFUA and PFOA with liver stiffness were modified by age.

CONCLUSIONS: This is the first study to assess associations between PFAS and liver TE measures. Results show that PFAS may alter liver measures indicative of NAFLD.

P-1090 Assessing the critical windows and aggregations of air pollution exposure on metabolic biomarkers in atherosclerotic patients

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BACKGROUND AND AIM: Air pollution exposure has been associated with metabolic biomarkers, but critical exposure window and appropriate aggregation of exposure duration is less understood. We aim to fill this research gap using air pollution exposure with flexible time intervals.

METHODS: We analyzed ten metabolic biomarkers in 1550 atherosclerotic patients from a cardiovascular cohort. Daily residential exposure to PM2.5 and NO2 was estimated using satellite-based spatiotemporal models and assigned to participants for up to 8 weeks before the blood collection. Distributed lag models were used to examine the single-day lag effects and cumulative effects. Effect modification by sex, smoking, and coronary artery calcium (CAC) score was explored.

RESULTS: In single-day-lag-effect models, apolipoprotein A (Apo A) was negatively associated with NO2 during the first 11 lag days (change range per 10 μg/m3: -0.21 to -0.07%) and with PM2.5 during the first 22 lag days (-0.06 to -0.03% per 10 μg/m3), and the effects peaked on the first lag day; while we observed critical windows for C-reactive protein (CRP) after first few lag days (NO2: lag4 to lag22 days, 0.51-0.78%; PM2.5: lag6 to lag23 days: 0.21-0.25%). In cumulative effect models, the effects became stronger when averaging NO2 exposure over longer periods compared to shorter periods for Apo A (-0.97% over 1-week to -1.59% over 8-week) and CRP (7.05% over 1-week to 15.85% over 8-week), whereas stronger associations appeared in shorter periods for triglycerides with NO2 (1.75 % over 1-week to 0.11% over 8-week) and glucose with PM2.5 (0.21 % over 1-week to -0.05% over 8-week). Association between NO2 and CRP was stronger among females, non-smokers, and individuals without CAC.

CONCLUSIONS: Air pollution impacts on inflammation and lipid and glucose metabolism were differed by critical windows and varying duration of exposure, suggesting different underlying mechanisms.

KEYWORDS: Air pollution, Critical windows, DLM

P-1091 Cardiometabolic, kidney, and thyroid markers and conditions in three Australian communities living with environmental per- and polyfluoroalkyl substances contamination

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) have been associated with altered kidney, thyroid, and cardiometabolic function markers, particularly elevated total cholesterol, but the evidence for specific health conditions has been inconclusive. We quantified the single and combined associations of PFAS on 17 biomarkers and 13 related health conditions in Australian communities with PFAS-contaminated water from the historical use of aqueous film-forming foam in firefighting activities.

METHODS: This was a cross-sectional study of 881 adults in three exposed communities and 801 adults in three comparison communities. Participants self-reported their health and sociodemographic characteristics, and provided blood samples for measurement of nine PFAS and 17 biomarkers. We estimated differences in mean biomarker concentrations for each PFAS (PFOS, PFOA, and PFHxS) using linear regression and for the PFAS-mixture using Bayesian kernel machine regression. We also estimated prevalence ratios of biomarker concentrations above/below the reference limit and self-reported health conditions using modified Poisson regression.

RESULTS: We observed higher mean total cholesterol and uric acid concentrations with higher single and mixture PFAS concentrations in blood serum, with varying certainty across communities and PFAS. PFOA was associated with higher prevalence of self-reported hypercholesterolemia (one community) and gout and kidney disease (two communities), but PFOS and PFHxS were associated with lower prevalence of gout and kidney disease. No clear associations were observed for self-reported cardiovascular disease, and there was less certainty for liver and thyroid function markers and disease due to low prevalence.

CONCLUSIONS: Our study is one of few that simultaneously quantifies the associations of a PFAS-mixture on a large number of biomarkers and underlying health conditions in multiple communities. Our findings for total cholesterol and uric acid were consistent with previous studies; however, few associations were consistent across communities and the cross-sectional design limited causal inference.

KEYWORDS: perfluoroalkyl substances, lipids, liver, kidney, thyroid

P-1097 Comparison of Carcinogenic Risk from Inhalation Exposures in Industrial and Non-Industrial Areas

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BACKGROUND AND AIM: Cancer of respiratory tract is the world's most common cause of death among all cancer diseases. It's occurrence is influenced by many risk factors including outdoor and indoor air pollution, occupational exposure and other risk factors. The aim was to compare selected significant risk factors for respiratory cancer in two different polluted areas.

METHODS: A combination of a longitudinal cross-section study with a risk assessment methodology was used. Data from a specially developed methodology were used to evaluate lifetime exposures, and in addition, exposures to aerosol fractions $PM_{2.5}$, $PM_{1.0}$ and $PM_{0.25}$ were measured using cascaded personal samplers. The results were expressed as lifetime cancer risks and their proportions to the overall incidence of the disease.

RESULTS: By comparing the risks of benzo[a]pyrene in ambient air and fibrogenic dust in workplaces, much more higher risks have been attributed to indoor radon exposures, while surprisingly a very high proportion of the most biologically effective ultrafine particles in the ambient air aerosol was found (UFP, ie $PM_{0.25}$ was in the ratio 0.43, 0.57 and 0.67 in SPM, $PM_{2.5}$ and $PM_{1.0}$). Proportions of carcinogenic risks in industrial (IA) and non-industrial (NA) areas take on very different values with dominance of other factors (85% for men in IA, especially smoking) or radon (100% for women in NA). The benzo[a]pyrene represents only a proportion of lung cancers below 1%.

CONCLUSIONS: The most significant proportion of respiratory cancers is represented by radon and other risk factors, although UFP mass dominance was found in IA and it is hypothesized as the major carrier of carcinogenic polycyclic aromatic hydrocarbons.

KEYWORDS:
radon; benzo[a]pyrene; lung cancer; occupational exposure; lifetime cancer risk, suspended particulate matter (SPM), fine and ultrafine particles (FP, UFP)

P-1099 Effects of Ambient Air Pollutants on Cardiac Structure and Function in ECHO-SOL

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BACKGROUND AND AIM: The relationship between air pollution (AP) exposure and incident heart failure has been investiagted; less is known about effects of AP on subclinical cardiac structure and function preceding clinical diagnosis. Cross-sectional associations between fine particulate matter (PM2.5) and nitrogen dioxide (NO2) and echocardiographic were assessed among 1,660 participants aged 45-74 years of the Echocardiographic Study of Latinos, an ancillary study to the Hispanic Community Health Study/Study of Latinos (HCHS/SOL).

METHODS: Measures including left ventricular (LV) mass index, relative wall thickness, average global longitudinal strain (GLS), LV ejection fraction, e', left atrial volume index, E/e' ratio, and diastolic function grades were assessed by echocardiogram. AP concentrations were estimated from spatio-temporal models at participant building residence. Primary exposures were interquartile range (IQR) increases in annual average PM2.5 and NO2 prior to clinical visit 1 (2008-2011). Survey linear regression estimated the effect of AP on measures of cardiac structure and function adjusting for age, sex, study site, alcohol use, physical activity, and education. Strain measurements are expressed as negative percentages (more positive numbers indicating worse myocardial strain).

RESULTS: 42.3% were male and 35.4% had no high school diploma. Average concentrations for PM2.5 and NO2 were 10.30 µg/m3 (standard deviation (SD) 1.9) and 17.4 ppb (SD 6.3), respectively. PM2.5 was associated with increased (worse) GLS (2.40%; 95% CI 1.03, 3.76) and decreased LV ejection fraction (-2.36; 95% CI -4.34, -0.38) per IQR increase. NO2 was associated with increased GLS (1.57; 95% CI 0.69, 2.46) and decreased LV ejection fraction (-2.07; 95% CI -3.77, -0.37) per IQR increase. Associations with other measures of cardiac structure and function were not found.

CONCLUSION:

These results provide evidence that in this Hispanic/Latino cohort, AP adversely affects GLS and EF, both known precursors to clinical heart failure.

P-1100 Differential uranium exposure and its association with hypertension and elevated blood pressure in American Indian communities in the Strong Heart Family Study

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BACKGROUND: Urinary uranium (U) is present at higher concentrations in American Indian (AI) participants in the Strong Heart Study compared to the general US population. Cardiovascular disease is the leading cause of death among American Indians, of which hypertension is an important risk factor. We evaluated the association between U exposure and incident hypertension and increased blood pressure (BP) among Strong Heart Family Study (SHFS) participants.

METHODS: We included 1453 SHFS participants with baseline visits in 1998-1999 or 2001–2003, and follow-up visits in 2001-2003 and/or 2006–2009. We estimated the association of urinary U exposure with changes in systolic BP and diastolic BP levels using linear regressions, and hypertension incidence using Poisson regression with robust variance, accounting for family clustering.

RESULTS: Median (IQR) urinary uranium levels were 0.029 (0.013, 0.059) µg/g creatinine. at follow-up, 17.4% of participants developed hypertension. After adjustment for sociodemographic variables, eGFR, pre-diabetes status, and BMI, comparing the highest to lowest urinary uranium quartiles, the RR (95% CI) of incident hypertension was 1.38 (1.00, 1.91) and the mean difference (95% CI) in systolic BP levels between baseline and follow-up was -2.00 (-3.83, -0.16) mmHg. After adjustment for urinary cadmium and arsenic, the corresponding RR (95% CI) was 1.44 (1.04, 1.99) and the mean difference (95% CI) for systolic BP between baseline and follow-up was -1.48 (-3.32, 0.37) mmHg. The association between uranium and blood pressure levels at follow-up was non-linear, with an increased risk at higher urinary uranium levels.

CONCLUSIONS: These findings suggest moderate increased risk for hypertension at urinary uranium levels greater than 0.06 µg/g, typical of the Southwest and Great Plains, furthermore a potential association with higher systolic BP levels and higher uranium exposure levels. Further work is needed to assess the cardiovascular effects of chronic uranium exposure in US populations.

KEYWORDS: Uranium, hypertension, blood pressure

P-1101 Acanthamoeba spp. in public parks' soils in Spain: presence, distribution and risks

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BACKGROUND AND AIMS: Acanthamoeba spp. is a protozoan that is becoming a public health threat. This parasite has been isolated in stray cats from Madrid (Spain), which could play a role in contaminating urban environments. The aim was to determine the presence/distribution of Acanthamoeba spp. in Alcalá de Henares (a major city in the Madrid Region) to identify potential risks.

METHODS: 227 topsoil samples were collected in July 2017 across urban parks/green areas (155), industrial (60) and a public garden (12). Following extraction of DNA with FastDNA® Spin, a triplex real-time TaqMan PCR assay was performed to detect Acanthamoeba spp., using established methodologies. Organic matter (OM), pH, electric conductivity (EC) and texture (sand, clay and silt percentages) were also determined in soils.

RESULTS: Acanthamoeba spp. was detected in 39 topsoil samples, which suggests a moderate distribution throughout Alcalá. Higher presence in the urban (24) area could be explained by the major presence of urban animals, such as stray cats, in this area. The presence of cysts would have not been affected by the OM, pH or EC, despite variations seen in the levels of OM in the studied soils. In contrast to sand and silt, Acanthamoeba spp. seem to be more present in the areas with lower percentages of clay (13.76 detected vs. 18.38 not detected; p=0.006), association which has also observed within the four sub-areas in which the urban area was divided (p=0.016). Clay has more water holding capacity than sand and silt, so it would have been expected to find Acanthamoeba positively associated with clay, although its lower permeability might affect their survival.

CONCLUSIONS: The low-moderate distribution of Acanthamoeba spp. detected could highlight a risk for the Alcalá population which should be further investigated as this protozoan can affect immunocompromised/immunocompetent individuals.

KEYWORDS: Acanthamoeba, urban soils, human risks

P-1106 Metal mixture mediates associations between socioeconomic indicators and blood pressure outcomes in rural Bangladeshi adults: Evidence from a prospective population study

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BACKGROUND AND AIM: There is limited evidence on the causal mechanism in the socioeconomic differentials in blood pressure (BP) in low and middle-income countries (LMICs). We, therefore, examined the associations of socioeconomic indicators (SEIs) and BP, socioeconomic disparities in metal mixture exposures, and the potential mediation effect of metal mixtures in the associations between SEIs and BP outcomes in rural Bangladeshi adults.

METHODS: This study included 900 rural Bangladeshi adults prospectively followed for six years in the Bangladesh vitamin E and selenium Trial (BEST). Blood pressure was measured at baseline and during three biennial follow-up examinations. Blood levels of arsenic, lead, selenium, and urinary arsenic, including socioeconomic indicators-years of education, and agricultural land ownership (ALO), were measured at baseline. Weighted quantile sum (WQS) regression was used to estimate the joint effects of metal mixture on systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse pressure (PP), and mean arterial pressure (MAP) taken at the third follow-up. Causal mediation effect of the metal mixture was estimated using the parametric g-computation method.

RESULTS: Education was positively, but ALO was inversely associated with BP. Participants with higher SEIs were less likely to be exposed to metal mixtures than their counterparts. Metal mixture mediated the associations of SEIs with SBP, DBP, MAP, and PP. for example, the randomized analogue of total natural direct effect (rRTNDE) was 5.31 (95% CI: 1.91, 8.77) and the pure natural indirect effect (rRPNIE) was -0.67 (95% CI: -1.34, -0.22) for education and SBP. Similarly, the rRTNDE was -2.31 (95% CI: -4.37, -0.33) and the rRPNIE was -0.29 (95% CI: -0.70, -0.03) for ALO and SBP. There was no evidence of the exposure-mediator interaction in the mediation models (Pint>0.20).

CONCLUSIONS: Our study suggests that metal mixture mediates socioeconomic differentials in BP.

KEYWORDS: Blood Pressure; Metals; SES; Mediation; Mixture

P-1107 Association between particle components and inpatient Parkinson's hospitalizations among people ages 40 years and up in the U.S. using Bayesian kernel machine regression (BKMR)

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BACKGROUND: Recent studies have shown that air pollutants may have adverse effects on neurological disorders. However, few studies have investigated the long-term exposure of particle components in conjunction with PM2.5 and ozone to assess their individual and additive effects on Parkinson's disease.
AIM: We aim to utilize a Bayesian Kernel machine regression (BKMR) to assess the individual and join effects of air pollutants including 15 different particle components such as organic carbon (OC), elemental carbon (EC), copper (Cu), and zinc (Z), along with PM2.5 and ozone, on counts of inpatient Parkinson's hospitalizations for adults ages 40 years and up.

METHODS: Inpatient records were collected from the State Inpatient Databases which included hospitals from 12 U.S. states ranging in years from 2000 through 2016. We also included temperature from Daymet and variables from the U.S. census to control for socio-economic status. All variables were aggregated to the annual level.

RESULTS: We observed a decrease of 0.05 (95%CI: 0.03,-0.14), 0.04 (95%CI: 0.05,-0.14), and an increase of 0.03 (95%CI: -0.07,0.12) in the number of Parkinson's inpatient hospitalizations each year at the 25th, 50th, and 75th percentiles of pollutant mixture, respectively. at the 90th and 95th percentile, there is a significant increase of 0.12 (95%CI: 0.01,0.22) and 0.17 (95%CI: 0.06,0.28) annual Parkinson's cases, respectively.

CONCLUSIONS: Our results contribute to the growing body of literature on air pollution and neurological disorders.

KEYWORDS: Parkinson's Disease, PM Components, PM2.5, Ozone, BKMR

P-1108 Effects of long-term exposure of particle components on inpatient stroke hospitalizations in U.S. adults ages 40 years and up using Bayesian kernel machine regression (BKMR)

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BACKGROUND: Air pollutants, including PM2.5, have been shown to adversely affect health; however, few studies have investigated the long-term exposure of particle components in conjunction with PM2.5 and ozone to assess their individual and additive effects on cerebrovascular incidents such as stroke.
AIM: We aim to utilize a Bayesian Kernel machine regression (BKMR) to assess the individual and join effects of air pollutants including 15 different particle components such as organic carbon (OC), elemental carbon (EC), copper (Cu), and zinc (Z), along with PM2.5 and ozone, on counts of inpatient Parkinson's hospitalizations for adults ages 40 years and up.

METHODS: Inpatient records were collected from the State Inpatient Databases which included hospitals from 12 U.S. states ranging in years from 2000 through 2016. We also included temperature from Daymet and variables from the U.S. census to control for socio-economic status. All variables were aggregated to the annual level.

RESULTS: We observed a significant increase of 2.00 (95%CI: 1.72,2.29), 5.87 (95%CI: 5.57,6.16), and 9.81 (95%CI: 9.51,10.12) in the number of inpatient stroke hospitalizations each year at the 25th, 50th, and 75th percentiles of pollutant mixture, respectively.

CONCLUSIONS: Our results indicate that the mixture of pollutants greatly contribute to the increase in the number of stroke hospitalizations each year and that the effects of short-term exposures of particle components on stroke hospitalizations should be assessed next.

KEYWORDS: Stroke, PM Components, PM2.5, Ozone, BKMR

THEMATIC 18: Occupational Exposures and Health

P-1112 Epidemiologic profile of work-related accidents with biological material in Brazil, 2007-2021

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Accidents with biological material involve contact with body fluids, contamination potential, and mainly occurs among healthcare workers. Notification of WA-BM is mandatory for health services in Brazil. This work aims to describe the epidemiologic profile of work-related accidents with biological material (WA-BM) in Brazil.

METHODS: Data of WA-BM from 2007-2021 was gathered from the Information System of Notifiable Diseases (Sinan). Absolute and relative frequencies, proportional variation, and incidence rates (IR) per 100,000 workers were presented and analyzed by year with sociodemographic and occupation characteristics.

RESULTS: From 2007-2021, 720,076 WA-BM were notified in Sinan, with a sharp upward increase over the years, soaring from 15,735 cases in 2007 to 67,012 cases in 2019 (+325%), followed by a decline to 61,791 cases in 2021 (-8%), what may have happened due to interruption of several clinical cares and non-emergency surgeries because of the Covid-19 pandemic. IR was 17.3 cases x 100,000 workers in 2007, 70.3 in 2019, and 64.8 cases in 2021. Most cases occurred among women (77.1%), white (54.7%) or brown (29.7%), aged 20-34y (56.5%) or 35-49y (31.9%), with completed high school (41.1%) or undergraduate (23.4%). Most WA-BM were needlestick (67.3%) and sharp (6.9%) injuries, and affected nursing technician or assistant (47.2%), followed by nurses (8.0%), students – probably from health courses (6.0%), and clinical physicians (4.0%).

CONCLUSIONS: Unsafe working conditions, lack of training and information on occupational risks, and psychosocial hazards (e.g., time pressure, long working hours, and shift work) are the main drivers of WA-BM in health care facilities, resulting in illness, injuries, absenteeism, and high expenditures for the health sector. Thus, it is urgent to strengthen occupational health and safety programs at national and facility levels, to identify hazards, to promote exposure and incident reporting, and to provide education, training, and immunizations against infectious disease.

P-1114 Assessment of fungal hazards in archives based on nasal swab samples

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BACKGROUND AND AIM: Scientists are looking for exposure indicators that could accurately describe the impact of bioaerosols on workers' health. Especially useful in this regard seems to be the swabs collected from the nose or nasopharynx, which represent easy to obtain biological samples. The aim of this study was to identify a mycobiota occurring in the upper respiratory tract of archive workers as a result of work shift exposure.
METHODS: Eleven workers from three archives and two libraries participated in this study. Each of them was equipped with a personal measurement set consist of CIS sampler to check the concentration of inhalable dust and, after work shift, the swab samples from nasal cavity were collected. Qualitative mycobiota analysis was performed using culture-based method and isolated pathogens were additionally diagnosed based on MALDI-TOF MS.
RESULTS: The average fungal concentration in swab samples was 43 CFU/ml, (SD=59). In turn, the concentrations of airborne fungi were very variable and depended on the place of measurement (mean value: 2916 CFU/m^3, SD=3051). The qualitative analysis of the samples revealed the presence of 33 fungal species belonging to 17 genera. The swab samples were dominated by the yeast of Candida genus and filamentous fungi from Penicillium and Aspergillus genera. It was shown that 59% of identified fungal strains were simultaneously present in the air at workplaces and in the nasal cavities of employees. Two isolated fungal genera, i.e., Aspergillus and Microsporum, represent human pathogens classified in risk group 2, according to the Commission Directive (EU) 2019/1833.
CONCLUSIONS: As airborne fungi in archives and libraries can colonize the upper respiratory tract of workers, the microbiologcal analysis of nasal swabs can be a precise tool to assess the exposure to biological aerosol in this working environment.

KEYWORDS:
archive workers, exposure assessment, fungal aerosols, nasal swabs

P-1117 Mortality and cancer incidence in British military veterans involved in human experiments at Porton Down: 40-year follow-up

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BACKGROUND AND AIM: To investigate whether veterans involved in chemical warfare agents research at Porton Down have increased rates of mortality or cancer incidence.

METHODS: The study is a historical cohort study. Participants are male UK veterans who participated in the 'Service Volunteer Programme', 1941-1989, identified from Porton Down experiment books, and a comparison group of similar 'non-Porton Down' veterans identified from military personnel files. of 19,233 records retrieved for each group, 18,069 (94%) Porton Down and 17,588 (91%) non-Porton Down are included herein our study sample.
The main outcome measures – National Health Service Central Registry Data on mortality and cancer registrations up to December 2019.

RESULTS: Over a median follow-up of 48.1 years, 10,889 Porton Down veterans (60.3%) and 10,657 non-Porton Down veterans (60.6%) died. After adjustment for age, year of birth, and military service characteristics, overall, Porton Down veterans had a 7% higher rate of all-cause mortality compared to non-Porton Down veterans.
Associations with all-cause mortality were stronger for veterans who attended Porton Down between 1960 and 1964 (1.36, 95% CI 1.20 to 1.54), compared to other periods; likelihood-ratio test, p=0.006. for cause-specific mortality, Porton Down veterans had a statistically significantly higher rates of death from infectious and parasitic disease (5%), genitourinary (45%), circulatory diseases (5%), external causes (23%) and deaths attributable to alcohol (48%).
There was no association between attendance at Porton Down and overall cancer incidence (0.99, 0.95 to 1.03). although Porton Down veterans had higher rates of neoplasms of 'uncertain or unknown behaviour' (1.26, 1.04 to 1.53), but lower rates of 'other urinary tract' neoplasms (0.77, 0.60 to 0.98).

CONCLUSIONS: Overall, mortality rates were slightly higher in Porton Down veterans, but there was no difference in cancer incidence. Associations were stronger in Porton Down veterans who attended in the early 1960s.

P-1118 Seroprevalence of Hepatitis B and Hepatitis C Virus Among Inmates and Staff in Lafia Correctional Service, Nasarawa State, Nigeria

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BACKGROUND AND AIM: Hepatitis infection has remained a reoccurring health challenge in blood transfusion, liver cirrhosis and hepatocellular carcinoma (HCC). This cross-sectional study assessed the seroprevalence of Hepatitis B and Hepatitis C virus among inmates and staff in Lafia correctional service, Nasarawa State, Nigeria.
METHODS: A total of 160 samples comprising 120 inmates within the age range of 20-70 years and 40 staff were collected. Serological blood screening was done using the HBV surface antigen (HBsAg) rapid test Dip-strip and HCVAb plus rapid test strip. The socio-demographic factors in form of a structured questionnaire were conducted among consenting inmates and staff. The significance of risk factors on the prevalence of the hepatitis infection among inmates was analyzed using logistics regression.
RESULTS: A total seroprevalence of 29.16 % HBV and 8.3% HCV among inmates and 5% HBV and 2.5% HCV among staff was determined. A prevalence of 30% HBV and 8.18% HCV male, 20% HBV and 10% HCV female inmates, 7% HBV males and 9% HCV female staff were recorded. The prevalence of hepatitis infection among inmates and staff below 40 years was higher than the prevalence above 40 years although insignificant between the two age groups ($p \leq 0.05$). Married inmates at 48.8% HBV and 16.3% HCV were more infected than 18.18% HBV and 4% HCV single inmates and single staff were more infected than the married staff. Illicit drug use and length of stay above 5 years in the correctional service were risk factors significant for HBV and HCV prevalence among inmates.
CONCLUSIONS: A high seroprevalence of HBV and HCV infections among inmates and staff in Lafia correctional service, Nigeria and the predisposing risk factors reaffirm the need for sensitization and routine screening of inmates and staff before and during incarceration.

KEYWORDS: Hepatitis, seroprevalence, correctional service, Inmates, staff

P-1121 Prevalence and predictors of per- and polyfluoroalkyl substances (PFAS) serum levels among US volunteer firefighters

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are synthetic persistent compounds of health concern. Firefighters may be exposed to PFAS through firefighting foams, combustion products, and equipment/gear. Studies have shown elevated PFAS levels in paid firefighters. Few studies include volunteer firefighters, who comprise 67% of US firefighters. We assessed seroprevalence and predictors of PFAS levels among US volunteer firefighters enrolled in the Firefighter Cancer Assessment and Prevention Study (CAPS), a research partner of the Fire Fighter Cancer Cohort Study (FFCCS).

METHODS: Consenting firefighters (n=413) enrolled from 34 volunteer departments in four US states - Connecticut (CT), Maine (ME), Maryland (MD), and New Jersey (NJ). Participants completed a survey and provided blood samples, analyzed for PFAS by online solid phase extraction unit and HPLC-MS/MS instrumentation. We calculated prevalence and geometric means by location (a single NJ department (NJ-Dept1), NJ-Other, CT&MD, ME). for select PFAS (prevalence ≥75%), we assessed associations between PFAS (log-transformed) and age, firefighting years, monthly responses, and location in single-PFAS multivariate models.

RESULTS: Most participants were non-Hispanic White (91%), male (92%), with an average age of 45.2 years (sd 15.4) and 20.2 years (sd 15.7) of firefighting. Serum levels of the six PFAS were similar between locations, except perfluorodecanoic acid (PFDeA) was significantly higher in NJ-Dept1 than elsewhere (0.25ug/L, vs 0.08, 0.09, 0.08; $p<0.0001$) and perfluorooctanoic acid (PFOA) was higher in NJ-Other than elsewhere (2.35ug/L vs 1.96, 1.23, 1.29; $p<0.0001$). In multivariate analysis, PFOA and PFDeA were positively associated with age ($p=0.006$, 0.0736, respectively) and location ($p<0.0001$ (for all locations, ref = NJ-Dept1)), controlling for firefighting years and monthly responses.

CONCLUSIONS: We observed spatial differences in volunteer firefighters' serum PFOA and PFDeA levels. Further research is needed to better understand sources of PFAS among volunteer firefighters, including their primary occupations and community exposures.

KEYWORDS: PFAS, firefighters, volunteers

P-1123 Heat stress and incidence of acute kidney injury among agricultural workers in Spain

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BACKGROUND AND AIM: Heat stress (HS) is associated with adverse health outcomes among agricultural workers, including acute kidney injury (AKI). The aim on this study was to estimate the incidence of AKI over the course of the work shift and the association with HS among agricultural workers in Spain, where summer temperatures are high and heat waves are expected to be more frequent.

METHODS: Male agricultural workers were enrolled in the study in two different periods and provinces: summer harvesting season in Alacant (n=43, September 2018) and winter harvesting season in Tarragona (n=52, November 2018 and January 2019). for each participant we estimated exposure to HS during a work shift based on the wet bulb globe temperature (WBGT) index (ISO 7243:2017) and AKI cross-shift incidence, defined as an increase in post-shift serum creatinine by at least 0.3 mg/ dl or at least 1.5 times the pre-shift serum creatinine levels. We collected information on potential confounders. for a subsample of participants (n=54), we measured neutrophil gelatinase-associated lipocalin (NGAL) levels before and after the working shift. We used regression models to assess if heat stress is a risk factors for AKI and increase in NGAL levels.

RESULTS: Mean WBGT was 24.5 °C (20.2-27.1) during the summer harvesting season and 14.2 °C (8.0-20.7) during the winter harvesting season. Nine percent of workers harvesting during the summer months were exposed to HS. Incidence of AKI was higher during the summer harvesting season (33% versus 4%). HS was associated with cross-shift incidence of AKI [Age adjusted OR (95%CI) =9.6 (1.4, 67.9)]. No differences in NGAL levels were observed between participants exposed to HS.

CONCLUSIONS: Heat stress is a risk factor for AKI among agricultural workers in Spain even when environmental temperatures are not extremely hot.

KEYWORDS:
Heat stress, Acute kidney injury, Agricultural workers, Mediterranean region

P-1124 Association between diesel exhaust exposure and mitochondrial DNA methylation

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BACKGROUND: Diesel exhaust is an established human carcinogen, however the mechanisms by which it leads to cancer development are not fully understood. Mitochondrial dysfunction is an established contributor to carcinogenesis, and recent studies have improved our understanding of the role played by epigenetic modifications in the mitochondrial genome on tumorigenesis. In light of these developments, we aim to evaluate the association between diesel engine exhaust (DEE) exposure with mitochondrial DNA (mtDNA) methylation levels in workers exposed to DEE.

METHODS: The study population consisted of 53 male workers employed at a diesel engine manufacturing facility in Northern China who were routinely exposed to diesel exhaust in their occupational setting, as well as 55 unexposed male control workers from other unrelated factories in the same geographic area. Exposure to DEE, elemental carbon as a DEE surrogate, organic carbon, and particulate matter (PM2.5) were assessed. mtDNA methylation for CpG sites (CpGs) from seven mitochondrial genes (D-Loop, MT-RNR1, MT-CO2, MT-CO3, MT-ATP6, MT-ATP8, MT-ND5) was measured in blood samples. Linear regression models were used to estimate the associations between DEE and mtDNA methylation levels, adjusting for potential confounders. The associations between elemental carbon, organic carbon, and PM2.5 exposures with mtDNA methylation levels were also assessed.

RESULTS: DEE exposure was associated with decreased MT-ATP6 (difference = -35.6%, p-value = 0.019) and MT-ATP8 methylation (difference = -30%, p-value = 0.029) compared to unexposed controls. Exposures to elemental carbon, organic carbon, and PM2.5 were also significantly and inversely associated with methylation in MT-ATP6 and MT-ATP8 genes (all p-values < 0.05).

CONCLUSIONS: Our findings suggest that DEE exposure perturbs mtDNA methylation, which may be of importance for tumorigenesis.

KEYWORDS: Diesel exhaust, mitochondrial DNA methylation

P-1128 Impact of COVID-19 Pandemic on Military Medical Encounters and Musculoskeletal Injuries

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BACKGROUND AND AIM: Musculoskeletal injuries (MSKI) are the leading cause of outpatient medical encounters in the U.S. Army, and trends have remained stable over the past decade. The COVID-19 pandemic has altered healthcare use and workplace and lifestyle patterns, potentially affecting injury trends. We investigated the impact of the pandemic on healthcare use and injuries within the Army.

METHODS: We quantified medical encounters (all, in-person only, telephone consults only) and incident MSKI from electronic medical records among active duty soldiers from April 2016 through March 2021. We compared weekly counts before and after the COVID-19 national emergency declaration on March 13, 2020 in an interrupted time-series analysis using autoregressive integrated moving average models accounting for time and seasonal trends.

RESULTS: From April 2016 to March 2020, the mean (SD) weekly count was 125,953 (20,782) for all medical encounters [in-person: 113,249 (19,139); telephone consults: 17,053 (2,536)] and 11,016 (1,907) for MSKI. Weekly counts for all and in-person medical encounters and MSKI decreased and telephone consults increased in the month following the declaration. All medical encounters gradually returned to levels predicted in the absence of the pandemic, yet the reductions for in-person medical encounters [-13,405 (95% CI: -21,516, -5,294)] and MSKI [-1,933 (95% CI: -2,812, -1,056)] and increases in telephone consults [1,530 (95% CI: 566, 2,496)] were sustained through March 2021.

CONCLUSIONS: Observed trends in healthcare use during the pandemic differed from previous years. All medical encounters appeared to have returned to predicted levels. While activities in the Army have largely resumed, the sustained reduction in MSKI is likely multifactorial and may be due to shifts in healthcare access and use.
The views expressed are those of the authors and do not reflect the official policy of the Department of Army, Department of Defense, or the U.S. Government.

KEYWORDS: COVID-19, occupational epidemiology

P-1129 Multiple Myeloma in Radiography Testing Worker

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BACKGROUNDS: Radiography Testing (RT) is a non-destructive testing method mainly using x-ray and γ-rays emitted from Ir192 and Co60 nuclides. X-rays, and γ-rays are reported by International Agency for Research on Cancer (IARC) as carcinogens inducing multiple myeloma in human with limited evidences. In this study, the amount of exposure to radiation and probability of causation (PC) of multiple myeloma were assessed in a 65-year-old of patient who worked as an inspector in shipyards and plumbing works using radiation for 9 years.

METHODS: Cumulative radiation exposure was calculated using the records of past personal dosimeter and previous studies. PC developed by the Occupational Safety and Health Research Institute (OSHRI) and Radiation Health Research Institute was used to assess the causal relationship between radiation exposure and disease under exposure scenarios.

RESULTS: Considering that the patient rarely used the collimator nor shielding equipment during works at shipyard (1983~1988), we calculated the radiation exposure under the scenario assuming collimator was used in half at shipyard work. The radiation exposure dose of workers was estimated to be a minimum of 73.76mSv and a maximum of 1688.34mSv. The PC accounting for attribution of radiation to the cancer was 47.74% applying the upper 95th confidence value.

CONCLUSIONS: The work-relatedness between RT without using protective equipment and shielding in the past and multiple myeloma was approved by the Epidemiological Investigation and Evaluation Committee for this case.

KEYWORDS: Occupational disease, Multiple myeloma, Radiography testing, Radiation exposure dose, KOSHA-PEPC

P-1131 Tracking the SARS-CoV-2 Omicron (B. 1.1. 529) health and economic impact by occupational sector

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BACKGROUND: Real-time outbreak patterns during the COVID-19 pandemic have been crucial to provide quick response, prevention and attention programs. Workers reflect a country's population, hence, paid sick leaves (short-term disability claims, STDC) can track epidemics, including the current pandemic. Our aim was to assess the impact of Omicron by occupational sector/subsector among N=19,961,714 private-sector workers affiliated to the Mexican Social Security Institute.

METHODS: We used STDC that had a linked SARS-CoV-19 diagnostic test between January and March 4, 2022. There were n=1,543,730 STDC and n=663,245 of them with a test. We calculated the positivity rate, lost work days (LWD), and relative risks (RR) of Omicron vs the same epidemiological weeks for the first, second and Delta COVID waves by economic sector/subsector.

RESULTS: Workers were 36±10.7 years old and 47% were men. We saw an 85.4% positivity rate, with an average of 6.8±3 LWD, representing 528.3 LWD per 1,000 workers. The RR of Omicron was highest compared to the first wave (RR= 1.84; 95%CI: 1.83, 1.84) with the Accommodation (RR= 3.98; 95%CI: 3.89, 4.07) and Educational Services-arts-entertainment-recreation (RR= 2.41; 95%CI: 2.37, 2.46) sectors having the highest RRs. The RR of Omicron vs Delta was the next highest RR= 1.29; 95%CI: 1.29, 1.29) with Health Care and Social Assistance (RR= 2.15; 95%CI: 2.12, 2.19) and Social and Community Services (RR= 1.79; 95%CI: 1.78, 1.81) having the highest RR. Omicron vs the second wave had a RR of 1.07; 95%CI: 1.07, 1.07, with Accommodation (RR= 1.40; 95%CI: 1.38, 1.41) and Educational Services-arts-entertainment-recreation (RR= 1.60; 95%CI: 1.57, 1.62) sectors having the highest RRs.

CONCLUSIONS: Omicron spread more effectively than the previous COVID-19 and Delta waves in Mexico, affecting the touristic and health care sectors more importantly, reflecting the entrance of the variant to the country through tourism.

KEYWORDS: Omicron impact, occupational sector, Mexico

P-1132 Anxiety, Depression and Post Traumatic Stress Syndrome and their Association with Presenteeism among a COVID-19 Hospital in Mexico City

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BACKGROUND AND AIM: Hospital workers providing care to COVID-19 patients have reported depression, anxiety and post-traumatic stress disorder (PTSD). These pathologies could be related to job presenteeism, decreasing productivity. Our aim was to analyze the association between depression, anxiety and PTSD, and job presenteeism among hospital workers.

METHODS: We applied a sociodemographic questionnaire, the Hospital Anxiety and Depression Scale (HADS), the Global Evaluation of Post-traumatic Stress (EGEP-5) Scale and the Stanford Presenteeism Scale (SPS-6) to n=272 workers of a COVID-dedicated hospital of the Mexican Social Security Institute in Mexico City. We used logistic regression models to analyze the odds of presenteeism associated with depression, anxiety and PTSD separately, adjusted for sex, age, marital status, education, direct contact with COVID patients and previous COVID-related incident (eg. being sick themselves or a relative).

RESULTS: Participants had a mean age of 32 years and 78% were female. 5.5% had depression, 18% anxiety and 19.1% PTSD. Presenteeism in the last month was 45.2%. The odds of presenteeism among those with depression were OR=5.69 (95%CI: 1.44, 22.47), among those with anxiety OR=18.93 (95%CI: 6.80, 52.71) and among those with PTSD OR=4.64, (95%CI: 2.19, 9.80). The odds of presenteeism among those caring directly for COVID patients were: depression OR=3.48 (95%CI: 2.03, 5.96), anxiety OR=4.49 (95%CI: 2.44, 8.24), PTSD OR=3.62 (95%CI: 2.08, 6.29). In the model for depression the odds for those having a previous COVID-related incident was OR=2.04 (95%CI: 1.20, 3.46). Women had larger odds of presenteeism than men in the depression OR=2.03 (95%CI: 1.05, 3.93) and the PTSD OR=2.03 (95%CI: 1.05, 3.93) models.

CONCLUSIONS: Depression, anxiety and PTSD were strongly associated with job presenteeism among hospital workers, pointing at the relevance of providing mental care for workers, especially those directly in contact with COVID patients.

KEYWORDS: Presenteeism, Mental Health, COVID-19 health care workers

P-1135 Lost work days associated with long COVID among healthcare workers

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BACKGROUND AND AIM: Long COVID among healthcare workers may have an important impact on productivity. Our aim was to analyze lost work days (LWD) related to long COVID among healthcare workers.

METHODS: We analyzed data from n=2,330 healthcare workers from the Mexican Social Security Institute previously diagnosed with SARSCoV-2, that submitted at least one short term disability claim (STDC) for a post-COVID symptom (April 2020-August 2021). Outcome was the sum of LWD for main reported post-COVID symptom for STDC submitted. Post-COVID symptoms included those reported by the literature at the time of the study, and categorized as: circulatory, kidney and liver symptoms (CKL), mental and behavioral disorders (MB), nervous system symptoms (NS) and respiratory symptoms (RS). We used linear regression to model adjusting for age, sex, work category (assistant to COVID attention (REF), direct COVID-patient contact and, administrative/no COVID attention), hospitalization due to SARSCoV-2 infection, having a STDC previous to SARSCoV-2 with the same post-COVID symptom and if the STDC was classified as work-related.

RESULTS: Participants had a mean age of 41±9 years and 70% were women. MB were most frequent (45%), followed by RS (30%), CKL (14%) and NS (11%). LWD were on average of 23±39 and n=312 participants submitted more than one STDC. Compared to RS, all categories were associated with increased LWD, NS: ß= 17.26 (95% CI: 2.46, 14.89), CKL: ß= 8.51 (95% CI: -3.49, 13.53) and MB: ß= 8.08 (95% CI: 4.36, 11.79). Sex was not associated with LWD, whereas all covariates were associated with increasing LWD, with work-related STDC classification having the strongest association (ß= 24.14, 95% CI: 17.42, 30.86).

CONCLUSIONS: LWD due to long COVID among healthcare workers increased the most among those with NS and especially for STDC classified as work-related.

KEYWORDS: long COVID, healthcare workers, lost work days.

P-1137 Epidemiological profile of work-related Covid-19 in Brazil, 2020-2021

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Covid-19 is the newest occupational disease, and its transmission patterns can lead to high rates among workers. This work aims to describe the epidemiological profile of work-related Covid-19 cases in Brazil.

METHODS: Descriptive study using notifications of work accidents by Covid-19 (B34.2) from 2020 and 2021. Data were collected from the Notifiable Diseases Information System (Sinan). Absolute and relative frequencies of sociodemographic characteristics and occupation groups were presented, and Incidence Rates (IR) per 100,000 workers calculated.

RESULTS: In 2020 and 2021, 70,618 cases of work-related Covid-19 were reported, with a mean IR of 37.2 cases per 100,000 workers. Most cases occurred among women (65.1%), brown (36.1%) or white (33.0%), aged between 35-39y (17.4%) and 40-44y (15.4%), with more than 8 years of study (60.2%). The most affected workers were nursing technicians or assistants (25.6%), followed by nurses (10.0%), doctors (5.1%), and administrative agents, assistants or auxiliaries (5.1%). Approximately 70.1% cases progressed clinically to cure, 14.5% to temporary disability and 2.0% to death caused by Covid-19.

CONCLUSIONS: Covid-19 has driven several physical, social and economic impacts to workers globally. In Brazil, frontline workers, particularly healthcare workers, appear to have a high probability of infection. Lack or misuse of protective equipment, workplaces with person-to-person physical contact, inadequate ventilation, shared eating, and accommodation areas, can be considered the main causes of outbreaks of Covid-19 at work. Despite most cases has progressed to cure, the impacts of long Covid-19 are still unknown and must be further investigated.

P-1139 Correlation between per- and polyfluoroalkyl substances (PFAS) in seminal plasma and semen quality parameters in firefighters

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BACKGROUND AND AIM: For decades firefighters have used aqueous film-forming foam (AFFF) to extinguish specific types of fires. Some of the AFFF formulations contains per- and polyfluoroalkyl substances (PFASs). PFASs exposure was reported to induce male reproductive toxicity in toxicological studies. Further current epidemiological studies linked increased exposure to PFASs with lowered testosterone and semen quality. As firefighters are exposed during their service to PFASs to a much greater extent than the general population we aim to evaluate the associations between occupational exposure to PFASs and semen quality and spermatozoa DNA damage.
METHODS: We developed an analytical method based on solid phase extraction followed by liquid chromatography tandem mass spectrometry (LC/MSMS) to detect selected PFASs in human seminal plasma. Subsequently, concentrations of PFASs in seminal plasma were determined among 23 firefighters recruited from a local fire-training center. The relationship between PFASs concentrations with semen quality parameters and DNA integrity will be addressed by statistical methods.
RESULTS: We screened in total for 16 PFASs in seminal plasma commonly found in AFFF. The highest detection frequency was observed for perfluorooctanoic acid (PFOA). Associations of PFASs concentrations with semen quality parameters, DNA integrity measures will be assessed by logistic or linear regression models with adjustment for potential confounders.
CONCLUSIONS: Several PFASs were detected in seminal plasma samples of male firefighters. Further we aim to test the potential effect of the substances on semen quality.

KEYWORDS:
Male infertility, occupational exposure, firefighters, per- and polyfluoroalkyl substances, spermatozoa

P-1140 Effects of heat exposure on occupational injuries in the agricultural sector in Italy

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BACKGROUND AND AIM: – The health effects of extreme temperatures at population level are well known. However, the effects on occupational injuries in different sectors have been scarcely investigated.

METHODS: We collected work-related injuries in the agriculture sector occurring in the 8,090 Italian municipalities from the Italian national workers' compensation authority (INAIL) between 2014-2018. Daily air temperatures from Copernicus ERA5-land were used to define exposure at municipality level. First, we applied distributed lag non-linear models (DLNM) to estimate the association between daily mean air temperature and injuries at regional level; then meta-analysed results to have overall estimates. The relative risk (RR) and attributable cases of agriculture-related injuries for an increase in mean temperature above the 75th percentile were estimated, as well as heatwave effects. Analysis were also stratified by age, duration of leave and professional qualification.

RESULTS: Analysis were conducted on 150,422 agricultural injuries. The overall relative risk of agricultural work-related injuries for an increase in temperatures was 1.13 (95%CI: 1.08; 1.18). The number of injuries attributable to heat is of 2050 cases in the considered period. A higher risk was observed among young workers (1.23 95% CI: 1.14; 1.34) and seasonal workers (1.25 95% CI: 1.03; 1.52). When considering duration of leave, a proxy of severity of heat-related injuries, the greatest risk and frequency was observed for short duration between 0-14 days (1.21 95% CI: 1.10; 1.33) with a decreasing trend. Considering extreme heat wave events, the risk of injuries in the agricultural sector was of 1.04 (95% CI: 1.01; 1.08).

CONCLUSIONS: Occupational exposure to extreme temperatures is a critical issue considering climate change especially among sectors engaged in outdoor and labour-intensive activities such as the agricultural sector. These results can help promote specific prevention actions for workers.

KEYWORDS: Work-related injuries; heat waves; agricultural sector.

P-1142 Deployment-Related Decline in Physical Fitness Increases Risk of Injury in U.S. Army Soldiers

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BACKGROUND AND AIM: Aerobic performance had been shown to decline during military deployment. Low levels of cardiorespiratory and muscular endurance may increase injury risk. We evaluated whether deployment-related declines in cardiorespiratory and muscular endurance increased injury risk.

METHODS: The study population was all U.S. Army Soldiers (N= 6,080) who had completed the Army Physical Fitness Test (APFT) 90 days before and after deployment from 2016-2019. We defined injury as receiving an injury-related lost or limited-duty profile within 1-year post-deployment. We used mixed models to evaluate change in 2 mile-run time, 2-minute repetition maximum for pushups and sit-ups and overall APFT score. We used logistic regression models to evaluate relationships between changes in all scores on injury risk. We adjusted the models for pre-deployment event performance, prior injury, change in BMI, deployment duration, age and sex.

RESULTS: 2-mile run time increased on average 16.6 seconds (95% CI: 12.6, 19.8) and overall APFT score declined 2.15 points (95% CI: -3.35, -0.94) after deployment. Pushups and sit-ups scores did not change after deployment. for every one minute increase in post-deployment run time, one point decrease in overall APFT score and one pushup decrease, the odds of receiving an injury-related profile increased by 6% (95% CI: 1.01, 1.11), 0.3% (95% CI: 0.995, 0.999) and 0.8% (95% CI: 0.986, 0.998), respectively.
CONCLUSIONS: We demonstrated that deployment-related declines in APFT-derived measures of physical fitness increased injury risk within 1-year post-deployment. Our findings suggest that maintaining pre-deployment cardiorespiratory and muscular endurance may be an effective strategy to attenuate injuries and lost duty time post-deployment.

KEYWORDS: deployment, physical fitness, injuries
Disclaimer: The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army or of the U.S. Department of Defense.

P-1144 Soil, sewage sludge and digestate samples contamination with Gram-negative bacteria from Enterobacteriaceae

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BACKGROUND AND AIM: In Poland, organic fertilizers may be used in agriculture, if no Salmonella are found in 100 g of the sample and the number of Enterobacteriaceae is lower than 1000 cfu/g. However, there are no standards of microbiological contamination methods dedicated directly to sewage sludges or digestate. The aim of the study was to assess the contamination levels of Enterobacteriaceae in sewage sludge, digestate and arable soil samples.

METHODS: The microbiological tests included 82 soil samples, 9 sewage sludge and 9 digestate samples. Due to the lack of applicable standards in the field of microbiological testing of sewage sludge and digestate for the presence of pathogenic bacteria, the tests were based on the procedures used to test soil, feed, and food. Detection of Salmonella, was performed according to the standard PN-Z-19000-1/2001, Escherichia coli - PN-EN ISO 16649-2:2004, the total number of bacteria - PN-EN ISO 4833-2:2013-12/AC, and Enterobacteriaceae - PN-EN ISO 21528-2:2017-08.

RESULTS: The total number of mesophilic bacteria ranged from 1,1 x105 to 1,0 x106 cfu/g, from 0,1 x108 to 9,8 x108 cfu/g, and from 1,6 x103 to 5,7 x108 cfu/g for soil, digestate and sewage sludge samples, respectively. for the soil samples, contamination with Enterobacteriaceae, was estimated at an average level of 1,1 x104 cfu/g, while for sewage sludge and digestate samples these values were 9,4 x105 cfu/g and 5,6 x106 cfu/g, respectively. The presence of Escherichia coli was confirmed in 2 soil, 6 digestate and 4 sewage sludge samples. None of the samples were contaminated with Salmonella, excluding one positive of digestate sample.

CONCLUSIONS: The development of standards for the use of sewage sludge and digestate as fertilizers should take into account microbiological contamination with Enterobacteriaceae.

KEYWORDS: Soil, sewage sludge, digestate, Enterobacteriaceae.
FUNDING: The research was financed by NCBiR (Poland); Project No.: GOSPOSTRATEG-III/0061/2020-00.

P-1145 Species diversity of bacteria isolated from soil, sludge sewage and digestate

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BACKGROUND AND AIM: Scientific research confirms the positive aspects of the using sludge to improve the physical, chemical and biological properties of soil. Organic compounds are well absorbed by plants, and thus the value of their organic matter increases. The one of the main difficulties in the management of sewage sludge or digestate are bacteria, which may cause humans' infections The aim of the study was to species identification of bacteria from the Enterobacteriaceae family and chosen Gram-positive bacteria presented in soil, sewage sludge and digestate.

METHODS: Identification of bacteria isolated from arable soil (82), sewage sludges (9) and digestate (9) samples was based on biochemical (ENTEROtest 24N, NEFERMtest 24N, GEN III MicroLog M System) and genetic methods. Total DNA from bacterial cultures was isolated using Qiamp® DNA Mini Kit. PCR reaction was performed with primers complementary to the conserved ribosomal DNA regions of most bacterial species, including the 16S rRNA genes. Sequencing was performed on ABI Prism 310 Genetic Analyzer (Applied Biosystems, USA).

RESULTS: From the soil samples, Gram-negative bacteria belonging to the genus Serratia, Citrobacter and Enterobacter were identified most frequently. The other identified bacteria species were: Pantoea agglomerans, Escherichia vulneris, E. coli, Hafnia alvei, Aeromonas salmonicida, A. hydrophila, Kluyvera intermedia, Rahnella aquatilis, Raoultella terrigena, Buttiauxella gaviniae, Klebsiella pneumoniae. Bacteria isolated from the sewage sludges and digestate included: Yersinia intermedia, Y. enterolitica, Y. frederiksenii, E. coli, Enterobacter cloacae, Klebsiella oxytoca, K. pneumoniae, Morganella morganii, Aeromonas salmonicida, Proteus mirabilis. Salmonella johannesburg and Listeria monocytogenes have been found in one and in 2 samples, respectively.

CONCLUSIONS: Standards relating to the use of sewage sludge and digestate for fertilization in agriculture should take into pathogenic/potentially pathogenic bacterial species presented in organic additives.

KEYWORDS: Bacteria species, Enterobacteriaceae, soil, sewage sludge, digestate.
FUNDING: The research was financed by NCBiR (Poland); Project No.: GOSPOSTRATEG-III/0061/2020-00.

P-1148 Cholangiocarcinoma and pleural mesothelioma: asbestos exposure as a shared risk factor? A comparison of age-standardized incidence rates in Italy

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BACKGROUND AND AIM: Cholangiocarcinoma (CC) is the second most common primary liver malignancy. Anatomically, CC is divided into intrahepatic (ICC) and extrahepatic (ECC) forms. A possible causal association between ICC and exposure to asbestos has been hypothesized. To support this, we compared age-standardized incidence rates (ASR) of CC and malignant pleural mesothelioma (MPM) in Italy considering that asbestos is thought one of the major risk factors for MPM.
MATERIALS AND

METHODS: We extracted ASR of ICC, ECC and MPM reported by 36 Italian cancer registries and listed in the last report on Cancer Incidence in Five Continents of the IARC. Data referred to 2008-2012 and covered 29 million population. We used linear regression analysis to evaluate the possible association between ASR of ICC, ECC and MPM. Analyses were stratified by sex.

RESULTS: From 2008 to 2012 ASR per 100,000/years in men ranged: 0.4-2.2 for ICC, 0.5-1.8 for ECC, and 0.0-0.7 for MPM. In women, ASR per 100,000/years ranged: 0.2-1.0 for ICC, 0.1-1.3 for ECC, and 0.0-0.6 for MPM. at regression analysis ICC did not report an association with MPM in men (beta coefficient -0.044, 95%CI -0.980–0.892) and women (beta coefficient -0.093, 95%CI -0.670–0.485). No association was detected for ECC as well.

CONCLUSIONS: This crude analysis does not appear to support the hypothesis that CC could be associated to exposure to asbestos. This could be related to the large amount of known and suspected risk factors for CC that include common liver diseases due to genes, viruses and personal habits. Analyses adjusted for aggregated data might help disentangle this issue.

KEYWORDS: Asbestos, Cholangiocarcinoma, age-standardized incidence rates.

P-1149 Occupational sectors and cancer mortality in a large administrative cohort

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BACKGROUND AND AIM: The International Labor Organization estimates 2.4 million work-related deaths every year. We aimed to investigate the role of the occupational sector in cancer mortality.

METHODS: We used the 2011 census cohort of Rome, including all residents aged 30+ years. We retrieved the information on occupational sectors from the 70s to 2011 for private-sector workers from the National Social Insurance Agency (INPS) database. We classified the occupational sectors into 23 categories and modeled occupational exposure as ever/never been employed in each sector. We followed the subjects from the census reference day (9 October 2011) to 31 December 2019, investigating cancer mortality overall and site-specific cancers (larynx, lung, pleura, kidney, liver). We used Cox regression models to estimate the age and sex-adjusted hazard ratio (HR) with 95% confidence intervals (CI) of being employed in an occupational sector. In addition, we performed the analyses for males and females separately.

RESULTS: We analyzed a cohort of 910,559 (53% males). We found evidence of a higher cancer mortality risk in workers of the paper and print industry for lung and pleural cancer (HR=1.22 95%CI:1.08-1.38 and HR=2.19 95%CI:1.18-4.05, respectively), food and tobacco for lung cancer (HR=1.34 95%CI:1.15-1.55), building construction industries for liver, lung and pleural cancer (HR=1.44 95%CI:1.21-1.63, HR=1.29 95%CI:1.20-1.39, HR=1.99 95%CI:1.32-3.00, respectively), hotels and restaurants sector for liver and lung cancer (HR=1.30 95%CI:1.05-1.61 and HR=1.27 95%CI:1.15-1.41), hairdressers for liver, larynx and lung cancer (HR=1.65 95%CI:1.30-2.10, HR=1.99 95%CI:1.05-3.80, HR=1.44 95%CI:1.28-1.62), and waste workers for lung cancer (HR=2.04 95%CI:1.34-3.10). The analyses by gender confirmed the results.
CONCLUSION:
The results confirm the well-known associations between occupational exposures (characteristic of specific sectors) and cancer mortality and highlights sectors with elevated cancer risk. Administrative data might be a valuable tool in occupational epidemiology research.

P-1150 Night shift work and altered metabolic profile among hospital female nurses: results from a targeted metabolomic approach

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BACKGROUND AND AIM: Shift work, especially including night shift (NSW), has been found associated with several diseases, including obesity, diabetes, cancers, and cardiovascular, mental, gastrointestinal and sleep disorders. Metabolomics (an omics-based methodology) may shed light on the mechanisms underlying these associations, which are not yet fully understood. We thus aimed to evaluate the effect of NSW on serum metabolites in a sample of hospital female nurses.

METHODS: We recruited 46 nurses currently working in NSW in Milan (Italy), matched to 51 colleagues not employed in night shifts. Participants filled in a questionnaire on demographics, lifestyle habits, personal and family health history and work, and donated a blood sample. The metabolome was evaluated through a validated targeted approach measuring 188 metabolites. Only metabolites with at least 50% observations above the detection limit were considered, after standardization and log-transformation. Associations between each metabolite and NSW were assessed applying Tobit regression models and Random Forest, a machine-learning algorithm.

RESULTS: When comparing current vs. never night shifters, we observed lower levels of 21 glycerophospholipids and 6 sphingolipids, and higher levels of serotonin (+171.0%, 95%CI: 49.1-392.7), aspartic acid (+155.8%, 95%CI: 40.8-364.7), and taurine (+182.1%, 95%CI: 67.6-374.9). The latter was higher in former vs. never night shifters too (+208.8%, 95%CI: 69.2-463.3). Tobit regression comparing ever (i.e., current + former) and never night shifters returned similar results. Years worked in night shifts did not seem to affect metabolite levels. The Random-Forest algorithm confirmed taurine and aspartic acid among the most important variables in discriminating current vs. never night shifters.

CONCLUSIONS: This study, although based on a small sample size, shows altered levels of some metabolites in night shift workers. If confirmed, our results may shed light on the mechanisms potentially underlying the association between NSW and several pathologic states.

KEYWORDS: night shift work, targeted metabolomics, machine learning

P-1151 Towards the Exposome Project for Health and Occupational Research (EPHOR) Mega Cohort

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BACKGROUND AND AIM: Existing cohort studies in Europe capturing occupational information enrol millions of persons. They are invaluable resources for understanding relationships between occupation and health. Within the Exposome Project for Health and Occupational Research (EPHOR) we aim to systematically construct a mega cohort combining data from multiple individual cohort studies to study the working life exposome and health.

METHODS: Participating cohorts are registered in an open online inventory containing cohort meta-data. A set of harmonised variables is being prepared, including occupational as well as non-occupational factors (personal, lifestyle, sociodemographic, other), and a framework for de-centralized large-scale pooling of data for epidemiological analyses is being implemented. Lifetime occupational histories are being coded and harmonised across coding systems and will be linked with a European Job-Exposure Matrix (JEM) being developed. A range of harmonised outcome data including cancer, as well as respiratory, metabolic and cardiovascular, neurodegenerative, and musculoskeletal diseases, mental disorders, and work participation will be defined based on registry, record, or other follow-up methods.

RESULTS: The EPHOR mega cohort currently includes participation of 28 cohorts from eight European countries, as well as multi-country studies, containing data on over 20 million participants. Initial cohorts were selected from the inventory with cancer diagnoses, respiratory outcomes, and/or information on working time prioritised in this first phase. Additional cohorts will be invited to participate here. The mega cohort will be used for a range of exposome analyses including 1) systematic and agnostic exploration of multiple risk factors in relation to health outcomes, 2) to identify vulnerable life stages and population subgroups, 3) to study rare exposures/outcomes.

CONCLUSIONS: We expect collaboration to be useful to explore relationships between occupations, multiple work-related exposures and health. The mega cohort is intended to be a long-term resource for occupational health researchers.

KEYWORDS: cohorts, data pooling, exposome, harmonisation, occupation

P-1154 Rotating night shift work, sleep and thyroid cancer risk in the Nurses' Health Study 2

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BACKGROUND AND AIM: Thyroid cancer is the most common endocrine malignancy with rising incidence worldwide. We prospectively evaluated whether rotating night shift work and sleep disturbances are associated with incident thyroid cancer risk in the Nurses' Health Study 2 (NHS2).

METHODS: We assessed rotating night shift work (≥3 nights/month) history (cumulative number of years) at baseline and throughout follow-up (1989-2015) and sleep duration and sleep difficulty in 2001. Cox proportional hazard models, adjusted for potential confounders were used to calculate thyroid cancer hazard ratios (HR) and 95% confidence intervals (CI) for shift work history (0.1-4.9yrs, 5-9.9yrs, 10+yrs), sleep duration (≤5, 6, 7, 8, ≥9hours) and difficulty falling or staying asleep (little or none of the time, sometimes, most or all of the time). We further stratified the analyses of night shift work by sleep characteristics.

RESULTS: We identified 588 incident cases among 114,534 women. We observed no association between night shift work history and thyroid cáncer risk (1-4.9 years: HR 1.19, 95% CI 0.98, 1.44; 5-9.9 years: HR 1.13 95% CI 0.86, 1.48; ≥10 years: HR 1.10, 95% CI 0.78, 1.54; Ptrend=0.55). Sleep difficulty was suggestively associated with higher incidence of thyroid cancer when reported sometimes (HR 1.26, 95% CI 0.95, 1.67) and most or all the time (HR 1.35, 95% CI 1.00, 1.81; Ptrend=0.03), compared to little or none of the time. Participants with >10 years of night shift work and ≤6 hours of sleep had a 2-fold increase in thyroid cancer risk (HR 2.23; 95%CI, 1.08-4.06). Shift workers with <5 years of shift work and frequent sleep difficulty had an increased risk of thyroid cancer (HR 1.95; 95% CI 1.03, 3.67).

CONCLUSION:

We found evidence that rotating night workers with frequent sleep difficulty or short sleep had an increased risk of thyroid cáncer.

KEYWORDS: night work, thyroid cancer

P-1155 Associations between BTEX-H/THC and neurological symptoms among Deepwater Horizon oil spill workers

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BACKGROUND AND AIM: Hydrocarbons are considered to be neurotoxic. However, less is known about health effects of generally lower exposures during oil spill response and clean-up. The Gulf Long-Term Follow-up (GuLF) Study follows individuals who were either involved in cleanup efforts ("workers") or were trained but not hired ("non-workers") following the 2010 Deepwater Horizon disaster. We studied the association of neurological symptoms with exposure to benzene, toluene, ethylbenzene, xylenes, and hexane (BTEX-H) individually and as a mixture among 23,641 workers.

METHODS: At enrollment, participants self-reported frequency of neurological symptoms including dizziness, nausea, sweating, heart palpitations, fatigue, insomnia, migraines, tingling, numbness, blurred vision, stumbling, and seizures in the preceding 30 days. Cumulative inhalation exposure to BTEX-H chemicals and total hydrocarbons (THC) was estimated using a job exposure matrix linking air measurement data to detailed self-reported cleanup work histories. We calculated adjusted prevalence ratios (PR) and 95% confidence intervals (CI) for the association between quartiles of exposure and neurological symptoms reported all or most of the time using multivariable log-binomial regression. Quantile G-computation was used to estimate the per-quartile increase in joint effects of the BTEX-H mixture on neurological symptoms.

RESULTS: 31% of participants reported experiencing at least one, and 21% reported 2 or more, neurological symptoms within the last 30 days. Exposure to THC was associated with increased risk of two or more neurological symptoms (Q4 vs. Q1 PR=1.57 (95% CI:1.45, 1.70)), with similar results observed for the individual BTEX-H chemicals. A quartile increase in exposure to the BTEX-H mixture was associated with an increased risk of reporting two or more neurological symptoms (PR=1.18, (95% CI: 1.15, 1.21)).

CONCLUSIONS: Exposure to oil spill-related THC and BTEX-H was associated with increased prevalence of neurological symptoms among cleanup workers.

KEYWORDS: Occupational epidemiology, crude oil, BTEX, neurological symptoms, disaster

P-1156 Forging Community Partnerships to Examine Pesticide Exposure and Risk Perceptions among Latinx Farmworkers

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BACKGROUND: Research with structurally marginalized populations has a history of being extractive and providing a benefit primarily to the researchers rather than the participants. To address these concerns, there is an increasing emphasis in the field of environmental epidemiology to conduct community-based work and return exposure results to study participants. The aim of this work is to forge partnerships with trusted community organizations to support and help facilitate a mixed-methods investigation of pesticide exposure and risk perceptions among Latinx farmworkers, a population that faces many barriers to health protection. We further aim to create multi-media science communication products to effectively translate individual- and group-level study findings and to increase engagement and empowerment among participants.

METHODS: We focused six months of the one-year study period prior to data collection on community engagement and gaining trust, first with community partners and then study participants. We used various strategies, including social media engagement, holding teleconference and in-person meetings, and snowball sampling to establish and build upon existing partnerships. Focusing our study on the benefit to participants and research communication plan was key in obtaining buy-in from community partners.

RESULTS: We partnered with County Health Coalitions; migrant head start programs; non-profit organizations; housing providers; social media groups; and mobile health clinics to recruit participants, establish trusting relationships, and develop strategies to maximize the benefits of participating in the study. Examples include developing tailored research communication products; providing food boxes with organic, culturally appropriate food items; and providing childcare during data collection events.
CONCLUSION: Forging collaborations with diverse individuals and community groups is critical in establishing trust with structurally marginalized populations. Our work provides an example of how to develop these partnerships, center community priorities, and maximize the benefit of participation both for study participants and partner organizations.

KEYWORDS: pesticides, farmworker, community-engaged research

P-1157 The association between working with poultry and esophageal cancer mortality; a case-cohort study

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BACKGROUND AND AIM: Certain avian retroviruses are carcinogenic to poultry and potentially harmful to exposed persons. Higher rates of certain cancers are observed among poultry workers. We aimed to investigate the association between working with poultry and esophageal cancer while concurrently investigating other occupational and non-occupational risk factors.

METHODS: We conducted a case-cohort analysis from an American cohort of members of the United Food and Commercial Workers International Union (N=46,816). We conducted follow-up from 1950-2019 through the National Death Index. Cases consisted of those who died of esophageal cancer. A subcohort was randomly selected (N=2,666). We interviewed participants/relatives by telephone about their work and personal life (4,948 questions). We conducted multivariate cox regression to estimate the hazard of esophageal cancer mortality due to working with poultry among the full cohort and weighted regression for the subcohort and interviewed. We conducted exploratory analyses to estimate the hazard associated with each interview question, adjusted for confounders, and computed a false discovery rate (FDR).

RESULTS: In the full and subcohort, working in a poultry plant was associated with an increased hazard of esophageal cancer (HR= 1.623, 95% CI= 1.053, 2.500; HR= 1.651, 95% CI= 1.030, 2.649, respectively). Among responders, working in a poultry plant appeared protective (HR= 0.674; 95% CI= 0.335, 1.354). We identified six questions with a FDR < 0.05 – two risks (e.g., radiation treatment) and four protective factors (e.g., working in a chicken processing plant).

CONCLUSIONS: In the full cohort and subcohort, working in poultry plants was associated with increased hazard of esophageal cancer mortality. We obtained contradictory results among those interviewed, likely due to nonresponse bias. Working with poultry may increase the risk of esophageal cancer, but further research is needed to explore potential mechanisms.

KEYWORDS: Esophageal Cancer, Poultry, Occupational Exposure

P-1158 Exposure to engineered nanomaterials and early biological effects measured in the exhaled breath condensate: First results from the NanoExplore cohort

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BACKGROUND AND AIM: Activities involving engineered nanomaterials (ENM) may raise concerns of occupational exposure and subsequent health effects. We aimed to build a multicenter prospective cohort to assess the potential effects of ENM exposure using biomarkers of early effects measured in exhaled breath condensate (EBC).

METHODS: We recruited seven centers in three countries (Switzerland, Spain, and Italy), where we conducted a 4-day exposure monitoring campaign and two EBC samplings, at the beginning (T1) and end (T2) of working week. The recruited workers were split in three groups depending on their exposure and compared in terms of their baseline individual and professional characteristics, and health status. EBC biomarkers of oxidative and nitrosative stress (malondialdehyde, 8-isoprostane, nitrotyrosine), systemic inflammation (High-Sensitivity C-Reactive Protein (hsCRP)), activation of pro-fibrotic cascade and interstitial lung disease (Krebs von den Lungen glycoprotein 6 (KL6)) and inflammatory cytokines (Interleukins (IL-10, IL-1β), Tumor necrosis factor (TNF-α)) were analyzed using multilevel mixed interval regression models.

RESULTS: The cohort included 140 participants: 43 non-exposed, 55 with negligible to low exposure, and 43 with medium to high exposure. The latter were gradually more often men, older, and in overweight than lowly exposed and non-exposed workers. A statistically significant change between T1 and T2 average concentrations was observed for malondialdehyde and KL6. Between-group differences were observed for all biomarkers but KL6 and nitrotyrosine. In multivariate models adjusted for age, sex and body mass index, a linear exposure-response relationship was observed for malondialdehyde, 8-isoprostane, IL-10, IL-1β, and TNF-α. ENM exposure was also associated with higher hs-CRP and KL6 levels, but not monotonically.

CONCLUSION: These first results suggest that ENM exposure might lead to early biological effects in workers' airways. These findings need confirmation and a caution interpretation of their clinical significance, as most effects are non-specific and likely reversible.

P-1159 Occupation and risk of testicular cancer: A case-control study in France

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BACKGROUND AND AIM: Testicular germ cell tumors (TGCT) are the most frequently diagnosed cancer in young men and their incidence rate has increased dramatically in recent decades. Occupational factors may play a role in testicular cancer etiology. This study aimed to further explore the association between occupation, industry, and the risk of TGCT in adulthood in France.

METHODS: The TESTIS study included 454 histologically confirmed TGCT cases at ages 18-45 years. Controls (N=670) were frequency-matched to cases on 5-year age group and region. Occupational histories, with detailed description of each job, were ascertained through telephone interviews. Occupations were coded according to ISCO68, and industrial sectors according to NAF99. A manual backward stepwise selection procedure was performed to select the covariates to be included in our analyses. Odds ratios (ORs) and 95% confidence intervals (CIs), adjusted for potential confounders, were estimated using conditional logistic regression.

RESULTS: An increased risk of TGCT was observed for "machine fitters, machine assemblers" and "electrical fitters, electrical and electronic " workers (ISCO: 8-41; adjusted-OR = 2.46; 95% CI [1.08-5.62]/ISCO: 8-5; adjusted-OR = 1.80; 95% CI [1.11-2.91], respectively). Analyses by industry supported these findings. Moreover, an increased TGCT risk (adjusted-OR = 1.71; 95% CI [1.02-2.82]) and non-seminoma risk (adjusted-OR = 2.12; 95% CI [1.11-4.04]) was identified for “agricultural and animal husbandry workers” (ISCO: 6-2).

CONCLUSIONS: Our results suggest that occupational exposures may be associated with an increased risk of TGCT in agricultural, machine, and electrical/electronic workers in this population. Our findings were consistent with previously published studies. Since these jobs may involve exposure to a variety of potential carcinogens/endocrine disruptors, such as pesticides and solvents, complementary studies with the application of job-exposure matrices will allow an in-depth evaluation of the role of the substances involved in the high-risk professions identified.

KEYWORDS: Occupation, epidemiology, testicular cancer, agriculture

P-1160 Animal husbandry neglected in occupational research for antibiotic resistance

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BACKGROUND AND AIM: Antibiotic resistance entails a major threat to global health. Exposure to antibiotics and bacteria, potentially increases risks for workers in environments with high and prolonged exposure. The objective of this review is to assess the occupational risk of antibiotic resistance in high risk occupations.

METHODS: This systematic literature reviews selected articles in MEDLINE (September 1964 - October 2021) and Embase (March 1988 - October 2021). Duplicates, articles without abstracts and non-English articles were removed before screening. Articles not related to antibiotic resistance and high-risk occupations, were excluded. Besides the medical sector, animal husbandry including aquaculture was considered as high risk. Animal husbandry here includes aquaculture and poultry farming, besides livestock farming such as pig and kettle farming and occupations were defined according to ISCO-08. Included articles were analyzed on occupations, methodology, bacteria, resistance and location.

RESULTS: 117 Articles were found eligible for final analysis of the abovementioned risks, which is limited. Current research has a strong focus on the medical sector, with 80 articles describing the medical sector in general and a majority focusing on workers in hospital settings (over 60%) and around 70% of these articles focus on MRSA or Tuberculosis. 44 Studies were related to animal husbandry, with a strong focus on especially pig farming and abattoir workers (over 54%). MRSA was the predominant focus of the articles (52%) followed by S. Aureus (19%). With one study research on aquaculture is scarce.

CONCLUSIONS: The risks of antibiotic resistance in animal husbandry and more specifically aquaculture, seems to be neglected in current research. To truly address the issue of antibiotic resistance as a one health issue, other sectors need to be explored with integrated nationwide surveillance and specific occupational risk assessments.

KEYWORDS: AMR, antibiotic resistance, One Health, bacterial infections, occupational risk, animal husbandry, aquafarming.

P-1162 The necessary strengthening the global role of occupational and environmental epidemiology about Asthma. Analysis and discussion of diagnosis of Asthma and the Workforce in Brazil -2019

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Environmental factors such as air pollution and occupational factors contribute to the asthma cases. Asthma is an important cause of hospitalization. In 2017, its prevalence and incidence were estimated 273 million cases and 43 million cases, respectively. Is the second leading cause of death among chronic respiratory diseases, with 500,000 deaths in 2017 and a mortality rate of 6.48/100,000 inhabitants. Almost 7% of these deaths were work-related, and 21.5% of adult asthma is occupational (OA) and asthma aggravated or exacerbated by work (AA/ET). Knowing the diagnosis of asthma in the face of the characteristics of the workforce can contribute to strategies. AIM: to analyze the diagnosis of asthma according to the workforce in Brazil in 2019.Descriptive study. Analysis of an open database of the National Health Survey - Ministry of Health and Brazilian Institute of Geography and Statistics. In 2019, 108,525 households were visited and 94,114 interviews were conducted. Analyzed by condition in relation to the work ratio in the reference week and home situation. Analyzed, busy, unoccupied and outside the workforce, gender, age, regions of Brazil.

RESULTS: People aged 18 years. Workforce: employed workforce: 5,236; in the unoccupied workforce: 777; out of the workforce: 3,097. The coefficients of variation in the employed workforce: 3.5; in the unoccupied workforce: 11.2; outside the workforce: 4.5. Work force and household situation. In the occupied workforce - urban area (UA): 4,445; in the occupied workforce - rural area (RA): 456; in the unoccupied workforce - UA 590; unoccupied workforce - RA 47; outside the workforce - UA 2,523; out of the workforce: 323 people. Research with open data can contribute to preventive measures in health, the diagnosis of asthma in relation to the insertion and/or exit of the work can support actions and early interventions

KEYWORDS: Occupational, Asthma, Environmental

P-1163 Objectively-assessed physical activity and heat stress and the association with kidney function in female harvest workers in Spain

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BACKGROUND AND AIM: Physical activity (PA) in hot environments has been associated with kidney damage. In harvest workers, PA has been primarily assessed by questionnaires in males. We aimed to study the association between objectively-measured PA intensity and incidence of acute kidney injury (AKI) over the course of one work shift, in female harvest workers in Spain.

METHODS: Ninety women working in greenhouses wore a Zephyr chest harness to measure PA intensity during one regular work shift in June 2020. We determined the mean (PA_mean), standard deviation (PA_sd), and 3-minute-maximum (PA_max, a proxy of peak PA intensity) of PA intensity (vector magnitude units). We estimated heat stress (HS) in greenhouses based on wet bulb globe temperature index (ISO 7243:2017). Serum creatinine and neutrophil gelatinase associated lipocalin (NGAL) levels were measured before and after the work shift. AKI was defined as an increase in post-shift serum creatinine by at least 0.3 mg/dl or at least 1.5 times the pre-shift serum creatinine levels. Additionally, we calculated pre-post-shift differences in NGAL. We used logistic regressions adjusted for age, body mass index, and HS. HS was also assessed as an effect modifier.

RESULTS: PA_sd and PA_max seemed to be associated with AKI (OR=1.57 (95%CI=0.82;3.21) and 1.41 (0.71;2.85), respectively), but not PA_mean. There was no interaction between any of the PA variables and HS (p-value LRT>0.1). Mean (SD) increase in NGAL levels over the course of a work shift was higher among participants with AKI (27.8 (7.5)) compared to those without AKI (12.2 (2.7)).

CONCLUSIONS: Results suggest that large changes and peaks in PA intensity should be avoided to protect renal function of harvest workers. Increased levels of NGAL among those with AKI are indicative of kidney damage among those with increased serum creatinine levels.

KEYWORDS: Occupational physical activity, acute kidney injury, ambient heat stress

P-1164 Cane Cutting and reduced kidney function at medical encounters among sugarcane workers in Nicaragua

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BACKGROUND AND AIM: Chronic kidney disease of non-traditional cause (CKDnt), a distinct form of kidney disease, has a high prevalence in agricultural communities in Central America. In Nicaragua's sugarcane industry, cane cutters have the greatest risk of developing CKDnt, possibly due to a high level of physical exertion and exposure to climatic heat. In a longitudinal study, we examined whether time worked as a cane cutter was associated with reduced kidney function during a medical visit.

METHODS: Employment and medical records from 1997-2010 were linked for 242 men employed at a Nicaraguan sugarcane plantation. Person-months worked were classified as cumulative months worked cutting cane. The outcome was experiencing an estimated glomerular filtration rate (eGFR) <60 ml/min/1.73m2 at a medical visit. To examine the association between cane cutting and low eGFR, logistic regression based on generalized estimating equations for repeated events was used to estimate the odds ratio (OR) and the 95% confidence interval (CI), controlling for age.

RESULTS: During 14,592 person-months, half of workers were ever a cane cutter, with median of 23 (IQR=39) months cane cutting. 41 workers experienced a low eGFR, with a median of 6 (IQR=8) events. Compared with never cane cutters, the adjusted odds of low medical eGFR for cane cutters was 2.18 (95% CI, 1.11, 4.30), and 4.79 (95% CI, 2.09, 10.99) among those cane cutting for at least 74 months. Additionally, each 6-month increase in time cane cutting was associated with a 1.12-fold increase in low eGFR (95% CI, 1.07, 1.18).

CONCLUSION: Cumulative months as a cane cutter was associated with an exposure-response relationship between low eGFR at medical encounters. eGFR was not routinely taken at medical encounters; the outcome may have captured existing low eGFR or more acute events. Future research into recurrence of acute kidney injury among these workers should be undertaken.

P-1166 Updated findings from the International Nuclear Workers Study (INWORKS)

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BACKGROUND:
Despite being a recognized carcinogen, public exposure to ionizing radiation has increased in recent decades. An update to the International Nuclear Workers Study (INWORKS) is being undertaken to strengthen direct assessments of the risks from low dose, low dose rate exposure to penetrating forms of ionizing radiation. Follow-up has been extended by 10 or more years in each partner country.
METHODS: We are conducting a pooled analysis of cohort mortality studies of nuclear industry workers in the UK, France, and the USA. Individual annual estimates of whole-body dose due to external exposure to penetrating radiation are derived from personal occupational exposure monitoring data. Vital status has been ascertained through 2012, 2014, and 2016 for workers in the UK, France, and the USA, respectively.
RESULTS: The updated pooled study includes 309,932 workers and 10.7 million person-years of observation. Over the period of follow-up, there have been 103,553 deaths observed, of which 31,009 are deaths due to cancer.
CONCLUSIONS: This presentation will describe the motivation for an update of the INWORKS study, the major aims of the project, and the progress that we have made to-date. We will report on a major update of this highly-influential study; the person-time in INWORKS increases by a factor of 1.3 and the number of cancer deaths increases by a factor of 1.6. The updated INWORKS analyses will provide some of the most informative direct estimates of low dose radiation risks reported to-date.

P-1167 Associations Between Serum Perfluoroalkyl Acid (PFAA) Concentrations and Health Related Biomarkers in Firefighters

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BACKGROUND AND AIM: Elevated serum levels of the persistent perfluoroalkyl acids (PFAAs); perfluorohexane sulfonate (PFHxS), perfluoroheptane sulfonate (PFHpS) and perfluorooctane sulfonate (PFOS) have been reported in firefighters who have used aqueous film-forming foam in occupational practices. The aim of the present investigation was to examine the association between potential health outcomes and serum concentrations of these three PFAAs, as well as perfluorooctanoic acid (PFOA), also frequently detected in human serum, in Australian firefighters.

METHODS: The relationship between PFAA serum concentration and cardiovascular disease, kidney-, liver- and thyroid function (assessed as biochemical marker serum concentrations, as well as self-reported health conditions), were assessed cross-sectionally in 782 firefighters. The relationships between PFAAs and biomarkers for cardiovascular disease and kidney function were further assessed longitudinally in a subset of the firefighters, where serum measurements were available from two timepoints, approximately five years apart (n=<130).

RESULTS: Increasing levels of one or several PFAAs were significantly associated with increasing levels of biomarkers for cardiovascular disease (total-cholesterol, and LDL-cholesterol), and biomarkers for kidney (urate) and thyroid function (TSH), in the cross-sectional analysis. However, increasing levels of PFAAs were not associated with biomarker levels outside the clinical reference values, or associated self-reported health conditions. No significant relationships were observed in the longitudinal analysis.

CONCLUSIONS: PFAAs may alter the homeostasis of several biomarkers. Further research is needed to determine if the associations observed in the present investigation are causal and if they are of clinical significance.

KEYWORDS:
Occupational Exposure
Outcome Assessment
Biomarkers
Cholesterol
Uric Acid

P-1168 Association of summertime daily mean temperature and sick leaves among employees of the City of Helsinki, Finland

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BACKGROUND AND AIM: Heat affects work productivity and well-being at work. People working outdoors are the most vulnerable to heat-related health issues that may cause absenteeism from work. However, the phenomenon concerns indoor workers without sufficient air conditioning as well. Previous studies concerning occupational heat stress have concentrated on health effects, the incidence of heat-related illness, preventative measures, and productivity losses. Correlation between heat waves and sickness related work absenteeism rates has not been studied. Therefore, this study aims to evaluate the relationship of daily summertime temperatures and heatwaves with sick leaves rates among employees of Helsinki City, Finland.
METHODS: We used Poisson time series models adjusted for potential confounders, such as time trend, air pollution, pollen, and barometric pressure to investigate the associations of daily temperature with daily rates of new sick leaves. Daily number of sick leaves for May-August 2002-2017 was obtained from the Helsinki City employee register and daily weather information from the Finnish Meteorological Institute.
RESULTS: Daily mean temperature ranged from 1.5 °C to 26.6 °C during the warm season. Preliminary results indicate that increased daily mean temperature is associated with decreased risk of sick leaves at lag 0 and lags 2-5. at 1 day lag, increased daily mean temperature is associated with decreased risk of sick leaves until the daily mean temperature exceeds 24 °C after which the risk begins to increase. Risk ratio [RR] is 1.003 at 26 °C compared to 24 °C.
CONCLUSIONS: Preliminary results indicate that increased daily summertime mean temperature is mostly associated with decreased daily sick leave rate. However, our preliminary analyzes suggest that there may be an increase in daily sick leave rate at 1 day lag when daily mean temperature exceeds a threshold. In further analysis, the effect of prolonged heatwaves will be evaluated.

KEYWORDS:
occupational health, heat

P-1169 Assessment of chemotherapy drug contamination in occupational settings

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Chemotherapy drugs can persist on surfaces in cancer clinics where they are administered, resulting in potentially hazardous exposures to healthcare workers and cancer patient caregivers. Literature reports that contamination by these drugs has the potential to travel out of oncology clinics to care facilities and homes of chemotherapy patients; however, the extent of the surface contamination from these drugs is currently unclear. This project focuses on the development of a new liquid chromatography-mass spectrometry method for the simultaneous detection of doxorubicin, cyclophosphamide, methotrexate, 5-fluorouracil, paclitaxel, and etoposide to test for potential surface contamination. The parent ion and corresponding fragment ions for each drug were determined using direct infusion mass spectrometry for their characterization and quantitation. The developed method was validated by spiking 0.25µg of the chemotherapy drugs onto stainless steel plates, simulating clinical surfaces. An aliquot of the samples were injected onto a triple quadrupole mass spectrometer using a Zorbax SB C18 with a linear gradient and electrospray ionization. The drug recoveries ranged from 45-80%. Calibration curves were obtained by analyzing increasing amounts of drugs combined with set amounts of labeled internals standards to calculate the limits of detection (0.002 to 0.17 ng/mL) and limits of quantitation (0.010 to 0.71 ng/mL) for each drug. Finally, wipe sample collection was conducted for specific areas in an oncology treatment room at the University of Minnesota Veterinary Medical Center, where doxorubicin and cyclophosphamide are administered to veterinary patients. The method identified traces of these drugs localized to their individual administration areas, supporting the ability of this method to precisely detect contamination by these drugs in an occupational setting. These preliminary results set the stage for investigating levels of contamination in various clinical settings and testing decontamination products and protocols to reduce workplace and environmental exposures.

P-1170 Why are Silica Dust Exposures and Silica-Related Health Effects Still a Global Concern?

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BACKGROUND AND AIM: Epidemiology studies of workers exposed to silica dust demonstrate that crystalline SiO2 is a multipotential hazard. Research among construction workers, miners, ceramic and brick workers, countertops workers, and sandblasters where respirable silica dust levels has been measured has demonstrated excess risk for silicosis, cor pulmopale, silica-tuberculosis (SiTB), several chronic respiratory conditions, coal workers pneumoconiosis (CWP), several auto-immune diseases, and cancers of the lung and gastro-intestinal tract.

METHODS: Despite knowledge of these links over the past decades, occupational and environmental health professionals have not been able to address three new silica-related health issues. They are silicosis and CWP among US coal miners, severe silicosis and auto-immune ailments among countertop workers; and ongoing risk for SiTB among Africa miners. The author examined the literature for other novel silica-related health risks.

RESULTS: Current workers and their managers seem to not have sufficient awareness of the occupational hazards of silica dust. There are new silica dust concerns including fracking sand, railroad ballast, and dust control in countertop machining. There are new cancer links with silica, including women and nonsmokers with excess lung cancer; excess lung cancer among patients with CWP; children's dust exposure in small-scale gold mining; and excess lung diseases and pulmonary cancer among railroad workers. There is need for research on improved silica sampling techniques and protective gear. Pathologists should explore whether silicosis leads to differences in cell characteristics that produce silica-linked lung cancers compared to 'garden variety' malignancies.
CONCLUSION:
Despite promises that global silica problems were controlled, that seems to be countered by excesses of CWP and SiTB that still bedevil the occupational medicine and public health communities. We need more worker education, prevention or regulatory policy, and basic silica biology and pathology to effectively intervene.

KEYWORDS: Silica health effects, future prevention efforts; improved sampling methods

P-1171 Work-related stress and the mental health status of retail commerce workers from Nicaragua: a cross-sectional web-based survey

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BACKGROUND AND AIM: In Currently, there are very few studies, that evaluate the consequences of occupational stress on mental health in Nicaraguan workers. Here, we studied the association between the levels of work-related stress (WRS) and the mental health status of retail commerce workers from Nicaragua.
METHOD: We carried out a descriptive cross-sectional study by conducting a web-based survey between August 1st and September 30th, 2021 through an online self-administered questionnaire, which was made available on the Google Forms platform. Subjects were randomly selected from an available database at the Social Security National Institute and were invited to participate by e-mail. Out of 1,212 invitations, 910 subjects completed the questionnaire. The ILO-WHO Occupational Stress Scale was used to assess stress levels, and the mental health component of the Goldberg General Health Questionnaire (GHQ-12) was used to assess emotional health.

RESULTS: Overall, 40% of participants were classified as having WRS risk levels. On the other hand, 1out 5 workers experienced severe stress. The proportion of cases currently classified as experiencing a probable mental or emotional health disorder was 30% (GHQ-12 with a score ≥12 points). Workers with a significant level of stress or severe level of stress had a 3 to 5-fold increased risk of experiencing a probable mental or emotional disorder. Other factors that were also associated with the presence of a probable emotional health disorder were being female, sleeping less than 7 hours regularly, experiencing mobbing at the workplace, and having experienced workplace violence.
CONCLUSION: This study showed a highly significant association between work relates stress levels and the presence of mental or emotional health disorders. WRS continues to represent a serious occupational and public health problem in Nicaragua.

KEYWORDS: work-related stress, mental health, retail commerce, Nicaragua.

P-1173 Biological monitoring for exposure assessment of phthalatesby Korean firefighters at the fire site

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BACKGROUND AND AIM: The phthalates metabolites in urine for exposed phthalates were evaluated for firefighters who participated in the actual fire suppression to determine whether firefighters were exposed to hazardous chemicals, which is the basic data on health risk of firefighters

METHODS: The results of comparing the concentration of metabolites of phthalates immediately after fire suppression and after 3 weeks of fire suppression in spot urine.

RESULTS: The concentration of Mono-n-butyl phthalate(MnBP), Mono-benzyl phthalate(MBzP), and total phthalates(Σphthalates) increased significantly immediately after fire suppression than after 3 weeks of suppression. In case of adjusted for creatinine, the concentration of MnBP, MBzP and Σphthalates were equally increased.
There was a statistically significant difference in the geometric mean concentration(GM) of firefighters who performed fire suppression tasks as 55.59 μg/g as Cr and 29.69 μg/g as Cr for other tasks. The GM concentration of firefighters who were active within 50m from the fire site was 44.80 μg/g as Cr, and when it fell over 50m, there was a difference of 20.47 μg/g as Cr. The GM concentration of firefighters with subjective symptoms within 7 days after extinguishing the fire was 61.68 μg/g as Cr and without symptoms was 31.62 μg/g as Cr, which was different.

CONCLUSIONS: This study confirmed that fire fighters are exposed to various phthalates during the firefighting process.

KEYWORDS: Fire fighter, Phthalate metabolites

THEMATIC 21: Water Quality

P-1247 Long-term exposure to nitrate and trihalomethanes in drinking-water and prostate cancer: A Multicenter Case-Control Study in Spain

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BACKGROUND AND AIM: Nitrate and trihalomethanes (THMs) in drinking water are widespread and potential human carcinogens. We evaluated the association between drinking-water exposure to nitrate and THMs and prostate cancer (PC).

METHODS: During 2008-13, hospital-based incident PC cases (n=697) and population-based controls (n=927) were recruited in five Spanish regions, providing information on residential histories and type of water consumed. Average nitrate and THMs levels were linked with lifetime residential water consumption to calculate waterborne ingestion. Odds ratios (OR) and 95% confidence intervals (CI) for PC were estimated using mixed models with area as random effect. Effect modification by tumor grade (Gleason score), age, lifestyle, and dietary factors were explored.

RESULTS: Mean (SD) for average lifetime waterborne ingestion to nitrate (mg/day), brominated (Br)-THMs (µg/day) and chloroform (µg/day) were 12.8 (10.8), 19.2 (29.2) and 15.4 (14.0), respectively, in cases; and 11.5 (9.0), 20.7 (32.4) and 15.1 (14.7) in controls. for each 10 mg/day increase of waterborne ingested nitrate, PC risk increased by 49% (OR 1.49; 95%CI 1.26-1.77) overall, 70% (OR 1.70; 1.36-2.12) for low-grade PC (Gleason score <7), and 36% (OR 1.36; 1.11-1.68) for medium-high grade PC (score ≥7). Risks were higher in the youngest and in those with lower intake of fiber, total fruit/ vegetables, and vitamin C. Waterborne ingested THMs were not associated with PC. However residential levels of Br-THMs and chloroform showed, respectively, inverse and positive associations with PC.

CONCLUSIONS: Findings suggest long-term waterborne ingested nitrate could be a risk factor of PC. Increased intake of fiber, fruit/vegetables and vitamin C may lower and even avoid the risk. Results indicate non-linear and opposite associations for residential Br-THMs and chloroform, suggesting a potential role of inhalation and dermal exposures.

KEYWORDS: Nitrate; trihalomethanes; water quality, prostate cancer, epidemiology

P-1248 Characterizing the coexistence of proteobacteria species and cyanobacteria in cyanobacteria positive lung cancer samples

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BACKGROUND AND AIM: Smoking and genetic factors cannot completely explain the risk of developing lung cancer. Inhalation of aerosol microbial insults can play a role in lung disease development. A recent lung microbiome cross-sectional study revealed an association between cyanobacteria and lung cancer. Further analysis of these patients showed a frequent coexistence between phylum cyanobacteria and proteobacteria in the lung tissues. Based on our findings and literature, we hypothesize that cyanobacteria and a proteobacteria species (Acidovorax temperans) are linked to the development of lung cancer.

METHODS: Nucleotide primers specific to Acidovorax temperans were used to screen Acidovorax temperans on lung cancer individuals positive for cyanobacteria. As a pilot analysis, the resulting amplicons were sequenced and the sequence analyzed.

RESULTS: A majority (66%) of the cyanobacteria positive samples were also positive for Burkholderia cepacia that shares the same lineage with Acidovorax temperans.

CONCLUSIONS: Based on our analysis, we were able to identify the presence of Proteobacteria in lung cancer individual samples with positive cyanobacteria presence. Further verification for the exact species will be done using 16S rRNA sequencing.

KEYWORDS: Bacteria, lung cancer, microbiome, water, blue algae, cyanobacteria, genome, aerosol inhalant

P-1249 Human enteric bacteria and viruses in five wastewater treatment plants in the Eastern Cape, South Africa

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BACKGROUND AND AIM: Monitoring effluents from wastewater treatment plants is important to preventing both environmental contamination and the spread of disease. We evaluated the occurrence of human enteric bacteria (faecal coliforms and Escherichia coli) and viruses (rotavirus and enterovirus) in the final effluents of five wastewater treatment plants (WWTPs) in the Eastern Cape of South Africa.
METHODS: Human viruses were recovered from the effluent samples with the adsorption–elution method and detected with singleplex real-time RT–PCR assays. Culture based approach using a membrane filtration method, and the filtrates were then transferred the m-FC agar and E. coli chromogenic agar for isolation faecal coliform, and Escherichia coli.
RESULTS: Rotavirus was detected in several effluents samples, but no enterovirus was detected. at WWTP-C, rotavirus titre up to 10^5 genome copies/L was observed and present in 41.7% of the samples. at WWTP-B, the virus was detected in 41.7% of samples, with viral titres up to 10^3 genome copies/L. The virus was detected once at WWTP-E, in 9% of the samples analysed. The viral titres at WWTP-A were below the detection limit in all 25% of the 1.25 L samples in which the virus was detected. Rotavirus was not observed at WWTP-D. Faecal coliform bacteria and E. coli were detected in all the WWTPs, but no correlation was established between the enteric bacteria and viruses studied.
CONCLUSIONS: The occurrence of rotavirus in effluent samples discharged into surface waters highlights the importance of assessing viral contamination in the water sources used for domestic water use.

KEYWORDS:
Enteric bacteria, enteric virus, wastewater quality, Effluent

P-1253 Determination of human-pathogenic free living amoebas in drinking water supplies in Leicester, UK

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BACKGROUND AND AIM: Acanthamoeba spp. and Balamuthia mandrillaris are free-living amoebas (FLA) that can severely affect individuals. FLA are naturally resistant to harsh conditions such as pH, temperature and chemicals. Although we have previously reported the circulation of Acanthamoeba spp. and B. mandrillaris in open-water systems from Leicester (UK), little is known about their presence in public drinking water supplies. Thus, the aim was to identify potential risks due to their presence in tap water.

METHODS: Twenty-five tap water samples were collected in duplicate in March 2022 from public restroom facilities, located in parks (14), shopping/leisure centres (7), bus (2) and train (1) stations and a cemetery (1). Taps were appropriately cleaned before and between collecting the water samples. Samples were centrifuged at 2500rpm for 30 minutes for spore recovery. Pellets were suspended in phosphate-buffered saline to extract DNA by disrupting the spores using the Fast DNA® Spin kit and purified. A triplex real-time TaqMan PCR assay was performed for the simultaneous detection of FLA species, using established methodologies.

RESULTS: All fifty samples tested for FLA were negative. The drinking water supplies in the taps of Leicester's public restrooms are not sourced from storage tanks, which reduce the overall risk of the presence of FLA in tap water. However, limitations in the collection may have affected our results, as the incidence of Acanthamoeba keratitis in the UK is much higher than in the USA and Netherlands. This higher incidence has been linked to the use of water storage tanks, which would be in line with our preliminary results.

CONCLUSIONS: Regular monitoring of tap water quality would be required at a wider scale in the city including households, public institutions and hospitals in order to rule out the risks for the presence of human-pathogenic FLA, particularly Acanthamoeba spp.

P-1254 Endocrine disrupting activity, pharmaceutical and virus occurrence in selected water sources along the Limpopo River, South Africa

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BACKGROUND AND AIM: There are concerns globally about decreasing water quality due to the presence of endocrine-disrupting chemicals (EDC), pharmaceuticals, and potentially viruses in the water system, posing health risks to humans,. Rural communities in Limpopo, South Africa, are dependent on water sources such as rivers, dams and boreholes for drinking water and small scale subsistence farming. The aim of study investigated the occurrence of endocrine-disrupting activity, quantification of select pharmaceuticals, and screening of viruses in water samples from four study sites; Bende-Mutale (BM), Doreen Farm (DF), Madimbo (MO) and Nkotswi (NO), all along the Limpopo River, Limpopo Province, South Africa.

METHODS: Analyses were done on the water samples to determine EDCs using a battery of bioassays (T47D-KBluc and MDA-kb2 assays), pharmaceutical screening (using the Agilent Forensic Toxicology Personal Compound database and Library (PCDL) library of 9200 compounds) and quantification using LC/MS-QTOF, and viruses using real-time reverse transcription-polymerase chain reaction (RT-PCR).

RESULTS: Estrogenic activity was detected in the river water samples with estrogen equivalents (EEq) values ranging from 0.08 to 0.69 ng/L using the T47D-KBluc assay. Pharmaceuticals ciprofloxacin, sulfamethoxazole, and trimethoprim which were detected and quantified in water from the study sites. When screening against the PCDL, a wide range of compounds were identified, BM (n=49), DF (n=34). MO (n=42) and NO (n=46). The top five categories of compounds were antibiotics, antidepressants, immunosuppressants, insecticides and parasympatholytics. Nora Virus 1 and 2, were not detected in any water samples.

CONCLUSIONS: This is the first study in the Limpopo province to screen and quantify emerging contaminants in river, dam and borehole water sources, and the results are concerning. The emerging contaminants from the screening data provide a basis for a follow-up study to quantify and determine the source and removal of these potentially harmful compounds.

KEYWORDS: EDCs, emerging contaminants, pharmaceuticals, South Africa

P-1255 Evaluation of the sanitary quality of the water consumed by the population of the Sambwa mission village in the Democratic Republic of Congo

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CONTEXT:
The village Sambwa mission has 5628 inhabitants and is located 30 km from the city of Lubumbashi along the river Kafubu, which river receives water from the different streams of Lubumbashi and its approximately would be more affected by various pollutants (mining, industrial and household). In addition, the populations located along this river are not served with drinking water they most often use the water of the river and wells to meet their needs. The objectives of this study were to identify the source of the water intended for human consumption of the population of the village Sambwa mission, to characterize the pollution of this water in trace metal elements in order to assess the health risk of the said population.

METHODS: The study was of the cross-sectional and analytical descriptive type, supported by a standardized questionnaire on a sample of 94 households present on the day of the survey. Water sampling was carried out at all the water supply points for human consumption and the determination of trace metal elements was carried out at the Robinson International laboratory in Lubumbashi.

RESULTS: The results show that the population of this village Sambwa mission has five points of water supply and that these waters are contaminated mainly by arsenic, cadmium and antimony. The highest concentrations of arsenic, cadmium and antimony were observed to be 0.031 mg/L, 0.010 mg/L and 0.046 mg/L, respectively, above the WHO drinking water standard with hazard quotients assessed to be greater than 1.
CONCLUSION:
The observed concentrations sufficiently demonstrate the poor quality of the water consumed by the population of the village of Sambwa mission and that the consumption of these waters constitutes a danger to human health in general and that of children in particular.

KEYWORDS: quality, health risk, water and population

P-1257 Microplastic Abundance and Distribution in a Wastewater Treatment Plant in Bangladesh

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BACKGROUND AND AIM: Of late, microplastics have been considered an emerging contaminant for humans and the environment due to their long-term persistence and unique properties. As a result, a lot of attention has been drawn to microplastic pollution in soil, sediments, rivers, and oceans. However, little attention has been paid to wastewater treatment plants that can be a significant source of microplastic pollution in different niches of the environment. In this study, an investigation was carried out on the Pagla Sewage Water Treatment Plant to determine the abundance and occurrence of microplastics through a well-developed systemic procedure. The broader goal was to give a comprehensive idea for a better understanding of wastewater treatment plants (WWTPs) as an important pathway for microplastics introduced to the environment.

METHODS: Samples were collected from eight stations, including influent, distribution chamber, measuring chamber, sludge, lagoon, and effluent. Samples collected were analyzed using techniques such as visual, microscopic, and Fourier-transform infrared (FTIR) analysis to determine the abundance and composition of microplastics.

RESULTS: The type of microplastics obtained in the treatment plant included polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyamide, and poly (methyl methacrylate). Interestingly, the total number of microplastics observed in the influent sample (34) was found to be decreased in the effluent sample (15) without any targeted treatment technology for the removal of microplastics. Therefore, the microplastics discharged in the effluent into the nearby Buriganga river may increase the load of microplastics in the river.

CONCLUSIONS: The present study provides an insight into the occurrence and abundance of microplastics in a wastewater treatment plant. Future research is needed to determine the role of wastewater treatment plants on the properties of microplastics and to develop technologies to mitigate the load of microplastics in the effluent.

KEYWORDS:
Microplastic, Wastewater treatment plant, influent, effluent, polyethylene

O-SY-126 Natural disasters and sexual risk taking behaviour: correlation or causation? and what is the relevance for global public health?

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BACKGROUND - AIM: Natural hazards have intensified as a result of climate change. Their impact has a negative effect on people's health, including mental health. Increased risk-taking behaviour such as alcohol (ab)use, excessive smoking and illicit drug use have been observed. High-risk sexual behaviour has poorly been investigated, to date. The aim of this ecological study is to investigate the association of exposure to natural disasters and sexual risk-taking behaviour as measured by increased HIV incidence, at country level, worldwide.

METHODS: All data was extracted from publicly available sources. Crude and adjusted linear regression models were built to explore the association between the proportion of people affected by natural hazards and HIV incidence. Models were adjusted for socio-demographic variables (literacy, income and age), and then further adjusted for antiretroviral therapy coverage and the healthcare access and quality index.

RESULTS: In the crude regression, the total number of people affected by disaster over a 5-year period was positively associated with HIV incidence: for every 10 new people per 100,000/year affected by natural hazards, the HIV incidence in the country was 1.5 per 1,000 uninfected higher. After adjusting for socio-demographic variables, the association was lost. When further adjusted, only antiretroviral therapy coverage and health care access and quality were positively and negatively associated with HIV incidence, respectively. No interaction was found with income groups, world regions or categories of high and low HIV prevalence.
CONCLUSION: No association between exposure to natural hazards and increased sexual risk-taking behaviour at country level worldwide was found, after accounting for socio-demographic variables. Nonetheless, countries with a higher proportion of population affected by natural disasters were those whose health system quality and accessibility was poorer, and this in turn was associated with higher incidence of HIV potentially highlighting different mechanisms explaining the crude association.

O-SY-130 Census tracts aren't neighborhoods: Issues in examining the impact of historical redlining in the USA on present-day environmental exposures and health outcomes

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BACKGROUND AND AIM: In the 1930s, the US Home Owners' Loan Corporation (HOLC) developed residential security maps for 239 urban areas across the US, ranking the investment risk using a color-coded scale: "A" (green), "B"(blue), "C"(yellow), and "D"(red/hazardous). Areas in proximity to industrial facilities and other sources of pollution were downgraded and more likely to have Black and foreign-born inhabitants—resulting in disproportionate exposure of racial/ethnic minorities to environmental toxicants. HOLC-derived neighborhood boundaries do not align with Census tracts, making the examination of historical redlining on present-day environmental exposures challenging. Multiple methods exist to define redlining when using Census data, but how well they classify redlining exposure is unknown.

METHODS: We examined agreement in redlining status when assigning exposure based on area-level geographic data compared to having complete address data (gold-standard). Our analysis included 5,042 addresses located in census tracts that overlapped with the HOLC map for Atlanta. We classified redlining status using complete address data and census tract using four methods: the Centroid, Majority, Weighted Score, and Highest HOLC methods. Each method was compared to the HOLC grades assigned when superimposing complete address data onto the HOLC map.

RESULTS: of the 5,042 addresses, 3% were A-graded areas, 9% B, 24% C, 12% D, and 52% ungraded. Overall percent agreement was highest for the Weighted Score method, which correctly classified 70% of addresses. The Majority, Centroid, and Highest HOLC methods had 68%, 65%, and 53% agreement, respectively. However, these methods only correctly identified 40%, 49%, and 57% of HOLC graded areas (excluding ungraded) compared to 76% using the Weighted Score method.

CONCLUSIONS: Full address data are often unavailable in population-based studies examining environmental exposures on health outcomes, thus relying on census tract to classify redlining exposure. Investigators should carefully consider the method used to minimize misclassification.

KEYWORDS: Redlining, exposure misclassification, validation study

DAY 3 (Wednesday, 21 Sept 2022)

THEMATIC 04: Built and Physical Environment exposures

P-0248 Maternal Exposure to Magnetic Field Non-Ionizing Radiation During Pregnancy and the Increased Risk of Allergic Conditions in Offspring: A Longitudinal Cohort Study with up to 22 Years of Follow-up

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BACKGROUND: Emerging epidemiologic studies and experimental animal studies have reported an impact of magnetic field (MF) non-ionizing radiation on the immune system. We examined the relationship between maternal MF exposure level during pregnancy and the risk of severe allergic conditions, having both asthma and atopic dermatitis (AD), in offspring.

METHODS: We enrolled 2,060 pregnant members of Kaiser Permanente Northern California. Consented participants were asked to wear an EMDEX meter for 24 hours in early pregnancy to measure MF exposure levels from all MF-emitting sources. To examine the risk of allergic conditions in offspring, 1,568 participants who delivered a livebirth were included. We used the median of the 24-hour MF measurements to determine maternal MF exposure level. Offspring were followed from birth to early adulthood (up to 22 years) to identify those with clinical diagnoses of both asthma and AD. Confounders were ascertained during in-person interviews. Cox Proportional Hazards regression was used for analysis.

RESULTS: After controlling for multiple confounders, a linear dose-response relationship between maternal MF exposure level during pregnancy and the risk of having both asthma and AD in offspring was observed. Every one milligauss (mG) increase of maternal MF exposure was associated with 21 percent increased risk of having both asthma and AD diagnoses in offspring: adjusted hazard ratio (aHR)=1.21, 95% confidence interval (CI): 1.03-1.43. Using categorical measures also showed a statistically significant dose-response relationship (p=0.04).

CONCLUSIONS: In this large cohort study with rarely-available objectively measured MF exposure, maternal exposure to high MF levels during pregnancy is associated with an increased risk of having both asthma and AD allergic conditions in offspring. This finding suggests that MF exposure could impact the human immune system, especially the fetal immune system which may be especially vulnerable to the impact of MF non-ionizing radiation.

KEYWORDS: Magnetic fields, non-ionizing radiation, allergy

P-0251 Soil Health as a Determinant to Health of People: Example of Soil Trace Elements Deficiencies in Kintampo Area of Ghana and Their Implications to Some Non-Communicable Diseases

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BACKGROUND: Selenium is a trace metalloid that is a natural constituent of many foods, and also available as a dietary supplement. Although excessive intakes of dietary Selenium may be harmful, insufficient intake of dietary Selenium may contribute to thyroid failure, cretinism, cardiomyopathy, immune dysfunction, bone defects, inflammation, male infertility, and probably increased risk of certain human cancers. Health trends relative to Selenium exposure have a connection with the amount of Selenium in soils derived from the underlying rocks.
AIMS: The study was aimed at determining Selenium geo availability in stream sediments in central Ghana and its implications on health.

METHODS: In this study, a total of 43 stream sediment samples were collected along streams using geographic information system to predetermine co-ordinates in the Kintampo area of Ghana. Concentration of Se and pH were determined. Degree of contamination, pollution load and geo-accumulation indices were calculated. Information was gathered on the health indices from health centers of communities.

RESULTS: Our findings showed that sandstones, shales, mudstones and phyllite rocks present have pH levels of 6.4 in the sediments formed over the parent rocks. Checks on the quality analysis indicated good assay repeatability among the duplicate pairs of sediment samples ($p = 0.31$). The geometric mean was 0.11 ppm for selenium. The analyzed results of all samples showed Se-deficiencies at over 80 % of the area (i.e. Se <0.2 mg/kg).
CONCLUSION: The study found almost the entire area to be deficient in selenium. This deficiency is feared to hamper the antioxidant role of dietary supplementation of selenium for the population as they eat what they grow. The health indices data obtained from the health facilities in the study area confirmed the presence of Se-related–diseases. This thus makes healthy eating not effective mechanism of preventing element-related-diseases.

KEYWORDS: Selenium; Soil Health; Non-Communicable Diseases

P-0252 Associations Between Minute-Level Smartphone-Derived Exposure to Walkability and Consumer Wearable-Derived Physical Activity in the US-based Nurses' Health Study 3 Cohort 2018-2020

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BACKGROUND AND AIM: Walkable environments have been linked to increased physical activity and improved health outcomes. However, most studies measure exposure based on residential address alone, not accounting for mobility patterns. We aimed to explore the association of smartphone mobility-derived walkability exposure and wearable-based physical activity in a group of US women.

METHODS: We quantified associations of minute observation level smartphone GPS-based walkability with daily Fitbit wearable accelerometry data. The NHS3 mhealth study followed 348 participants who completed four seasonal seven-day sampling periods. GPS points collected every 10 minutes were linked to a census tract-level walkability index calculated by a summed z-score of road intersection density from 2018 TIGER/Line shapefiles, 2018 Infogroup business density, and 2015-2019 5-year American Community Survey population density estimates. Mean Fitbit-derived steps per minute was calculated for each 10-minute period (n=639,364). Generalized Additive Mixed Models accounting for correlated data within individuals and enabling penalized splines were used to explore associations. We adjusted for GPS based socioeconomic status, daily GPS temperature and precipitation, satellite-based greenness in the 30m around each GPS point, and individual factors.

RESULTS: Mean minute-level walkability was 0.24 (SD = 3.07) and mean steps per minute was 7.04 (SD = 14.98). Associations were non-linear in nature, trending steeply upward and plateauing at the highest levels of walkability. We found an increase of 2.24 (95% CI: 1.40, 3.09) mean steps per minute for each 1-point increase in walkability scores from -1.66 to 5.50.

CONCLUSIONS: We used data at fine spatial-temporal scales to present novel estimates on time-intensive longitudinal associations between walkability and physical activity, while accounting for within- and between-participant differences. Participants were more likely to be physically active in more walkable areas, suggesting improvements in the built environment may improve health outcomes downstream of physical activity.

KEYWORDS: Wearables, Walkability, Physical Activity, Mixed Models

P-0254 Suicide and transportation noise: a prospective cohort study from Switzerland

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BACKGROUND: Evidence for effects of transportation noise on mental health remains scarce, mainly due to a lack of high quality studies. Meanwhile, psychiatric diseases are among the most prevalent non-communicable diseases worldwide, and suicide as a mortality outcome presents a pressing public health issue. The aim of this study is to investigate the association between transportation noise and suicide, while adjusting for air pollution.

METHODS: Road traffic, railway and aircraft noise exposure as well as PM2.5 exposure were linked to 5.1 million participants 15 years or older in the Swiss National Cohort, accounting for their address history. Mean noise exposure in 5-year periods was calculated. Individuals were followed for up to 15-years (2001-2015). Time-varying Cox regression models were applied to total suicides and cause-specific suicide deaths. Models included all three noise sources, PM2.5 plus individual and spatial covariates including socio-economic status. Effect modification by sex was also explored.

RESULTS: During the follow-up, there were 11,265 suicide deaths. Road traffic and railway noise were associated with total suicides (Hazard ratio: 1.039 [95% CI: 1.015-1.064] and 1.022 [1.004-1.041] per 10dB Lden, respectively), while no significant association was found for aircraft noise. Associations were stronger for females than males. The pattern was robust across all outcomes, with the strongest association seen in non-violent suicides (poisoning: HR 1.122 [1.042-1.209] per 10dB Lden road traffic noise). No robust association was observed for PM2.5, whether adjusted for noise or separately.
CONCLUSION: In this longitudinal, nationwide cohort study, we report a robust association between exposure to road traffic and railway noise and an increased risk for death by suicide. These findings add to the growing body of evidence that mental health disorders may be related to transportation noise exposure.

KEYWORDS: road traffic, railway, aircraft, Lden, air pollution, mental health

P-0255 Using publicly available data to describe multiple environmental pressures and explore the link with end-stage renal disease.

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End-stage renal disease (ESRD) is the final stage of chronic kidney disease, where renal function is highly impaired leading to the need of a long-term dialysis or a kidney transplant. Etiology of ESRD remains partly unknown and in particular the role of the environment. The objective of this work is to identify new etiological hypothesis related to the environment. The main argument supporting its influence is the spatial and temporal heterogeneity observed in ESRD incidence at various geographical scales.
Since 2005, in Northern France, newly detected ESRD cases are recorded in a health register called Nephronor. On this basis, standardized incidence ratios were calculated at the municipal level after being adjusted for age, sex, social deprivation and distance to dialysis centers. Using an isotonic spatial scan statistic, six significant spatial clusters were detected three of high incidence and four of low incidence.
In parallel, a complete environmental database was built using publicly available data. After an exhaustive inventory of existing data, the most appropriate databases were selected and a long data management process was achieved. Finally, more than one hundred variables were included and allocated in one of the six following dimensions: Contamination levels (air, water, soils), Emission levels, Source locations, Land use, Agricultural practices and Climate. Therefore, physical environment was described as completely as possible and for each dimension, a composite indicator was built at the municipal level. Each of these composite indicators were used to test etiological hypothesis, by comparing high-incidence with low-incidence ESRD spatial clusters. With this territorial approach, the ambition is not to demonstrate causal effects but rather to identify hypothesis that could be tested at the individual level in future epidemiological studies.

KEYWORDS: spatial composite indices, multiple environmental pressures, publicly available data, spatial heterogeneity of incidence, end-stage renal disease.

P-0256 Living and working close to sports facilities and physical inactivity and obesity: a cross-sectional study

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BACKGROUND: The majority of previous studies on the associations between proximity of physical activity facilities and behavior-related health have focused on proximity from home address, while studies on proximity from work address are scarce. We add to the literature by investigating associations for proximity of these facilities to work and home address and including different types of physical activity facilities.

METHODS: Aim was to assess the associations of proximity of physical activity facilities from home and work address with self-reported physical inactivity and obesity. The analytical sample of 7358 participants was from the 2018 wave of the Swedish Longitudinal Occupational Survey of Health. Log-binomial regression was used for analyses. Covariates included age, sex, education, civil status, individual and neighborhood socioeconomic status, number of children under 12 years of age, work strain, and chronic disease.

RESULTS: We observed that longer distance from home to the nearest paid outdoor physical activity facility was associated with physical inactivity (fully adjusted Relative Risk 1.08, 95% CI 1.00-1.16). However, associations of any, free outdoor or paid indoor facility with physical inactivity were not robust for covariate adjustments. There were associations between long distance from workplace to the nearest any, outdoor, free outdoor and paid outdoor facility and physical inactivity in age and sex adjusted models, however, associations were not robust to full adjustments. Results for obesity were in the same direction as for physical inactivity, however, these were not statistically significant.
CONCLUSION: Proximity Longer distance to paid outdoor physical activity facility from home was associated with physical inactivity. There was an indication that proximity to work address could be an additional determinant of physical activity behavior and obesity, however, longitudinal and larger studies are needed to confirm these findings.

P-0257 Built and Social Environment Exposures association with Obesity in Kaunas Citizens'

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BACKGROUND AND AIM: The evidence for social and environmental factors that contribute to obesity are often underappreciated. This Citizen science study examined the relationship between built and social environment exposures and obesity in men and women.

METHODS: The cross-sectional study included 1071 18-74-year-old Kaunas citizens. Using GIS, we measured the surrounding greenness exposure level of each home address as NDVI for the participants' home addresses. We used questionnaires to determine participants' social factors, physical activity, and environmental quality perception and linked this information with personal data of anthropometric measurements of height and weight. The health outcome was participants body mass index (BMI): normal weight (BMI 18.5-24.9 kg/m2), overweight (BMI> or = 25 kg/m2) and obesity (BMI > or =30.00 kg/m2). We used multivariate logistic regression to assess the associations between environmental issues and BMI in men and women.

RESULTS: 578 women and 493 men with a mean baseline BMI of 24.71 (SD 4.71) kg/m2 and 26.14 (SD 3.92) kg/m2, respectively, were studied. Recommended physical activity was low in men and women (15.5% and 14.3%, respectively). The prevalence of obesity was significantly higher among men with lower education, the adjusted OR 1.79, 95% CI 1.02-3.09, while among women obesity was associated with part-time work (OR 1.88, 95% CI 1.09-3.23) after adjusting for confounders. Green space-health associations were stronger for women than for men. Low surrounding greenness NDVI in the place of residence and irregular park visits tended to increase the risk for obesity in women.

CONCLUSIONS: Our results suggest that improving the social environment and city green spaces might reduce health problems for all.

P-0258 Street-View Greenspace Exposure and Measured Adiposity in Early Adolescence

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BACKGROUND AND AIM: Research on greenspace and adiposity in adolescents is dominated by satellite-derived exposure measures and self-reported adiposity. Google Street View (GSV) images measure ground-level specific greenspace exposures, which may better capture pathways linking greenspace to adiposity. We examined GSV-based greenspace assessed in childhood and adolescence and research-measures of adiposity in adolescence in Project Viva, a cohort in eastern Massachusetts participating in the Environmental influences on Child Health Outcomes (ECHO) consortium.

METHODS: We applied deep learning algorithms to GSV images to derive novel metrics of visible greenspace within 250m of participant's residential addresses in 2007-2010 (mid-childhood, mean age 7.9y) and 2012-2016 (early adolescence, 13.2y). We calculated % total greenspace (combined % grass, % trees, % plants, % fields, and % flowers) within each image, and % grass and % trees separately. at in-person early adolescence research visits, trained research assistants assessed age- and sex-specific body mass index (BMI) z-scores, waist circumference, and dual-energy x-ray absorptiometry (DXA). We used linear regression to examine cross-sectional (adolescence) and longitudinal associations (mid-childhood to adolescent) between greenspace (per IQR) and adiposity, adjusting for child's sex, race/ethnicity, and age; mother's education, marital status, and pre-pregnancy BMI; father's education and BMI; household income; neighborhood median income, and population density.

RESULTS: In cross-sectional analyses (N=652), higher % grass was associated with lower BMI z-score (-0.13 (-0.25, - 0.01)); lower waist circumference (-1.38cm (-2.65, - 0.10)); and lower DXA total fat (-0.30 kg/m² (-0.67, 0.08)) and trunk fat (-0.14 kg/m² (-0.32, 0.04)). No cross-sectional associations were observed for % total greenspace or % trees. In longitudinal analyses (N=400), there was a suggestion that higher % grass was associated with lower waist circumference (-0.86cm (-1.98, 0.27)), but no other associations were present.

CONCLUSIONS: Street-view grass exposure was associated with lower measured adiposity among participants in early adolescence in cross-sectional analyses.

P-0259 Street-View Greenspace Exposure and Childhood Asthma-Related Outcomes: Analyses in Project Viva

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BACKGROUND AND AIM: While higher levels of greenspace can mitigate air pollution, reduce stress, and increase physical activity, its role in childhood asthma is unclear. The aim of this study is to examine the associations of neighborhood greenspace based on Google street view (GS) images with asthma-related measures among children in Project Viva, a cohort in eastern Massachusetts participating in the Environmental influences on Child Health Outcomes (ECHO) consortium.

METHODS: We leveraged GSV images from 2007 to 2011 within 250m of participants' home addresses at mid-childhood and applied deep learning algorithms to derive unique metrics of ground-level greenspace exposure. We calculated total greenspace exposure, which combined %grass, %trees, %plants, %fields, and %flowers within each image. Mothers reported the child's asthma status in mid-childhood (median 7.7 yr) and early adolescence (median 12.7 yr). Trained research assistants performed lung function tests (FEV1 and FVC) using spirometry and collected blood for total serum IgE measurement. We constructed linear and logistic regression models to examine associations of neighborhood greenspace with these asthma-related outcomes adjusting for child's sex, race/ethnicity, age at outcome, maternal and paternal education, marital status and household income (at enrollment), and census tract level household income and urbanicity (at delivery).

RESULTS: In adjusted cross-sectional analyses (N=486), each interquartile range increase in total greenspace was associated with lower FEV1 (-44.7 mL [95% CI: -82.7, -6.64]) and higher total IgE (56.4 kU/L [95% CI: 0.86, 112]). Similar associations were observed for %tree but not for %grass. Greenspace was not associated with asthma status cross-sectionally in mid-childhood. There were no longitudinal associations between any greenspace measures in mid-childhood and any asthma-related outcomes in early adolescence (N=414).

CONCLUSIONS: We observed cross-sectional but not longitudinal associations between GSV-based greenspace with FEV1 and total serum IgE in adverse directions and found no association between greenspace and asthma status.

P-0260 Urban Heat Islands and Heat-Related Cardiovascular Morbidity Among Adults Aged 65+ in US Metropolitan Areas

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BACKGROUND AND AIM: Extreme heat increases the risk of hospitalization due to cardiovascular disease (CVD). The USA (US) population largely resides in urban areas where climate change is projected to increase temperatures, yet little is known about this association across urban heat islands (UHIs). We aimed to identify the urban populations most at risk of and burdened by heat-related CVD morbidity.

METHODS: We obtained daily counts of CVD hospital admissions (HAs) for Medicare enrollees (aged 65+) in 120 metropolitan areas (MSAs) in the contiguous US between 2000-2017. Daily average temperatures were estimated through the interpolation of monitor observations. A measure of UHI intensity was estimated from satellite-derived temperatures in urban vs. non-urban areas. We used quasi-Poisson regression with distributed-lag, non-linear models to estimate MSA-specific associations and pooled these estimates with multivariate meta-analyses. Stratified analyses were performed by UHI intensity quartile. We also calculated the number of CVD HAs attributable to heat in each MSA.

RESULTS: Overall, extreme heat (99th percentile, ~28.6°C) was associated with a 3.0% [1.4%, 4.6%] increase in CVD HA risk relative to the minimum hospitalization temperature (MHT) (91st percentile, ~25.4°C). MSA-specific risks showed substantial differences, with higher risk in MSAs with lower annual average temperatures. We estimate that 1.6% (31,498) of CVD HAs on days above the MHT were attributable to heat. Although the interquartile risk differences were not significant, the highest quartile of UHI intensity was responsible for 47% (14,636) of all heat-attributable CVD HAs.

CONCLUSIONS: Our results show that extreme heat increases the risk of CVD HAs among older adults in US urban areas, with considerable variation between cities. Areas with higher UHI intensity had the highest heat-related burden, indicating a potentially vulnerable subset of the urban population. This abstract does not necessarily reflect EPA policy.

KEYWORDS: Extreme heat, cardiovascular morbidity, urban heat islands

P-0262 The Impact of Residential Greenness on Psychological Distress among Hurricane Katrina Survivors

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KEYWORDS: green space, mental health, disasters, extreme weather

BACKGROUND: Hurricanes are potentially traumatic events that can produce long-lasting health issues for survivors. Research shows that neighborhood-level social features, such as social and economic capital, are associated with lower risk of mental disorders among survivors. However, to our knowledge, there is no work assessing the impact of neighborhood-level environmental features, such as greenness. We hypothesize that, like community social features, the salutary effects of environmental features may modify recovery among disaster-affected populations.

METHODS: We used data from the Resilience in Survivors of Katrina Study, a cohort assembled in 2004-2005 (time 0 [T0]) of low-income parents in New Orleans, Louisiana, USA, most of whom later experienced Hurricane Katrina. We obtained data on psychological distress (Kessler [K]-6 scores), sociodemographics, and hurricane exposure for 214 participants who were interviewed again in 2006-2007 (T1) and in 2016-2018 (T2). We assessed greenness using average growing season Normalized Difference Vegetation Index (NDVI) in 300-m buffers around participants' homes at each timepoint and estimated neighborhood concentrated disadvantage (a common composite metric for neighborhood-level socioeconomic status) at the Census tract-level. We assessed the impact of residential greenness on psychological distress among Katrina survivors using adjusted linear regressions with sandwich clustering.

RESULTS: Preliminary results found that residential greenness was not significantly associated with distress at any time point. However, moving to a greener neighborhood immediately after Katrina (T1) was associated with a reduction in K6 scores, indicating lessened psychological distress (-1.43 [95% CI: -2.82, -0.04]) compared to moving to a neighborhood with the same or lower greenness. We found similar but non-significant associations at T2.
DISCUSSION: In this disaster-affected population, moving to a greener neighborhood was associated with reduced psychological distress in the short term. These findings suggest that neighborhood environmental features may provide temporary health benefits for disaster survivors.

P-0263 Dwelling type and risk of chronic obstructive lung disease

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BACKGROUND AND AIM: Previous research has shown an association between dwelling type and chronic obstructive lung disease (COPD). However, existing research has primarily been based on cross-sectional data making the temporal relation between dwelling type and COPD uncertain. The temporal relation is of importance since people with existing COPD might move into a more COPD friendly type of dwelling (e.g., without stairs) or move due to consequences of their COPD (e.g., financial strains). Hence, we aimed to test the hypothesis that dwelling type was associated with risk of developing COPD.

METHODS: We performed a cohort study of participants who replied to the Danish Health and Morbidity survey in 2000. Participants were followed from inclusion in 2000 until end of 2018 for incident COPD based on information from the Danish National Patient Register and the Danish National Prescription Registry. Incidence rate ratios (IRR) of COPD with 95% confidence intervals (CI) were estimated using Poisson Regressions of incidence rates (IR). Analyses were adjusted for construction-year, urbanization, educational level, age, sex, smoking status and calendar year.

RESULTS: A total of 12,054 participants, free of COPD at inclusion, were included. Most participants lived in detached houses (56%) whereas 17%, 16% and 11 % lived in semi-detached houses, apartments, or other dwelling types, respectively. A total of 1,078 developed COPD during follow-up corresponding to an overall IR of COPD at 8.6. The IRR was 1.45 (95% CI: 1.21-1.73), 1.51 (95% CI: 1.26-1.81), 1.14 (95% CI: 0.86-1.52) and 1.45 (95%: CI 0.81-2.59) for people living in semi-detached houses, apartments, farms and others dwelling types, respectively, as compared to people living in detached houses.

CONCLUSIONS: The IR of developing COPD was significantly higher among participants living in semi-detached houses and in apartments as compared to participant living in detached houses.

KEYWORDS: Dwelling type; COPD; Cohort study

P-0265 The association between perceived annoyances in the indoor environment at home and respiratory infections: A Danish cohort study with up to 19 years of follow-up

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BACKGROUND AND AIM: The relation between perceptions of environment and respiratory infections has been studied by few and with inconsistent findings. Exposure to environmental contaminants may trigger the onset of respiratory infections, either directly or indirectly via annoyance. Perceived annoyance at home caused by the indoor environment is reported by 28% of Danish adults. This study aims to investigate the rate of respiratory infections for individuals exposed to perceived annoyance from the indoor environment, stratified by chronic respiratory disease.

METHODS: A total of 16,688 individuals completed a questionnaire and were interviewed to the Danish Health and Morbidity Survey in 2000. We grouped all eligible individuals based on whether they perceived a low, medium or high annoyance from their home indoor environment by latent class analysis of 13 items. The items covered sensory annoyance and discomfort by the indoor air, lighting, acoustics, and thermal comfort. Participants were followed for respiratory infections in Danish registers, until they met the criteria for censoring or end of study (1/1/2019). Poisson regressions of incidence rates were applied to estimate incidence rate ratios (IRRs) with 95% confidence intervals (CIs) for respiratory infections for each group of perceived annoyance.

RESULTS: We observed a significantly increased incidence of respiratory infections with increasing perceived annoyance. The highest IRR of respiratory infections was in the group with high perceived annoyance (adjusted IRR: 1.13, 95% CI: 1.07-1.20) and progressive decreases among the medium annoyance group (adjusted IRR: 1.05, 95% CI: 1.00-1.10) compared with low annoyance (reference).

CONCLUSIONS: We observed a significant dose-response relationship between the level of perceived annoyance and respiratory infections.

KEYWORDS:
Home environment
Indoor environment
Respiratory infection
Perceived annoyance
Perceived environment
Cohort study

P-0266 Predictors of perceived neighbourhood comfort in urban and suburban areas in Finland

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BACKGROUND AND AIM: The quality of residential environment, or, neighbourhood, is one determinant of overall quality of life. International studies have observed that neighbourhood perceptions are associated with socio-demographic and dwelling-related factors, and subjective and objective neighbourhood qualities such as safety or low noise levels. However, only a few studies have examined all these attributes at once and assessed the role of inclusion in neighbourhood decision-making processes; these were the aims of this study.

METHODS: A survey was conducted among adults (aged 18-97) in urban centres and suburbs in five Finnish cities (n=2057; response rate 34%) in 2021. Ordinal mixed regression models (using the latent probit link function) were specified to assess the importance of socio-demographic, dwelling, and neighbourhood attributes for perceived neighbourhood comfort.

RESULTS: Almost 80% of the respondents perceived their neighbourhood as comfortable or very comfortable. Apart from age and relationship status, socio-demographic factors were not associated with perceived neighbourhood comfort. Concerning dwelling, neighbourhood comfort was related to being satisfied with the dwelling (vs unsatisfied/neither: b=.77), having a green view and looking at it often (vs seldom/no green view: b=.48) or sometimes (b=.16), and living in a detached house (vs a flat: b=.27). of subjective neighbourhood attributes, the strongest predictors of neighbourhood comfort were being satisfied (vs unsatisfied/neither) with neighbourhood safety (b=.66), green areas (b=.40), blue areas (b=.32) and maintenance of traffic routes (b=.31); and good/very good (vs poor/very poor) possibilities to influence the decisions regarding the neighbourhood (b=.42).

CONCLUSIONS: Supporting previous studies, perceived neighbourhood comfort was most strongly explained by satisfaction with dwelling and neighbourhood qualities -especially safety and natural environments- and, as a novel result, being able to influence neighbourhood decisions. In upcoming analyses, we will add objective neighbourhood attributes and examine whether selected factors moderate these relationships.

KEYWORDS: neighbourhood satisfaction, suburbs, green space, residential satisfaction

P-0267 Exposure to artificial light-at-night and cardiometabolic health: an urban perspective from the Catalan GCAT cohort study

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BACKGROUND AND AIM: It has been suggested that artificial light-at-night (ALAN) exposure may lead to metabolic disturbances through circadian misalignment and sleep disruption. The present study investigated associations between residential outdoor ALAN exposure and cardiometabolic risk factors and disease outcomes.
METHODS: We used data from 9,752 participants (59% women) in the Genomes for Life (GCAT) cohort study in Barcelona. Residential ALAN was assessed from images of the International Space Station with a 30m resolution. We estimated the visually relevant photopic illuminance and the metabolic and circadian-regulation relevant melanopic equivalent daylight (D65) illuminance, in lux. We examined cross-sectional associations between ALAN and cardiometabolic risk factors (obesity, glycaemia and hypertension). During a mean follow-up time of 2.5 years (SD 0.97) we prospectively assessed, in 5,743 participants, incident diseases (angina pectoris, myocardial infraction, stroke, diabetes, hypercholesterolemia and hypertension) ascertained through electronic health records. We adjusted our main models for demographic characteristics and further adjusted for greenness density and air pollution.
RESULTS: In cross-sectional analyses we found an association between photopic and melanopic Illuminances and hypertension, OR = 1.15 (95% CI 1.03-1.29) and 1.58 (1.08-2.32), per unit increase; associations remained stable after adjusting for other urban exposures. The association between illuminances and obesity was less consistent across adjustments. In incident analyses, photopic and melanopic illuminances were associated with hypercholesterolemia, OR = 1.94 (1.06-3.55) and OR = 1.30 (1.09-1.55), respectively. We had limited power, due to few incident cardiovascular events, and did not observe an association between ALAN and cardiovascular diseases nor diabetes.
CONCLUSIONS: The present study suggests an association between photopic and melanopic illuminance at night and risk of hypertension and hypercholesterolemia, key risk factors for cardiometabolic diseases. Results should be interpreted carefully since satellite-based ALAN assessment, even in high resolution, estimates individual exposure only partially.

KEYWORDS:
Light-at-night, circadian misalignment, hypercholesterolemia, hypertension, cardiovascular, obesity

P-0269 Associations Between Hospital Readmissions and Proximity to Brownfields in North Carolina

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BACKGROUND: Contaminated sites known as brownfields contribute to air, water, and land pollution and also prevent the beneficial use of lands by the community. The health effects surrounding brownfields have been understudied which can impair efforts to quantify the benefits of their remediation.

METHODS: Our study cohort was composed of 21,776 heart failure patients diagnosed between 2004 and 2016 at a University of North Carolina Healthcare System affiliated hospital or clinic. We examined the associations between brownfields and hospital readmissions. We used proximity to the nearest brownfield as our exposure based on the primary residence at the time of heart failure diagnosis. Zero-inflated Poisson models were used to associate distance to the nearest brownfield with readmissions while adjusting for age, race, sex, and socioeconomic status indicators based on the 2010 US Census. In sensitivity analyses we examined log transformed distance, restricted to only those brownfields within 2 km of an individual, and further adjusted for county-level indicators of access to healthcare.

RESULTS: A 1 km increase in distance to the nearest brownfield was associated with a 1.29% (95% confidence interval = 0.43-2.14%) decrease in 7-day readmissions as well as a 0.55% decrease (95% confidence interval = 0.20-0.90%) in 30-day readmissions. Associations with 7-day readmissions remained when restricting to brownfields within 2km, in the log-transformed distance models, and after adjusting for county-level indicators of access to healthcare. Associations with 30-day readmissions were substantially attenuated under all sensitivity analyses.
CONCLUSION: Proximity to brownfields is associated with increases in hospital visits and readmissions among heart failure patients. These associations may reflect exposure to chemicals present in the brownfields as well as land disinvestment. Understanding the health risks surrounding brownfields may help communities to better protect their environmental health. This abstract does not necessarily represent the views or policies of the US EPA.

P-0270 Associations of greenness, public parks, and blue space with cardiovascular and respiratory disease hospitalization in the US Medicare cohort

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BACKGROUND AND AIM: Natural environments have been linked to decreased risk of cardiovascular disease (CVD) and respiratory disease (RSD) mortality. However, few cohort studies have looked at associations of natural environments with CVD or RSD hospitalization. Our aim was to evaluate these associations in a cohort of U.S. Medicare beneficiaries (~63 million individuals).

METHODS: Our open cohort included all fee-for-service Medicare beneficiaries (2000-2016), aged ≥65, living in the contiguous U.S. We assessed zip code-level average greenness (Normalized Difference Vegetation Index, NDVI), public park cover based on the USA Geological Survey Protected Areas Database, and percent blue space cover based on Landsat satellite images. Cox-equivalent Poisson models were used to estimate associations of the exposures with first CVD and RSD hospitalization in the full cohort and among those living in urban zip codes (≥1000 persons/mile2).

RESULTS: NDVI was weakly negatively correlated with percent public park cover (Spearman ρ = -0.23) and not correlated with percent blue space (Spearman ρ = 0.00). After adjustment for potential confounders, an IQR (0.27) increase in NDVI was negatively associated with CVD (HR: 0.97, 95%CI: 0.96, 0.97), but not with RSD hospitalization (HR: 0.99, 95%CI: 0.98, 1.00). In urban zip codes, an IQR increase in NDVI was positively associated with RSD hospitalization (HR: 1.02, 95%CI: 1.00, 1.03). Percent public park cover was not associated with CVD or RSD hospitalization in the full or urban population. In stratified analyses, percent public park cover was negatively associated with CVD and RSD hospitalization for Medicaid eligible individuals and individuals living in low socioeconomic status neighborhoods in the urban population. We observed no associations of percent blue space cover with CVD or RSD hospitalization.

CONCLUSIONS: This study suggests that natural environments may benefit cardiorespiratory health; however, benefits may be limited to certain contexts and certain health outcomes.

P-0271 Urban green spaces and suicide mortality in Belgium (2001-2011): a census-based longitudinal study

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BACKGROUND:
Exposure to green spaces is associated with improved mental health and may reduce the risk of suicide. Here, we investigate the association between long-term exposure to residential surrounding greenness and suicide mortality.
METHODS: We used data from the 2001 Belgian census linked to mortality register data (2001-2011). We included individuals aged 18 years or older at baseline (2001) and residing in the five largest urban areas in Belgium (n=3,549,514). Suicide mortality was defined using ICD-10 codes X60-X84, Y10-Y34, and Y870. Surrounding greenness was measured using the Normalized Difference Vegetation Index (NDVI) within 300m and 1,000m buffers around the residential address at baseline. To assess the association between residential surrounding greenness and suicide mortality, we applied Cox proportional hazards models with age as the underlying time scale. Models were adjusted for age, sex, marital status, migrant background, educational attainment, neighbourhood socio-economic position. We additionally explored potential mediation with residential outdoor nitrogen dioxide (NO2) concentrations. Associations are expressed as hazard ratios (HR) and their 95% confidence intervals (CI) for an interquartile range (IQR) increase in residential surrounding greenness.
RESULTS: Between 2001 and 2011, 8,577 suicide deaths were registered. We observed a 7% (95%CI 0.89-0.97) and 6% (95%CI 0.90-0.98) risk reduction of suicide mortality for an IQR increase in residential surrounding greenness for buffers of 300m and 1,000m, respectively. Furthermore, this association was independent of exposure to NO2. After stratification, the inverse association was only apparent among females, and residents of Belgian origin, and that it was stronger among residents aged 36 or older, those with high level of education, and residents living in socio-economic deprived neighborhoods.
CONCLUSION:
Our results suggest that urban green spaces may protect against suicide mortality, but this beneficial effect may not be equally distributed across all strata of the population.

KEYWORDS:
Suicide mortality; surrounding greenness; longitudinal study

P-0272 Effects of greenness, public parks, and blue space on neurodegenerative disease hospitalizations in the US Medicare cohort

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BACKGROUND AND AIM: Exposure to natural environments has been associated with health outcomes that are related to neurological disorders. However, the few studies that examined associations of natural environments with neurological disorders reported mixed findings. Our goal was to evaluate associations of multiple features of natural environments with Alzheimer's disease and related dementia's (ADRD) and Parkinson's disease (PD) hospital admissions.

METHODS: We created an open cohort including all fee-for-service Medicare beneficiaries aged 65+, who lived in the contiguous US January 1, 2000 through December 31, 2016 (~63 million individuals). Zip code level greenness (Normalized Difference Vegetation Index, NDVI), percent public park cover, and percent blue space cover (≥1 % cover vs. <1% cover) were assessed. We examined associations of these exposures with first ADRD or PD hospitalizations based on primary or secondary discharge diagnosis, using a novel Cox-equivalent Poisson model. We also assessed if associations varied by demographics and area-level socioeconomic status.

RESULTS: We observed 7,910,111 and 1,196,981 first ADRD and PD hospitalizations, respectively. After adjustment for potential individual- and area-level confounders, NDVI was negatively associated with ADRD hospitalization (HR=0.95, 95%CI: 0.94-0.96, per IQR increase). Percent public park cover and blue space cover were not associated with ADRD hospitalization. for PD hospitalization, we observed negative associations of NDVI (HR=0.94, 95%CI: 0.93-0.95, per IQR), percent public park cover (HR=0.97, 95%CI: 0.97-0.98, per IQR), and blue space cover (HR=0.97, 95%CI: 0.96-0.98, ≥1% v. <1%). Patterns of effect modification by demographics differed between the exposures. for example, for PD hospitalization, negative associations of NDVI were strongest in the mid and high SES neighbourhoods, while negative associations of percent public park cover were strongest in the low SES neighbourhoods.

CONCLUSIONS: Features of natural environments are associated with a decreased risk of ADRD and PD hospitalization in this cohort of US-based older adults.

P-0274 School and residential green- and bluespace and academic performance in Polish schoolchildren with and without attention deficit hyperactivity disorder

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BACKGROUND: Some ecological studies, mainly in the USA, reported that school greenspace is associated with better academic performance. Based on individual data, we investigated whether exposure to school and residential green- and bluespace can improve the academic performance of Polish schoolchildren.

METHODS: NeuroSmog is a case-control study currently being conducted to investigate the impact of air pollution on brain development of children with and without attention deficit hyperactivity disorder (ADHD) in Poland. Cases were recruited by study field psychologists, while controls were randomly recruited from schools across 18 towns in southern Poland. The analytic sample for the current analysis consists of 339 10 to 13-year-old children. Polish and maths grades are reported by parents, while perceived performance in these subjects is reported by children. Tree, grass, and water cover were abstracted in 500 and 1000m Euclidean buffers around residential addresses and school. Age, gender, mother's education, and financial status were selected as confounders by Directed Acyclic Graph. Adjusted logistical models were used to evaluate the associations.

RESULTS: We did not find any consistent associations between academic performance and residential or school green- and bluespace. This held true for population subsample and children with ADHD.

CONCLUSIONS: Residential and school green and bluespace do not boost academic performance in Polish schoolchildren. More studies on individual data and from different countries are needed to confirm this finding.

P-0275 Biophilia and “Body-Philia": Does positive body image change due to short visits in outdoor green environments?

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BACKGROUND: Mounting evidence suggests that exposure to natural environments has beneficial effects on positive emotion, but less is known about the effects on positive body image and on the beneficial effects of green walls.
Aim: The aim of the study is to examine the effects of short visits to different outdoor environments on positive body image.

METHODS: We recruited 200 healthy adult participants (139 women) and conducted a quasi-experimental study using within-subjects design. We examined the effect of short visits to randomly assigned ordered outdoor environments (green wall, small green garden and gray wall), as compared to baseline indoor environment on: mean positive body image, evaluated by SBAS-2 (State Body Appreciation Scale) and changes in sum of positive and negative emotions evaluated by PNAS (Positive and Negative Affect Schedule). The differences were examined using a repeated nonparametric Friedman test and any significant difference between environments was further explored using post hoc analysis with Wilcoxon signed-rank test, with Bonferroni correction.

RESULTS: The median of positive body image in the small garden environment [4.0, Inter Quartile Range (IQR):3.1- 4.74] and the green wall [3.9, IQR:3.08- 4.63] were higher compared to the gray wall [3.7, IQR:3.0 - 4.23] and to the indoor environment [3.7, IQR:2.8 - 4.53], [$X2(3) = 44.27$, $p < 0.00$]. for positive emotions, a higher but not significantly different sum was observed for small garden and green wall ([29, IQR: 23 to 35] and [28, IQR:21 to 34], respectively), and significantly higher compared to gray wall [25, IQR:20 to 31], [$X2(3) = 70.453$, $p < 0.00$]. for negative emotion, there was no significant differences between the environments.

CONCLUSIONS: Short visits to outdoor green environments compared to non-green, or indoor environments, raises participants’ body appreciation and positive emotions.

KEYWORDS: Positive body image, Positive and negative emotions, Green environment, Green vertical wall

P-0276 Walkability and Physical Activity in Nurses' Health Study 3 with Measurement Error Correction Using Smartphone Mobility Data

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BACKGROUND AND AIM: Studies of walkability and physical activity often rely on residential measures that omit exposures occurring in other environments, likely leading to exposure misclassification. We measurement-error corrected traditional residential walkability measures using smartphone mobility-based walkability estimates and examined its association with self-reported physical activity in a US-based cohort.

METHODS: We calculated typical minutes per week spent walking and running from Nurses' Health Study 3 (NHS3) participants using validated physical activity questionnaires (n=23,983). We spatially joined residential addresses to census tract-level walkability, calculated by summing z-scores of 2018 TIGER/Line road intersection density; 2018 Infogroup business density; and 2015-2019 5-year American Community Survey population density estimates. A subset of NHS3 (n=337) provided smartphone GPS data every 10 minutes across four 7-day sampling periods that captured seasonal variability, which was used to create our 'gold standard' walkability exposure. We used standard regression calibration for generalized linear models to produce corrected estimates and 95% confidence intervals for associations of walkability with physical activity in the full NHS3, adjusting for confounders.

RESULTS: Participants reported on average 273.15 minutes of physical activity per week (SD = 257.00), had a mean residential walkability score of 0.03 (SD=2.64), and had a mean GPS based walkability score of 0.36 (SD=2.39). Each SD increase in uncorrected residential walkability was associated with a 7.95-minute increase in time spent walking and running per week (95% CI; 3.83, 12.08), whereas each SD increase in measurement error corrected walkability was associated with a 10.80-minute increase in time spent walking and running per week (95% CI: 4.96, 16.64).

CONCLUSIONS: Our study indicates that traditional residential estimates of walkability may underestimate associations between walkability and physical activity. These findings highlight the impact of exposure misclassification on epidemiological studies of physical activity and the built environment.

KEYWORDS: Wearables, Mobility, Measurement Error, Physical Activity, Exposure Correction

P-0277 Relations of Residential Greenness with Markers of Immunity and Inflammation in the Green Heart Study

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BACKGROUND AND AIM: Exposure to vegetation has been linked with long-term health benefits, including reduced risk of mortality, reduced cardiovascular disease, and improved mental health. However, the underlying mechanistic pathways remain poorly understood, and few studies have explored the relationship between greenness with markers of inflammation. Therefore, we examined the associations between residential greenness with circulating levels of inflammatory biomarkers and immune cells.

METHODS: We recruited adult participants, aged 20-70 years, from a neighborhood in Louisville, KY during the summer months of 2018 and 2019. A complete blood count panel, cytokines, and immune cells were measured in 606 participants at baseline. Surrounding greenness was assessed from Sentinel-2 satellite data by Normalized Difference Vegetation Index (NDVI) and by leaf area, within 100m and 500m buffers. To estimate associations between greenness and log-transformed outcomes we fit linear regression models adjusting for socio-demographic and behavioral risk factors.

RESULTS: Higher levels of all greenness metrics were associated with lower hsCRP, ranging from -10.6% to -17.7% lower levels of hsCRP per IQR higher greenness. Leaf area within a 100m radius was inversely associated with TNF-α (-4.0% per IQR; 95% CI: -7.3% to -0.5%), MIP-1α (- 5.65% per IQR, 95% CI: -10.93% to -0.04%), MIP-1β (-7.3% per IQR; 95% CI: -12.7% to -1.6%), while IL-6 was inversely associated within a 500m radius (-6.6%; 95% CI: -12.2% to -0.6%). In our analysis of immune cells, we found consistent inverse associations with white blood cell counts, B-cells, and monocytes with multiple metrics of greenness. Natural killer T-cells were positively associated with leaf area within a 500m radius (7.0% per IQR; 95% CI: 0.5% to 13.9%).

CONCLUSIONS: Residential greenness may lower levels of inflammation and improve immune responses that could be beneficial to cardiovascular health.

KEYWORDS: vegetation, greenness, inflammation, immune cells, cytokines

P-0278 Unintended impacts of the Open Streets program on noise complaints in New York City

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BACKGROUND AND AIM: Exposure to high levels of environmental noise and noise annoyance have been associated with detrimental health outcomes. In 2012, a campaign in New York City (NYC) measured noise levels frequently exceeding recommended standards. Noise complaints have been used as a proxy of noise annoyance and exposure. NYC has been opening parts of its street network to recreation and physical activity through the Open Streets program. We aim to describe the citywide distribution of noise complaints by census tract percentage of Open Streets.

METHODS: We conducted analyses at the census tract level from 2019 to 2021 across NYC. We used noise complaints from 311 calls for specific locations and times, which we aggregated to daily census tract counts of noise complaints. We focused on two categories of noise complaints that may be impacted by Open Streets: vehicle and street/sidewalk noise complaints. We used a mixed-effects model with random intercepts for census tracts to estimate the association between changes in noise complaints and area covered by Open Streets (%) given tract-level socioeconomic status and street geometry. We allowed for nonlinear exposure–outcome relationships using natural splines. We also carried out sensitivity analyses using data from a citizen's survey on Open Streets implementation levels gathered by Transportation Alternatives (TA) to assess its impact on model results.

RESULTS: Census tracts with increasing use of street space as Open Streets (i.e. higher than 5%) reported more daily street/sidewalk noise complaints. for vehicle noise complaints, 5 to 10% of area covered by Open Streets showed increasing noise complaints but estimates plateaued at higher percentages. The sensitivity analyses using TA implementation data showed that our estimates were fairly robust.

CONCLUSIONS: Our preliminary results suggest that Open Streets were associated with increases in street/sidewalk noise complaints.

KEYWORDS: (2-6): Policy, Noise annoyance, Open Streets, Urban planning, Cities

P-0280 Traffic noise in relation to markers of obesity in nine Nordic cohorts

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BACKGROUND AND AIM: Evidence suggests that transportation noise may increase the risk of obesity. However, there are uncertainties regarding e.g. exposure-response relations, potential threshold effects and interactions, in particular with air pollution. In this study, we aim to assess the exposure-response associations between residential exposure to road traffic noise and Body Mass Index (BMI), overweight and obesity, as well as to investigate interaction with air pollution ($PM_{2.5}$).

METHODS: The study was based on pooled analyses of nine cohorts from Denmark and Sweden, including 128 000 subjects, recruited 1990–2004. Road traffic noise was calculated as time-weighted average Lden exposure five years prior to the baseline of each cohort. Linear and logistic regression models were used to assess associations with BMI and overweight (BMI ≥25 kg/m²) and obesity (BMI ≥30 kg/m²), respectively, adjusting for individual and area-based demographic, socio-economic, lifestyle and environmental factors. Exposure-response relationships were assessed using restricted cubic splines.

RESULTS: In the fully adjusted model, exposure to road traffic noise was associated with an increased BMI of 0.07 kg/m² (95% confidence interval, 95% CI, 0.03–0.10) per 10 dB Lden, as well as with an excess risk of being overweight, odds ratio (OR) 1.03 (95% CI 1.01–1.05), or obese, OR 1.06 (95% CI 1.03–1.09). There appeared to be a threshold around 50–55 dB Lden in the exposure-response relationship for BMI. Furthermore, stronger associations were suggested at levels above the mean PM2.5 (15 µg/m³): 3rd quartile 0.11 kg/m² (95% CI 0.04–0.17) and 4th quartile 0.22 kg/m² (95% CI 0.16–0.28).

CONCLUSIONS: Preliminary findings from this study indicate positive associations between road traffic noise and BMI as well as with overweight and obesity. Stronger associations appeared at noise levels above 50–55 dB Lden and at higher $PM_{2.5}$ levels.

KEYWORDS: Road traffic noise, BMI, overweight, obesity, exposure-response function, interaction

P-0281 Time course of electromagnetic hypersensitivity in a prospective cohort of Dutch individuals

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BACKGROUND:
Some individuals attribute health complaints to radiofrequency electromagnetic field (RF-EMF) exposure. This condition, known as electromagnetic hypersensitivity (EHS), can be disabling for those who are affected. Psychosocial factors are thought to play a role but little is understood about the time course of EHS.
In this study we assessed factors related to developing, maintaining, or discarding EHS over the course of 10 years, defined as reporting health complaints attributed to RF-EMF exposure.
METHODS: Participants (n=892, mean age 50 at baseline, 52% women) from the Dutch Occupational and Environmental Health Cohort Study AMIGO filled in questionnaires in 2011/2012 (T0), 2013 (T1), and 2021 (T2) where information pertaining to perceived RF-EMF exposure and risk, symptoms, sleep problems, and EHS was collected. We fitted multi-state Markov models to represent how individuals transitioned between states (yes, no) of symptom attribution to RF-EMF exposure.
RESULTS: At each time point, about 1% or study participants reported health complaints that they attributed to RF-EMF exposure. While this percentage remained stable, the individuals who reported such complaints changed over time: of 9 persons reporting health complaints at T0, only 1 reported EHS at both T1 and T2. Overall, participants had a 95% chance of transitioning from yes to no over a time course of 10 years, and a chance of 1% of transitioning from no to yes. Participants with a high RF-EMF exposure and risk perception had a general tendency to move more frequently between states.
CONCLUSIONS: We observed a low prevalence of symptom attribution to RF-EMF exposure in our population. Prevalence did not vary strongly over time but there was a strong aspect of change: over 10 years, there was a high probability of not attributing symptoms to RF-EMF exposure anymore. Being EHS appears to be a more transient condition than previously assumed.

KEYWORDS:
electromagnetic hypersensitivity

P-0283 Interactions between multiple environmental factors and associations with generalized anxiety disorder in Nurses' Health Study II

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BACKGROUND AND AIM: Built and natural environments are linked to lower anxiety. Results are mixed due to heterogeneous study populations and definitions of anxiety. We longitudinally examined associations between generalized anxiety disorder (GAD) symptoms and exposure to residential greenness, walkability, and neighborhood socioeconomic status (nSES) and their interactions in the Nurses' Health Study II.

METHODS: 79,838 participants completed the 7-item GAD Assessment (GAD-7) in 2013 and/or 2017. GAD-7 scores for both time points were dichotomized at a clinically-relevant cutoff (GAD-7 ≥ 5), indicating at least mild anxiety symptoms. Annual average and peak (July) greenness were assigned to residential addresses using Landsat-based Normalized Difference Vegetation Index (NDVI) at 270m and 1230m buffers. Walkability was calculated from summed z-scores of 2010 Census population density, Tiger/Line shapefile road intersection density, and Infogroup business density. nSES z-scores were linked using 2010 Census data. We employed generalized estimating equations (GEE) for individual and joint exposure models to estimate odds ratios (OR) and 95% confidence intervals (95% CI) adjusted for sociodemographic and lifestyle risk factors for anxiety.

RESULTS: Interquartile range increases in peak 270m NDVI (OR: 0.98, 95% CI: 0.96, 1.00), peak 1230m NDVI (OR: 0.97, 95% CI: 0.95, 1.00), and nSES z-score (OR: 0.97 95% CI: 0.95, 0.99) were protective. Higher walkability (OR: 1.02, 95% CI: 1.01, 1.03) was associated with elevated odds of anxiety symptoms. Interaction models showed substantial heterogeneity. for example, peak 270m NDVI was more protective in lower nSES areas (lowest quintile OR: 0.94, 95% CI: 0.90, 0.98, highest quintile OR: 1.01, 95% CI: 0.96, 1.06). The adverse association observed with walkability was stronger in higher NDVI areas.
CONCLUSION: Higher residential NDVI and nSES and lower walkability were associated with decreased odds of anxiety symptoms. Interactions between these contextual factors identified subpopulations that could benefit from improved residential built and natural environments.

P-0284 Presence and distribution of Encephalitozoon spp. spores across different soil types

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BACKGROUND AND AIM: The presence of Encephalitozoon spp. (E. intestinalis, E. hellem and E. cuniculi) in urban topsoils has been poorly studied despite increasing reports of infection in humans. The aim was to determine factors that could affect the presence/distribution of these species in Alcalá de Henares (Spain).

METHODS: 227 topsoil samples were collected in July 2017 across urban parks and green areas from: urban (155), industrial (60) and a public garden (12). DNA was extracted by disrupting the spores using Fast-Prep for Soil®, followed by SYBR Green real-time PCR. Urban/industrial areas were sub-divided into four and two areas to investigate distribution. Organic matter content (OM), pH, electric conductivity and the texture (percentages of sand, clay and silt) were also determined in the soils.

RESULTS: Encephalitozoon spp. were detected in 22 of the soil samples (16 urban, 6 industrial). The processes of the composting used for fertilising public gardens might have inactivated the potential presence of any spores. OM and silt were significantly higher in industrial vs. urban soils, meanwhile percentages of clay and sand were significantly higher in urban areas. Meanwhile E. cuniculi did not show any relationship with soil textural factors, E. intestinalis was associated with industrial soils that presented lower percentages of sand (14.5 vs. 21.7; $p<0.001$) and higher levels of silt (78.5 vs 64.9; $p=0.023$). Silt could provide adequate shade and moisture for the survival of the spores, meanwhile sand does not retain water well. E. intestinalis/E. hellem, species that could not be distinguish between them, were associated with urban soils with higher content of clay (19.02 vs. 11; $p=0.020$).

CONCLUSIONS: Our results indicate a moderate effect of soil conditions and types in the prevalence and distribution of Encephalitozoon spp. spores in Alcalá's topsoils, which could be used to reduce their presence.

P-0285 Higher proportion of agricultural land use around the residence is associated with higher urinary concentrations of AMPA, a glyphosate metabolite

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BACKGROUND & AIM:
Pesticides are widely used and there are concerns about their health effects. Little research has been done into the extent to which agricultural land use in the residential surroundings contributes to exposure.
We investigated associations between proportion of agricultural land use around the residence and exposure to pesticides.
METHODS: We included 424 adolescents participating in a Flemish biomonitoring study (FLEHS IV) between 2016 and 2020. Proportions of agricultural land use around the residence were estimated in several buffers (300m, 500m, 1000m and 2000m) after geocoding of residential address. Concentrations of biomarkers of pesticides were measured in urine and adjusted for specific gravity: glyphosate and its metabolite, aminomethyl-phosphonic acid (AMPA); 3-phenoxybenzoic acid (3-PBA); 3,5,6-trichloro-2-pyridinol (TCPy) and 2,4-dichlophenoxy-acetic acid (2,4-D). We categorized pesticide biomarkers in three categories and used ordinal logistic regression models adjusted for sex, season and household education to estimate odds ratios for an interquartile range (IQR) increase of proportion of agricultural land use. We also used binary logistic regression models in which the highest exposure was compared to the lowest exposure and explored effect modification by sex and season.
RESULTS: We found a significant association between proportion of agricultural land use in 2000m buffer around the residence and levels of urinary AMPA (OR=1.35 for an IQR increase in proportion of agricultural land use around the residence; 95% CI: 1.00-1.83). This association was less pronounced and not statistically significant for other studied pesticides (OR between 0.95 and 1.16). Stratified analysis showed strongest associations of proportion of agricultural land use within 2000m buffer for AMPA among boys (OR=1.89; 95% CI: 1.19-3.04).
CONCLUSIONS: A higher proportion of agricultural land use around the residence might increase exposure to AMPA. A potential mechanism is wind erosion of contaminated soils.

KEYWORDS:
Pesticide, glyphosate, aminomethyl-phosphonic acid, human biomonitoring, residential land use, built environment

P-0286 Awareness and Perception of Plant-Based Diets at an Urban Community College

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BACKGROUND AND AIMS:
Despite the environmental and human health benefits of consuming minimally processed plant-based foods, research on best education and promotion practices for plant-based diet (PBD) is lacking among urban community college students. Education on the benefits of a PBD and gardening may create more knowledgeable and environmentally conscious consumers. Potential benefits may result in positive health outcomes and assist a dietary shift towards a PBD. We explored awareness and perception of PBDs among young adults on an urban college campus containing an urban farm. We developed and implemented a cross-sectional survey instrument, tailored for the community college population, to examine dietary intake and gauge PBD familiarity/exposure, knowledge, perceptions, and attitudes.
METHODS: A cross-sectional survey was conducted Fall 2020 through Spring 2021 at Kingsborough Community College in Brooklyn, NY (N=8,849). Participants (N=287) completed a 70-item online survey that included sociodemographic questions, food frequency questions, and five PBD scales developed for this survey (familiarity, knowledge, attitudes, exposure, perception).
RESULTS: Cronbach's alpha reliability scores were run on the five PBD scales demonstrating strong reliability results for familiarity (α=.80), knowledge (α=.72), attitudes (α=.70); lower reliability for exposure (α=.48), and perception (α=.64). of all participants, 75% reported a 3-6 servings per week or less of fruit alone and vegetables alone. Those with exposure to growing fruits and vegetables reported higher intake of fruit (p-value=0.002) and vegetables (p-value=0.033) compared with those who reported no exposure to 'growing'. Those exposed to the 'campus farm/event' had higher fruit intake (p-value =0.042) when split into high/low intake.
CONCLUSIONS: These findings suggest that community college students in our sample generally have an awareness and positive perception of a PBD and are willing to consider trying it, though many are not actively following a PBD.

KEYWORDS:
Plant-based diet perceptions, nutrition, diet, fruit and vegetable gardening, urban farm, community college

P-0289 A comprehensive evaluation of built-environment as a risk factor for sleep disruption

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BACKGROUND/ AIM:
Sleep disruption is a significant public health issue, given its high prevalence and links to both injury and chronic disease. Interventions for improving sleep often focus on individual-level behaviour change. Modifying aspects of the built environment may be a strategy for population-level improvements. Few studies have evaluated the impacts of built environment on sleep. We assessed relationships between the built environment and sleep disruption using a well-characterized, population-based cohort.

METHODS: Analyses were conducted among participants of the British Columbia Generations Project (BCGP) with complete data on built environment factors and self-reported sleep duration and quality(n=23,556). Measures of air pollution ($PM_{2.5}$, NO_2), greenness (density within 250-metres) and intensity of light-at-night (LAN) were obtained from the Canadian Urban Environmental Research Consortium (CANUE), and linked to participants residential postal codes. Logistic regression analysis, adjusted for age and sex, was used to estimate the association between each built environment factor and self-reported sleep duration (<7 hours, ≥7 hours) and difficulty in falling or staying asleep (sometimes/most of the time/ always vs. rarely/never).

RESULTS: Increased $PM_{2.5}$ was associated with lower odds of insufficient sleep duration (OR=0.85/5µg/m³; 0.74-0.97) and greater odds of difficulty falling/staying asleep (OR 1.54/5µg/m³; 1.37-1.74). Increased LAN intensity was associated with greater odds of insufficient sleep (OR=1.04/10-unit; 1.02-1.07) but not with difficulty falling/staying asleep. Greenness exposure in the top quartile was associated with reduced odds of insufficient sleep (OR=0.92; 0.86-0.99) and difficulty staying/falling asleep (OR=0.97; 0.95-0.99) compared to those in the bottom quartile. Greenness, LAN and $PM_{2.5}$ were moderately correlated ($-0.5 < r < 0.5$).

CONCLUSIONS: BCGP's rich data enabled a comprehensive evaluation of the built-environment as a modifiable determinant of sleep disruption. Further analyses will elucidate the mediating effects of sleep on the links between built-environment and chronic disease.

KEYWORDS: Sleep; Built Environment; Air Pollution; Greenness; Light pollution

P-0290 Geomagnetic Disturbances and Ventricular Arrhythmia in Patients with Implantable Cardioverter Defibrillators from a US-Based Hospital

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BACKGROUND AND AIM: Episodes of ventricular arrhythmias (VA) have been associated with environmental exposures such as air pollution. Solar driven geomagnetic disturbances may alter autonomic nervous system activity, modify systemic oxidative stress, or induce changes in aerosols. However, few studies have investigated if there is an association between VA and geomagnetic disturbances (GMD). The aim of this study was to assess whether GMD is associated with the initiation of VA in patients with implantable cardioverter defibrillators (ICDs).

METHODS: This study examined the association between GMD driven by solar activity on VA, defined as sustained and non-sustained ventricular fibrillation or ventricular tachycardia, in patients with ICDs using a time-stratified case-crossover analysis between September 2006 and March 2010 from Tufts Medical Center's Cardiac Arrythmia Center in Boston, MA. Patients were identified from a single Massachusetts-based Medical Center and VAs were identified from retrieved ICD records as part of routine care. We considered several pollutants such as PM2.5, black carbon (BC), O3, NO2 and ultrafine particles (PN) in our analyses using time lags prior to the event. Daily GMD information was appended for the week previous to each event and matched control day.

RESULTS: During the study period, 91 patients had a total of 1,050 VA. During periods of increased GMD, patients with low ejection fraction and a history of a MI or coronary intervention had increased odds of VA, with patients who had a coronary bypass graph being the highest (OR: 1.63, 95% CI 1.05, 2.52).

CONCLUSIONS: Among patients with ICDs, exposure to GMD was associated with higher odds of VA in those with pre-existing heart disease and/or a history of coronary interventions. GMD driven by solar activity has the potential to affect heart health in patients with cardiac comorbidities.

KEYWORDS: Solar activity, geomagnetic disturbances, implantable cardioverter defibrillator, ventricular arrhythmia

P-0291 A tale of many neighborhoods: latent profile analysis to derive nationally representative neighborhood typologies in the US

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BACKGROUND AND AIM: Neighborhoods are critical to health, yet challenging to model effectively and consistently across geographies. We used latent profile analysis (LPA) to derive a typology of residential neighborhood found across the US, and then explored how self-reported health varies between neighborhood types.

METHODS: We defined neighborhoods as census tracts and compiled 2015-2019 ACS tract-level estimates for neighborhood indicators of commute mode, education, immigration, race, recent growth, and urban form. LPA models ranging from 1 to 6 classes were fit to these data. We the used a one-way ANOVA to compare tract-level 2019 prevalence estimates of poor physical health and poor mental health, provided by the US Centers for Disease Control and Prevention PLACES dataset, between neighborhoods grouped by latent profile.

RESULTS: Model fit statistics identified a 6-profile model permitting varying variances and covariances as the optimal categorization of neighborhood profiles. of the 73,057 census tracts classified, 55% of tracts fell into one of two profiles that were broadly characterized as rural typologies. The remaining 45% of tracts fell into four broadly urban profiles, differentiated by sociodemographic composition, education, and recent growth. Tracts characterized as rural and with a high racial/ethnic minority class had the highest poor health prevalence (MeanPoor Physical health(SD): 16.3 (3.96), MeanPoor Mental health(SD): 18.0 (3.42), whereas tracts characterized as urban with high education had the lowest poor health prevalence (MeanPoor Physical health(SD): 10.5 (2.40), MeanPoor Mental health(SD): 12.4 (2.6); $p<0.001$)
CONCLUSION: LPA can be used to derive meaningful and standardized partitioning of census tracts sensitive to the spatial patterning of health in the US. These neighborhood types can be used to quickly categorize tracts in the US, and there is potential to replicate these methods in non-US contexts to promote population health globally.

KEYWORDS: neighborhood, built environment, social environment, latent profile analysis

P-0293 The importance of ecological quality of public green and blue spaces for subjective well-being

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BACKGROUND AND AIM: There is now considerable evidence that the natural environment provides health and well-being benefits in urban environments. However, little is understood about the role of ecological quality in maximising well-being gains.

METHODS: We examine the relationship between the accessibility of public natural spaces of high ecological quality and two measures of subjective well-being for adults, using the British Household Panel Survey (BHPS), a large, longitudinal panel dataset. We then compare this relationship with that found with all Public Open Spaces, regardless of their ecological quality. We use the designation of Sites of Importance for Nature Conservation (SINC) as an objective indication of high-quality green- or bluespace, and life satisfaction and mental distress as measures of well-being. We use the Areas of Deficiency dataset from Greenspace Information for Greater London CIC (GiGL) to identify residential areas with more than a 1 km walk from a SINC, based on actual walking routes from known access points.

RESULTS: Postcode-level analysis using regression modelling reveals that living beyond a 1 km walk of a SINC decreases an individual's life satisfaction by 0.117 points on a scale of 1 to 7. No relationship is found for mental distress. We also do not find any significant relationship between either well-being measure and all Public Open Spaces.

CONCLUSIONS: These findings suggest that the ecological quality of publicly accessible open spaces is important for the well-being of residents in Greater London and highlights the need for improving the provision of, and access to, high-quality green- and bluespaces in urban areas.

KEYWORDS: Biodiversity; Greenspace; Bluespace; Well-being; BHPS

P-0294 Environmental, economic, and health co-benefits of a shift away from motor vehicles in London - Presenting a simplified modelling framework for preliminary screening of urban transport interventions

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BACKGROUND AND AIM: Cities contribute to 75% of global greenhouse gas emissions, accelerating climate change and significantly impacting public health. Rapidly rising rates of urbanization and population growth are emphasizing these effects. This presentation investigates how co-benefits can be generated when redesigning cities to reduce car-reliance. It makes the case for a system-thinking approach that can leverage intersectoral relationships, exploit synergistic effects, and maximize health co-benefits of climate change strategies. It aims to bridge the gap between research and policy by offering an open-source framework that can quantify the co-benefits of traffic reductions in Europe.

METHODS: A suite of publicly available models was assembled into a unified framework to quantify health benefits of car reduction strategies in cities. These include: SHERPA and SHERPA-City to simulate impacts on NO_2 and $PM_{2.5}$; AirQ+ to calculate the respective premature deaths prevented; HEAT to estimate health benefits from physical activity stemming from traffic re-allocated to active travel; UTOPHIA methodology to assess benefits of noise reduction and green space improvements. Lastly, statistical analysis is used to highlight how system-thinking can be economically advantageous. The framework was applied to hypothetical scenarios in London.

RESULTS: for a reduction in traffic between 10 and 50%, annual mortality was impacted by changes in physical activity (169 to 878 deaths prevented), NO_2 (45 to 227 deaths prevented), $PM_{2.5}$ (7 to 52 deaths prevented), noise (34 to 167 deaths prevented), and green space (20 to 97 deaths prevented).
CONCLUSION: The results were in accordance with published literature, revealing co-benefits of modifying travel habits are substantial and attractive to multiple stakeholders. Physical activity from active transport was found to be particularly beneficial and should therefore be the focus of urban mobility interventions, proving to be greener, healthier, and more equitable than shifting to a carbon-neutral fleet.

KEYWORDS: Co-benefits, climate change, active transport

P-0296 Quantifying the public health benefits of expanding natural spaces in urban areas

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BACKGROUND AND AIM: Access to greenspace (e.g. parks, trees) has been shown to improve physical and mental health by facilitating physical activity and social interaction as well as reducing stress, air pollution, and the urban heat island effect. While the health impacts of blue space (e.g. coastline, lakes, rivers) have been less studied, blue space is also hypothesized to provide similar health benefits through many of the same pathways. Here we assess the combined benefits of green and blue spaces, or natural space, for reducing all-cause mortality in approximately 100 cities worldwide that are members of the C40 Cities network.

METHODS: We use 2021 normalized difference vegetation index (NDVI) derived from the Landsat 8 satellite to identify urban natural spaces. We then use an epidemiologically-derived health impact function from a systematic review of the effects of greenspace on mortality along with WorldPop population estimates and Global Burden of Disease mortality rates from 2020 to quantify the health benefits of natural spaces in terms of reductions in all-cause mortality in each city.

RESULTS: Cities vary in their extent of natural space, including green and blue space individually, as well as the combined natural space metric. We estimate that these natural spaces reduced all-cause mortality in each city, and that variation in mortality benefits across cities is driven both by differences in natural space extent, as well as population and baseline mortality rates.

CONCLUSIONS: Cities around the world experience different levels of natural spaces and associated health benefits. Expanding natural spaces to reduce carbon emissions and enhance urban sustainability and livability may further benefit local public health.

KEYWORDS: greenspace, blue space, natural space, NDVI

P-0299 Mixed methods (qualitative and quantitative) in environmental epidemiology : an industrial area study, France

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BACKGROUND AND AIM: The Lacq industrial area has been the site of numerous chemical activities over the past 60 years. To assess the impact of these activities on the local population health, the French national public health agency has developed a sequenced and participative approach, combining qualitative and quantitative studies.

METHODS: A qualitative local context study, based on 39 semi-directive interviews with different categories of local stakeholders and residents, was first conducted to identify the perceptions and expectations of local actors regarding the links between health and the environment around the industrial site.
Two geographical epidemiological studies were then launched to describe mortality and morbidity (cancers, acute and chronic diseases) near the industrial area.
Not clinically assessed health outcomes (irritation symptoms, anxiety), quality of life and their link with environmental disturbances will be assessed with an ongoing individual perceived health survey.

RESULTS: Social demand, analyzed in the local context study, led to the integration of diseases of concern (e.g. digestive cancers, thyroid disorders), reported by local residents and health professionals, in the mortality and morbidity studies. Furthermore, people's mistrust of authorities and desire for more transparency on the scientific process were taken into account and participatory citizen workshops were set up to co-create the perceived health survey questionnaire.
The mortality study reported non-cancerous respiratory and circulatory excess death rates. Those pathologies will be thoroughly explored in both morbidity (health care system use) and perceived health (irritations, discomfort) surveys for a more comprehensive overview of the population health, closer to their life experience.
CONCLUSION:
This innovative approach, mixed and participative, developed around Lacq industrial area shows the benefit of sequential mixed methods design in environmental health. It enables to better respond to social demand and to overcome blind spots of health surveillance around industrial areas.

KEYWORDS: Health, Industrial pollution, mixed methods,

P-0303 Does air pollution negate benefits of exercise in those with long-term health conditions? – Rapid review

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BACKGROUND AND AIM: In healthy adults, exercise is generally beneficial for health unless air pollution levels are very high (Tainio, 2016). However, recent studies (e.g. Sinharay et al 2018) raise the possibility that air pollution at levels seen on busy streets in western countries may offset the physiological benefits of exercise for people with long-term health conditions.
The aim of this study was to conduct a rapid literature review to inform the European Space Agency funded Personalized Space Technology Exercise Platform (P-STEP) app development. The app will advise people with pre-existing conditions on exercising based on environmental conditions such as air pollution and meteorology.
METHODS: We identified papers in PubMed, with search terms on air quality, long-term conditions and exercise. Additional papers were identified from authors' own library. Papers selection and data extraction was conducted by a single reviewer (MP).
RESULTS: A relatively small number of papers were identified. Designs were heterogeneous including chamber and cardiac stress test (experimental), panel and cohort studies considering short or long-term exposures. Short-term exposure to traffic pollution may offset some of the beneficial cardiopulmonary effects of walking for individuals with ischemic heart diseases and COPD, affecting autonomic function, heart rhythm and associated with ST segment depression (a marker of ischaemia) and angina symptoms. On the other hand, long-term studies in Asia and Europe suggest long-term benefits of exercise on mortality and disease risk in those with chronic disease even in moderate air pollution settings, despite adverse effects seen in short-term studies.
CONCLUSIONS: More studies are needed to be able to quantify short-term air pollution concentrations that may offset beneficial effects of exercise in those with chronic disease. However, long-term studies available suggest exercise remains a good way to reduce future disease risk.

KEYWORDS:
#exercise, #air pollution, #long-term health conditions, #temperature, #short-term effects

P-0305 Associations between greenness and hemodynamic markers at varied spatial scales and metrics of greenness

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BACKGROUND AND AIM: Residential greenness, often measured through NDVI, has been linked to cardiovascular disease (CVD) outcomes and associated risk factors. However, physiological mechanisms underlying these associations are not well understood, nor is the influence of differing types and scales of greenness. Therefore, we examined associations between CVD risk markers of systolic blood pressure (SBP) and arterial index (AI), a measure of arterial stiffness, with residential greenness at multiple greenness metrics and spatial scales.

METHODS: We recruited 723 adult participants from a 4.5sqmi area of Louisville, Kentucky, USA, and measured SBP and AI. We collected high resolution greenness metrics of NDVI, canopy, and leaf area in spatial radii of 20m to 500m around participants' residence via Aerial LiDAR and Sentinel-2 satellite imagery. We utilized adjusted linear regression with a hierarchical modeling approach to examine associations between greenness and hemodynamic markers.

RESULTS: We observed inverse associations between SBP and multiple greenness metrics at radii of 300m and 500m (-0.26 to -2.66% per IQR), but not 20m or 100m. We observed inverse associations between AI and metrics of greenness with all models at a 100m radius (-1.41 to -2.25% per IQR), but only leaf area and models with basic adjustments at 300m and 500m radii (-1.79 and -1.9% per IQR). When stratified, we observed significant associations between greenness and SBP among only females and those with higher levels of education. Among stratified results between greenness and AI, we observed significant associations only in females, participants <50 years of age, and higher educational attainment.

CONCLUSIONS: Greenness is associated with hemodynamic markers of SBP and AI with inconsistent associations between metrics and spatial scales. Future investigations of such high-resolution data may inform links between greenness and health and could help to design targeted greening interventions to address CVD.

KEYWORDS: Greenness, Blood Pressure, Hypertension, CVD

P-0306 Cadmium in the wild edible mushroom species of Agaricus bitorquis in Leicester, UK

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BACKGROUND AND AIM: Consumption of urban garden products is increasing despite the risks that they can represent due to high urban contamination. Effects of urbanisation in wild edible mushrooms are scarce. The aim was to assess the risks to cadmium (Cd) present in wild edible mushrooms Agaricus bitorquis collected in Leicester (UK).

METHODS: Twenty-two A. bitorquis mushrooms were collected from an open green area close to St Augustine Road, a high traffic area within Leicester. Species identification was confirmed by DNA barcoding using internal transcribed spacer 1/4 primers after extracting DNA from 100 mg of frozen homogenised ground mushroom material using DNeasy Plant Mini Kit®. Cd was monitored by ICP-MS in cleaned, dried and homogenised mushrooms' caps and stipes mineralised with HNO3/H2O2 [LoD=0.081 mg/kg dry weight (dw)].

RESULTS: Cd was detected in all samples, with significantly higher levels in caps ($p<0.001$), median and ranges are provided in mg/kg dw: 3.878 (2.213-6.598) vs. 2.068 (0.899-3.679). Concentrations were similar to those recently reported in different species of the genus Agaricus collected in urban habitats within Berlin (Germany; <0.1-32.7 mg/kg DW), but much higher than the reported in sixteen A. bisporus (median 0.2 mg/kg DW) cultivated in high traffic areas within Berlin. All caps monitored exceeded the established maximum concentration limit for Cd in Europe (0.2 mg/kg wet weight, approximately 2 mg/kg dw), in line with the high accumulative metal capability described in the literature for Agaricus spp. Non-carcinogenic health risks in adults and children for Cd in the monitored mushrooms were 3.16E-07 and 1.47E-09, respectively.

CONCLUSIONS: Our results would suggest potential contamination by Cd in the inner city of Leicester that should be further investigated to protect human health. Although non-carcinogenic risks characterised for Cd were negligible, consumption of wild edible species should be limited and substituted by cultivated mushrooms when possible.

P-0309 Residential road traffic noise and pregnancy complications – The NordSOUND study

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BACKGROUND AND AIM: Only few studies have evaluated the effects of exposure to environmental noise on pregnancy. The NordSOUND project utilizes high-quality register data in four Nordic countries to comprehensively study the health effects of environmental and occupational noise. The present study evaluates associations between maternal exposure to road traffic noise during pregnancy and pregnancy complications.

METHODS: The study included metropolitan areas of Copenhagen, Denmark, Helsinki, Finland, and Gothenburg and Stockholm, Sweden. Data from Oslo, Norway, will soon become available, too. Gestational diabetes, gestational hypertension, and severe and mild pre-eclampsia were used as outcomes. Data sources were national population and patient registers. Residential yearly levels of transport-related noise and air pollution were modelled. Logistic regression analyses, followed by meta-analyses, were adjusted for age, parity, smoking, education, marital status, neighborhood income, traffic-related air pollution, green and blue areas, and other transport noise sources.

RESULTS: The total number of pregnancies in the final analyses was 417 000. No associations were observed between road traffic noise and gestational hypertension or pre-eclampsia. However, exposure to road traffic noise during pregnancy was associated with an increased risk of gestational diabetes: odds ratio (95 % confidence intervals) in a random effect model was 1.09 (1.03; 1.15) per 10 dB increase in exposure. The analyses will be repeated adding data from Norway.

CONCLUSIONS: These preliminary results suggest that maternal exposure to road traffic noise during pregnancy increases the risk of gestational diabetes.

KEYWORDS:
Noise, road traffic, pregnancy complications, maternal exposure

P-0313 Exposure to Noise and Cardiovascular Disease in a Nationwide US Prospective Cohort Study of Women

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BACKGROUND AND AIM: Long-term noise exposure is associated with cardiovascular disease (CVD); however, most longitudinal studies of noise and CVD have been conducted in Europe. We aimed to examine the prospective association of outdoor long-term noise from anthropogenic sources with incident CVD using a US-based, nationwide cohort of women.

METHODS: We linked L50 (median) nighttime and L50 daytime modelled anthropogenic noise estimates from a US National Park Service (NPS) model to geocoded residential addresses of 93,365 Nurses' Health Study participants. CVD (incident MI or stroke) was confirmed via medical record review. We used time-varying Cox proportional hazards models to estimate risk of incident CVD from 2000 to 2018 associated with long-term average noise exposure, adjusted for fixed and time-varying confounders and CVD risk factors. We assessed pre-determined effect modification by race, region, population density, air pollution, greenness (NDVI), and neighborhood socioeconomic status, and explored mediation by self-reported sleep duration.

RESULTS: Over 1,331,658 person-years, there were 6,409 incident CVD events. In fully-adjusted models, the hazard ratio (HR) for each interquartile range increase in L50 nighttime noise (3.73 dBA) was 1.02 (95% confidence intervals (CI) 0.99, 1.05) for CVD, 1.03 (95% CI 0.99, 1.07) for MI, and 1.01 (95% CI 0.97, 1.05) for stroke; daytime noise results were similar. Stratified analyses suggested that associations of noise with CVD were strongest among participants residing at addresses with the least surrounding greenness. for example, the fully-adjusted HR for nighttime noise and MI in the least green quintile was 1.07 (95% CI 1.00, 1.16). We found no evidence that short sleep duration (≤ 5 hours) mediated associations.

CONCLUSIONS: NPS modelled outdoor median nighttime and daytime noise was not associated with total CVD in this cohort, but was associated with an increase in MI risk for participants living at the least green addresses.

P-0314 Association between Residential Green Space and Healthcare Utilization

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BACKGROUND AND AIMS:
Prior studies have shown greenness to be associated with beneficial health outcomes. We sought to determine if residential greenness correlated with healthcare utilization within an integrated health delivery system.

METHODS: We linked 5,189,303 members of Kaiser Permanente Northern California (KPNC) to Normalized Differentiated Vegetation Index (NDVI) values from Landsat satellite data (30m x 30m resolution) in 250, 500, and 1000 m radial buffers around each member's home. Healthcare utilization data for inpatient, outpatient, and emergency room visits were obtained by accessing data from the KPNC electronic health record.Using generalized estimating equations that adjusted for demographic, socioeconomic and other environmental factors, we regressed green space (in deciles) on healthcare utilization across the 2013 and 2017 study period.Adjustments were made for area sociodemographic and socioeconomic factors, and population and housing density.

RESULTS: We observed a significant trend across the decile range between higher levels of residential greenness and lower utilization of inpatient services ($p<0.01$) and emergency room visits ($p<0.01$).For outpatient visits, we observed a U-shaped curve where residing in middle of the NDVI range for this population was associated with greater outpatient visits than either the highest or lowest green space areas. Sensitivity analyses, including using various buffer sizes and tree canopy cover, an alternative measure of green space, yielded consistent findings.
CONCLUSION: Residing in an area with greater greenspace relative to low levels of greenspace was associated with greater in-patient and emergency room utilization. Residential greening can have a significant healthcare impact as measured by healthcare utilization.

KEYWORDS: green space, green cover, healthcare utilization, healthcare services

P-0315 Initial Findings of 80,000 US Residences: Structure, Behavior, Reported Symptoms

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BACKGROUND AND AIM: The health and well-being of residential occupants is the purpose of an increasing number of research projects to create healthy homes. The COVID-19 pandemic with its increased occupancy of homes has intensified efforts. Information is lacking about the perceived house characteristics, occupant behavior, and reported symptoms. Subjective reporting is still information, and can be objectively explored. Consideration of the perceptions of the occupants of residential structures can assist the development of research questions, educational methods, and for supporting actionable behaviors.
METHODS: Hayward Score developed a free website questionnaire for the purpose of obtaining exploratory and descriptive data for cataloging selected characteristics of residential structures, occupant behaviors, and self-reported symptoms. With over 300 variables and 80,000 responses from all 50 states in the US, analysis and synthesis of the data is a daunting task. Initial analysis included: A) reporting calculated percentages of general statements; B) exploring a range of statistical methods of analysis, and C) providing examples of representative findings of the results. Once statistical categories have been developed, relationships between them can be explored for further investigation.
RESULTS: Preliminary analysis identified several general statements about house characteristics, behaviors, and reported symptoms. A follow-up of participants indicated that about two-thirds of those who made recommended improvements reported a reduction in symptoms. One in-depth analysis consistently associated house dust with the number of reported symptoms.
CONCLUSION:
In addition to initial findings, the combination of the three disparate categories crosses traditional boundaries of analysis. Instead of clearly differentiated categories a multifaceted exploration of open-ended relationships of the categories could provide an interesting future project. Specifically, does the structure affect the behavior of occupants? Do the occupants impact the structure? and what is the role of experienced symptoms because of the structure and behavior?

KEYWORDS:
House characteristics, Behavior, Symptoms, Residential, questionnaire

THEMATIC 07: Climate change and Health

P-0553 Association of acute ambient temperatures with NICU admissions: results of a case-crossover analysis

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BACKGROUND: In the face of a changing climate, understanding the impacts of increasing temperatures on population health is critical, particularly for vulnerable groups such as pregnant people and neonates. Air pollution has been shown to increase risk for neonatal intensive care unit (NICU) admission, but the effect of temperature has not been studied.

METHODS: Using data from the Consortium on Safe Labor (n=27,189 infants admitted to NICU), we conducted a case-crossover analysis to assess NICU admission risk in association with ambient temperature during the week prior to delivery. Hazard ratios and 95% confidence intervals estimated NICU risk associated with a 1°C increase and 1°C decrease in temperatures in the warm and cold seasons, respectively with adjustment for time-varying air pollution and humidity. Analyses were repeated among infants born during weeks with average temperatures greater than 27°C.

RESULTS: Increased temperatures in the warm season were associated with higher risk of NICU admissions on the day of delivery, the day before delivery, and the entire week while days 2-7 prior to delivery were associated with reduced risk. During the cold seasons, decreases in temperature increased risk on the day of delivery but reduced risk at other times. NICU admission risk was highest in weeks with an average temperature exceeding 27°C with 12-38% increases observed in the week preceding delivery.

CONCLUSIONS: Ambient temperature, particularly increasing heat during the warm season in the week prior to delivery, was associated with NICU admission and the effects appear independent of air pollution exposures.

KEYWORDS: NICU admissions, temperature, case-crossover, neonatal health

P-0555 The association of maternal exposure to ambient temperature with low birth weight is not positive in every single location: In Brazil, positive associations may occur only in the Amazon region

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BACKGROUND AND AIM: Exposure to extreme ambient temperature has been linked to adverse health outcomes, including cardiorespiratory and neonatal morbidities. Among the pregnancy outcomes, a large body of the epidemiological investigations has indicated low birth weight as an important public health concern, given that the consequences of low birth weight may extend through the life course. In this study, we assessed the association between low birth weight following pregnancy and ambient temperature exposure in about 1 million babies in Brazil.

METHODS: The ambient temperature exposure window was based on the gestational intervals, which included the first (week 1 to week 12), the second (week 13 to week 28), and the third trimesters (week 29 to week 37). for each birth record, we calculated the average values for the exposure and covariate variables in each trimester of gestation. We applied a case-control study design using logistic regression model to estimate the association between low birth weight and ambient temperature during a specific trimester of pregnancy. We adjusted the model for air pollution and meteorological variables, PM2.5, NO2, O3, sex, mother's age, mother´s race, mother´s marital status, mother´s education level, year of birth, and moth of birth.

RESULTS: In the primary analysis, we found positive associations only in the North region, where Amazon is located. We found that ambient temperature in the North region is associated with an increase of 3.39% (95%CI: 1.88; 4.92), 5.16% (95%CI: 3.60; 6.74), and 3.17% (95%CI: 1.63; 4.72) in low birth weight when the exposure occurred in the trimesters 1-3 of pregnancy, respectively. for the other regions, there were positive associations only in the sensitivity analysis.

CONCLUSIONS: Our study can provide a mechanism to improve pregnancy exposure assessment to ambient temperature while controlling for modifier effects related to air pollution sources.

KEYWORDS: Ambient temperature, Birth weight, Pregnancy

P-0556 Systematic review and meta-analysis for suicide associated with air pollution and ambient temperature

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BACKGROUND AND AIM: Study results for air pollution, ambient temperature, and suicide are inconclusive. Given the health threats of climate change, a comprehensive review of the impacts of temperature and air pollution on suicide is needed with a focus on disparities of risks by population characteristics such as income and baseline health risks. We performed a systematic review and meta-analysis for suicide risks associated with short-term exposure to temperature and air pollution.

METHODS: Pubmed, Scopus, and Web of Science were searched for English-language publications using relevant keywords. Observational studies assessing risks of daily suicide and suicide attempts associated with temperature, particulate matter (PM_{10}, $PM_{2.5}$), ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) were included. Random-effect meta-analysis pooled risk ratios (RRs) for daily suicide for an interquartile range (IQR) increase in exposure. Meta-regression analysis examined effect modification by income level based on gross national income (GNI) per capita, national suicide rates, and average level of exposure factors.

RESULTS: In summary, 18 studies for air pollution and 32 studies for temperature across 24 countries were included. RRs of suicide per IQR increase in temperature, $PM_{2.5}$, PM_{10}, and NO_2 were 1.09 (95% CI: 1.06–1.13), 1.02 (95% CI: 1.00–1.05), 1.01 (95% CI: 1.00–1.03), and 1.03 (95% CI: 1.00–1.07), respectively. O_3, SO_2, and CO were not associated with suicide. RR of suicide was significantly higher in lower-income than higher-income countries (1.20, 95% CI: 1.14–1.26 vs. 1.09, 95% CI: 1.07–1.11 per 7.1°C increased temperature). Suicide risks associated with air pollution did not significantly differ by income level, national suicide rates, or average exposure levels.
CONCLUSIONS: Suicide was associated with temperature, PM, and NO_2. research gaps were found for addressing the interactions between air pollution and temperature on estimating suicide risks, which warrants future studies.

KEYWORDS: Air pollution, climate change, suicide, temperature, meta-analysis.

P-0558 Future mortality burden attributable to non-optimal temperatures under the dual threats from climate change and population aging

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BACKGROUND AND AIM: Elderly population subgroups are amongst the most vulnerable to heat and cold. While temperature-related health impacts are projected to increase with progressive global warming, the influence of population aging on these trends remains unclear. Here we quantify the contribution of population aging to future temperature-related mortality in 729 locations across 42 countries at 1.5 °C, 2 °C, and 3 °C of warming using climate models of the latest Coupled Model Inter-comparison Project (CMIP6).

METHODS: We first estimated the location-age-specific temperature-mortality associations in a two-stage time-series analysis using quasi-Poisson regression with distributed lag nonlinear models and multivariate dose-response meta-regression using data from the Multi-Country Multi-City (MCC) Collaborative Research Network. We then combined the association estimates with future temperature series (18 models from CMIP6) to derive excess temperature-mortality projections at three warming levels. We derived age group-specific population and baseline mortality projections according to the Shared Socio-economic Pathway 5-8.5 to derive the corresponding excess mortality. Finally, we quantified the impact of population aging as the difference in the change in temperature-related mortality fractions (warming target minus historical period) between "climate-population" and "climate-only" scenarios (i.e., either accounting or not accounting for changes in population demographics).

RESULTS: Future heat-related mortality will increase by 0.8%-7.0% at 1.5-3.0 °C warming, among which 1 in 2 to 5 in 7 deaths would be attributable to population aging. Population aging would mostly offset the decrease of future cold-related mortality driven by climate only, leading to a net increase of 1.5%-5.3% at 1.5-3 ºC warming. Countries in Middle-East Asia, East-Asia, South-East Asia, and South America that have larger increases in population aging generally will face substantially elevated temperature-related mortality.

CONCLUSIONS: Our findings suggest that population aging would constitute a crucial driver for a larger impact of non-optimal temperatures under a warming climate.

P-0560 Blackout: A nationwide county-level accounting of power outages and vulnerability, 2018-2020

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BACKGROUND AND AIM: Power outages – expected to increase as climate change accelerates and power grids age – threaten public health but remain understudied in the US. Outages have been linked to a variety of health outcomes including temperature-related illnesses and hospitalizations. We aim to characterize power outage exposure at the county level and to identify areas with high vulnerability and high exposure.

METHODS: We acquired outage data from PowerOutage.US and generated county-hour estimates of customers without power. Under our study, an outage event occurred whenever >0.5% of county customers were without power for 8+ and 1+ continuous hours. We characterized social vulnerability with the Centers for Disease Control and Prevention's Social Vulnerability Index and medical vulnerability with Medicare electricity-dependent durable medical equipment (DME) use. Bi-variate local indications of spatial association (LISA) analyses between each vulnerability characteristic and 8+ hour outages identified counties with high exposure disparities.

RESULTS: Between 2018-2020, the 2,978 counties in our study experienced a yearly median of 2 (IQR = 3) 8+ hour outages and 45 (IQR = 42) 1+ hour outages. of these counties, 92% and 99% faced at least one 8+ and 1+ hour outage respectively. Longer 8+ hour outages happened more in the summer, spring, and fall than winter. Outages occurred frequently along the Appalachia and portions of the Northeast and South. Counties with high 8+ hour outages and high SVI concentrated in Louisiana and West Virginia, while counties with high 8+ hour outages and high DME use were found in West Virginia and Ohio.
CONCLUSIONS: Power outages are an emerging environmental exposure that will likely increase with climate change. Our findings are important for future epidemiologic studies, equitable disaster preparedness, and energy policies.

KEYWORDS:
Power Outage, Electricity, Disparities, Climate Change

P-0562 Optimal heat stress metric for predicting warm-season mortality varies from country to country

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BACKGROUND AND AIM: While heat combined with high humidity is frequently described as the main driver of heat stress, this remains unclear in epidemiological literature. A range of heat stress metrics, each being a different combination of temperature and humidity and sometimes other variables, are available in the literature. We compared eight heat stress metrics with warm-season mortality, with the aim of finding the optimal metric(s) for predicting mortality.

METHODS: We performed a two-stage time-series approach using quasi-Poisson regression with distributed lag nonlinear models to derive warm-season exposure-response associations between each heat stress metric and mortality, over 604 locations in 39 countries within the Multi-Country Multi-City (MCC) Collaborative Research Network. The metrics studied were dry-bulb temperature (Tmean), wet-bulb temperature (Tw), apparent temperature (AT), discomfort index, and swamp cooler temperatures at 20, 40, 60 and 80% efficiencies (Swmp20 to Swmp80). The goodness-of-fit of each exposure-response model was assessed using the Quasi-Akaike Information Criterion (qAIC). for each metric and country, we summed the qAIC values across all locations and identified the metric with the lowest country-level qAIC as the optimal metric. We also compared the heat-mortality fraction for each metric.

RESULTS: According to qAIC, AT, a metric combining temperature, humidity and wind speed, is the dominant driver of warm-season mortality, especially in Northern and Eastern Europe. Metrics with no or little humidity modification (Tmean and Swmp20) dominate in Southern and Western Asia, Eastern Asia, and Australia. Tw, a metric with large humidity modification, dominate in Caribbean, Central and South American countries but with large uncertainties. However, using Tmean as the only exposure metric does not result in significantly different attributable fractions compared to using the optimal metric.

CONCLUSIONS: There is no one-size-fits-all metric for predicting heat-related mortality, but Tmean is suitable enough for estimating impacts in present-day climate.

KEYWORDS: heat stress, mortality

P-0563 How is Australia progressing on climate change and health? - Evidence and implications of the MJA-Lancet Countdown

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BACKGROUND AND AIM: Australia has experienced unprecedented bushfires, heatwaves, floods and other weather extremes. It is imperative for Australia to build a detailed understanding of health and wellbeing-related responses to the impacts of climate change. In partnership with The Medical Journal of Australia (MJA) and the Lancet Countdown on health and climate change, the MJA-Lancet Countdown produces annual reports to assess Australia's health and climate change progress until 2030.

METHODS: The MJA-Lancet Countdown has published four national assessment reports since 2018, developing and tracking 40+ indicators in 5 sections: impacts, exposures and vulnerability, adaptation, mitigation, finance, and political and public engagement. The methodological framework largely followed the Lancet Countdown but adjusted for Australian contexts and databases. A few new indicators were developed uniquely for Australia population, e.g. bushfire adaptation, climate change and Indigenous Health, and commenwealth research funding on the topic.

RESULTS: These national assessment reports are the first to investigate Australia's broad progress on climate change and health, considering the social, economic, and political contexts and progress towards mitigation and adaptation. These reports have not only identified gaps in policies but also opportunities in responding to climate change in Australia. The MJA-Lancet Countdown has also published annual Policy Briefs for Australian policymakers, providing key policy recommendations through engagement with health professional organisations and other stakeholders.
CONCLUSIONS: Our reports indicate that Australia is vulnerable to climate change, but the responses are inefficient to protect people's health from changing climate. The presentation will provide an overview of the MJA-Lancet Countdown, including its key findings and policy recommendations, and the implications of the work in advancing climate change responses for Australia's health and wellbeing.

KEYWORDS:
Health, Climate Change, MJA-Lancet Countdown

P-0565 Temporal changes of heat-attributable mortality in Prague, Czech Republic, over 1982-2019

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BACKGROUND AND AIM: While previous research on historical changes in heat-related mortality observed decreasing trends over the recent decades, future projections suggest increasing impact of heat on mortality in most regions of the world. This study aimed to analyse temporal changes in temperature-mortality relationships in Prague, Czech Republic in the warm season (May-September), using a daily mortality time series from 1982 to 2019.

METHODS: To investigate possible effect of adaptation to increasing temperature, we divided the study period into four decades (1980s–2010s). We used conditional Poisson regression models to identify decade-specific relative risk of heat-related mortality and to calculate the annual number of heat-attributable deaths and the heat-attributable fraction of total warm season deaths. We estimated their trends over the whole study period by a generalized additive model with non-parametric smoothing spline.

RESULTS: Our results showed that the unprecedentedly hot 2010s was associated with approximately twice as large relative risk of heat-related mortality than in previous decades. This resulted in the reversal of the trend in heat-attributable mortality in the 1990s and its increase during the last two decades.
CONLCUSIONS: Our findings highlight the importance of further improvement of adaptation measures such as heat-and-health warning systems to protect the heat- susceptible population.

KEYWORDS: heat-attributable mortality, DLNM, trend analysis

P-0566 Short-term effects of heat on cardiovascular mortality and morbidity in Germany – Small-area analysis in the framework of the EXHAUSTION project

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BACKGROUND AND AIM: Short-term heat effects on cardiovascular outcomes have been examined mainly in major cities. So far, few studies have assessed heat effects in both urban and rural areas. This study aimed to investigate short-term associations of air temperature with cause-specific cardiovascular mortality and morbidity in the warm season (May-September) in German small areas.

METHODS: Daily counts of mortality and hospital admissions for ischemic heart disease (IHD), myocardial infarction (MI), heart failure (HF), and cerebrovascular diseases from 2000 to 2016 were collected at the small-area level (defined as districts for mortality and municipalities for hospital admission data). Daily mean air temperatures estimated by a spatio-temporal model were assigned to each small area. We applied district-specific Poisson regression using distributed lag nonlinear models to examine the heat effects on cardiovascular outcomes at lag 0-1 days. The district-specific estimates were pooled by random-effects meta-analysis to derive German-wide heat effects. We assessed effect modification by age and sex in subgroup analyses.

RESULTS: An increase in air temperature from the 75th to the 99th percentile was associated with increased cardiovascular mortality. The most substantial heat effect was observed for HF mortality, with a pooled risk ratio (RR) of 1.32 (95% CI: 1.29, 1.36). The heat effects on IHD, MI, and HF mortality were slightly stronger among the elderly (75+ years) and females. for cardiovascular hospital admissions, we found decreased risks associated with heat. for example, the pooled RR of HF hospital admissions for the same increment in temperature was 0.96 (95% CI: 0.95, 0.97).

CONCLUSIONS: This study provides evidence for the adverse heat effects on cause-specific cardiovascular mortality in Germany, considering both urban and rural areas. Besides, our findings indicate potentially different heat effects on cardiovascular mortality versus hospital admissions.

KEYWORDS: Air temperature, heat, cardiovascular, mortality, hospital admissions

P-0568 Associations of Weather Regimes and Ambient Temperature with the Timing of Birth in Southern Israel

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BACKGROUND AND AIM: Previous studies demonstrated associations between exposure to ambient temperature and timing of birth, but did not consider the role of weather regimes as an independent factor or as a modifier of the effect of temperature. We aimed to investigate associations of weather regimes and ambient temperature with the timing of birth in Southern Israel.

METHODS: We conducted a case-crossover study of 60,761 singleton live births in Southern Israel during 2004-2014. The case exposure period was the week before the birth date and the control exposure period was 28 days later. Ambient temperature was estimated using a spatio-temporal model at 1 km resolution in Israel. We fit separate conditional logistic regression models for preterm and term births using weekly mean temperatures divided into five quintiles, adjusting for seasonality. Additionally, we created similar models for assessing the associations between weather regimes and the timing of birth for each day preceding the delivery up to 6 days, adjusted for seasonality and temperature.

RESULTS: Higher temperature during the week before the birth was associated with the timing of term birth, with an adjusted odds ratio of 1.18 (95% CI: 1.07-1.31) for the highest quintile compared with the lowest, but no association for preterm births. The presence of a Persian Trough was consistently associated with timing of term births, with the strongest association on the date of birth (odds ratio = 1.07, 95% CI: 1.02–1.12) compared with Red Sea Trough. In addition, the association between temperature and term birth was stronger during weeks with a Persian Trough (odds ratio per 1 °C increase = 1.46, 95% CI: 1.44-1.49).

CONCLUSIONS: These findings demonstrate a possible role for weather regimes in determining the timing of birth beyond their influence on ambient temperature.

KEYWORDS: Ambient temperature, Weather regimes, Timing of birth

P-0572 Short-term heat effects on cardiopulmonary morbidity using national small area data – Results of the EXHAUSTION project

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BACKGROUND AND AIM: Short-term associations between heat and cardiopulmonary morbidity have been examined mostly in major cities. Given potential differences in the effects of heat between urban and rural areas, it is important to analyze areas of various degrees of urbanization to better understand the health effects of heat. This study investigated heat effects on cardiopulmonary hospital admissions in the warm season (May-September) in Italy and Germany at the small-area level.

METHODS: Daily counts of cardiovascular and respiratory hospital admissions were obtained for each municipality in Italy (2001–2015) and Germany (2000–2016). Spatio-temporal models estimated daily mean air temperatures at the municipality level. In each municipality-aggregated district, we first assessed heat effects at lag 0-1 days using district-specific Poisson regression with adjustment for a 4-way interaction between municipality, year, month, and day of the week, using the distributed lag non-linear model approach. Multivariate meta-analysis was then applied to pool the district-specific estimates in each country. Effect modification by age and sex was examined in subgroup analyses.

RESULTS: for an increment in daily temperature from the 75th to the 99th percentile, the risk for respiratory hospital admissions increased in both Italy [pooled risk ratio (RR): 1.112, 95% CI: 1.098-1.126] and Germany (pooled RR: 1.074, 95% CI: 1.067-1.081). We did not observe adverse heat effects on cardiovascular hospital admissions in either country. The heat effects on respiratory hospital admissions were stronger in the elderly (75+ years) and females.

CONCLUSIONS: Our study provides evidence for an adverse heat effect on respiratory morbidity, which was stronger in Italy with lower latitude. In both countries, the observed heat effects were more prominent in the elderly and females. Further analyses are ongoing to disentangle effects between urban and rural areas.

KEYWORDS: air temperature, heat, cardiopulmonary hospital admissions, small area

P-0573 Building Capacity for Disaster Research Response (DR2): Lessons, Tools and Resources from the University of Washington - National Institute of Environmental Health Sciences DR2 Workshop

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BACKGROUND AND AIM: Environmental health research in the aftermath of disaster is necessary to learn about short- and long-term health consequences, as well as response and recovery strategy effectiveness. However,several relational, logistical and administrative barriers facing disaster research necessitate intentional and collaborative planning among researchers, practitioners, funding agencies, and communities. In response, the University of Washington (UW) and the National Institute of Environmental Health Sciences (NIEHS) co-designed a "Disaster Research Response" (DR2) workshop to improve preparedness to conduct rapid environmental and health-related research that concurrently advances science and is responsive to community information needs. This presentation provides an overview of the DR2 workshop planning process and resultant tools, resources, and lessons learned.

METHODS: Over 50 NIEHS staff, UW faculty, students, and staff from environmental and occupational health, nursing, medicine, policy, planning, and engineering, and public health, healthcare and emergency management practitioners worked together for 2.5 years to build relationships, engage community members to identify research priorities, including through listening sessions and co-development of research protocols/plans, plan for ethical review of time sensitive research, and identify workforce development needs.

RESULTS: The workshop resulted in the development of several sharable tools and resources, including a Concept of Operations Plan; protocols for and highlights of community listening sessions, approaches to engaging communities in pre-disaster research planning, and research plans and protocols for conducting pre- and post-disaster data collection; institutional review board training; a gap analysis of disaster and health graduate training in the U.S.; and identification of lessons learned for communities embarking on similar efforts.

CONCLUSIONS: As climate change increases the global risk of disasters, processes, tools, resources, and lessons from the UW-NIEHS DR2 workshop can inform other communities seeking to build capacity to conduct environmental health disaster research.

KEYWORDS: Disaster research, climate change, community-engagement

P-0575 Integrative review to develop a holistic ecological framework exploring pathways to climate change impacts on mental health among priority groups

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BACKGROUND AND AIM: Climate change is already having a profound impact on human health. However, the impact of climate change on mental health remains poorly understood. Climate change impacts mental health directly via exposure to traumatic events such as floods, and bushfires and indirectly by compounding mental health impacts of socio-economic factors such as poverty, and unemployment. Climate-induced disasters can cause many forms of mental health issues such as increased anxiety, distress, depression, and post-traumatic stress disorder. Emerging evidence demonstrates more chronic impacts of changing climate on psychosocial health such as solastalgia and eco-anxiety. Although nearly one in ten people globally live with any mental health disorder, the current understanding of how climate change adds to the mental health burden is unknown.

METHODS: We have undertaken an integrative review to develop a conceptual framework underpinned by the ecological model explaining the mental health impacts of climate change. This study aims to develop a holistic socio-ecological system framework to understand the mental health impacts of climate change, with a particular focus on heightened vulnerabilities experienced among priority groups.

RESULTS: People and communities differ in their exposures, inherent sensitivity, and adaptive capacity to respond to and cope with mental health threats related to climate change. The proposed framework outlines different pathways through which mental health impacts of climate change may occur and maps these pathways to various priority groups such as children, adolescents, pregnant and postpartum women, older people, disadvantaged people, ethnic minorities, and Indigenous populations. These pathways are further aligned and extended to cover Bronfenbrenner's five environmental systems – microsystem, mesosystem, exosystem, macrosystem, and chronosystem.
CONCLUSION: A framework like this will serve as a crucial starting point for generating awareness around mental health impacts of climate change and for designing targeted interventions to mitigate mental health impacts of climate change.

P-0576 Short-term effects of heat on respiratory mortality and morbidity in Germany – small-area analysis in the framework of the EXHAUSTION project

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BACKGROUND AND AIM: Short-term associations between heat and respiratory mortality and morbidity have been well recognized. However, most studies were conducted in major cities, whereas evidence for more rural areas is limited. In this study, we assessed the short-term associations between air temperature and cause-specific respiratory mortality and hospital admissions in the warm season (May-September) in Germany at a small-area level.

METHODS: Daily counts of mortality and hospital admissions for respiratory diseases, chronic obstructive pulmonary disease, asthma, lower respiratory tract infections, and pneumonia from 2000 to 2016 were obtained for Germany at the small-area level. Small areas were defined as districts for mortality data and municipalities for hospital admission data. Daily mean air temperatures estimated by a spatio-temporal model were assigned to each small area. We first applied small area-specific Poisson regression allowing for overdispersion, using Distributed Lag Non-linear Models to assess the heat effects at lag 0-1 days (average of same- and previous-day temperatures). Random-effects meta-analysis was then used to pool the small area-specific estimates. Besides, we conducted subgroup analyses to investigate effect modification by age and sex.

RESULTS: We observed increased risks for all investigated cause-specific respiratory mortality and hospital admissions associated with heat. The strongest heat effect was found for pneumonia. for an increment from the 75th to the 99th percentile of the temperature distribution, the pooled risk ratio was 1.49 (95% CI: 1.42, 1.57) for pneumonia mortality and 1.20 (95% CI: 1.19, 1.22) for pneumonia hospital admissions. The heat effects were stronger among the elderly (75+ years) and females.

CONCLUSIONS: Using data from both urban and rural areas, our study suggests the adverse heat effects on respiratory mortality and morbidity in the warm season in Germany. These heat effects were more pronounced among the elderly and females.

KEYWORDS: Air temperature, heat, respiratory, mortality, hospital admissions

P-0578 The short-term effect of weather variables on heart rate variability in patients after open-heart surgery

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BACKGROUND: The effect of meteorological indicators may be more pronounced in more sensitive subpopulations. The aim of the study was to detect the associations between parameters of heart rate variability (HRV) and weather variables in patients who underwent coronary artery bypass grafting or valve surgery.

METHODS: The study was performed in Kaunas city, Lithuania, during 2008-2012. We used data of 220 patients. HRV was assessed by electrocardiographic data collected on a continuous 5-minute electrocardiogram (ECG). Data were collected at 1.5 months, 1 year, and 2 years after the surgery. The data of 495 ECG measurements were used. To investigate the associations, a mixed linear model was used adjusting for the linear trend, the month, and sociodemographic and health variables.

RESULTS: On days of a higher relative humidity (RH) (>89%), a lower mean average normal-to-normal interval between R waves (NN) was observed. Two days after RH>89%, a lower mean very low-frequency (VLF) in normalized units (n.u.) and a higher high frequency (HF) in n.u. was found; besides, the effect was stronger 1.5 months after the surgery. A lower mean value of the standard deviation of the RR intervals (SDNN, ms), VLF, a low frequency (LF), and HF powers were observed on days of air temperature (T) <-1 oC and this effect was weaker if T two days before was negative. A negative association of these HRV parameters with the daily North Atlantic Oscillation indices (NAOIs) was observed. Two days after low wind speed (<2.75 kt), a higher SDNN, VLF, and LF were found. The effect of low wind speed, the NAOI, and RH two days before was observed only in males, and the effects of changes in atmospheric pressure were stronger in females.
CONCLUSION: Among patients after open-heart surgery, the HRV variables may be related to specific weather changes.

P-0581 Early delivery following chronic and acute in utero ambient temperature exposure: a comprehensive survival approach

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BACKGROUND: Ambient temperature, particularly heat, is increasingly acknowledged as a trigger of preterm delivery, but study designs have been limited and results mixed. We aimed to comprehensively evaluate the association between ambient temperature throughout pregnancy and preterm delivery.

METHODS: We estimated daily temperature throughout pregnancy using a cutting-edge spatiotemporal model for 5,347 live singleton births from three prospective cohorts in France, 2002-2018. We performed Cox regression (survival analysis) with forward (weekly from conception) and backward (30 days before delivery) distributed lags to evaluate time-varying associations with preterm birth. We examined weekly mean, daytime, night-time, and variability of temperature, and heatwaves accounting for adaptation to location and season.

RESULTS: Preterm birth risk was higher following cold (5th vs 50th percentile of mean temperature) 7-9 weeks after conception [relative risk (RR) 1.3, 95% confidence interval (CI) 1.0-1.6 for 2°C vs 11.6°C] and 10-4 days before delivery (1.6 [1.1-2.1] for 1.2°C vs 12.1°C). Night-time heat (95th vs 50th percentile of minimum temperature; 15.7°C vs 7.4°C) increased risk when exposure occurred within five weeks of conception (2.0 [1.05-3.8]) or 20-26 weeks after conception (2.9 [1.2-6.8]). Overall and daytime heat (high mean and maximum temperature) showed consistent effects. We found no clear associations with temperature variability or heatwave indicators, suggesting they may be less relevant for preterm birth.
CONCLUSION: In a temperate climate, night-time heat and chronic and acute cold exposures were associated with increased risk of preterm birth. These results suggest night-time heat as a relevant indicator. In the context of rising temperatures and more frequent weather hazards, these results should inform public health policies to reduce the growing burden of preterm births.

KEYWORDS: preterm birth, heat, cold, exposure windows

P-0582 Trends in Tropical Nights and their Effects on Mortality in Switzerland across 50 years

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Despite its temperate climate, increasing temperature and more frequent and severe heat waves in Switzerland are leading to more heat-related health burden. Especially, high nocturnal temperature, usually associated to urban heat island effect, reduces the well-being of the society. We aimed to assess the spatiotemporal patterns in the frequency, the exposed population to Tropical Nights and its effect on daily mortality in Switzerland.
We derived the number of TN (night temperature ≥20°C) per district using district-specific population-weighted temperature series based on high resolution hourly mean temperature (ERA5-Land reanalysis data set) between 1969-2019. Through a spatiotemporal analysis, we assessed the change of TN frequency as well as the exposed population per district and decade. We then estimated the TN-mortality association by canton using conditional quasi-Poisson regression analysis using data on all-cause mortality at district level from 1980-2019. The model accounted for long-term and seasonal patterns and daily mean temperature.
We found an overall increase in the frequency of TN and exposed population in Switzerland between 1969-2019, mainly in the surrounding areas of the main cities of Lausanne, Geneva, Basel, Lugano and region of Zurich, and during the last 2 decades. Across Cantons, no clear spatial patterns were found in the level of vulnerability. In particular, TNs were associated with an increase of 37-22% in the risk of mortality in the cantons of Vaud (RR:1.37 [CI:1.19-1.59]), Zurich (1.33 [0.99-1.79]), Lucerne (1.33 [0.95-1.87]) and Solothurn (1.22 [0.88-1.69]), while a negative association was observed in Ticino (0.51 [0.37-0.7]), Basel-Land (0.4 [0.24-0.65]) and Thurgau (0.65 [0.5-0.85]). A null association was found in the remaining Cantons.
Our findings indicate that TN is a relevant health hazard for a large part of the Swiss population with potentially larger impacts in the future due to climate change and increasing urbanization.
Climate Change, Tropical Night, Mortality, Human Health, Switzerland

P-0584 Temperature Variability and Birthweight: Epidemiological Evidence from Africa

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BACKGROUND AND AIM: In 2015, 14.6% of infants worldwide were born with a low birthweight (LBW), of which 91% were from low- and middle-income countries (LMICs). Although LBW has been reported to be associated with heat exposure, its relationship with temperature variability (TV) remains unclear. We aimed to quantify the association between TV and LBW among LMICs in Africa.

METHODS: Data on birthweight in 37 LMICs during 1990–2020 were collected from the Demographic and Health Surveys Program. Using hourly air temperatures at ~9km resolution from ERA5-Land, three TV metrics were calculated for the entire pregnancy and each trimester: 1) standard deviation (SD) of all daily maximum and minimum temperatures (overall TV during pregnancy); 2) average diurnal temperature range (intra-day TV during pregnancy); and 3) average absolute difference in mean temperatures between two adjacent days (inter-day TV during pregnancy). We employed generalized linear mixed logistic regression, with random effects for country and survey cluster, to regress the LBW indicator on various TV metrics separately, adjusting for sociodemographic characteristics.

RESULTS: There was a total of 333,392 children with birthweight available, of which 33,386 had LBW and 2,333 had very low birthweight (vLBW). Comoros has the highest prevalence of LBW (16.0%) whereas Rwanda has the lowest (6.2%). During the entire pregnancy, each one degree Celsius increase in overall, intra-day, or inter-day TV during pregnancy was associated with 3.3% (95% confidence interval (CI) 1.9–4.7%), 1.2% (95% CI 0.5–2.0%), or 13.2 (95% CI 3.8–23.5%) increase in the odds of having a LBW birth, respectively. The effects of TV on vLBW were consistently stronger for all pregnancy periods except for the 3rd trimester.

CONCLUSIONS: Our study suggests the adverse impact of TV on the risk of LBW in African LMICs, with the strongest association with inter-day TV.

KEYWORDS: Temperature variability, climate, low birthweight, pregnancy outcome

P-0587 Effect modification of greenness on the association between heat and mortality: a multi-city multi-country study

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BACKGROUND AND AIM: Identifying how greenspace impacts the temperature-mortality relationship in urban environments is crucial, especially given climate change and rapid urbanization. To date, studies on this topic have indicated conflicting findings and typically focus on a localized area or single country. We evaluated the effect modification of greenspace on heat-related mortality in a global setting.

METHODS: We collected daily ambient temperature and mortality data for 452 locations in 24 countries and used Enhanced Vegetation Index (EVI) as the greenspace measurement. We used a distributed lag non-linear model to estimate the heat-mortality relationship in each city and evaluated the effect modification of greenspace. City-specific average temperature, city-specific temperature range, city-specific population density, and GDP was adjusted as meta-predictors in a multivariate meta-regression. We derived the pooled heat-mortality relative risk (RR) comparing the 99th temperature percentile to the minimum mortality temperature (MMT) for each greenspace group (high, medium, low).

RESULTS: Cities with high greenspace value had the lowest heat-mortality relative risk of 1.19 (95% CI: 1.13, 1.25), while the heat-related relative risk was 1.46 (95% CI: 1.31, 1.62) for cities with low greenspace while comparing the 99th temperature percentile to the MMT. 20% increase of greenspace would reduce 9.02% (95%CI: 8.88, 9.16) heat-related attributable fraction, and this would result in saving approximately 933 excess deaths per year in 24 countries.
CONCLUSIONS: Our findings can inform communities on the potential health benefits of greenspaces in the urban environment and mitigation measures regarding the impacts of climate change.

KEYWORDS:
Temperature, mortality, greenspace, effect modification

P-0588 The effect of temperature modified by season on lung function in the GINIplus/LISAplus cohort: A 15-year follow-up

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BACKGROUND AND AIM: Climatic variables such as temperature and relative humidity (RH) impact lung function in the elderly. However, there is little research on the effect of temperature on lung function in adolescents. This preliminary study aims to assess the effect of temperature modified by season on lung function in adolescents.

METHODS: Spirometric lung function measurements (Forced vital capacity; FVC, forced expiratory volume; FEV1, and forced expiratory flow; FEF25-75%) were collected from GINIplus/LISAplus, two German birth cohorts at their 15-year follow up examination. A total of 2174 adolescents from the Wesel and Munich areas were assessed. We used generalised additive models to assess the linear effect of 8-day moving average temperature on FVC, FEV1, and FEF25-75%. The core model was adjusted for the 8-day moving average concentrations of RH, fine particulate matter ($PM_{2.5}$) and ozone (O_3), and was stratified by season (warm or cold).

RESULTS: We found that there was a decrease in FEF25-75% [relative risk (RR): 1.009 (95% Confidence interval (CI): 1.001 to 1.017)], FEV1 [RR: 1.013 (95%CI: 1.002 to 1.024)], and FVC [RR: 1.011 (95%CI: 1.001 to 1.021)] per 1°C increase in temperature (8-day moving average) during the warm season, respectively. Similarly, there was a decrease in FEF25-75%, and FEV1 when exposed to low mean temperature (8-day moving average) during the cold season, however, the results were not statistically significant.

CONCLUSIONS: Negative associations between prior exposure to 8-day temperature and lung function were apparent during the warm season but not necessarily in the cold season. The association remains robust after the addition of pollutants ($PM_{2.5}$ and O_3). We speculate that a decline in lung function associated with warm temperature could be due to behavioural changes on relatively warm days, because of increased participation in outdoor activities.

KEYWORDS: Temperature, respiratory health, climate change, air pollution

P-0589 Climate emergencies and health system resilience collaborative research action (CHESS): challenges and best practice from the UK and Australia

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BACKGROUND AND AIM: Health was chosen as a science priority area for the 2021 UN Climate Change Conference in Glasgow as well as in other international initiatives such as the UN Sustainable Development Goals, to bring a stronger focus to the environmental protection and disaster risk reduction agendas. Within this global context, the UK and Australian National Health Systems are committed to providing equitable, high quality health care, which requires capability and capacity to respond to the health emergencies of climate and humanitarian disasters.

METHODS: We have launched the climate emergencies and health system resilience collaborative research action (CHESS) between UK and Australian research institutions and healthcare associations to develop and strengthen a shared, evidence-based understanding of two key priorities: (1) Adaptation to climate change through building climate resilient health systems with people and nature in mind and (2) Mitigation of climate change through developing and implementing low carbon sustainable health systems. This collaborative research action is based on a series of roundtable discussions and comparative analysis of case studies.

RESULTS: CHESS includes case studies in the following areas to better inform planning of health systems: 1) Resilience of health services and communities to climate and humanitarian disasters with emphasis on how mitigation and adaption measures can be amplified to address disparities; 2) Support of workforce and patient physical and mental health and well-being, and training to champion and promote sustainable healthcare services; 3) Sustainability of the healthcare sector to reduce carbon emissions, waste and low value care. CHESS will foster the use of scientific evidence in evaluating specific interventions.

CONCLUSIONS: This talk will introduce the current research priorities and outline future research perspectives, considering the current evidence and gaps in knowledge in the UK and Australian healthcare systems.

KEYWORDS: Climate, Policy and practice, Natural and humanitarian disasters, Sustainability

P-0591 The Effects of Heat and Air Pollution on Mental Health Related Mortality in California

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BACKGROUND: Higher ambient temperature and air pollution may play a role in increasing the risk of mental health related mortality; however, findings vary depending on study location. We examined the relationship between temperature and air pollution with deaths due to suicide and homicide in California—a region prone to high temperature and air pollution.

METHOD: California death certificates from 2014 to 2019 were used to identify the deaths due to suicide and homicide. Residential data for decedents were used to assign exposure to daily temperature (maximum [Tmax], minimum [Tmin]) and daily average air pollution concentrations (particulate matter <10 µm [PM10] and <2.5 µm [PM2.5], nitrogen dioxide [NO2], ozone [O3]). A time-stratified case-crossover study design using conditional logistic regression was used to assess the effects of daily exposure to Tmax, Tmin, PM10, PM2.5, NO2, and O3 on suicide and homicide mortality, adjusting for relative humidity as a potential confounder. Two-exposure models pairing temperature with a single pollutant and interactions between temperature and air pollution were also explored.

RESULTS: We observed 24,250 deaths due to suicide and 10,148 deaths due to homicide. A 1-ºC increase in same-day Tmax and Tmin was associated with 0.44% (95% confidence interval, CI, 0.02%–0.90%) and 0.76% (95%CI, 0.17%–1.35%) increased odds of death due to suicide, respectively. The increased odds of homicide mortality per 1-ºC increase in same-day Tmax and Tmin were 0.86% (95%CI, 0.23%–1.50%) and 1.05% (95%CI, 0.15%–2.00%), respectively. Associations for air pollution were null. Tmax and Tmin associations were robust to the adjustment of each air pollutant. We found marginally significant interaction effects of minimum daily temperature with PM10 and O3.

CONCLUSION: Our findings suggest that risk of suicide and homicide mortality increases with both increasing daily ambient maximum and minimum temperatures.

KEYWORDS: Temperature, Air pollution, Suicide, Homicide, Mortality

P-0593 Excess deaths after tropical cyclones in the USA

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BACKGROUND AND AIM: In the US, hurricanes and other tropical cyclones have a devastating impact on society and are an important public health concern. Knowledge of excess deaths is essential for understanding the true public health burden of climate-related disasters. However, methodology to calculate post-tropical cyclone deaths has been hitherto inconsistent; even estimates for the same tropical cyclone can vary greatly, such as for Hurricane Maria in 2017, for which official death counts were up to seventy times lower than the total number of excess deaths.

METHODS: We used mortality data from the National Center for Health Statistics and a comprehensive record of tropical cyclone occurrence in the US over 31 years (1988 – 2018). for each tropical cyclone, we formulated a Bayesian ensemble of forecasting models to estimate monthly all-cause and cause-specific death rates for the six months after exposure of tropical cyclone-impacted counties—defined as counties with a sustained maximal wind speed ≥34 knots—for the counterfactual scenario that these counties were not exposed to the tropical cyclone. We compared actual death rates to counterfactual rates and used population estimates to calculate excess deaths. We also examined how excess deaths varied by age group, sex, and social vulnerability.

RESULTS: There were 106 named tropical cyclones which contributed to US exposures in 1,206 counties during 1988 – 2018. In initial estimates, we found that for Hurricane Sandy in 2012, there were 172 [95%CrI,125–226] post-tropical cyclone excess deaths; the official figure is 72. for Hurricane Katrina in 2005, there were 1,793 [95%CrI,1,559–2,105] post-tropical cyclone excess deaths; the official figure is 1,836.

CONCLUSIONS: A full cataloguing of excess deaths by cause, age group, sex, and social vulnerability with a consistent methodology improves understanding of the true public health burden of hurricanes and other tropical cyclones.

P-0594 Rising temperatures and alcohol- and substance-related disorder hospitalizations

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BACKGROUND AND AIM: Temperature affects human health, but there is limited evidence on how temperature increases are associated with alcohol- and substance-related disorders. Over half of American adults regularly consume alcohol or substances. Plausible behavioral and physiological pathways exist for the association, including more perspiration in warmer weather, and temperature-dependent efficacies of substances. Our aim was to comprehensively evaluate associations between ZIP Code-level temperature and alcohol- and substance-related disorder hospitalization rates in New York State (NYS).

METHODS: Using a case-crossover design coupled with distributed lag non-linear terms, we examined how ZIP Code-level temperature was associated with daily alcohol- and substance-related disorder hospitalization rates up to six days before hospitalization, and how these estimated associations varied by location, age group, sex, and social vulnerability. Hospitalization records in NYS were collected from the NY Department of Health Statewide Planning and Research Cooperative System (SPARCS) along with a comprehensive record of temperature over 20 years (1995–2014). Daily individual-level hospitalizations were grouped into two causes (alcohol-, substance-related disorders) and four sub-causes (cannabis-, cocaine-, opioid-, sedative-related admissions).

RESULTS: We found a near-linear increase in alcohol-related disorder hospitalization rates between -28°C and 10°C (19.3% [95%CI,9.8%–28.9%]) and between 10°C and 20°C (4.7% [95%CI,3.3%–6.2%]), above which the association flattened at 32°C for a 6.0% [95%CI,1.5%–10.5%] increase relative to 10°C. Substance-related disorder hospitalization rates increased between -29°C and 10°C (36.1% [95%CI,26.1%–46.2%]) with no change from 10°C to 32°C (1.6% [95%CI,-2.8%–5.9%]). for cocaine, there was a near-linear increase from the coldest temperature to the mean (-29°C to 10°C) and an increase in rates above mean temperature, up to an 5.4% [95%CI,2.2%–13.0%] increase from 10°C to 32°C.

CONCLUSIONS: From 1995–2014, rising temperatures were associated with higher hospitalization rates for alcohol- and substance-related disorders up to a threshold, above which no association was detectible.

P-0596 Assessment of heat effects on all-cause and cardiopulmonary mortality and effect modification by air pollution in Attica prefecture, Greece; a small-area analysis in the framework of the EXHAUSTION Project

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BACKGROUND AND AIM: The effects of short-term exposure to increased temperature on mortality are known, mostly based on time-series studies of city-wide data, whereas the evidence on temperature- air pollution interaction is limited. We investigated the association of short-term exposure to high temperatures with mortality in the Attica prefecture, Greece, by municipality, in the warm period (May-September) during 2000-2016, assessing daily air pollution exposure as effect modifier.

METHODS: We applied municipality-specific Poisson regression, allowing for overdispersion, on all-cause and cause-specific daily mortality, using Distributed Lag Nonlinear Models to assess temperature-mortality association. To evaluate interactions, a tensor product between mean temperature (lag 0–1) and PM_{10} or ozone (both lag 0–1) was defined and temperature estimates, corresponding to temperature increases from 75th to 99th percentile, were extrapolated at low, medium, and high levels of pollutants (5th, 50th and 95th percentile of pollutant's distribution respectively). Multivariate meta-analysis was applied to summarize results over the study area.

RESULTS: A rise in temperature was associated with a 20%(95% Confidence Interval (CI): 18.0, 23.0) increase in all-cause mortality. The increase was higher on days with higher pollution levels: 13.0% (95%CI: 8.4, 17.8) during low and 21.7% (95% CI: 18.4, 25.2) during high PM_{10} levels; 13.2%(95% CI: -3.0, 32.3) during low and 14.9% (95% CI:10.8, 19.1) during high O_3 levels. The same pattern was observed for cardiopulmonary mortality, with stronger heat effects for respiratory mortality, where, although the effects were not statistically significant for low air pollution levels, the increase in mortality was 55.1% (95% CI: 40.1, 71.6) and 45.0% (95% CI: - 27.4, 65.0) on days with high PM_{10} and O_3 levels, respectively.

CONCLUSIONS: A pattern of stronger heat effects on high air pollution days was observed. Under climate change, co-beneficial policies to mitigate heat and air pollution exposures are urgent.

KEYWORDS: Mortality,Short-term Exposure,Temperature,Air pollution,Synergetic effects.

P-0597 HEAL – Australian Research Network in Human Health and Environmental Change

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BACKGROUND AND AIM: The HEAL Network aims to strengthen the Australian community and health system resilience to climate change, extreme events, and other environmental change. This is achieved by building capacity and stimulating collaborative research that improves our understanding of the interactions between climate, the natural and built environment, public health, and their inequitable impacts across communities. HEAL is embedding systematic co-design processes with First Nations people on environmental change preparedness, capacity building, and mitigation and adaptation solutions.

METHODS: The HEAL Network is regionally distributed and includes multiple Communities of Practice (local knowledge exchange forums), comprising researchers, practitioners, community organisations, and decision-makers from across Australia. Based on initial gap analyses and stakeholder consultations, we have established 10 interdisciplinary research themes (Indigenous Knowledge Systems; Data and Decision Support Systems; Science Communication; Health System Resilience; Bushfires and Extreme Events; Food, Soil and Water Security; Biosecurity and Emerging Infectious Diseases; Urban Health; Rural and Remote Health; At-risk Populations and Lifecourse Solutions) and a range of capacity building activities that support communities and nurture early career researchers.

RESULTS: HEAL addresses capacity and capability gaps in health and environmental change, and credibility gaps in interactions between policy-makers, practitioners, industry and communities. One crucial outcome is developing the meta-capacity needed to formulate priorities, co-design research, and translate and implement research findings into policy and practice. New interdisciplinary collaborations springing from HEAL have led to development of community-based, solution-focussed research: e.g. facilitating Aboriginal community-led climate adaptation plans based on traditional Knowledges and environmental health data.

CONCLUSIONS: HEAL prioritises evidence and capacity needs, and local action with community-led co-design of solutions embedded in a monitoring and evaluation framework. This will lead to more effective national, regional and local policies to protect and improve public health and reduce inequalities within and across communities.

KEYWORDS: Climate change, environment, adaptation, resilience

P-0598 Early exposure to ambient temperature is associated with newborn lung function with sex-specific effects

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BACKGROUND AND AIM: Despite recognition of climate change, little is known on how ambient temperature may affect fetal development and child respiratory health. This study investigated the effect of prenatal and early postnatal exposure to ambient temperature on newborn lung function in France.

METHODS: Prenatal and early postnatal mean temperature and temperature variability at the mother's residence were estimated based on a validated spatiotemporally resolved exposure model in 343 mother–child pairs from the SEPAGES cohort. Newborn lung function was assessed at two months during unsedated sleep with tidal breathing and multiple breath washout test. Associations of ambient temperature with newborns lung function were analyzed using adjusted Distributed Lag Non-linear Models (DLNM) for the whole cohort and then stratified by sex. Both chronic (the first 35 gestational weeks and the 4 weeks after birth) and acute (the 7 days before the respiratory tests) exposures were investigated.

RESULTS: Among girls, chronic exposure to severe cold (the 5th percentile vs the median temperature) was robustly related to lower Functional Residual Capacity (FRC), lower tidal volume and higher respiratory rate. Chronic exposure to severe heat (the 95th percentile vs the median temperature) in girls was related to lower FRC and higher respiratory rate. Most of the significant windows of vulnerability to ambient temperature occurred between the second trimester of pregnancy and the first weeks of life.

CONCLUSIONS: Prenatal and early postnatal exposure to severe cold or heat may alter lung function among infants, especially in girls. Lung volumes appeared more specifically affected than airflows. Considering children and adults respiratory health are closely linked, long-term consequences may be substantial.

KEYWORDS: Ambient temperature; Climate change; DLNM; Infants; Lung function; Prenatal/Postnatal exposure; Restrictive lung disease

P-0600 What are the feelings prompted by manifestations of climate change among the young generations? A survey among University students in Fryslân (Northern Netherlands)

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BACKGROUND AND AIM: The threat posed by the changing climate potentially generates emotional anguish, anxiety, frustration, and grief (e.g. eco-anxiety or solastalgia). However, individuals can also experience positive emotions leading to the promotion of productive engagement with climate change. The wide range of feelings evoked by the same phenomena likely change across age, gender, and cultural background. Limited research has investigated the mental impact of climate change on young people. The aim of this research is to assess the type and intensity of feelings that different manifestations of climate change elicit in young people in Friesland, a rural region in North Netherlands.

METHODS: A questionnaire has been designed for this research. Two pictures per each of the nine climate change manifestations (melting glaciers and rising sea levels, warming oceans and acidification, extreme weather conditions that include droughts, floods, wildfires, extreme precipitation, tornadoes/storm/hurricanes, and frosts) were included. Participants were asked to associate one or more emotions (happiness, sadness, anger, boredom, fear, anxiety plus a distractor) to each of the pictures, and its relative intensity. Information on socio-demographic backgrounds was also collected.

RESULTS: A descriptive analysis of results will be conducted by tabulating the distribution of answers across several stratifying variables, i.e., gender, age. Furthermore, the researcher will look for correlations between each picture that depicts the same manifestation of climate change, to see whether different pictures of the same phenomenon evoke different emotions.
CONCLUSION: The same phenomenon can evoke different feeling in people, when fear prevails the anxiety feeling often leads to frustration and inaction; when rage prevails, this often leads to action, and change. Understanding the emotional impact of climate change on the new generations might help contribute and supporting campaigns aimed at triggering action rather than increasing anxiety and hopelessness.

KEYWORDS: climate change; eco-anxiety;

P-0601 Associations of Extreme Precipitation with Emergency Department Visits Among Older Adults in the Upper Midwest, USA, 2006-2013

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BACKGROUND: Extreme precipitation events have increased in the Upper Midwest. The impacts of precipitation on health here are poorly understood, especially for vulnerable populations. We examined the association between precipitation and gastrointestinal and respiratory emergency department (ED) visits in Medicare recipients age 65+ (N = 5.1 million ED visits) in 30 counties in Michigan, Ohio, and Pennsylvania.

METHODS: We used Poisson regressions of daily ED visit counts by ZIP/postal code on a daily population-at-risk offset; precipitation and temperature from 4 km resolution daily PRISM data; county; and time trends. We included distributed-lag non-linear transformations of precipitation and temperature for lags 0-20 days to account for delayed effects.

RESULTS: Overall, precipitation was non-linearly associated with both gastrointestinal and respiratory ED visits, with 20-day cumulative increased risk on days without precipitation and days with precipitation above the 75th percentile vs. 75th percentile (2 mm). Results varied by season--spring melt (March-May), warm (June-September), and cold (November-February)--and diagnosis. for gastrointestinal visits, in the warm season, risk was increased 13% (95% CI: 4.5%, 21%) at the 99.5th (45 mm) vs. 75th percentile. In the cold season, effects were deleterious at 0 mm but protective at high levels. In the spring season, effects were null. for respiratory visits in the warm season, risk was increased 20% (95% CI: 12%, 29%) at 99.5th vs. 75th percentile. In the spring and cold seasons, effects were deleterious at 0 mm and high values but null at very high values.

CONCLUSIONS: In the Upper Midwest, ED visits increased substantially following days with no precipitation and days above the 75th percentile, depending on season and cause of admission. A future project will explore effect modification by water distribution infrastructure age, which might increase health risks through drinking water contamination and increased flooding risk.

KEYWORDS: precipitation, emergency department visits, gastrointestinal, respiratory

P-0602 Trends in temperature-mortality projections across urban and rural regions under different climate change scenarios in Switzerland

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Temperature vulnerability tends to be heterogenous between urban and rural regions, with usually larger risks in the former. However, it is unclear whether this pattern will persist under different climate change scenarios. Climate change combined with population growth, ageing and urbanization is expected to amplify the current temperature-related mortality burden, particularly since these drivers will follow diverse trajectories across urban and rural areas in the future. This study aimed to compare the impact of climate change regarding changes in heat- and cold-related mortality under various warming scenarios across urban/rural districts in Switzerland, while also accounting for changes in population demographics.

We first estimated the district-age-specific (<75/>=75years) temperature-mortality association between 1990-2010 in Switzerland using a two-stage time series design with distributed-lag nonlinear models. We then projected heat- and cold-related mortality under 1.5C, 2.0C, 3.0C and 4.0C warming scenarios using downscaled temperature projections under RCP8.5 while accounting for the Shared Socio-economic pathway (SSP5) population development storyline.

In Switzerland, heat- and cold-related mortality will increase by 2,420(95%CI:1654;3,884) and 993(82;1883) deaths /year, respectively, under 4.0C warming (vs. 1990-2010). Urban areas are more affected by both heat and cold and this pattern appears to be amplified under warmer scenarios. In particular, per 100 heat-related deaths in rural areas, there will be an increase from 362 to 391 deaths in urban areas, with similar results for cold (from 262 to 286 per 100 deaths in rural areas), indicating a slight increase in vulnerability to climate change in urban regions in the near future.

Our preliminary findings suggest that climate change will increase current heat and cold-related mortality in Switzerland, and moreover, urban areas will continuously more be disproportionately affected. Further analyses will aim to account for urbanization projections and disentangle the contribution of the different drivers across urban and rural regions.

P-0603 Examining the Relationship Between Extreme Temperature, Microclimate Indicators, and Gestational Diabetes Mellitus in Pregnant Women Living in Southern California

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BACKGROUND AND AIM: Gestational diabetes mellitus (GDM), a form of glucose intolerance with an onset during pregnancy, impacts 5-10% of USA pregnant women. Previous studies have identified characteristics that increase GDM risk, including environmental exposures such as air pollution, temperature, and road traffic noise; however, few studies have assessed the influence of extreme temperature exposure on GDM risk at more refined temporal scales. We therefore aimed to investigate the relationship between extreme high and low temperature exposure and GDM risk at the weekly level during the first 24 weeks of gestation and to examine potential effect modification by microclimate indicators.

METHODS: Data from Kaiser Permanente Southern California electronic health records were used for pregnant women who gave birth from 2008-2018 (n=395,927). Daily maximum, minimum, and mean temperature exposures were linked to participants' residential addresses, and GDM screening occurred during 24-28 gestational weeks. Exposure-lag-response associations were examined between each of the 12 weekly extreme temperature exposures and GDM risk using distributed lag models coupled with logistic regression models that assessed the lag of gestational weeks from the first to the corresponding week. The relative risk due to interaction (RERI) was used to estimate effect modification of microclimate indicators on the relationship between extreme temperature and GDM risk.

RESULTS: GDM risk increased with extreme low temperature during gestational weeks 20-24 and with extreme high temperature at weeks 11-16. Microclimate indicators modified the influence of extreme temperatures on GDM risk, including non-NDVI, impervious surfaces, land surface temperature, water use efficiency, global human settlement, and evapotranspiration canopy.

CONCLUSIONS: Windows of susceptibility to extreme temperatures were observed during the second trimester of pregnancy. Microclimate indicators were identified that may be modified to attenuate extreme temperature exposures during these windows, which could in turn reduce GDM risk.

KEYWORDS: Extreme Temperature; Microclimate; Gestational Diabetes Mellitus

P-0605 More than a sneeze: Effects of daily airborne pollen exposure on blood pressure in adults (EPOCHAL study)

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BACKGROUND AND AIM: The dose-response relationship between pollen exposure and acute systemic health effects, such as elevated blood pressure (BP), has been inadequately studied. The EPOCHAL cohort study (Effects of Pollen on Cardiorespiratory Health and ALlergies) aims to investigate the association between pollen exposure and six different health outcomes, including BP.

METHODS: We collected seated systolic and diastolic BP (BPsys, BPdia) in 102 allergic and non-allergic adults repeatedly (minimum 14 days) over six weeks during their typical symptomatic period. A skin prick test was performed to confirm pollen sensitization. We applied mixed effects models to regress daily BPsys and BPdia on daily pollen concentration of two highly allergenic species (birch, grasses) as well as the total of twelve species. Daily pollen concentration (grains per m3) was log-transformed prior to analysis. We adjusted for age, sex, BMI, food consumption, medication use and exercise before the test, time of day, and daily air pollution (NO2, PM2.5) and temperature.

RESULTS: Total pollen concentration was associated with a significant increase of 0.54 mmHg in BPsys per increment of 1 log[Pollen]. The same increment for grass pollen was significantly associated with 0.39 mmHg higher BPsys as well as 0.28 mmHg higher BPdia. In a subgroup analysis of participants with self-reported symptoms and positive skin prick test (N=68), we found significant associations between total pollen concentration and elevated BPsys (0.69 mmHg) and BPdia (0.43 mmHg) as well as between birch pollen concentration and BPsys (0.79 mmHg) and BPdia (0.62 mmHg).
CONCLUSIONS: We found increased BPsys and BPdia related to higher same-day pollen exposure. Effect sizes increased if we restricted the analysis to objectively confirmed pollen allergy sufferers. After completion of data collection (N=400) in 2022, we will investigate lagged pollen exposure and splines to further describe pollen-BP dose-response relationships.

KEYWORDS:
Air pollution, Pollen Allergy, Cardiovascular diseases

P-0610 High ambient temperature or ultrafine particles – which one has the largest effect on high burden diseases in New York State (NYS)?

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BACKGROUND AND AIM: Exposure to fine particles and extremely high temperatures poses substantial health threats, but their health impacts are rarely compared, and the research estimating the disparities of exposure-health associations is lacking. This study compared the health risks of either increased temperature or ultrafine particles (UFPs) while controlling for other co-pollutants, and investigated if their association varied by sociodemographic (SES), different diseases, and season.

METHODS: We used a case-crossover study to examine the excess risk (%) for each interquartile range (ER_IQR%) increase of UFPs and temperature on five high burden diseases (HBDs), including ischemic heart diseases (IHD), diabetes, stroke, kidney diseases, and depression due to their large absolute increases in disability-adjusted life years. Daily temperature and pollutant exposure were obtained from GEOS-Chem+APM, a state-of-the-art chemical transport model with aerosol microphysical simulation. We used the principal diagnosis to define five HBDs from NYS Discharge Data, 2013-2018. Conditional logistic regression analyses were conducted while controlling for PM2.5, NH3, SO2, temperature, relative humidity, and various time-varying variables.

RESULTS: Among 1,268,526 cases, significant ER_IQR of UFPs on all HBDs occurred from lag 1-3 days (ER_IQR% ranges from 1.0 to 1.3, $P< 0.05$), and ER_IQR of temperature lasted from 0-4 days (ER_IQR% ranges from 1.1 to 7.3, $P< 0.05$). High temperature consistently impacted all five diseases the most. Males, older adults, Hispanics, and uninsured cases were more susceptible to the adverse effects of both heat and UFPs. Depression and IHD showed the highest ER_IQR% to high temperature (7.1 and 7.7, respectively). The risks of HBDs were higher in fall and winter.

CONCLUSIONS: We identified significant short-term associations between elevated temperature or UFPs and HBDs admissions. Temperature's effect was the highest. There were consistent disparities in exposure-health associations by SES, season, and different diseases.

KEYWORDS: ambient temperature, ultra-fine particles, high burden diseases, demographics, disparity.

P-0614 Hurricanes, Industrial Hog Operations, and Acute Gastrointestinal Illness in North Carolina, USA

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BACKGROUND AND AIM: North Carolina (NC) is the third most hurricane-prone state and second leading hog producer. NC's hogs are housed in industrial hog operations (IHOs) in its eastern, hurricane-prone region. Hurricanes can inundate hog waste lagoons, transporting fecal bacteria that may cause diarrhea, vomiting, and/or nausea, collectively known as acute gastrointestinal illness (AGI). Hurricanes Matthew (2016) and Florence (2018) were NC's most recent deadliest hurricanes. We aim to understand the association between hurricanes and AGI in areas with and without IHOs.

METHODS: We used NC ZIP code-level surveillance data to calculate rates of AGI emergency department (ED) visits during 2016-2019. Using gridded PRISM precipitation data and swine permit data, we assessed the increase in AGI rate during the three weeks after Hurricanes Matthew and Florence in ZIP codes with heavy rain (>75th percentile of storm precipitation) and ≥10 IHOs and in ZIP codes with heavy rain but no IHOs by comparing AGI rates in these areas to their AGI rates during comparable non-hurricane time periods (2017, 2019).

RESULTS: The AGI rate in ZIP codes with heavy rain and ≥10 IHOs increased 13% (RR=1.13, 95% CI: 1.00, 1.29) after Hurricane Florence and 8% (RR=1.08, 95% CI: 0.87, 1.33) after Hurricane Matthew, while the AGI rates in ZIP codes with heavy rain and no IHOs experienced no increase (Florence: RR=0.99, 95% CI: 0.88, 1.12; Matthew: RR=0.98, 95% CI: 0.82, 1.16). ZIP codes with heavy precipitation and IHOs also had a higher proportion of Black, American Indian, and Hispanic residents than the state average.

CONCLUSIONS: Heavy rain from hurricanes in areas with IHOs may increase AGI rates, disproportionately harming people of color in NC.

KEYWORDS: Climate change, extreme weather, hurricane, disaster, flooding, industrial animal operations

P-0618 Method to set the wet bulb globe temperature criterion beyond which the heatstroke alert is issued

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BACKGROUND AND AIM: We have investigated the relation between daily maximum wet bulb globe temperature (= WBGTmax) and ambulance car visit due to heatstroke. Unlike WBGT-mortality relation, we could not find a minimum mortality temperature. Thus, so far there has been no good method to set the criterion for the heatstroke alert. Here, we propose the method that uses incremental “preventable number” of heatstroke cases.

METHODS: If a counterfactual "perfect action" is implemented at a certain WBGTmax criterion, all the EVs occurred on the day with the WBGTmax equal to or higher than the criterion should be prevented. This number can be regarded as “preventable number” (= PN). Our aim is to show the incremental PN, i.e., how many more visits would be prevented for each degC reduction, using Tokyo data as an example. Both the ambulance visit data and WBGT data were obtained from the respective governmental agencies. The observation period was from 2015 to 2019 during warmer months (from May to September). Using these data, we first modelled the relation between daily maximum WBGT (= WBGTmax) and the ambulance visits due to heatstroke, assuming quasi-Poisson distribution with log link in generalized linear model. With this model, we calculated 1 degC-incremental PN from the integer part of the highest daily maximum WBGTmax to that of the lowest WBGTmax.

RESULTS: The highest incremental PN was observed at 24, 26, 31, 32, and 29 degC for May, June, July, August and September, respectively. Here, 24 indicates 24.0 <= WBGTmax < 25.0. The current WBGTmax criterion in Japan is 33 degC, but the cumulative PN down to this criterion was less than half the total PN; the current criterion appeared too high.
CONCLUSIONS: The method shown here is a good method to set the criterion for the heatstroke alert.

P-0620 First steps for new extreme temperatures Health Early Warning System in Portugal

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Both extremely hot and cold temperatures are considered to have significant effects on population's health. More likely heat waves and cold spells due to climate change could result in excess deaths. Public health institutions play a crucial role in assessing the impacts of such events and, subsequently, in providing adequate early warnings and suitable mitigation recommendations.
AIM: In this work we propose an update of the heat and cold health early warning systems currently in use in Portugal. The aim was to develop a risk indicator, active throughout the whole year, and easily understood by the entire population, with the highest possible spatial resolution. Daily data of all-cause mortality and maximum, minimum and mean temperatures was gathered from public data sources for the 1995-2019 time period. District-specific temperature-mortality associations were estimated using quasi-Poisson with linear threshold distributed lag models for cold and hot semesters (minimum temperatures were considered in autumn/winter and maximum temperatures in spring/summer, to identify worst case exposure scenarios). Regressions included seasonality and long-term trends and year population estimates as an offset. Influenza incidence was also included in the model to improve predictive performance. Cold and hot thresholds were defined for each semester and for each district independently based on best data fit criteria.

RESULTS: show good predictive ability of the district-specific models and allowed the identification of different temperature-mortality associations between regions. The overall cumulative RRs estimated for low (4ºC) and high (34ºC) temperatures were 1.62 (95% CI: 1.65 - 1.69) and 2.35 (95% CI: 2.19 - 2.51) for the most populated district and 1.07 (95% CI: 1.04 - 1.11) and 1.03 (95% CI: 1.02 - 1.03) for the least populated district. Variation of optimum cold and hot thresholds between districts provided interesting insights about varied regional population vulnerability.

KEYWORDS: Heat waves, Cold waves, Mortality, Prevention plans, DLM

P-0621 Short-term impacts of ambient temperature on self-rated health in Augsburg, Southern Germany

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BACKGROUND AND AIM: Short-term exposure to low or high temperatures is known to be harmful for human health. Previous literature on associations between ambient temperature and health outcomes has mostly focused on mortality and hospital admissions in ecological studies. Self-rated health is a strong predictor of premature mortality but has rarely been used as a predictor for checking the effects of temperature on health. Our study was aimed to examine the short-term association of daily mean temperature with self-rated health and the potential effect modification by socio-demographic, lifestyle or medical history as well as air pollution covariates.

METHODS: The study is based on the KORA FIT follow-up study, a cross-sectional survey conducted in 2018/2019, which included 3,059 participants from Southern Germany. Self-rated health was assessed by the EuroQol Five Dimensions questionnaire (EQ5D). A higher score indicates better self-rated health. Daily mean air temperature was estimated by a highly resolved spatio-temporal model incorporating observation and remote sensing data and was assigned to participants' residential addresses. Generalized additive models using the distributed lag non-linear model (DLNM) approach with a lag period of 21 days, adjusted for potential confounders, were used to investigate the association between daily mean temperature and self-rated health.

RESULTS: The mean values of daily temperature and EQ5D were 9.01(min. = -12.18, max. = 26.90) degree Celsius and 0.91(min.= -0.13, max. = 1.00), respectively. No association was found between ambient temperature and self-rated health of participants. These are preliminary results and further analysis on effect modification is ongoing.

P-0622 Vulnerability and adaptation to climate change: perceptions and experience in an Arab urban locality in Israel

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BACKGROUND AND AIM: Situated in a climate hotspot, Middle East cities should assess their vulnerability and build climate resilience. Understanding the population's perceptions and existing adaptation can support appropriate preparedness action. We aim to analyze climate change experience, vulnerability, adaptation, and perceptions in Shefa-'Amr.

METHODS: Mixed methods: 1) online questionnaire, 2) semi-structured focus groups; both with resident population.

RESULTS: Questionnaire respondents (n = 482) represented the three local religions, 58.2% women, overrepresentation of higher education. 96.8% indicated they believe climate change is happening, 50.6% answered they were "very worried" about it. 47.7% and 28.6% of respondents indicated that they have experienced "some" negative health consequences from extreme heat and heavy rain/flooding, respectively. Respondents indicated high rates of willingness regarding preparedness actions like signing a petition (89.8%), ensuring good housing drainage (88.3%), planting trees (85.6%), or designing buildings to require less air-conditioning (83.8%). They were relatively less interested about whether political candidates include climate preparedness in their agenda (65.5%). There was low willingness to sell or exchange land, a socio-politically sensitive topic, for developing local green spaces (32.8%). Social resilience was not very high, 1.64 ± 0.49 (1 – 3 scale).
Focus groups (n = 8, 4-8 per group, total 52 participants) revealed a contrast between traditional adaptation to heat methods and current reliance on air conditioning, lack of resilient urban infrastructure and inequality with neighboring Jewish municipalities, mixed attitudes towards preparedness (active and fatalistic) and towards social resilience, and frustration towards the municipality.
CONCLUSIONS: Mixed methods showed high levels of awareness and concern regarding climate change, and willingness to take a range of actions. Focus groups revealed a more complex picture of social resilience. These findings can be used to engage with and advocate for the community in resilience building.

KEYWORDS:
climate change, adaptation, preparedness, vulnerability

P-0627 Large Scale Climate Indices, Environmental Variability, and Impact on human health

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BACKGROUND AND AIM: Large-Scale Climate Indices (LSCI) are numerical indicators of the strength and phase of teleconnections between the atmosphere, oceans, and continents for given regions. Most of the LSCI are interconnected and have been demonstrated to contribute to the climate variability, and extreme environmental conditions and then indirectly impact human health. The current work aims to further understand LSCI and their impacts on environmental variability, Skin temperature, and pollution by PM10 in Morocco.

METHODS: The current work has used LSCI, Skin temperature, and PM10 over the cities of Casablanca and Marrakech. Discontinuities in annual and seasonal datasets were analyzed using Pettitt and Hubert's approaches. Trends in datasets were studied using Theil and Sen's slope. Correlations between time series were estimated employing the Spearman coefficient.

RESULTS: Trends in annual LSCI were positive. Shifts in annual and seasonal large-scale patterns were recorded between the mid-1960s and early-1980s. at the annual and monthly scales, weak but significant connections were found between the SaOI and Skin temperatures in the cities of Casablanca and Marrakech. at the daily scale, all the LSCI were interconnected. PM10 was positively correlated to the Mediterranean Oscillation Index (MOI) and negatively to the Saharan Oscillation Index (SaOI).

CONCLUSIONS: In the studied area, Skin temperature and thus the thermal comfort, and particulate pollution and thus their impacts on human health may be partly explained by large scale atmospheric patterns. LSCI may be further explored in their relationships with environmental extremes. Mastering large-scale atmospheric patterns inducing phenomena that impact human health would be a good step toward a Climate/Air/Health warning system.

KEYWORDS: Large Scale Climate Indices, Skin Temperature, Environmental Variability, Rupture, PM10, Health, Morocco

P-0628 Trends in wildfires caused by electrical power and the use of Public Safety Power Shutoffs in California

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BACKGROUND AND AIM: Wildfires have increased in frequency and intensity in recent years, particularly in California. As climate change continues to alter weather patterns, producing high temperatures and drought conditions, catastrophic wildfires will persist. To prevent electrical lines from sparking wildfires, the California Public Utilities Commission has developed policies to implement Public Safety Power Shutoff (PSPS) events, which authorize utility companies to de-energize power lines to mitigate wildfire risk. This study aims to 1) characterize trends in fires caused by electrical power in portions of California between 2010 and 2020, 2) describe the use of PSPS events, and 3) examine if PSPS events are associated with fewer wildfires.

METHODS: Our study sample is the 27.5 million acres of land for which the California Department of Forestry and Fire Protection (CAL FIRE) and Contract Counties are responsible for preventing and suppressing fires. The area covers more than a quarter of the state, including much of the Wildland Urban Interface, where the human-built environment meets wildland vegetation. We obtained CAL FIRE's annual Wildfire Activity Statistics reports and extracted information on the number and causes of wildfires. Data about PSPS events were obtained from the California Public Utilities Commission. In further analysis, we will spatially link these data and use regression to examine the association between PSPS events and fires started by electrical power.

RESULTS: Preliminary results are focused on descriptive patterns of fires and PSPSs. Between 2010 and 2020, CAL FIRE and Contract Counties attended to 37,749 fires. Electrical power started approximately 9% of these fires. PSPS events, first approved in 2012, increased in frequency between 2017 and 2020.
CONCLUSIONS: Public Safety Power Shutoffs are a potentially powerful engineering intervention to prevent wildfires started by electrical power. Next steps will examine if PSPS events have prevented wildfires.

KEYWORDS:
Climate change, wildfires, intervention

P-0629 Extreme weather events and their impacts on malaria: historical records from the Nordic countries

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BACKGROUND AND AIM: Warm summer temperature has been associated with historical malaria incidence in the Nordic countries with cool temperate climate, e.g., Finland, Sweden and Denmark. However, other weather factors, especially climatic extreme events and their impacts on malaria outbreak have rarely been rigorously studied. for example, coastal flooding caused by extreme sea level rise, could rapidly alter the larval habitat of brackish water malaria vectors. Other hydrological events like extreme rainfall and severe drought are also likely to impose nonlinear exposure responses and delayed effects of the climate–malaria relationship. This study aims to evaluate the historical malaria occurrence related to extreme precipitation events, and to distinguish the impact of different climate forces on malaria outbreaks by investigation whether there is statistically significant attribution of individual climate extremes to malaria epidemics.

METHODS: Historical symptom-based malaria cases during the 17-18th centuries were obtained from the Nordic countries, to compare with local long-term meteorological observations of temperature, precipitation and sea level. The non-linear relationship and delayed effect of precipitation events and malaria occurrence were further explored using the distributed lag nonlinear model (DLNM).

RESULTS: From long-period data of the Nordic countries, this study intends to investigate whether the magnitude of historical malaria epidemics was affected by local coastal flooding which mostly occurred during storm surges.
CONCLUSIONS: This study highlights the critical importance to distinguish the impacts induced by climate change perturbations, such as extreme rainfall and drought, and in particular coastal flooding, in order to provide a better understanding of diverse effects of climate change on the burden of malaria.

KEYWORDS:
Malaria, Nordic, sea level rise, extreme rainfall, drought, DLNM

P-0631 Home Medication and Heat-Sensitive Emergency Department Visits in Atlanta

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BACKGROUND AND AIM: Several classes of drugs are known to affect heat tolerance by impairing sweat production, thermoregulation and thirst sensation. However, few population-based studies have considered the influence of prescribed medications on heat-related morbidity. This study aims to evaluate the hypothesis that patients on certain medications are more vulnerable to short-term high ambient temperatures.

METHODS: We obtained electronic health records of emergency department (ED) visits from Emory Healthcare hospitals during May to September for the period 2016 to 2018. Patients reported current prescriptions at ED intake and we categorized medications into 12 classes of interest. Daily meteorology from the Daymet 1km product was linked to patient residential ZIP codes. Using a case-crossover design, we examined associations between maximum temperature averaged over lag 0-2 days and ED visits for two heat-sensitive ED outcomes: acute kidney injury (AKI) and fluid and electrolyte imbalance (FEI). Effects of temperature were modeled non-linearly and effect modification by medication type was examined in age-matched stratified analyses.

RESULTS: There were 11,423 AKI and 22,506 FEI ED visits during the study period. for AKI, we found stronger associations with temperature (comparing 34 ^{o}C to 29 ^{o}C) among patients with prescriptions of antipsychotics (OR = 1.88, 95% CI: 1.17-3.01) and diuretics (OR = 1.32, 95% CI: 1.04-1.70) compared to patients without any reported medication. for FEI, stronger associations were observed among patients with prescriptions of beta-adrenergic blocking agents (OR = 1.20, 95% CI: 1.00-1.46) and diuretics (OR = 1.33, 95% CI: 1.07-1.64). No effect modification was observed for several common medication types, including ACE inhibitors, anticonvulsants, antihistamines, calcium channel blockers and statins.

CONCLUSIONS: We identified several subpopulations more vulnerable to short-term heat exposures based on self-reported home medications. These results are important for the development of more targeted strategies to reduce heat-related morbidity.

KEYWORDS: Heat, Medication, Morbidity

P-0635 Impact of extreme weather events on Sub-Saharan African child and adolescent mental health: The implications of a systematic review of sparse research findings

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BACKGROUND AND AIM: Over the past 10−15 years there has been increasing attention to the potential impact of extreme weather events (EWE) on children's mental health. Because sub-Saharan Africa (SSA) is experiencing an increase in the frequency and severity of these events, we decided it was necessary to conduct a systematic review. The focus was to examine research findings on EWE direct and indirect impacts on the mental health of children and adolescents living in SSA to inform protective adaptation strategies and promote resilience.

METHODS: In 2020 we conducted a systematic review in line with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and a grey literature review. The systematic review and grey literature search identified 1342 studies.

RESULTS: The titles and abstracts of 858 articles and grey literature were assessed for eligibility (e.g., mental health outcomes for children and adolescents linked to exposure to an EWE in SSA) with 21 articles identified for full-text review. of these, only two were eligible for full review. Both articles focused on extreme flooding events and associated psychological distress. Several protective factors were identified (e.g., age, sex, encouragement, and shared hardship) that ameliorated the psychological distress.
DISCUSSION: There is an alarming lack of research focusing specifically on the mental health of youth exposed to EWE in SSA, where EWE, especially extreme heat, flooding and droughts, continue to increase. The indication is that children and adolescents living in SSA are at risk of mental health impacts such as depression and post-traumatic stress disorder. With the severe shortage of SSA-specific research, SSA decision-makers, planners and adaptation strategy developers are not guided by local and regional evidence and may be missing areas of concern and opportunities for prevention.

KEYWORDS: Extreme weather events, Children, Adolescents, Mental health, Climate change, sub-Saharan Africa, Resilience, Vulnerability, Depression, PTSD, well-being

THEMATIC 09: Environment and health in low and medium income areas

P-0690 Biomonitoring of Exposure to Metals in a Population Residing in an Industrial Area in Brazil: A Feasibility Study

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BACKGROUND: Industries are sources of environmental pollutants. However, there are few human biomonitoring (HBM) studies in the vicinity of industrial areas. Thus, we evaluate the feasibility of conducting an HBM study to assess exposure to metals in an industrial area in Rio de Janeiro, Brazil. METHODOLOGY: A cross-sectional survey was conducted near a steel factory. Adults (exposed = 775; controls = 775) were randomly selected and sex-matched. Subjects were interviewed using a questionnaire and a 24 h dietary recall. Blood samples were collected to analyze metal concentrations, blood count, biochemical parameters, and thyroid hormones. The feasibility of the survey was assessed following guidelines. The descriptive analysis was performed for the first 250 participants (pilot study).

RESULTS: Adjustments were made to the survey execution, including age-matching, fieldwork team, questionnaire, blood collection, and research awareness. The complete questionnaire was answered by ≥97% of participants; metals were measured in ≥98% and clinical parameters in ≥89%, except thyroid hormones (13–44%). The average age and family income were of 50 years and USD 575/month, respectively. The participants had equal distribution among sexes: 50% had a medium education level, and 59% were nonwhite.
CONCLUSION: This preliminary HBM study demonstrates feasibility for the total population, with results indicating representativeness of the target population.

KEYWORDS: survey; human biomonitoring; feasibility; toxic metals; steel industry; Brazil

P-0693 Detection and Genotyping of Toxoplasma gondii in the Environmental matrices (Soil and Water) in Gaza-Palestine

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BACKGROUND AND AIM: The aim of the present study was to detect the prevalence as well genotyping of T. gondii oocysts, which is the environmental infectious stage, in Gaza- Palestine.

METHODS: for this purpose, 290 environmental samples were collected for T. gondii oocysts detection and genotyping through the use of sheather's solution and PCR techniques.
More specifically, soil samples were collected from five sites, which were Wadi-Gaza, Near trash dumpsters, residential house yards, open-air markets, public squares and gardens.

RESULTS: The results of the present study revealed that from the 290 environmental samples, 22 (7.58%) and 31 (10.68%) were contaminated with T. gondii oocyst according to the test methods of PCR and Sheather's solution, respectively. The highest rate of contamination detected was from samples collected from residential house yards, while public squares and gardens represented the lowest rate. Moreover, 26 (13%) from the 200 soil samples pool were contaminated according to the Sheather's solution method, while under the PCR, 18 (9.99%) samples were contaminated. Regarding the prevalence of contamination in water samples, only samples collected from Wadi-Gaza reported contamination levels.

CONCLUSIONS: The present study revealed that the contamination of T. gondii oocyst in soil is higher than water. The highest rate of soil contamination detected were from samples collected from residential house yards, while public squares and gardens represented the lowest rate. On another hand, the contaminated water samples are only from running water samples collected from Wadi- Gaza, while water which collected from other sources are free of contamination. Finally, this study concluded that all samples that were genotyped belong to T. gondii type I.
It is recommended that the Gaza Municipality should take measure towards the sanitation of the contaminated sites.

KEYWORDS: Toxoplasma gondii – oocysts – Environment – Soil- Water – PCR- Sheather's - Gaza

P-0695 Exploring the Relationship between Hog Farm Exposure and Chronic Obstructive Pulmonary Disease (COPD)

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BACKGROUND: Chronic Obstructive Pulmonary Disease (COPD) and related conditions continue to be a major public health concern. The primary cause of COPD is cigarette smoking; however, other risk factors include air pollution, work environment, infectious diseases and genetic predispositions. Related human studies have suggested that air quality and environment surrounding hog farms, specifically within low-middle income counties, have the potential to induce lung dysfunction.
AIM: The aim of this study is to explore the relationship between hog farming practices and chronic obstructive pulmonary disease .

METHODS: Geographical Information Software (GIS) was used to determine the association between state-wide hog farm location density and COPD. A retrospective (2000-2016) partial ecological study of 14 major Arkansas hog farm cities was conducted using the International Classification Code of Diseases- 10. Seven case cities (as those containing a hog farm) and seven control cities (as those without a hog farm) were identified.

RESULTS: Hog farm density was positively correlated with state-wide COPD prevalence and low median income. Further analysis, after controlling for county level race, gender, ethnicity, establishment year, alcohol abuse, drug abuse, smoking, obesity, and chronic neurological conditions, resulted in a protective association between hog farm exposure and COPD 0.78 (0.734, 0.840).

CONCLUSIONS: Given the study's results, city-wide hog farm exposure is not positively associated with county-level COPD prevalence. However, farm location density was determined to be correlated with state-wide COPD prevalence and low median income. A follow-up study using individual data, should be conducted to provide further insight in this exposure, outcome relationship.

KEYWORDS: FARMING COPD CHEMICALS RESPIRATORY LUNG

P-0701 How agricultural droughts are contributing to child undernutrition in sub-Saharan Africa

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Countries in sub-Saharan Africa (SSA) have some of the highest levels of child malnutrition, with more than one third of children under five in the region characterized as chronically undernourished. High reliance on subsistence farming, poor adoption of irrigation technologies and variable climate conditions make populations in SSA highly vulnerable to malnutrition during droughts. We use anthropometric data for 570,540 children under the age of five from 34 countries in SSA in combination with high resolution agricultural and climate data to estimate the association between agricultural droughts and child undernutrition in the region. We use global gridded data on the geographical distribution of crop areas for 19 major crops. Data on crop planting and harvesting dates are also collected for each crop. The Standardized Precipitation Evapotranspiration Index (SPEI), a multi-scalar drought index, is used to measure the intensity and spatial distribution of droughts during key periods of agricultural production (planting, growth and harvesting) and of different duration (seasonal and long-lasting droughts). Our preliminary analysis shows that droughts during the main crop growing season are associated with increased risk of child undernutrition in SSA. As a next step, we will quantify the impact of droughts during the planting and harvesting seasons and for specific crops. We will additionally investigate whether droughts impact pastoral communities, for example through livestock loss. The findings presented in this study call for urgent action to improve drought monitoring and response in SSA where the risks to child health posed by global warming are considerable. Under climate change, the severity and frequency of extreme weather and climate events, including droughts, are projected to increase in the future, which will place millions of children at risk of hunger unless timely actions plans are taken to improve food security in the region.

KEYWORDS: drought, undernutrition, agriculture, sub-Saharan Africa

P-0702 Household Air Pollution and Respiratory Health in Rural Crete, Greece: An Observational FRESH AIR Study

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BACKGROUND AND AIM: During the Greek austerity, the unusual outdoor air-quality deterioration observed in cities was attributed to the increased use of biomass-burning fireplaces for domestic heating, resulting from rises in the price of conventional fuels. Indoor air data, particularly for the disproportionally affected rural periphery, was lacking. We explored levels of household air pollution and respiratory health in rural Crete, Greece.

METHODS: An observational, implementation science study with repeated design was conducted (November 2017- March 2018). PM2.5 and CO levels were measured in 32 purposively selected rural households, during periods of lesser (baseline) versus extensive (follow-up) heating. Residents' fuel-use practices, respiratory symptoms and respective awareness were assessed through questionnaires. McNemar and Wilcoxon tests were used to explore outcome differences between assessments.

RESULTS: Mean PM2.5 levels were not significantly different between measurements (36.34μg/m³ versus 54.38μg/m³; p=0.60) but exceeded WHO's air-quality guidelines (25μg/m³ for 24-hours mean). Mean CO levels were 0.56ppm (baseline) and 0.34ppm (follow-up; p=0.414). Maximal CO levels reached 26.1ppm (baseline) and 9.72ppm (follow-up; p=0.007). CO values were below WHO's cut-offs (26.6ppm for 1-hour and 6.1ppm for 24-hours mean). Overall, 90.6% of households were using wood-burning fireplaces/stoves, but half also owned clean-fuel devices. Differences between devices owned versus used were attributed to financial constraints. Most frequently reported respiratory symptoms [N=42 residents, 72.7% women, mean (SD) age: 66.8(14.9) years] were phlegm (27.3% versus 15.2%; p=0.34) and cough (24.2% versus 12.1%; p=0.22). Less than half of residents (48.5%) knew that indoor biomass-burning can harm health.

CONCLUSIONS: Levels of PM2.5 exceeding international standards were documented, in line with evidence regarding the return to harmful practices. Further research is required to confirm results. Advocating for fuel poverty, raising awareness and empowering communities seem important Public Health targets during austerity/energy crisis periods.

KEYWORDS: household air pollution, PM2.5, CO, respiratory health, fuel poverty, economic crisis, Greece

P-0703 Environmental Exposures in Lebanese Infants (EELI) Study: Methods, Findings, and Contextual Considerations to Launch A Birth Cohort in the Eastern Mediterranean Region

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BACKGROUND AND AIM: The EELI Study is a longitudinal birth cohort launched in 2021 in Beirut, Lebanon to examine the long-term impact of environmental exposures on the health and wellbeing of prospective Lebanese mothers and infants and disease outcomes. The aim of the present study is to delineate the adopted study design and protocols, current progress, and contextual considerations for the planning and launching of a birth cohort in a resource-limited setting.

METHODS: Pregnant women expected to give birth at the Hôtel-Dieu de France University Hospital were recruited. During prenatal clinical visits and through phone interviews, they provided biological specimens and completed multiple questionnaires and semi-structured qualitative interviews. at birth, clinical records and samples of cord blood, colostrum, and meconium were collected. Nested cohort studies focused on the influence of maternal diet on infant gut microbiome and the influence of COVID-19 pandemic, economic crisis, and indoor environmental exposures on maternal mental health are conducted on sub-populations of the study.

RESULTS: A sample of n=123 participants has been recruited since the study launch. Over 500 variables have been recorded for each participant, and over 1000 biological specimens have been processed and stored in a biobank for further analysis. Household visits at 1 year from birth are set to be conducted starting May 2022 to complete more questionnaires and collect biological specimens from the infants. The retention rate in Year 1 is 92.2%.

CONCLUSIONS: The EELI study establishes a methodological and logistic basis to explore the concept of the exposome and its implementation in resource-limited settings and to establish a toolkit of the SOPs and questionnaires that can be employed by the other countries in the Eastern Mediterranean region.

KEYWORDS: birth outcomes, children's environmental health, exposure assessment, pregnancy outcomes; environmental exposures

P-0709 Wastewater-based epidemiology: an additional tool for TB surveillance?

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BACKGROUND AND AIM: Tuberculosis (TB) is a global public health concern that causes a significant strain on healthcare systems, particularly in sub-Saharan Africa. Current surveillance using clinic and hospital data are inadequate as they exclude those patients who either cannot access healthcare or choose not to, due to potential stigmatisation associated with HIV/TB coinfection. Wastewater based epidemiology using molecular methods may be used as an alternate surveillance system to augment data.

METHODS: We used droplet-digital-PCR to assess the presence, quantity and diversity of tuberculosis-causing Mycobacterium spp. in wastewaters across several sub-Saharan African countries. Wastewater samples from Ghana, Nigeria, Kenya, Uganda, Cameroun and South Africa, from both influent and effluent (post-chlorination) were analysed.

RESULTS: Mycobacterium spp. (MTBC, M. tuberculosis, M.bovis, M africanum, M.caprae) were detected in wastewater samples pre and post-treatment from all six countries, at significantly varying concentrations. The highest median concentration detected in untreated wastewater was up to 4.8 (±2.73) log copies/ml for total mycobacteria, 4.6 (±3.86) log copies/ml for MTBC, 3.4 (±2.79) log copies/ml for M. africanum all from Ghana, 3.9 (±3.17) log copies/ml for M. tuberculosis from Uganda and 3.8(±0.10) log copies/ml for M. caprae from South Africa. Apart from a significant difference between Kenya and Cameroun, removal efficiency was similar in all tested treatment plants.

CONCLUSIONS: The detection of M. africanum in South Africa and other African indicates that migration should be considered in TB control strategies, particularly with developing resistant strains. The diversity of MTBC species in wastewater samples from these countries may be correlated to the prevalence of tuberculosis infections in the population served by these wastewater treatment plants and the migration of people across different countries. This study emphasizes the utility of wastewater-based epidemiology in tracking tuberculosis infections for use in surveillance.

KEYWORDS: Wastewater-based epidemiology, droplet-digital polymerase chain reaction, TB surveillance

P-0710 Prevalence and Antibiogram Signature of selected Vibrio species Recovered from Giant Shrimps (Penaeus Monodon) Samples in Malokun Sea, Ilaje, Ondo State, Nigeria

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BACKGROUND: Giant shrimps (Penaeus monodon), an important native of the aquatic food chain and abundant crustaceans in Malokun sea, Ilaje, Ondo state, serves as significant seafood recipe. This study investigated the incidence and antibiotic susceptibility signature of Vibrio species isolated from crayfish sample from Malokun sea, Ilaje, Ondo State so as to evaluate its potential as reservoir of Vibrio species in this environment.
METHOD: A total of 30 fresh giant shrimp samples were obtained from Malokun sea and densities of Vibrio spp. were determined using MPN-PCR method. Shrimp samples were macerated in sterile blender and aliquots were processed using thiosulfate-citrate-bile salts-sucrose agar. The presumptive isolates were further confirmed as Vibrio spp. using PCR assay and then subjected to antibiotic susceptibility testing against a panel of 8 commonly used antibiotics using Kirby Bauer method.

RESULTS: Twenty (20) presumptive Vibrio isolates were randomly selected for molecular confirmation and 12 isolates were confirmed genotypically as Vibrio species. High antibiotic resistance was observed against penicillin (100%), ceftazidime (91.66%), cefepime (91.66%) doripenem while susceptibility to norfloxacin (75%), amikacin (100%), kanamycin (83.33%), streptomycin (66.66%) was likewise observed respectively. The multiple antibiotic resistance index (MARI) among Vibrio spp. ranged between MARindex 0.25-0.625 with highest MARI of 0.625 observed in 33.33% of Vibrio species showing resistance to five antibiotics.
CONCLUSION: This study revealed high prevalence of Vibrio species and multiple antibiotics resistance among examined marine shrimps in Malokun sea, Ilaje, Ondo state. as well as raised resistance against samples. We therefore concluded that the shrimps might pose health risk if undercooked contaminated shrimps were consumed and are potential reservoir of Vibrio species which could cause Vibrio associated infections in sea animals in this marine environment.

KEYWORDS: Vibrio spp., Shrimps, Penaeus Monodon, antibiotic resistance, Nigeria

P-0711 Differential Impact of Exposure to PM2.5 Composition and Contributing Sectors on Anemia Prevalence Amongst Children Under age five in India

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Anemia, a condition of low red blood cell count and diminished hemoglobin levels, is highly prevalent in India. India has one of the highest anemia prevalence approx. 60% among children under age five (U5) in the world. Ambient PM2.5 exposure has been identified as a potential risk factor for anemia via systemic inflammation. Moreover, whether the impact varies with PM2.5 composition and sources contributing to such components is not known. Here, we examine the differential impact of exposure to ambient PM2.5 components on anemia prevalence among children U5 in India using exposure data from the CMAQ model and satellite-derived PM2.5, health data from the NFHS-IV. Here we focus on the exposure to PM2.5 components such as Black Carbon, Organic Carbon, nitrate (NO3), ammonium (NH4), sulfate, soil, and others, during the early life period. We use multilevel models adjusted for the risk factors - smoking, cooking fuel, BMI, wealth, and residence to assess the impact of PM2.5 components on anemia prevalence among children. at the ecological level, for every IQR increase in ambient PM2.5 exposure, the odds ratio for average anemia prevalence is 1.19 (95% UI: 1.17,1.22). for each IQR of NO3, anemia prevalence increased with an odds ratio of 1.26 (95% UI: 1.24,1.29). for the corresponding increase in NH4, others, BC, OC, SO4, and soil, anemia prevalence increased by odds ratio 1.19 (95% UI: 1.17,1.21), 1.16 (95% UI: 1.14, 1.18), 1.15 (95% UI: 1.13, 1.17), 1.11 (95% UI: 1.09, 1.13), 1.12 (95% UI: 1.11,1.13), and 1.10 (95% UI: 1.08,1.11), respectively. Sectorally, the domestic sector has the highest impact, followed by the unorganized sectors, road dust, agriculture waste, industry, etc. Our results will support the policymakers to target specific sectors that are contributing to exposure to PM2.5 and its components and, in turn, causing lethal health impacts.

KEYWORDS: Anemia, PM2.5, LMICs

P-0713 Hakuna matata! Can campus green spaces be restorative? A case study from Tanzania

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BACKGROUND: The majority of studies reporting the beneficial effects of urban green spaces on mental health, well-being and restoration have been conducted in developed and high-income countries. The present study explores the association of urban green spaces with mental health and restoration in a low/middle income country (LMIC) following exposure to the University of Dar Es Salaam's green spaces in Tanzania.

METHODS: In February 2022 an online survey was conducted among 108 participants working and studying on the University campus on their exposure to the University's green spaces (perceived greenness, quality, duration, frequency, availability, motivation and NDVI) and the impact on their mental health. Mental wellbeing and restoration were assessed with the Warwick–Edinburgh Mental Wellbeing Scale (WEMWBS) and Restoration Outcome Scale (ROS) respectively, while Nature Relatedness Scale (NRS-6) was used to determine the participants' connectedness with nature.

RESULTS: Participants' mental health improved after visiting the University's green spaces (WEMWBS: Mean= 24.7, SD = 4.6, ROS: Mean= 4.9, SD = 1.2). Multiple linear regression indicated an association between green space exposure and mental health. Participants' mental wellbeing (WEMWBS) was positively associated with the motivation to visit the University campus's green spaces ($p<0.05$). Objective greenness (NDVI) of the study areas (81% chose to spend their time in study areas with high NDVI, $p<0.05$) and nature relatedness scale (NRS-6) (Mean = 3.9, SD = 0.8, $p<0.05$) were both positively associated to restoration (ROS).

CONCLUSIONS: Our findings show the positive association between campus green space exposure and mental health improvement in an LMIC context, particularly for objective greenness and nature relatedness. Furthermore, the motivation for visiting green spaces can play an essential role in mental well-being and restoration.

KEYWORDS: University, campus, green spaces, LMIC, mental wellbeing, restoration

P-0714 Noise effects on health in studies in Low-Middle-income-countries (LMICs): a mapping review update of epidemiological evidence

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BACKGROUND AND AIM: Noise has been linked to adverse non-auditory health problems, including annoyance, sleep disturbance, cardiovascular disease, and impaired cognitive function. However, most studies on these topics have been conducted in developed countries. This review focussed on studies in Low-and Middle-income-countries (LMICs), where populations are exposed to relatively higher levels of noise

METHODS: We conducted a literature search of Medline and Web of Science from 2009-2021 for studies in LMICs investigating environmental noise ((including road traffic noise, railway noise, aircraft noise, community noise, wind turbine noise, etc.) effects on health (including annoyance, cardiovascular disease, mental health condition).

RESULTS: Fifty-six papers were included in the review. Thirty-four (60.7%) of the 56 studies assessed exposure based on fixed-site sound level meter, thirteen with noise mapping, six with subjective ratings, three with personal monitoring. The mean level of noise exposure among all the reviewed studies ranged from 36.6 dB to 121.2 Db.
Twenty-two (39.3%) of the 56 studies looked at noise annoyance and perception and found, as with non-LMIC studies, higher noise levels are associated with higher annoyance. Eleven studies examined cardiovascular outcomes reported that short-term noise exposure may slightly increase blood pressure among children and long-term noise exposure was linked to higher prevalence of hypertension and coronary artery disease in adults. Studies on all other outcomes remain very limited which preclude a meaningful synthesis of the findings.
CONCLUSION: To our knowledge, this is the first review to summarize current evidence on the relationship between noise exposures and health outcomes in LMICs. This review provides critical and concise evidence on the knowledge gap to inform the future research agenda to help better understand noise pollution and human health in a global context.

KEYWORDS: Noise; Health; Low-and Middle-income-countries (LMICs)

P-0721 International variations in air pollution and cardiometabolic risk among Ghanaian migrants: The RODAM study

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BACKGROUND AND AIM: Long-term exposure to ambient air pollution has many links to cardiovascular diseases. However, its role on migrant populations, especially those who originated in low-and-middle-income countries is less well known. The aim of this project was to examine the relationship between ambient air pollution and cardiovascular risk factors in the Research on Obesity and Diabetes Among African Migrants (RODAM) study.

METHODS: We examined cardiovascular risk factors (hypertension and/or diabetes) for 5,889 Ghanaian migrants living either in Berlin (578), Amsterdam (1,663), London (1,120) or urban (1,449) or rural Ghana (1,109). Ambient PM2.5 and NO2 was predicted using global satellite models and paired to the residential co-ordinates for RODAM participants living in Europe and to pooled area co-ordinates for those in Ghana. Logistic regression models evaluated the relationship between ambient air pollutants and cardiovascular risk factors.

RESULTS: Overall, inverse or null relationships were observed for PM2.5 and NO2 when examining hypertension and diabetes separately. However, for those with one (or both) of these conditions, a positive association with NO2 was observed where a 5 µg/m3 increase in NO2 was associated with an OR of 1.16 (95% CI: 1.00, 1.34). This association varied across the various RODAM sites including an inverse relationship in rural Ghana (OR: 0.87, 95% CI: 0.24, 1.02) a null relationship in Berlin (OR: 0.99, 95% CI: 0.72, 1.27) and a positive relationship in London (OR: 1.05, 95% CI: 1.02, 1.63).

CONCLUSIONS: A positive association between having one or more cardiovascular risk factor and NO2 was observed. However, no such association was observed when examining risk facts individually. A more detailed analysis, including more precise pollution predictions (including more information on domestic fuel use) and a wider array of cardiovascular risk factors (e.g. BMI) is required to better understand this relationship.

KEYWORDS: Migrant health; Air pollution; Cardiovascular health

P-0722 The Folic Acid and Creatine Trial: Treatment effects on arsenic metabolite concentrations in blood

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BACKGROUND AND AIM: Arsenic exposure is a global issue. Inorganic As (InAs) undergoes methylation to monomethyl (MMAs) and dimethyl-arsenical species (DMAs); full methylation to DMAs facilitates urinary excretion and can reduce risk of adverse health outcomes. Folate and creatine influence one-carbon metabolism which provides methyl groups for As methylation. We investigated the effects of folic acid (FA) and/or creatine supplementation on As metabolites and primary (PMI: MMAs/InAs) and secondary (SMI: DMAs/MMAs) methylation indices in blood in Bangladeshi adults.

METHODS: In this double-blind, placebo-controlled trial, 622 participants (20% folate deficient) were randomized to receive FA (400 or 800 µg/day), 3 g creatine/day, 3 g creatine+400 µg FA/day, or placebo for 12 weeks. for the following 12 weeks, half of the FA participants received placebo. All participants received As-removal water filters.

RESULTS: Blood As metabolite concentrations decreased in all groups due to filter use. After 1 week, the mean within-person increase in SMI for the creatine+400FA group exceeded the placebo group. The mean decreases in blood concentrations of MMAs (bMMAs) between baseline and week 12 was greater for all treatment groups compared to placebo, and the increase in bDMAs concentrations for the FA treated groups exceeded that of placebo. The decrease in PMI and increase in SMI in all FA groups at week 12 exceeded placebo. Data from week 24 showed evidence of rebound from week 12, with decreases in SMI in those who switched from 800FA to placebo, whereas for those who remained on 800FA, PMI and bMMAs concentrations continued to decline.

CONCLUSIONS: FA supplementation lowered bMMAs and increased bDMAs in adults in Bangladesh. Evidence of rebound in As methylation capacity following FA cessation suggests short-term benefits of supplementation and underscores the importance of long-term interventions such as FA fortification and As mitigation in drinking water.

KEYWORDS: Arsenic, Nutritional Intervention

P-0723 Ambient nitrogen dioxide exposures in Latin American cities

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BACKGROUND AND AIM: Ambient nitrogen dioxide (NO_2) is a ubiquitous urban air pollutant emitted by fossil fuel combustion. Exposure to NO_2 is associated with respiratory disease and all-cause mortality. Health research on ambient NO_2 is sparse in Latin America, despite high urbanization and the high prevalence of NO_2-associated respiratory diseases in the region. This study aims to describe highly-granular population exposures to ambient NO_2 and urban characteristics associated with NO_2 exposure within 326 Latin American cities.

METHODS: We leveraged estimates of annual surface NO_2 at 1km² spatial resolution, population counts from national census bureaus, and urban characteristics compiled by the SALURBAL project for the year 2019, aggregating all data to the neighborhood (i.e. census tract) level. We described the percent of the urban population living in neighborhoods with ambient NO_2 levels exceeding WHO Air Quality Guidelines (annual, 10 μg/m³). We used multilevel models to describe associations between neighborhood-level ambient NO_2 concentrations and population and urban characteristics at the neighborhood and city levels. All models were adjusted for country and included all characteristics concurrently.

RESULTS: We examined 47,251 neighborhoods in 326 cities representing eight Latin American countries. of the ≈236 million urban residents observed, 85% lived in neighborhoods with ambient annual NO_2 above WHO guidelines. In adjusted models, higher neighborhood-level educational attainment, closer proximity to the city center, and lower neighborhood-level greenness were associated with higher ambient NO_2. at the city level, higher congestion, population density, and intersection density were associated with higher ambient NO_2.

CONCLUSIONS: Almost nine out of every 10 residents of Latin American cities are exposed to ambient NO_2 concentrations above WHO guidelines. Increasing neighborhood greenness and reducing city-level congestion warrant further attention as potential actionable urban environmental interventions to reduce urban population exposure to ambient NO_2.

KEYWORDS: nitrogen dioxide, air pollution, exposure, Latin America, urban environment

P-0725 SARS-CoV-2 Wastewater Based Epidemiology in Low and Lower Middle-Income Countries: A Systematic Review

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BACKGROUND AND AIM: Wastewater based epidemiology (WBE) is a promising tool to monitor the prevalence of COVID-19 disease at community level through detection of SARS-CoV-2 RNA in wastewater. Although WBE has been largely adopted in developed countries as complementary to clinical surveillance, the approach is still not widely applied in low-and-lower-middle-income countries (LMICs) owing to number of drawbacks. Despite these limitations, a small number of studies on wastewater based epidemiology for SARS-CoV-2 detection have been conducted in LMICs. The current systematic review provides an overview of the efficacy of WBE in LMICs.

METHODS: We conducted keyword searches in PubMed, Web of Science, and Scopus for articles published between January 2020 to February 2022. A total of 2,057 relevant articles were identified, and 21 met our inclusion/exclusion criteria.

RESULTS: The most common analytical steps used in included studies are sampling, storage, concentration, extraction, and detection. Studies utilized either composite/grab raw sludge or influents mostly from wastewater treatment plants, which covered a population of one to ten million. Among the studies, Among the studies, the most commonly used concentration technique was Poly Ethylene Glycol (PEG), and the most frequently targeted gene was the N gene. The overall sample positivity was found 81.18%, with viral loads of 40 to 45,000 copies/L. Most of the studies found positive correlation between SARS-CoV-2 viral loads in wastewater and the detected COVID-19 cases. Besides, few studies found higher signals in wastewater with a time lag of one to two weeks before clinical case detection.

CONCLUSIONS: These findings of systematic review illustrate the analytical methods used in WBE research, as well as the future of WBE in LMICs, thereby allowing decision-makers to take strategic preventative actions to curb the spread of COVID-19 diseases in LMICs.

P-0728 The health effects of the 2020 Bangladesh floods in the rural and isolated areas

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BACKGROUND AND AIM: In Bangladesh, severe floods occurred in 2020, and the health effects such flood disasters in the rural areas are not clear. Identifying the environmental risk factors in health after the disaster is crucial for mitigating health burdens. The study aims to describe the effects of floods on the worsening of the perceived health conditions and identify those environmental risk factors in the rural and isolated coastal areas, which are severely affected by the 2020 Bangladesh floods.

METHODS: The questionnaire survey was conducted in the coastal areas of two upazilas (sub-districts) (Amtoli & Golachipa) in August 2021. By using logistic regression analysis, we evaluated the health effects according to the affected levels, evacuation status, sanitation, access to drinking water/food (within 3days) and medicine (within 7days) in the early emergency phase, and access to the prescription medications during floods.

RESULTS: Among 168 participants, 82.1% of people were affected (partially inundated: 29.8% and inundated: 52.4%), and 43.5% were evacuated to some places. Water supply (57.14%) and sanitation (73.80%) were severely disrupted and more than half of the participants could not access drinking water (57.1%), food (54.2%), and medicine (65.6%) in the early emergency phase. During floods, about 35% of people were difficult to get needed medicines, and 62.5% were experienced diarrhoea in their household members. People without accessing the medicine during floods had more experiences of diarrhoea [Odds ratio: 2.18 (95% CI: 1.08-4.38)], worsening their mental health [3.31 (1.69-6.46)] compared with people who could access. Childhood malnutrition, mental health problems and worsening chronic disease (hypertension/diabetes) in their family were more likely observed among people affected or evacuated.
CONCLUSION: In the isolated coastal areas, the disaster severely disrupted sanitation and access to adequate services and exaggerated the health conditions. Further investigations immediately after the disaster should be conducted in rural areas.

P-0730 Microbial Contamination of the Stem Bark of Mitragyna ledermannii, A Commercially Available Medicinal Plant in the District of Abidjan (Cote d'Ivoire)

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Raw plant material sold on markets may constitute hazardous risk to population due to storage conditions. This study aimed at assessing the microbial quality of Mitragyna ledermannii an important medicinal plant being used in Cote d'Ivoire for treating malaria and other diseases.
A total of 188 samples of stem barks of M. ledermannii were purchased from markets in 3 settings (Abobo, Adjamé, Yopougon) over a period of 3 months. The samples were analyzed using standard microbiological methods. Also, some physicochemical parameters were measured. The moisture of the samples varied from 5.3 to 61.18%, pH was 4.88-6.35 and temperature 24.5-31°C. The samples showed high rate of contamination to mesophilic aerobic bacteria (100%), total coliforms (99.50%), thermotolerant coliforms (99.50%), Escherichia coli (10%), Staphylococcus aureus (98.93%), Enterococci (85.56%), Pseudomonas (61%), yeasts and moulds (93%). Any Salmonella was found in all samples. Average loads of microorganisms ranged from 2.6 $x10^3$ to 8.7 $x10^7$ CFU/g for mesophiles, 4.0 $x10^3$ to 3.4 $x10^7$ CFU/g for total coliforms, 1 $x10^3$ to 6.6 $x10^6$ CFU/g for thermotolerant coliforms, 8.0 $x10^4$ to 4 $x10^8$ CFU/g for Staphylococcus aureus, from 3.2 $x10^3$ to 2.2 $x10^8$ CFU/g for Enterococci, and 2.0 $x10^4$ to 4.4 $x10^7$ CFU/g for yeasts and moulds. Most of samples had unsatisfactory microbiological quality compared to WHO standards.
This study demonstrates population exposure to health risk and the great need to carry out microbiological tests frequently in these medicinal plants marketed in Abidjan.

KEYWORDS: Medicinal plants; markets; storage; microbiology; quality; Cote d'Ivoire

P-0735 Household Air Pollution and the Nasal Microbiome in Children from Rural Ghana

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BACKGROUND AND AIM: Associations between household air pollution exposure, the nasal microbiome and lung function in childhood are unknown.

METHODS: Analyses included n=53 children from the Ghana Randomized Air Pollution and Health Study (GRAPHS) in Kintampo, Ghana. Personal air pollution exposures (carbon monoxide, CO, and fine particulate matter, PM2.5) were measured prenatally, postnatally and at four years. Age four nasal swabs underwent DNA extraction and 16S rRNA gene sequencing on the Illumina MiSeq with subsequent taxonomic profiling using QIIME2. We employed linear regression to assess relationships with high vs low air pollution exposures and α-diversity, and we used permutational analysis of variance to assess associations with β-diversity. Associations between log transformed continuous exposures and individual taxa were assessed using MaAsLin2. We examined associations between α-diversity and individual taxa, considered separately, and age four impulse oscillometry lung function by linear regression.

RESULTS: High prenatal PM2.5 was associated with lower α-diversity (p = 0.04) and richness (p=0.02), as compared to low prenatal PM2.5. B-diversity was associated with high vs. low prenatal PM2.5 (R2=0.07, p=0.03), postnatal CO (R2=0.04, p=0.03), and age four PM2.5 (R2=0.04, p=0.07). Prenatal CO and postnatal PM were negatively associated with three bacterial genera each, while postnatal CO was positively associated with four (including Haemophilus) and negatively associated with 15. Prenatal PM was positively associated with two genera, and negatively associated with 23 (including Ralstonia and Brachybacterium). Age four PM was positively associated with 11 genera (including Ralstonia). A-diversity was associated with large airway resistance (R20 β=0.53 p=0.05). Lung function was inversely associated with Brachybacterium, and Haemophilus, and positively associated with Collinsella and Ralstonia.

CONCLUSIONS: Early life exposure to household air pollution is associated with differences in the nasal microbiome of children at age four, potentially influencing lung function.

KEYWORDS: Air pollution, nasal microbiome, low-middle income country, lung function

P-0736 Neighborhood socioeconomic status and the human gut microbiome composition: relating socioeconomic environment to microbial diversity and MDRO colonization

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Low socioeconomic status is correlated with a greater vulnerability to both chemical and non-chemical stressors, however, there is limited research on how socioeconomic status relates to the human gut microbiome, and subsequent associations with downstream health outcomes. Here, we aimed to examine associations between neighborhood level economic hardship, an indicator of overall cumulative risk, gut microbiome composition and additional cofactors that might be involved in this association including diet quality and food insecurity. We conducted a cross-sectional analysis of 721 adults living in geographically diverse (urban vs. rural) regions of Wisconsin (USA). 16S rRNA gene amplicons were analyzed from human stool samples using QIIME2 to evaluate both the composition and diversity of the gut microbiotas from 721 participants. Next, we determined correlations with each individual's neighborhood score for socioeconomic status, or Economic Hardship Index (EHI), using simple and zero-inflated negative binomial regression models. Our model of EHI, with alpha diversity (Inverse-Simpson) as an outcome, found a correlation (β= 1.68, p=0.03) that it is partially mediated by food insecurity (p= 0.02). Moreover, we found differential abundances of known health-associated bacteria including members of the genera Bifidobacterium and Akkermansia, and the family Ruminococcaceae between high and low levels of EHI that were robust to correction for multiple comparisons. Finally, we discovered a higher prevalence (p=0.03) and number (p=0.02) of multi-drug resistant bacteria isolated from individuals with low alpha-diversity and high EHI. Our analyses suggest that living in low socioeconomic communities is associated with lower gut microbial diversity and potential increase in colonization by multi-drug resistant microbial pathogens. Mediation of associations by food insecurity is consistent with previous work from our group examining impacts of metal exposures on gut microbiome dysbiosis indicating dietary factors play an important role in mitigating environmental influences on gut microbial diversity.

P-0738 The Nigerian Environmental Epidemiology Accelerated Research Program (NEEAR): Evaluation of an Environmental Epidemiology Short Course for Nigerian Researchers

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BACKGROUND AND AIM: The Nigerian Environmental Epidemiology Accelerated Research (NEEAR) Program seeks to promote collaborative capacity and research development in environmental epidemiology in Nigeria. In 2021, a short course on environmental epidemiology was developed to strengthen the ability of Nigerian researchers to conduct environmental epidemiology research and thereby, to fill gaps in research capacity.

METHODS: The course was extensively advertised through social media and professional networks. Eligible applicants included Nigerian graduate students and scientists with degrees in Environment and Health related disciplines. Training was weekly 2-hour online sessions for 2 weeks and a 1-day in-person session in Nigeria. It included tutorial, videos, group work and hands-on exercises with faculty from Emory University USA and the Nigerian Institute of Medical Research. Session topics included study design, exposure assessment, data analysis, research ethics, and dissemination. A career talk and transferable skills sessions were also included. Pre- and post-session quizzes were administered during each session to assess whether the training improved participants' understanding of the session topics.

RESULTS: A total of 240 Nigerian researchers applied to the program, of which 35 (15%) top applicants were invited. Short course participants were 47% female and 53% male, with 87% possessing postgraduate qualifications. The participants came from 8 states within Nigeria. There was a marked improvement in participants post-session quiz scores compared to scores from the beginning of the sessions. Participants feedback was very positive. There was clarity on how the training will be applied in their current studies or work. CONCLUSIONS: The short course was impactful and fostered collaborative research capacity among Nigerian researchers. There is potential for more of such courses to be held due to the large number of eligible applications received. Future courses on intermediate/advanced epidemiology and biostatistics methods, internships and post-training connects are recommended.

KEYWORDS:
Capacity development, Nigeria, collaborative research

P-0739 Socioeconomic Determinants of Household Stove Use-Choice and Stove Stacking Patterns in Ghana Using Multinomial Logit Models

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BACKGROUND AND AIM: Air pollution is the fourth-highest risk factor for premature deaths globally and the second-highest risk factor for premature deaths in Ghana. Understanding the socioeconomic correlates of cooking stove/fuel choices and stove stacking patterns is a precursor to designing effective household air pollution interventions.

METHODS: The study used a quantitative cross-sectional design to collect data from sampled districts in all 16 regions of Ghana, covering about 7,400 household-level respondents in 370 enumeration areas (EAs); across 177 urban EAs and 193 rural EAs. Face-to-face interviews were conducted at home. The questionnaire was designed to elicit information on primary, secondary, and tertiary cooking stoves and fuels.

RESULTS: Use of LPG correlates positively with education (Primary education-RRR:2.377, p<0.01, CI: 95), (Middle/JHS education-RRR:3.019, p<0.0, CI:95), (Technical/SHS education-RRR:6.491, p<0.01, CI: 95), (Post-secondary/University education-RRR:14.41, p<0.01, CI:95). Similarly, use of an LPG-charcoal stove mix compared to Charcoal stove-open fire mix correlates positively with education. All else equal, households with more than one cookstove (RRR:1.185, p<0.05, CI:95), and urban households (RRR:6.488, p<0.01, CI:95) reported usingLPG stoves as their primary cookstove more frequently than did households using a single stove or living in rural areas. The age of the primary cook (RRR:1.44, p<0.1, CI:95), household income (RRR: 1.052, p<0.1, CI:95), and urbanicity (RRR:4.134, p<0.01, CI:95) were statistically significant in predicting use of an LPG-Charcoal mix compared to Charcoal stove-open fire mix. LPG, charcoal and 3-stone (open fire) stoves refer to cooking devices that are fueled by combustible gas, charcoal and wood respectively.
CONCLUSION: Most households in Ghana use multiple cookstoves and fuels. Biomass fuel use is concentrated in poorer, less educated, and rural households. Equitable household energy transitions will require particular attention to encouraging sustained exclusive use of clean fuels in these communities to improve health.

KEYWORDS: socioeconomic factors, cookstove, choice, stove stacking,

P-0740 Health impacts of solid fuel use in Ghana: A nationally representative assessment of cooking-related burns

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BACKGROUND AND AIM: Burns and burn-related injuries are still a major public health problem. Every day, over 30,000 people suffer new severe burns worldwide. Low- and middle-income countries (LMICs) bear a disproportionate burden (70%) of these burns. While burn prevention strategies have successfully been implemented in high-income countries, a paucity of data regarding the incidence and risk factors of burns in LMICs limits their expansion. Here, we aimed to describe the country-level incidence of serious cooking-related burns in Ghana and to identify household-level risk factors for adults and children.

METHODS: We conducted a nationally representative household energy use survey in Ghana in 2020. The final sample included 7,389 households across 370 enumeration areas in all 16 regions of Ghana. An adapted version of the Global Alliance for Clean Cookstoves Burns Surveillance Module was administered to each respondent. We computed incidence rates and 95% confidence intervals using the Byar's approximation and conducted univariate logistic regression to identify potential risk factors.

RESULTS: Out of 7,389 households, we documented 129 serious cooking-related burns which had occurred in the previous 12 months. Slightly more than half (55%) of those burns occurred among adults. The incidence rate (95% CI) of cooking-related burns per 1000 person-years was 9.7 (7.7; 12) and 11 (8.5; 14) among adults and children respectively. Among adults, the odds (95% CI) of experiencing a serious cooking-related burn were 2.29 (1.02; 5.14) and 2.40 (1.04; 5.55) times higher among primary wood and charcoal users respectively compared to primary LPG users. No children burns were documented in households where LPG was primarily used.
CONCLUSIONS: Using a nationally representative sample, we characterized the incidence of cooking-related burns across demographic groups in Ghana. Solid fuel use compared to LPG use doubled the odds of experiencing such burns.

KEYWORDS:
Burns; Solid fuel; Energy access; LMICs; Ghana

P-0741 Developing an Air Quality Health Index for Cape Town, South Africa – A time-series study

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BACKGROUND: South Africa currently uses a single-pollutant based air quality index (AQI) to communicate the air quality levels. However, this does not fully capture the risk associated with air pollution related illness as the index is reported using the highest concentration level of all the pollutants. Therefore, a revision of the AQI using a multipollutant approach could better reflect the combined health effect associated with multipollutant exposure.

METHODS: Using time-series analysis we derived the air pollution coefficient, daily concentration values for PM10, NO2, SO2 and O3 were regressed against total all-cause mortality in a Quasi-Poisson generalized additive model using data from Cape Town, 2006 – 2015. We estimated the short-term association after controlling for confounders, long-term trends and seasonality. Thereafter, we calculated the exponential function of the product of the coefficients from each single-pollutant model and the daily pollutant concentration – these calculated values were multiplied by 10 and further divided by the maximum daily percent excess mortality to scale the daily values for the AQHI. We provide preliminary findings, as the analysis is still ongoing.

RESULTS: The coefficients obtained per 10 µg/m3 were 0.007: PM10, 0.014: NO2, 0.009: SO2 and 0.017: O3. These values will be used to develop the multi-pollutant health based air quality index. The lag structure for the pollutant and cause-specific mortality models also showed significant evidence of mortality displacement for PM10 on both cardiovascular and respiratory mortalities from lag5–10.

CONCLUSIONS: This study serves as a framework that can be adopted and validated by the department of environmental affairs in South Africa. The presence of harvesting supports the need for an updated AQHI. It further merits consideration for review and update of the existing AQI. Thus, improving health risk communication of ambient air pollution for the general population and frail people.

KEYWORDS: AQHI, mortality, multipollutant, harvesting

P-0742 High-resolution air quality forecasts for LMIC using a combination of machine learning and earth model simulations

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BACKGROUND AND AIM: With the recent advancement of Earth observation, computer simulations, and low-cost monitoring technologies, the capacity to obtain accurate geospatial data has increased tremendously, particularly for locations without expansive in-situ monitoring networks. Here we present an optimized machine learning model to estimate near real-time air pollutant concentrations in selected locations in Africa and Latin America using a combination of NASA Goddard Earth Observing System Composition Forecasts (GEOS-CF) and low-cost sensor data.

METHODS: We use a machine learning approach to estimate near real-time air pollutants concentration at selected locations across Africa and Latin America. Several meteorological and chemical parameters are retrieved from NASA's GEOS-CF to train a bias corrector model and predict corrected concentration estimates for these locations which are then validated against local monitoring data. We also conduct an explainability approach via SHAP Analysis to quantify the model contributing factors across these locations and track the model performance in extreme conditions.

RESULTS: The optimized machine learning model shows good agreement with ground air quality data, with R2 values from 0.61- 0.65 for locations in Mexico City (Mexico), Bogotá (Columbia) and Kigali (Rwanda). Via SHAP analysis, we demonstrate the need to conduct a measure of variance to determine model performance for different conditions and intervals, knowing that the model performance can be affected by various training conditions.
CONCLUSION: Combining observations and optimized model simulations using machine learning techniques can significantly improve air quality forecasts in low- and middle-income countries, where the rapid pace of industrialization and communities are highly susceptible to air pollution health effects, and rarely have local air quality data and health risks alerting systems in place. These results are being used to assist air quality managers and environmental agencies in these locations to improve risk communication and reduce health burdens associated with outdoor air pollution.

P-0748 Building stronger public health institutions (BIS) project: Deciphering the burden of air pollution in Ethiopia, (2021-2025)

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Linking air pollution and health at a national level demands the use of a wide variety of data. The current state of science and practice recommends, countries to monitor pollutant concentrations in microenvironments and through satellite technologies. for this reason, countries with better policies and regulations are relentlessly assessing population exposure to air pollutants using air monitoring systems, from fixed atmospheric monitoring stations, atmospheric dispersion modelling, or spatial interpolation techniques for pollutant concentrations. Moreover, the use of systematic diseases surveillance system to document diseases distribution tandem with census data, administrative registers, and data on the patterns of the time-based activities at the individual scale, allowed them to better understand the burden of air pollution.

Hitherto, Ethiopia has not established a national air pollution and health impact surveillance program or system to generate data that can be translated into policy or action. for this reason, the global burden of diseases lacks to present the full depiction of Ethiopia. This was ascribed to the dearth of information available on temporal and spatially representative ambient and indoor air quality monitoring efforts; inadequate documentation of population exposure, activity pattern, and diseases incidence to represent wide range of the social fabric.

To this effect, the Norwegian public health institute (NIPH) through its four years program, building stronger public health institutions (BIS) (2021-2025), agreed to work with the Ethiopian public health institute (EPHI), to develop environmental epidemiological studies, to link air pollution and health. In doing so, establishing monitoring sites in collaboration with pertinent national authorities will be the first phase of the project. The second milestone will be identifying sentinel sites so as to track sex and age specific mortality and morbidity data of non-communicable diseases attributed to air pollution. Overall, the epidemiological studies will benefit Ethiopia to understand the burden of air pollution.

P-0750 Lead exposure is still a serious problem for pregnant women in Nicaragua

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BACKGROUND AND AIM: A series of studies were carried out in Nicaragua between 2000 and 2010 reporting concerning levels of lead in women and children in urban areas. However, during the last decade, no other study has been published. Current population levels of lead are unknown. We aimed to assess blood lead levels in pregnant women living in the urban area of Managua, the capital of Nicaragua.
METHOD: We conducted a cross-sectional descriptive study in 2017, assessing blood lead levels in 133 pregnant women (15 to 49 years of age), randomly selected among those treated at four health centers in Managua. We additionally explored the presence of potential lead exposure factors.

RESULTS: Overall, the median blood lead concentration (Pb-S) was 61.3 µg/L (range 15.1-336). Almost 25% of the women had Pb-S levels >100 µg/L, and 68% >50 µg/L. No significant association was observed between the levels of Pb-S and factors such as residence close to areas of intense traffic, presence of artisan car battery workshops in the neighborhood, personal exposure from car battery recycling, residence in homes that preserve walls with original paint prior to the 90's, etc. However, a significant difference was observed in relation to the area of residency.
CONCLUSION: The risk of negative effects on the offspring due to prenatal exposure to lead is important in our population of pregnant women. The levels observed in a considerable proportion of the investigated women are above those at which effects on the neuropsychomotor developmental development of the infant have been observed. These women and their children will most likely continue to be exposed to lead in their areas of residence if effective interventions are not made to control sources of exposure and reduce contamination levels.

KEYWORDS: Blood lead level, pregnant women, prenatal exposure, Nicaragua.

P-0753 Value of multiple correspondence analysis (MCA) to build road traffic crash typologies in low-income countries in Latin America

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BACKGROUND AND AIM: There is a need to identify statistical tools that are both valid and feasible to be implemented in low-resource settings, focusing on identifying individual and event typologies of those at most risk of suffering a road traffic crash (RTC). Multiple correspondence analysis (MCA) has been previously used to build such typologies in other regions. Here, we aimed to explore the typology of both the people involved in the accidents and the events.
METHOD: We selected as a case study the city of Loja, located in southern Ecuador, and conducted a web bases survey. A total of 754 drivers agreed to participate, of whom 41.5% reported having been involved in a traffic accident at least once in life. MCA was used to build typology (profile) of people who have suffered an RTC, and typology of RTC events.

RESULTS: Typology of drivers who reported participation or involvement in an RTC was characterized by a predominance of people between 25 and 40 years of age, who drive mainly automobiles (cars) and experience frequent sensations of distraction, and frequently use a mobile phone when driving. Additionally, MCA indicated two distinctive typologies of RTC events. One is characterized by collision vehicle to vehicle, with behavioral factors as a main group of causes, and RTC occurring on low-speed limit roads during the afternoon. The second typology is characterized by collision vehicle-surrounding, occurring on medium speed limit roads during the evening or late evening.
CONCLUSION: MCA suggested the main determinants of RTC are modifiable, mainly related to behavioral factors. MCA is an easy technique to perform, does not require highly trained personnel, and is compatible with information commonly collected in community-based surveys, making MCA a valuable tool for accident research in low-income countries.

KEYWORDS: Road traffic crash, typology, multiple correspondence analysis

THEMATIC 10: Environmental Equity

P-0754 Patterns of personal care product use and their association with sociodemographic characteristics along with endocrine disrupting chemicals among reproductive-aged Black women

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BACKGROUND: Compared to White women, Black women in the USA are exposed to higher, more hazardous concentrations of endocrine disrupting chemicals (EDCs), which are found in personal care products. Personal care product use differs by race/ethnicity across multiple product categories such as hair care, skin care, and feminine hygiene products. These differential patterns of exposure are important as they may contribute to environmental health disparities including increased risk of breast cancer, cardiometabolic outcomes, adverse birth outcomes, and uterine fibroids. We previously examined hair product use patterns among reproductive-aged Black women and found that women with higher socio-economic status were more likely to use more products. Our objective was to expand that work to include a wider range of product types including cosmetics, skin care products, nail care products, and feminine hygiene products.
AIM: Identify and describe distinct personal care product use patterns and their correlates among a cohort of reproductive-aged Black women living in Detroit, Michigan.

METHODS: Using self-reported data, we employed latent class analysis to determine distinct personal care product use patterns among women enrolled in the Study of Environment, Lifestyle and Fibroids. We compared self-reported sociodemographic characteristics across latent classes and examined whether classes were associated with urinary concentrations of EDCs.

RESULTS: We will describe the latent classes and report their association with (1) sociodemographic characteristics, and (2) urinary concentrations of EDCs.

CONCLUSIONS: The results of this work may be used to address whether product use patterns and related chemical exposures are associated with health outcomes that disproportionately impact Black women. Such information would help identify subgroups of women who may particularly benefit from intervention and potentially modifiable exposures that may be amenable to targeted public health interventions.

KEYWORDS: personal care products; Black women; exposure; endocrine disrupting chemicals; latent class analysis

P-0757 Racial/ethnic disparities in nationwide PM2.5 exposure: perils of assuming a linear relationship

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BACKGROUND AND AIM: Studies of racial/ethnic disparities in air pollution exposure assume an equal magnitude of disparity across the demographic distribution, which may under- or over-estimate the true disparity. Further, historic practices such as racist zoning policies could plausibly drive non-linear relationships between racial/ethnic composition and air pollution exposure. We aimed to conduct a nationwide analysis in urban areas allowing for non-linearity in the relationship between racial/ethnic composition and ambient particulate matter less than 2.5 micrometers ($PM_{2.5}$), and test whether racial segregation modified this relationship.

METHODS: We obtained tract-level demographic information from the 2010 Census and computed the multi-group dissimilarity index, a metropolitan-area level measure of racial segregation. Ambient $PM_{2.5}$ data was obtained from a publicly available source. We evaluated the relationship between percent non-Hispanic Black and percent non-Hispanic White residents and ambient $PM_{2.5}$ using natural splines.

RESULTS: In 58,029 U.S. urban census tracts in 2010, we observed first a very steep and then a plateauing relationship between percent non-Hispanic Black residents and ambient $PM_{2.5}$ concentration. Moving from the 25th percentile (1%) to the median (5%) of non-Hispanic Black residents was associated with a 0.58 μg/m³ (95% CI: 0.56, 0.60) increase in $PM_{2.5}$, while moving from the median to the 75th percentile (16% non-Hispanic Black) was associated with a 0.005 μg/m³ (95% CI: -0.012, 0.020) increase. Reciprocally, in predominantly White census tracts, increases in the proportion of White residents was associated with a rapid decrease in ambient $PM_{2.5}$. Segregation modified these relationships in a non-monotonic manner.
CONCLUSIONS: Our results suggest larger than previously reported Black-White disparities in exposure to $PM_{2.5}$, especially in communities with a modest Black population, which make up the majority of urban census tracts in the US.

KEYWORDS:
Racial/ethnic disparities; Air pollution; Particulate Matter; Environmental justice

P-0759 Scoping report and interactive evidence map on studies of environmental exposures, psychosocial stressors, and cardiovascular diseases in disproportionally impacted communities

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BACKGROUND AND AIM: Worldwide, cardiovascular disease (CVD) is the leading cause of death, with two-thirds of CVD- related deaths occurring in low- and middle-income countries. In addition to socioeconomic status (SES), CVD rates vary by race, ethnicity, and place. Environmental Health disparities (EHD) are predominately caused by systematic racism leading to higher exposure to environmental toxins, higher indicators of psychosocial stress, and social inequities. Our goal is to inform the scientific community and disproportionally affected populations (DAP) on the scope of the literature on CVD EHD and identify research gaps.

METHODS: To target relevant epidemiological studies and reviews, we searched PubMed using a broad range of terms for DAPs, environmental exposures, psychosocial stressors, and CVD outcomes. DAPs included racial, ethnic, and sexual minority groups and people with lower SES status or living in rural areas. Using exclusion/inclusion criteria, we screened the studies to determine relevancy. Included studies were reviewed and characterized by specific populations, environmental exposures, psychosocial stressors, and CVD outcomes. We visualized and explored the findings using six interactive evidence maps in Tableau.

RESULTS: We identified >1,400 relevant primary studies on CVD and psychosocial stressors or environmental exposures; >800 were conducted in DAP. The most studied racial/ethnic population was Black people (>300), and there were very few studies on sexual minorities (<10). Most DAP studies reported on personal behaviors (>60%), air pollution (~35%), SES indicators, and hypertension (~55%) for all DAP; however, some patterns differ according to the DAP. About 20% of studies reported allostatic load, and 7% evaluated racism and CVD. A research gap is the evaluation of environmental-psychosocial stressors interactions and CVD.

CONCLUSIONS: Our evidence map is a resource for DAP and scientific communities to explore the state of the science on CVD EHD and can be used to develop health equity solutions.

KEYWORDS: EHD, CVD

P-0763 The 2021 Texas Power Crisis: Distribution, Duration, and Disparities

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BACKGROUND AND AIM: Precipitated by an unusual winter storm, the 2021 Texas Power Crisis lasted from February 10 to 27. Such large-scale outages reflect aging electrical grids, underinvestment, and a changing climate. Power outages can have serious health consequences, especially among vulnerable subpopulations such as those reliant on electricity to power medical equipment, but limited studies have evaluated disparate exposures to outages. We used an environmental justice lens to characterize the distribution, duration, and disparities of the Texas Power Crisis.

METHODS: We used hourly Texas-wide county-level power outage data to describe the association and geographic clustering between outage exposure (distribution and duration) and six variables: electricity-dependent durable medical equipment (DME) usage, the Centers for Disease Control and Prevention Social Vulnerability Index (SVI), Black and Hispanic populations, nursing homes, and hospitals. We supplemented these county-level analyses with an internet survey among Texas residents to further investigate issues of environmental justice related to outage experiences and preparedness.

RESULTS: At the peak, nearly 1/3 of customers (N = 4,025,815) in the state lost power. County-level spatial analyses indicated racial/ethnic but not socioeconomic or medical disparities in power outage exposure. With individual survey data, we found less preparedness among younger individuals and those with lower educational attainment. Overall preparedness levels among Texans were low and were no higher among DME users (45% vs. 44%) – the group that likely faces the greatest health risks during outages.

CONCLUSIONS: Power outages coupled with extreme weather events can be deadly, and medically vulnerable, socioeconomically vulnerable, and marginalized groups may be disproportionately impacted. Climate and energy policy must consider these groups in planning and decision-making processes surrounding power outages including future grid improvements, and disaster preparedness and management

KEYWORDS: power outage, durable medical equipment, Texas, climate change, extreme cold weather, environmental justice

P-0765 Long-term Exposure to Particulate matter and cardiovascular disease in South Korea: investigating multi-level interaction with individual- and area-level factors

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BACKGROUND AND AIM: It has been well known that individuals or groups are not equally vulnerable to air pollution. However, few studies have investigated whether individual susceptibility to air pollution varies across different community environments. This study aimed to estimate the effects of long-term PM_{10} exposure on cardiovascular disease (CVD) in South Korea and to examine whether individual status of underlying disease and area-level medical infrastructure modify the effect.

METHODS: The study population comprised 392,104 subjects from the National Health Insurance Service-National Sample Cohort (2006-2015) residing in 120 districts in South Korea. The CVD event was defined as the first occurrence of a hospital visit or admission from 2006 to 2015. Time-varying Cox proportional-hazards models were used to estimate the association between five-year moving averages of PM_{10} and CVD events. Effect modifications by the individual status of underlying disease (cancer, diabetes, and hypertension) were determined by two-way interaction, stratifying by area-level medical index (calculated with the number of hospitals, hospital beds, and medical personnel).

RESULTS: Long-term exposure to PM_{10} was positively associated with the risk of CVD events (HR per 10 $\mu g/m^3$, 1.04; 95% CI, 1.02-1.06). In areas with a low medical index, PM_{10}-associated CVD risks were higher among those with cancer (HR 1.19; 95% CI, 1.00-1.42) as compared to those without (HR, 1.07; 95% CI, 1.02-1.12). In areas with a low medical index, subjects with cancer showed a lower risk of CVD associated with PM_{10} than those without.

CONCLUSIONS: This study suggests that the individual-level status of an underlying disease and area-level medical infrastructure could be interrelated in determining the health effect of PM_{10}. Consideration of this multi-level interaction in population vulnerability to air pollution can help understand the complex mechanisms by which air pollution creates health disparities.

KEYWORDS: Particulate matter, cardiovascular disease, effect modification, underlying disease, medical infrastructure

P-0768 Monitoring the environmental health status in the Swedish population 1999-2019

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BACKGROUND AND AIM: Since 1999, self-reported environmental health status and exposure has been monitored by questionnaires to the Swedish population in order to to follow up and act on emerging environmental health risks. This data, which is compiled in comprehensive environmental health reports, is unique and cannot be retrieved from any national register. The survey is administered by the Public Health Agency of Sweden, in close collaboration with the regions.

METHODS: Large random samples of the Swedish population (alternating between adults and children) have every 4th year since 1999 received a questionnaire about environmentally related diseases, exposures, annoyance and symptoms. The data has been completed with registry data, e.g. type of housing, educational level, income and country of birth. The last questionnaire (2019) was administered to caretakers of children, thereby completing two time series for adults and children, respectively, over a 20-year period. A focus on environmental health equity has been included in the data analysis of the results in recent years.

RESULTS: The number of administered questionnaires has increased from 15,750 in 1999 to 114,500 in 2019. However, the response rate has declined from 72% to 42% where it has stabilized, but due to the large sample sizes, the results are representative of the target populations. Among the noticeable trends are increasing annoyance from traffic noise and pollen allergies. A positive trend is a rapid decrease in indoor exposure to environmental tobacco smoke. New fields are also emerging, like urbanization, green space and climate change. In the last survey, inequity in exposures was especially elucidated.
CONCLUSIONS: Environmental health surveys are important as a complementary tool to other forms of monitoring environmental health and can be used for decision making at national and regional levels. Inequities can be identified and hence appropriate measures taken.

KEYWORDS:
Survey, environmental exposure, equity

P-0770 The Intersection of Immigrant and Environmental Health: A Review of the Literature

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BACKGROUND: Transnational immigration has grown since the 1950s. In countries such as the USA, immigrants now comprise over 15% of the population. Although differences in health between immigrants and non-immigrants are well-documented, it is unclear how environmental exposures contribute to these disparities.
AIM: We systematically reviewed current knowledge on exposure to environmental pollutants for immigrants compared to non-immigrants. We also considered observational epidemiologic studies that estimated health effects associated with environmental exposures, separately for immigrants and non-immigrants.

METHODS: We screened 3705 articles identified through Pubmed and selected those that fit our inclusion criteria. After abstract and full-text review, we summarized findings from 50 studies.

RESULTS: We found a high degree of evidence for higher exposures to metals and fine particulate matter (PM2.5), as well as a moderate degree of evidence for higher exposures to select organic compounds and hazardous air pollutants in immigrants compared to non-immigrants. Among immigrants, there was some evidence for disparities by country of origin and time since immigration. of the 50 studies, 43 were conducted in North America. There was a low degree of evidence for disparities in health effects from exposures in immigrants compared to non-immigrants.

CONCLUSIONS: The environmental health of immigrants remains an understudied area, especially outside of North America. While most identified studies explored potential exposure disparities, few investigated subsequent differences in health effects. Future research should investigate environmental health disparities of immigrants, especially outside North America, and the role of country of origin, time since immigration, and combined effects with socioeconomic status, race/ethnicity, education, and related characteristics.

KEYWORDS: Environmental Equity, Environmental Justice, Immigrant Health, Health Disparities, Systematic Review

P-0771 Urban environmental vulnerability in Rome: a spatial composite indicator

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BACKGROUND AND AIM: In recent decades, in order to respond to the growing need for systematic information on complex realities, there have been increasing attempts to create synthetic and complex indicators, in many areas of knowledge, capable to integrate a large amount of information. The aim of this paper is summed the environmental dimension in a synthetic index able to inform on the urban risk in one of the largest cities in Europe, Rome, Italy.

METHODS: Rome is characterized by a complex landscape with various anthropogenic and natural source of pollutions. To analyses different landscape components and tries to make a synthesis 1km2 grid cells were fixed as the reference unit for all spatial predictor indicators. Variables include several aims: Anthropic Industrial pressure; Airport; Land cover data; Road data defined as road density and traffic intensity and noise; Green area, ndvi and lai; hydrogeologic risk; environmental pollution; temperature; socioeconomic status. The Geographically Weighted Principal Component Analysis (GWPCA) method was used to construct a composite indicator by integrating all the dimensions.

RESULTS: The first four components are used to explain the most variation in the data structure. The total percentage of variance (PTV) explained ranges from 78% to 85% with an average value of 82%. The overall value of the urban vulnerability composite indicator evidence the spatial variability of the landscape. Sign with high level the major urbanization areas and the main industrial sites of the city, detects also a gradient between the most populated areas and the green areas.

CONCLUSIONS: A spatial principal component analysis will be performed to integrate several indicators. Synthesis has the advantage of avoiding the presentation and interpretation of a large number of elementary indicators in order to perform simpler and faster analyses, especially in comparative terms.

KEYWORDS: Geographically Weighted Principal Component Analysis, composite indicator

P-0773 Adverse childhood experiences intensify retinal microvascular and inflammatory responses to semi-controlled acute traffic related air pollution exposure

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BACKGROUND: Potential synergy between childhood exposure to psychosocial stressors and traffic-related air pollution exposure, two factors that commonly overlap in socially disadvantaged groups, could increase the risk of cardiovascular disease and lead to greater health disparity than what is currently attributed to these factors independently.
AIM: To test whether adverse childhood experiences (ACEs) potentiate the response of retinal microvasculature caliber and circulatory pro-inflammatory cytokines following a two-hour semi-controlled exposure to traffic related air pollution.
METHOD: In a crossover experiment, 57 participants were exposed to near-traffic ambient air and filtered ambient air, in separate occasions for two hours each time. Central retinal arteriolar/venular equivalent (CRAE/CRVE), blood pressure, pulse, and circulating interleukin (IL)-1β, IL-6, IL-8, and tumor necrosis factor-α (TNF-α) were measured pre-exposure and, again, 1 hour and 24 hours post-exposure. ACEs were documented using the ACE questionnaire. Based on ACE scores, participants were grouped into high (ACE ≥ 4) and low (ACE ≤ 1) ACE groups. Microvascular and inflammatory response to the exposure were analyzed across groups.

RESULTS: ACE scores significantly predicted CRAE, IL-6, IL-8, and pulse reactivity. Left eye CRAE narrowing was greater in the high- vs. low-ACE group at 1-hour and 24-hours post-exposure. 24-hours post-exposure, IL-8 and pulse were significantly higher in the high- vs. low-ACE group. IL-6 was significantly lower in the high- vs. low-ACE group at 1-hour post-exposure.
CONCLUSION: Our results support the hypothesis that ACEs may induce susceptibility to air pollution across the lifespan. These findings may thus help explain how health disparities develop and persist across the lifespan in persons who are most vulnerable to experiencing ACEs and poor air quality, leading to continued social disadvantage.

P-0774 Environmental justice and well waste disposal from oil and gas development in Pennsylvania

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BACKGROUND AND AIM: Community socioeconomic deprivation (CSD) may be related to increased oil and natural gas development (OGD). We tested for distributive environmental injustice by examining whether waste disposal from OGD occurred disproportionately in areas with higher CSD in the Pennsylvania Marcellus Shale.

METHODS: Data on well waste type, disposal method, and disposal location from 2005-2019 were downloaded from the Pennsylvania Geologic Survey's Exploration and Development Well Information Network database. Analyses were restricted to waste disposed in-state and analyses were performed at the county subdivision level (n=1848). A CSD Index was created using 2005-2009 American Community Survey data. Regression analyses tested for nonlinear relationships, controlled for population density and well drilling prior to 2005, accounted for spatial dependence, and were stratified by urban/rural status. Logistic and linear regression analyses evaluated associations between CSD Index and receipt of any versus no well waste and cumulative volume of well waste deposited.

RESULTS: Between 2005-2019, we identified 7.0 million tons of solid waste and 19 million barrels of liquid waste disposed of in Pennsylvania, with the highest volumes occurring in 2017-2019. We observed that a higher CSD Index was linearly associated with any well waste disposal (urban county subdivisions: OR= 1.13, 95% CI: 1.00, 1.28; rural county subdivisions: OR= 1.02, 95% CI: 0.97, 1.08) and with cumulative volume of waste disposed (urban: β = 5627 bbl-equivalent, 95% CI: -1957, 13211; rural: β = 6198 bbl-equivalent, 95% CI: 2007, 10390).

CONCLUSIONS: We observed distributive environmental injustice with respect to well waste disposal in county subdivisions across the Pennsylvania Marcellus Shale. These results point to potential downstream disparities from OGD; future studies should investigate mechanisms that explain these disparities.

KEYWORDS: Environmental Justice; Social Factors; Hydraulic Fracturing; Natural Gas

P-0775 Environmental Health and Justice Impacts of Steam Cracker Facilities

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BACKGROUND/AIM: Steam crackers (SCs) convert gas feedstocks into ethylene and propylene (the building blocks of plastics) at high temperatures and release toxic/carcinogenic chemicals and greenhouse gases (GHGs). The recent shale boom in the USA (US) has incentivized the expansion of SCs, but analyses of their potential environmental health and justice impacts are limited. We described SC operations, constructed a US SC emissions inventory, and evaluated socioeconomic characteristics of populations residing in proximity to SCs.

METHODS: We searched peer-reviewed and gray literature to describe SC operations. We constructed an inventory using publicly available datasets from industry, government, and non-governmental sources. We used descriptive statistics and data visualization to sumarize emissions from the US Environmental Protection Agency's (EPA's) Toxic Release Inventory (TRI) and EPA's GHG Reporting Program. We compared population characteristics from US Census block groups (BGs) less than versus greater than 5km of an SC, within counties with a SC.

RESULTS: SC operations include: (1) pyrolysis, (2) quenching, (3) compression, cooling, and drying, and (4) fractionation. Major toxic emission sources include furnaces, fugitive emissions, and flaring. We identified 32 SC facilities across five states, with most in the Gulf Coast of Texas and Louisiana. TRI chemicals with the highest self-reported cumulative air-emission volumes from 1987-2019 were: ethylene, propylene, hydrochloric acid, benzene, n-hexane, 1,3-butadiene, ammonia, toluene, vinyl acetate, and methanol. SC facilities emitted >650 million metric tons (carbon dioxide equivalents) of GHGs in total from 2010-2019. We found that 752,465 people live in census BGs within 5km of an SC. BGs closer to SCs had higher proportions of residents who were Black, had non-professional occupations, lower educational attainment, and lower median household income.
CONCLUSION: SC operations have the potential for adverse human health impacts and environmental inequities, underscoring the need for additional research on hazards of petrochemical infrastructure.

KEYWORDS: plastics, petroleum

P-0776 Geospatial assessment of racial/ethnic composition, social vulnerability, and lead service lines in New York City

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BACKGROUND/AIM: The state of New York expects to receive $115 million in 2022 from the US Infrastructure Investment and Jobs Act to replace lead water service lines. Our objective was to determine the number and proportion of Potential Lead water service lines across New York City (NYC), and the association between racial/ethnic composition, housing vulnerability, and child lead exposure vulnerability with service line type (Potential Lead, Unknown) at the census tract level for N= 2,083 NYC tracts.

METHODS: We used conditional autoregressive Bayesian Poisson models to assess the relative risk (median posterior estimates, and 95% credible interval, CrI) of service line type per 20% higher proportion of residents of a given racial/ethnic group, and per higher housing vulnerability and child lead exposure vulnerability index scores corresponding to the interquartile range. We also evaluated flexible natural cubic spline models.

RESULTS: Out of 854,672 residential service line records, 136,891 (16.0%) were Potential Lead and 227,443 (26.6%) were Unknown. In fully adjusted models, higher proportions of Hispanic/Latino residents and higher child lead exposure vulnerability were associated with Potential Lead service lines in flexible spline models and linear models (RR 1.15, 95% CrI 1.11, 1.21, and RR 1.11, 95% CrI 1.02, 1.20, respectively). Associations were modified by borough. Potential Lead service lines were associated with higher proportions of non-Hispanic White and non-Hispanic Asian residents in the Bronx and Manhattan, and with higher proportions of non-Hispanic Black residents in Queens.

CONCLUSIONS: NYC has a high number of Potential Lead and Unknown service lines. Communities with a high proportion of Hispanic/Latino residents and those with children who are already highly vulnerable to lead exposures from numerous sources are disproportionately impacted by Potential Lead service lines. These findings should inform equitable service line replacement efforts across NY state and within NYC.

KEYWORDS: lead; water; environmental justice

P-0778 Neighborhood Socioeconomic Context and Autism Spectrum Disorder

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BACKGROUND AND AIM: Neighborhood deprivation and autism spectrum disorder (ASD) risk associations are inconsistent across countries with different health systems. We examined associations between neighborhood SES during pregnancy and ASD in a U.S. mother-child cohort with good health care access.

METHODS: This retrospective cohort study included 318,826 children born in Kaiser Permanente Southern California (KPSC) hospitals in 2001-2014. Children were followed through electronic medical records until ASD diagnosis, non-KPSC membership, death, or December 31, 2019, whichever came first. Birth addresses were matched to U.S. Census tracts. A neighborhood deprivation index was developed using principal component analysis of seven census tract-level deprivation indicators (%poverty, %unemployment, %public assistance, %female-headed households, %less than high school, %bachelor and post, %professional occupation) obtained from the 2005-2009 and 2010-2014 American Community Survey and 2000 census. Hazard ratios (HRs) of ASD associated with neighborhood deprivation were scaled to interquartile range (IQR) and estimated using Cox regression models adjusted for birth year, child sex, maternal age, parity, maternal history of comorbidity, maternal race/ethnicity and education. Effect modification by maternal race, education, and child sex was assessed.

RESULTS: During follow-up 6,357 children (1.99%) had ASD diagnosis over a median of 9.0 follow-up years. Pregnancy residence in more deprived neighborhoods was associated with child ASD risk [HR=1.07 (95% confidence interval 1.02, 1.11) per deprivation IQR increase]. Maternal race interacted with neighborhood deprivation ($p<0.05$); deprivation-associated ASD risk was only observed among the White population [HR = 1.24 (1.11, 1.37)]. Results were consistent in alternative specifications of neighborhood deprivation.

CONCLUSIONS: Children living in more deprived neighborhoods had a higher risk of ASD among a population with uniform health care access. This association was mainly observed in White populations, suggesting that in other races factors such as systemic racism may overwhelm effects of ASD-associated neighborhood deprivation.

KEYWORDS: Neighborhood deprivation, Autism

P-0779 Changes in socioeconomic and demographic disparities for traffic-related air pollution exposure during pregnancy over a 20-year period in Texas

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BACKGROUND AND AIM: Environmental justice issues surround population exposure to ambient air pollution; however, few studies have specifically examined traffic air pollution (a pollutant with localized concentration patterns) and pregnancy exposures (maternal-infant dyads may be particularly susceptible to air pollution effects). How socioeconomic and demographic disparities may change over time is also unclear but could have important policy implications.

METHODS: We identified ~ 6.9 million pregnant mothers in Texas from 1996 to 2016 using individual-level vital statistics records. We estimated traffic air pollution exposures using full residential addresses and calculated the total vehicle miles travelled (VMT) within 300 m, assigned nitrogen dioxide (NO2) concentrations from a spatial-temporal land use regression model (an indicator of vehicle tailpipe emissions), and linked the National Air Toxic Agency cancer risk index from vehicles emissions to maternal addresses. From census tract data, we examined median household income. We quantified annual absolute and relative mean percent differences in traffic air pollution across socio-demographic indicators of maternal race and ethnicity, educational attainment, and maternal birthplace.

RESULTS: We observed marked differences in traffic air pollution exposures by all socio-demographic variables examined. Overall, the strongest disparities were seen among non-White and foreign-born pregnancies. While the absolute level of disparity shrank from 1996 to 2016 (e.g., in 1996 Black individuals were exposed to NO2 levels 1.8 ppb higher than white individuals, while in 2016 NO2 levels were 1.5 ppb higher among Black compared to white individuals), the relative level of disparity continued to increase. Within census tracts (i.e., neighborhoods), we also observed sizeable disparities among socioeconomic and demographic groups.
CONCLUSION: Despite considerable reductions in traffic-related air pollution, the magnitude of disparity has increased when we compared groups with lower socioeconomic positioning to their higher socioeconomic positioned counterparts.

KEYWORDS: traffic-related air pollution, pregnancy, environmental justice

P-0780 Associations between long-term exposure to air pollution and cause-specific mortality in River Sacco Valley area

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BACKGROUND AND AIM: The River Sacco Valley is an industrial contaminated site in a central area of Italy. It is characterized by environmental pollution and socioeconomic deprivation. The study aim is to evaluate the chronic effects on cause-specific mortality of air pollution and socioeconomic deprivation (SEP) in an administrative cohort of residents in an industrial polluted site.

METHODS: Subjects who were resident in River Sacco Valley between 2008 and 2018 were enrolled by linking administrative data. We collected information about age, sex, residential address and cause of death. Exposure to PM10, PM2.5, NO2, SO2, Benzene and O3 were assessed by FARM models for each residential address, while socioeconomic deprivation has been derived by an area-level indicator. Cox proportional hazard models adjusted by age (as time-scale), sex and city of residence were used to evaluate the effects of exposure to air pollutants and SEP to natural, cardiovascular, respiratory and malignancies mortality.

RESULTS: 182578 subjects were enrolled in the cohort, among which 30% were aged 50+ years and 35% had high SEP. We observed 9205, 4019, 573, 2790 non-accidental, cardiovascular, respiratory and malignant cancer deaths, respectively. Each pollutant had average levels above the WHO guidelines standards. The results of main analysis showed positive hazard ratios (HR) per IQR increases up to 1.084 (95% confidence intervals: 0.99, 1.18) and 1.136 (0.99, 1.30) for PM10 and non-accidental and cardiovascular mortality, respectively. Furthermore, high deprivation was associated positively with each outcome. In particular, we registered HRs equals to 1.064 (0.98, 1.16) and 1.101 (0.97, 1.25) for non-accidental and cardiovascular mortality in high vs low SEP category.

CONCLUSIONS: Living in a polluted site worse the health status for several causes. We observe that high levels of air pollutants and socioeconomic deprivation are linked to excess of risk of cause-specific mortality in the River Sacco Valley area.

P-0781 Development of report-back materials of air pollution exposure results to participants in the HAPIN trial in Guatemala and Rwanda

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BACKGROUND: Interpretation of individual exposure information for reporting to research participants is an important aspect of the research process that can empower participants, increase community engagement with scientific research, and better tailor future community-engaged research. In the multi-country Household Air Pollution Randomized Intervention Network (HAPIN) trial, a randomized controlled trial among 3200 pregnant women that assessed the effect of a liquefied petroleum gas (LPG) stove and fuel intervention, we engaged a subset of study participants in Guatemala and Rwanda in the development of context-appropriate materials. The purpose of this study was to: 1) report and explain air pollution exposure levels to: 2) present strategies to increase awareness of the health effects of air pollution; and 3) discuss strategies to reduce personal exposure to air pollution.

METHODS: Local project staff in Guatemala and Rwanda were trained to conduct qualitative research. Individual interviews and participatory observations in participant homes (n=42 in Guatemala; n=20 in Rwanda) were followed by working groups to assess interpretability of different graphical displays of exposure data. Finally, focus groups assisted in iteration of contextually relevant visual aids illustrating exposure results, health impacts, and strategies to reduce exposures.

RESULTS: After iterations, visual materials depicting community and personal exposure to fine particulate matter (PM2.5) using a simple “thermometer-style” graphic were chosen, including a marker of community-level impacts of the liquefied petroleum gas (LPG) stove intervention. Educational material about the health impacts of air pollution and contextually feasible and available methods to reduce exposure were presented. Capacity was built among field teams to conduct qualitative research.

CONCLUSIONS: Development of materials to report back scientific results to study participants in accurate and understandable ways is an ethical obligation to communities participating in complex research and may yield important benefits to researchers and participating community alike.

KEYWORDS: report-back; environmental health literacy; HAPIN trial

P-0782 Environmental justice in Colorado: variation in proximity to oil and gas wells across race-ethnicity and income groups

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BACKGROUND AND AIM: Oil and natural gas (O&G) extraction has moved closer to residential areas in Colorado, where population has also boomed. Proximity to O&G wells is associated with risks to health and quality of life. Evidence on whether socially disadvantaged groups – particularly low-income residents and people of color – tend to live closer to wells is mixed. We use a birth registry dataset to estimate the odds of living within 2 miles of O&G wells across income and racial groups and across counties in Colorado, USA.

METHODS: We combined large-N geospatial O&G datasets from the Colorado Oil and Gas Information System with data from the Colorado State Birth Registry (2007-2017) on birthing people's location, race-ethnicity, and low-income status (eligible for Medicaid). We used logistic regressions to estimate the relationship between demographics and proximity to O&G wells for a pooled sample and for county-specific samples.

RESULTS: for the pooled sample, Hispanic birthing people faced higher odds of living within 2 miles of an O&G well compared to White birthing people (OR: 1.15 [95%CI: 1.14-1.17]), while Medicaid eligibility was negatively associated with proximity to wells (OR: 0.86 [95%CI: 0.85-0.87]). However, pooled data mask significant variation across counties. In the county responsible for nearly 90% of Colorado's oil production (Weld), non-White and low-income groups were both more likely to live near wells. However, in the most populous O&G producing county (Adams), the opposite patterns were observed.

CONCLUSIONS: Patterns of proximity to O&G development vary with race-ethnicity and income in ways that differ substantially across counties. These patterns are linked to the timing and drivers of O&G development and residential growth across space, as well as policies and regulations. Investigating these patterns is key to assessing potential environmental injustices and their remedies.

KEYWORDS: Environmental Justice, Oil and Gas, Environmental Epidemiology, Socio-Economic Factors

P-0783 Trends in air pollution emissions in the contiguous USA from 1970 to 2010: an environmental justice analysis

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BACKGROUND: Air pollution emissions have substantially decreased in the US since the 1970 Clean Air Act. We examined racial and economic disparities in emissions reductions from specific pollution sources.

METHODS: We evaluated racial/ethnic and economic disparities in emissions reductions from six pollution sectors [industry (SO2), energy (SO2), agriculture (NH3), commercial (NOx), residential (organic carbon), and on-road transport (NOx)] across the contiguous US from 1970–2010. We used the CEDGBD-MAP emissions inventory to estimate the average relative emissions change from one decennial to the following and its link to demographics (percent White, Black, Asian, American Indian Hispanic, family income, property value, poverty, and unemployment) at the county level. We constructed hierarchical models with the relative emissions change as the dependent variable and demographics as independent variables. We modeled each pollutant and demographic variable separately, adjusting for potential confounding, and tested for nonlinearities.

RESULTS: On average, national emissions decreased from 1970 to 2010 except in the agriculture and the residential sectors. The largest reductions across the study period were in industry and energy SO2 emissions (-66% and -89%, respectively) and on-road transport NOx (-59%). Although average emissions decreased nationally, trends varied across counties. We found racial disparities in industry, energy, and agriculture emissions. An increase in % American Indian, Hispanic, or Asian was associated with increases in industry SO2, agriculture NH3, and energy NOx. We also found economic disparities: an increase in median family income was associated with decreases in emissions from all sectors except agriculture, and increases in unemployment or poverty were associated with increases in industry and energy SO2 emissions.

CONCLUSION: Although air pollution emissions, on average, decreased since 1970, the trends in emissions varied across counties. On average, low-income and communities of color have experienced smaller improvements or a relative increase in emissions despite the nationwide downward trends.

P-0787 Is it you or your neighborhood: what matters more when it comes to air pollution exposure?

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BACKGROUND AND AIM: Studies have examined individual and neighborhood social factors and air pollution independently; few have investigated which is more strongly associated with air pollution exposure. We leverage individual harmonized data from large observational cohorts to cross-sectionally interrogate this question.

METHODS: Data came from three US cohorts at time of enrollment (1989-2007): Cardiovascular Health Study, Reasons for Geographic and Racial Differences in Stroke, and Multi-Ethnic Study of Atherosclerosis (ntotal = 39,860). Individual exposures include race and ethnicity and income (ISES). Neighborhood exposures include SES (NSES) and divergence, a spatial multi-race measure of racial residential segregation (RRs), both derived from 1990-2010 Census data and linked to participants' residence. Annual averaged fine particulate matter (PM2.5) and nitrogen dioxide (NO2) were estimated from spatiotemporal models. Random intercept multilevel models estimated and compared associations between z-scores of individual and neighborhood social factors and unit changes in air pollution concentrations, adjusting for individual sex, age, cohort, and urbanicity.

RESULTS: The mean (SD) air pollution exposure was 12.9 µg/m3 (3.55) for PM2.5 and 13.3 ppb (8.72) for NO2. We observed lower air pollution exposure among those with higher ISES (βISES-PM2.5= -0.05, 95% CI: -0.07, -0.03) and higher exposure among racial and ethnic minority participants. In fully adjusted models including individual and neighborhood-level variables, lower NSES and higher RRS were associated with higher air pollution (βNSES-PM2.5= -0.56, 95% CI: -0.61, -0.51; βRRS-PM2.5= 0.98, 95% CI: 0.83, 1.13), but ISES-PM2.5 and Black race-PM2.5 associations become null (βISES-PM2.5= -0.00, 95% CI: -0.02, 0.02; βBlack race-PM2.5= 0.03, 95% CI: -0.03, 0.9).
CONCLUSION: Findings suggest the neighborhood social environment may be more correlated with air pollution burden than individual-level factors. Careful consideration should be made when considering how to analytically account for social factors in air pollution-health associations.

KEYWORDS: air pollution, social environment, socioeconomic status, racial residential segregation

P-0788 Differential changes in air pollution exposure by racial residential segregation in the USA: a longitudinal multi-cohort study

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BACKGROUND AND AIM: While levels of ambient air pollution have declined over time in the USA, studies have found persistent exposure disparities by race and ethnicity. Racial residential segregation may contribute to differential reductions in air pollution and perpetuate related health inequities.

METHODS: We analyzed harmonized data from three longitudinal cohort studies, spanning the years 1990-2017: Cardiovascular Health Study (CHS), Multi-Ethnic Study of Atherosclerosis (MESA), and Reasons for Geographic and Racial Differences in Stroke (REGARDS) (N=466,513 person-years). Annual average NO_2 and $PM_{2.5}$ exposures for residential addresses were estimated from national spatio-temporal models. Neighborhood segregation indices of multi-race divergence, Black-White dissimilarity, and single-race isolation were created from Census tract-level data, with linear interpolation for intercensal years. We evaluated percent changes in NO_2 and $PM_{2.5}$ over time by segregation z-score and race using log-linear repeated measures models adjusted for age, sex, individual and neighborhood socioeconomic status, urbanicity, and cohort.

RESULTS: From 1990 to 2017, mean (SD) NO_2 exposure decreased by 62.2% for Black participants [from 23.3 (9.6) to 8.8 (4.8) ppb] and 61.8% for White participants [17.0 (8.0) to 6.5 (4.1) ppb]; since 1999, $PM_{2.5}$ respectively declined by 54.5% [16.5 (2.5) to 7.5 (1.0) µg/m3] and 54.4% [14.9 (2.8) to 6.8 (1.2) µg/m3]. Among Black participants, exposure levels were consistently higher in more segregated neighborhoods, where the rate of decline lagged: each standard deviation increase in divergence was associated with 0.19% (95% CI: 0.14-0.24) and 0.14% (0.12-0.16) slower average annual declines in NO_2 and $PM_{2.5}$, respectively, with similar trends for dissimilarity and isolation.
CONCLUSIONS: Despite improvements in air quality, Black individuals continue to experience higher levels of air pollution than White individuals, particularly in more segregated neighborhoods. These trends may contribute to enduring racial inequities in health outcomes, warranting further research and action to improve environmental injustice.

KEYWORDS:
Air pollution, segregation

P-0789 Estimating the Effect of Congestion Mitigation on Traffic Air Pollution and Local Housing Prices

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BACKGROUND AND AIM: Billions of dollars are spent on roadway congestion mitigation projects annually, however there's limited evidence on the air quality consequences of these. Additionally, changes in environmental quality may result in local neighborhood change due to changes in housing prices. We examined the influence of congestion projects on local air quality and housing prices.

METHODS: We spatially locate congestion projects across Texas from 2005-2020 (n=1,483). We compiled daily EPA air pollution monitor data and residential housing transactions, which we linked to projects within 300, 500, and 1,000m (n=1,285,646 residences, 144 monitors). We rescale pollutants by their interquartile range (IQR): 19 parts/billion for NO2 and 6 micrograms/m3 for PM2.5. We then implemented a spatial differences-in-differences design to explore the associations among congestion projects, outdoor air pollution, and housing costs.

RESULTS: Our preliminary results show projects have a limited, negative impact on air quality. During project construction, both PM2.5 (0.16 IQR increase, 95% CI: [0.086, 0.239]) and NO2 (0.13 IQR increase, 95% CI: [0.046, 0.212]) increase within 300m of the project. After project completion, PM2.5 remained elevated (0.105 IQR increase, 95% CI: [0.019, 0.191] while NO2 returned to pre-project levels (0.041 IQR increase, 95% CI: [-0.076, 0.159]). Housing prices increased modestly both during (1.11%, 95% CI: [-0.09%, 2.30%] and after a project (1.18%, 95% CI: [-0.13%, 2.29%]), though the confidence intervals are somewhat wide.

CONCLUSIONS: We present preliminary evidence that congestion projects lower local air quality during construction and after project completion. This highlights the trade-off between traffic congestion and volume. This pollution effect is either not apparent to homebuyers or is countered by other neighborhood improvements, as housing prices instead increase with congestion mitigation. This provides suggestive evidence that congestion mitigation results in neighborhood change through more channels than just air quality.

KEYWORDS: traffic-related air pollution, hedonics, environmental justice

P-0790 A ranking of environmental indicators among historically redlined neighborhoods in Detroit, Michigan, USA

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BACKGROUND AND AIM: The Home Owners' Loan Corporation (HOLC) in the 1930s drew maps of cities across the US that labeled neighborhoods by mortgage risk. This historical practice, commonly called "redlining", labeled neighborhoods deemed "hazardous" with the color red. This policy denied mortgage loans to minority persons seeking homes in White/affluent neighborhoods, segregating these areas by race and ethnicity. This legacy of de jure segregation shaped neighborhoods today and influenced their environmental exposures, a form of environmental racism. The aim of this study was to identify the most pervasive exposures associated with redlining.

METHODS: The Detroit shapefile defined by the HOLC and digitized by the Mapping Inequality project overlaid onto the Environmental Protection Agency's EJSCREEN and the Department of Transportation National Transportation Noise Map was used to determine modern environmental exposures and transportation noise within historical boundaries. Differences in demographic and environmental hazards between redlined (red or D grade) and non-redlined neighborhoods (grades A, B, and C) were assessed using hypothesis testing and a boosted classification tree algorithm.

RESULTS: Historically redlined Detroit neighborhoods experience significantly higher environmental hazards than non-redlined neighborhoods from diesel particulate matter (PM), traffic volumes, hazardous road noise, cancer risk from air pollution, and are closer to hazardous waste and Risk Management Plan (RMP) sites. With all factors taken together, boosted regression trees indicated the most pervasive environmental exposures among redlined neighborhoods in Detroit are the proximity to RMP sites, hazardous road noise, diesel PM, and cancer risk from air pollution.

CONCLUSIONS: Institutional segregation via historical redlining is associated with environmental injustices in Detroit today. Policies targeting transportation-related air and noise pollution, particularly from sources of diesel exhaust, in redlined neighborhoods may ameliorate some of the disproportionate impacts of historical redlining, providing a proof-of-concept to apply to other redlined cities.

KEYWORDS: environmental justice; redlining; EJSCREEN; noise, Detroit

P-0791 An association between historical redlining and road, rail, and air transportation noise today among eleven cities in Michigan, USA

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BACKGROUND AND AIM: Maps of >200 US cities, including 11 in Michigan, were drawn by the Home Owners' Loan Corporation (HOLC) in the 1930s to classify neighborhoods by mortgage risk. The HOLC used descriptions, grades, and colors to define neighborhoods as "best-A-green", "still desirable-B-blue", "definitely declining-C-yellow", and "hazardous-D-red". This practice of "redlining" systematically segregated neighborhoods by denying mortgage loans to minority populations in predominately-white neighborhoods. These policies continue to shape neighborhoods today; however, to our knowledge, no studies have assessed its impact on transportation noise. The objective was to assess how transportation noise (air, road, and rail) varies by HOLC grade within and across redlined cities in Michigan.

METHODS: The US DOT National Transportation Noise Map and the 1930s HOLC-maps of 11 Michigan cities, digitized by the Mapping Inequality Project, were used to access how various metrics (average, 90th percentile, and maximum noise by transportation source and cumulatively) varied by HOLC grade. To understand if redlined neighborhoods experience a higher proportion of hazardous noise, we estimated the proportion of hazardous transportation-related noise (24-hr Leq ≥70 dBA) for each neighborhood. T-tests between redlined and non-redlined neighborhoods and mixed effects linear regression with city as a random intercept were performed to assess the relationship across all redlined Michigan cities for each noise metric.

RESULTS: Redlined neighborhoods in Michigan experience more high noise exposure more often than A-grade neighborhoods. Average difference in maximum noise levels between redlined and non-redlined neighborhoods ranged from 6.5 to 12.4 dBA depending on the transportation source. Redlined neighborhoods have more than twice the prevalence of hazardous transportation noise (24-hr Leq ≥70 dBA) when considering all sources.

CONCLUSION: Noise exposure should be considered in environmental justice research, and dismantling environmental racism is critical to alleviating excess burden on minority communities.

KEYWORDS: transportation noise, environmental justice, DOT NTNM, redlining, Michigan

P-0792 Translating scientific evidence into policy and practice: the European Urban Health Cluster

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BACKGROUND AND AIM: Over the past decades the impacts of urbanization on public health have been investigated and analyzed extensively. It is now the time to increase visibility for urban health research and bring stronger contribution to policies such as the EU Urban Agenda, translate scientific evidence into policy and practice, while identifying mechanisms for action locally and careful attention to closing the gaps in the societal distribution of health and wellbeing gains.

METHODS: In this direction, six European projects (eMOTIONAL Cities, ENLIGHTENme, HEART, RECETAS, URBANOME and WELLBASED), resulting from the Horizon 2020 call "Innovative actions for improving urban health and wellbeing -addressing environment, climate and socioeconomic factors", have established the European "Urban Health Cluster'' (UHC). The cluster will facilitate international cooperation with other relevant ongoing and potential future initiatives on urban issues and health. It will deliver more robust evidence for policy making on improved urban health in the EU, will enhance population health, physical and mental, while reducing health inequalities.

RESULTS: The UHC comprises six working groups with clear targets and objectives, where more than one hundred research institutions are represented, to draw and build upon individual project results and working closely with an International Advisory Board to connect the UHC to significant urban initiatives, including the European Urban Agenda. The Cluster launch event has been organized on May 20th 2021 and brought together in an open event representatives from the European Commission, the six projects and representatives of European initiatives and Networks, international pioneers in the field of urban health and political decision makers.

CONCLUSIONS: The Urban Health Cluster will operate for four years to improve and safeguard health and wellbeing of citizens, leaving none behind and to promote an alliance between cities and different actors where citizens will be an important part to support decision making.

P-0793 Development of the Navigation Guide Evidence-to-Decision Framework for Environmental Health

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BACKGROUND: Globally there are hundreds of thousands of registered and unknown chemicals in production. There is sufficient evidence that industrial chemicals can increase the risk of adverse health outcomes across the lifecourse and these effects are amplified in historically marginalized communities that experience systemic racism and injustice. As such, there is a need for timely and effective decisions and policies on interventions to prevent and mitigate the exposures and health effects attributable to harmful chemicals, while ensuring health equity.

METHODS: To meet this need, we developed a transparent framework to guide decision making for environmental health interventions. We convened a multi-disciplinary Steering Committee to evaluate current evidence-to-decision frameworks in medicine and public health. Building from a scoping review of this literature, we proposed the Navigation Guide Evidence-to-Decision Framework for Environmental Health. We then assembled a diverse group of researchers, government and non-profit practitioners, and community-based leaders working on environmental justice to provide feedback.

RESULTS: This new framework considered several criteria previously published in the World Health Organization's INTEGRATE framework. The framework includes three key criteria for decision making: environmental justice, sociopolitical climate, and maximizing benefits and reducing harms for communities that are affected by harmful chemical exposures. for each of these criteria, we proposed potential signaling questions for data gathering. In addition, three foundations are relevant to all criteria: human rights, quality and strength of evidence, and essentiality.

CONCLUSIONS: This proposed framework can improve the basis of decision making by incorporating key considerations, including health equity and social justice, when formulating recommendations, in addition to scientific evidence on harmful effects. This will facilitate effective and timely decisions that reduce harmful exposures and protect public health, particularly for the most vulnerable populations. Piloting of the framework at local and national levels of decisions will further refine its utility in real-world settings.

P-0795 Historical redlining and change in ambient air pollution in the USA, 2000-2016

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BACKGROUND: Studies have identified drivers of racial inequities, of which most are attributable to structural racism. In the 1930s, the Home Owners' Loan Corporation (HOLC) developed residential security maps classifying neighborhoods that were "best" (outlined in green) to "hazardous" (outlined in red, hence the term "redlining") for real estate investments, overtly basing the grading on the neighborhood's racial makeup. Though redlining became illegal in 1968, the structures it created remain largely intact. Through the siting of highways and emission sources proximate to areas made low-income through historical investment policies, redlined neighborhoods experience increased exposure to environmental hazards, such as poorer air quality, increased intra-urban heat, and a lack of greenspace. Though air pollution has improved in the past several decades, the rate of change is differential by race and class. However, the extent to which housing policies may have perpetuated environmental disparities as a consequence of systematic disinvestment has been limitedly explored.
Aim: We are currently examining the rate of change in air pollutants PM2.5 and NO2 in 202 U.S. cities over 16 years by historical redlining.

METHODS: Nationwide annual mean concentrations of the census tract level PM2.5 and NO2 were predicted from 2000 to 2016 from three machine learning models that incorporated satellite data, meteorological variables, land-use variables, elevation, and chemical transport model predictions. Historical redlining was defined at the census tract level according to the graded investment risk assigned by the HOLC. I will use a linear mixed model to analyze the association between redlining on the change in air pollution over 16 years.

RESULTS: Results from this analysis are forthcoming and will be presented in September.
CONCLUSION: This research will advance our understanding of how environmental hazards may result from historical practices that fail to center underserved communities in adapting environmental amenities.

KEYWORDS: environmental justice, air pollution

THEMATIC 12: Exposome

P-0798 Associations of perfluoroalkyl substances (PFAS) with non-targeted metabolomics across two independent cohorts of elderly individuals

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BACKGROUND AND AIM: Perfluoroalkyl substances (PFAS) have been linked to adverse health effects including increased blood cholesterol levels and hepatic toxicity. Alterations in metabolism and oxidative stress are among the hypothesized mechanisms by which PFAS exposure may exert effects; however, studies of associations between PFAS and metabolome are scarce. The main aim of this study was to assess associations of PFAS exposure and metabolome by using non-targeted metabolomics in two independent cohorts of elderly individuals.

METHODS: In two population-based cohorts of elderly individuals from Sweden and California (the Prospective Investigation of the Vasculature in Uppsala Seniors [PIVUS, n = 901, median age 70 years]; and the California Teacher Study [CTS, n = 325, median age 69 years]), plasma/serum PFAS concentrations were determined using isotope-dilution ultra-pressure liquid chromatography (UHPLC) coupled to tandem mass spectrometry. Non-targeted metabolomics was performed using UHPLC high-resolution mass spectrometry (QTOFMS). Associations of PFAS and metabolomics signatures was assessed using a discovery-validation approach with multivariable linear regression.

RESULTS: In the discovery cohort 89 annotated metabolites out of 204 could be associated with levels of five PFAS following adjustment for age, sex, and correction for multiple testing. Eleven associations could then be replicated in the CTS. The metabolites being replicated in the CTS were primarily lipid related metabolites such as lysophosphatidylcholine, phosphatidylcholine, sphingomyelin as well as amino acids such as betaine.

CONCLUSIONS: Using a non-targeted metabolomics discovery-validation approach, we the previously reported associations between PFAS and lipid related metabolites and identified and replicated novel associations. Our results encourage additional studies investigating the underlying mechanisms of our findings.

KEYWORDS: PFAS, PFOS, PFOA, Metabolomics, Lipid metabolism

P-0799 Benchmark dose modelling of blood lead levels and thyroid hormones – Study in Serbian population

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BACKGROUND AND AIM: There is limited understanding of the effects of lead (Pb) on endocrine health, specifically thyroid function. Our study aimed to identify the relationship between blood Pb levels (BLLs) of the Serbian population and thyroid hormone levels and to determine a benchmark dose (BMD).

METHODS: The study included 435 participants, 218 females, and 217 males. BLLs and levels of free triiodothyronine (fT3), free thyroxine (fT4), and thyroid-stimulating hormone (TSH) in were measured. Multivariate linear regression analyses of BLLs (Pb µg/dL) and levels of hormones were performed. Further, BMD-response modelling for tested endpoints using PROAST70.1 software was performed, where hormone levels were coded as quantal data (0–in normal range and 1–out of normal range).

RESULTS: Male BLLs (β = -0.01, P = 0.0281) and overall BLLs (β = -0.0041, P = 0.0143) were negatively correlated with fT4 levels, but no correlation was found in the female group. Dose-response modelling showed a positive incidence of abnormal hormone levels. for TSH, related BMDLs were 0.702 µg/dL for males and 0.686 µg/dL for females. In males, derived BMDL was 0.268 µg/dL and in females, 1.8 µg/dL for fT3. In case of fT4, derived BMDLs were 0.736 µg/dL and 0.478 µg/dL in males and females, respectively.

CONCLUSIONS: The presented results suggest that Pb acts as a thyroid hormone disruptor in males. BMD modelling has shown a clear dose-response relationship with a positive trend between BLLs and levels of TSH, fT3 and fT4. The observed BMDLs were lower than median BLLs. In males, the lowest BMD was derived for fT3 (0.268 µg/dL), while in females, the lowest BMD was for fT4 (0.478 µg/dL), providing new insight into assessing human health risk assessment of low Pb exposure, especially with regards to its endocrine-disrupting effects. (PROMIS DecodExpo project: 6066532)

KEYWORDS: BLL, BMD, Human data, Endocrine disruptor

P-0801 Characterizing the heat stress exposome to assess acute kidney injury in New York City runners

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BACKGROUND AND AIM: Heat stress occurs when the body's ability to regulate internal temperature begins to fail, which may result from intense physical exertion (exercise-induced or occupational), shifts in environmental conditions, (i.e., temperature and humidity) or a combination of these factors. Chronic and repeated acute heat stress exposures can result in damage to the kidneys and other systems further priming an aberrant sequelae of subsequent acute kidney injury (AKI) and chronic disease. Yet, population-based methods to assess heat stress exposure (including internal body temperature, sweat rate, heart rate variability, minute ventilation, etc) and subsequent kidney function changes in real-time are limited.

METHODS: Here, we will assess acute recurrent heat stress exposures in a cohort of long-distance runners to better understand how metabolic heat and ambient temperature impact kidney function. During the summer of 2022, 24 athletes (12 men, 12 women) will be solicited to run 21km three times, with 7 days between each run. Before each run, we will provide several environmental sensors on the athlete to capture individual-level exposures of ambient temperature, humidity, internal core temperature, volume loss, sodium loss, minute ventilation, heart rate variability and air pollution. Additionally, after each run, we will collect plasma and urine to analyze traditional and novel renal biomarkers.

RESULTS: Using a within-host state-space model to evaluate individual exposure profiles, we will develop a heat stress exposure index to assess changes in subclinical renal biomarkers. We will evaluate several environmental exposures to understand the association of ambient temperature, humidity, internal core temperature, volume loss, sodium loss, minute ventilation, heart rate variability and air pollution of these exposures and the athlete's kidney function.
CONCLUSIONS: Our methodologies developed herein for heat stress assessment will be broadly applicable to future environmental and occupational exposure assessment scenarios.

P-0802 Comparison of untargeted chemical profiles of dried blood spots, dried blood microsamplers, and plasma

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BACKGROUND AND AIM: Capillary blood collection is minimally invasive, easy to perform, and when dried, is more stable at higher temperatures than liquid blood, making dried capillary blood microsamplers a promising alternative to venous blood for epidemiological research. To evaluate the utility of dried blood samplers for use in exposome studies, comparisons of metabolite profiles between capillary dried blood and conventional plasma collection are needed.

METHODS: Commercially purchased whole blood from a single adult smoker was used for experiments. Dried blood spots were generated by pipetting 50 µL for 5-mm punches, 10 µL VAMS were generated from the whole blood following manufacturer's instructions, and 10 µL plasma aliquots were generated by centrifugation. Samples were stored overnight at -80C. Triplicate samples were randomized and analyzed for each device using Liquid Chromatography-High Resolution Mass Spectrometry (LC-HRMS). Metabolites were identified using Agilent Profinder software. Metabolite levels (abundance) were compared for each sample type using a one-way ANOVA and fold change (FC).

RESULTS: We identified 305 metabolites from LC-HRMS analysis. Among those compounds, 222 metabolites show significant differences in abundance among Guthrie, VAMS, and plasma samples (p value<0.05). 42 compounds have higher abundance (>3 FC) in Guthrie or VAMS than plasma samples. Among these compounds, carboxylic acids and derivatives (7) and organooxygen compounds (7) are the major compound classes, but also included two metabolites of alcohol exposure. Three compounds have a higher abundance (>3 FC) in plasma than Guthrie or VAMS.

CONCLUSIONS: Several metabolites have a higher abundance in Guthrie or VAMS than in plasma samples. However, most compounds showed a comparable fold change among these three sample types. Depending on the group of metabolites or exogenous compounds of interest, microsampling devices are an alternative to conventional plasma collection for exposome studies.

KEYWORDS: Untargeted chemical analysis, dried blood spots, microsamplers, exposome.

P-0803 Urban exposome and stroke incidence across Europe

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BACKGROUND AND AIM: Multiple environmental factors of urban environments may influence cardiovascular health, however their complex interplay has scarcely been studied. Within the EXPANSE project, we evaluated the association between multiple urban exposures and stroke incidence across Europe.

METHODS: We will conduct a meta-analysis including 3 population-based cohorts (from Sweden, Netherlands, Germany) and 6 administrative cohorts (from Greece, Rome, Catalonia, Switzerland, Sweden, Netherlands). Participants were followed-up until incident stroke, death, migration, disappearance or end of study period. We estimated multiple long-term exposures at residential addresses from different domains: ambient air pollution (nitrogen dioxide, particulate matter <2.5 m, black carbon, ozone), built environment (green and blue spaces, impervious surface) and meteorology (mean and standard deviation temperatures during summer and winter). Associations between environmental exposures and incident stroke were estimated in single and multiple-exposure Cox proportional hazard models, and Principal Component Analyses (PCA) derived prototypes for exposures domain (i.e built environment).

RESULTS: Preliminary results from Sweden (N=19,247), from single and multiple exposures, indicate associations between increased levels of NDVI and reduced incident stroke (hazard ratio (HR) per 0.1 units = 0.92, 95%CI 0.85; 0.99). The first component of each domain in the PCA explained more than 60% of the variability. The built environment domain (capturing high levels of green spaces and low levels of impervious surface) showed a borderline association with incident stroke (HR per interquartile range of the component = 0.92, 95%CI 0.83; 1.01). We also found a suggestive association between air pollution and increased stroke incidence.

CONCLUSIONS: In preliminary results in Sweden, we found a suggestion for independent effects of green space and air pollution on incident stroke. Further analyses on the other cohorts are ongoing.

KEYWORDS: stroke, urban exposome, meta-analysis, air pollution, green space, temperature, blue space.

P-0805 DNA methylation and multiple pollutants exposures from petrochemical industries

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BACKGROUND: This study aims to clarify the association between exposure levels, SNPs, and DNA methylation in residents living in areas with multiple industrial pollutants.

METHODS: We compared DNA methylation between high (HE) and low exposure (LE) groups, and analyzed association between urine concentrations of As, Hg, and V with DNA methylation, respectively among 159 residents near No. 6 Naphtha Cracking Complex in Taiwan. HE (n=78) and LE (n=81) were based on urine PAHs exposure biomarker 1-OHP and V concentrations. All participants were analyzed for 11 pollutants urine exposure biomarkers, DNA methylation, and 11 SNPs.

RESULTS: Urine levels of 1-OHP, V, As, Hg, Cr, Mn, Sr, and Tl were significantly increased in HE compared to LE. We identified 68 CpG probes corresponding to 45 known human genes using Wilcoxon's rank sum test comparing between HE and LE. We used DAVID for pathway analysis and found 16 pathways associated with exposure in KEGG pathway hsa04940: Type I diabetes mellitus (two gene hits PTPRN2, HLA-B,). We further used correlation analysis and found 70 CpG probes associated with urinary As levels, two with Hg, and 46 with V, which correspond to 62, none, and 32 known human genes, respectively. GSEA pathway analysis found four biological pathways associated with As (including ascorbate and aldarate metabolism), four with Hg (including linoleic acid metabolism), while no pathways were found associated with V. Fisher's exact test and Wilcoxon rank sum test results showed 11 SNPs significantly associated with CpG probes methylation. Linear regression revealed rs11085020 (NFIC) and rs199442 (NSF) could be associated with exposure, the translated proteins of which are associated with activating gene transcription and replication, and vesicle-mediated transport, respectively.

CONCLUSIONS: We identified industrial pollutants-associated SNPs, DNA methylation, and biological pathways among exposed population.

KEYWORDS:
petrochemical industry, air pollution, heavy metal, polycyclic aromatic hydrocarbon, DNA methylation, SNPs

P-0807 Cardiometabolic Health Associated with Exposures to Mixtures of Chemical Pollutants: Results from the EHES-LUX Study

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BACKGROUND AND AIM: The recent decades have seen a worldwide increase in cardiometabolic diseases. This study analyses associations of mixtures of chemical pollutants with cardiometabolic health.

METHODS: We analysed information from 606 randomly selected adults from the European Health Examination Survey. We analysed 152 chemical pollutants in hair samples, of which 74 were present in more than 6% of the samples and classified into groups (subdivided into banned and currently used): 6 flame-retardants, industrial wastes and plasticizers, 32 insecticides, 21 herbicides and 15 fungicides. We used weighted quantile sum (WQS) regressions adjusted by age, education, job status and physical activity to estimate the associations of groups of chemicals and cardiometabolic outcomes in men and women separately.

RESULTS: In women, a quartile increase of mixtures of banned insecticides, currently used insecticides, banned herbicides and currently used fungicides was associated with risk of hyperglycemia (WQS adjusted odds ratio [95% Confidence Interval] 1.81 [1.06, 3.10], 3.05 [1.29, 7.21], 2.00 [1.18, 3.38], 3.77 [1.82, 7.81], respectively). We also observed a quartile increase of banned herbicides mixtures associated with risk of low HDL-cholesterol in women (1.68 [1.09, 2.60]). Additionally, a quartile increase of currently used insecticides mixtures and currently used herbicides mixtures was associated with an increased risk of hypertriglyceridemia in men (2.76 [1.25, 6.10], 3.09 [1.33, 7.18], respectively). A quartile increase of currently used herbicides mixtures was associated with lower risk of abdominal obesity in men (0.46 [0.23, 0.94]). The most highly weighted chemicals associated with hyperglycemia among women were γ-HCH, β-HCH, Cl2CA, imidacloprid, trifluraline, metolachlor, boscalid and prochloraz. Among men, the most highly weighted chemicals associated with hypertriglyceridemia were 2-ClBA, IMPy, 1-(3,4-dichlorophenyl)-3-methylurea and fenuron.

CONCLUSIONS: This study contributes with further evidence on the possible negative effects of exposure to chemical mixtures on cardiometabolic health.

KEYWORDS: Chemical Mixtures; Pesticides; Exposome; Hair Analyses; Chronic Conditions

P-0810 Omics associations with non-persistent endocrine-disrupting chemicals (EDCs) exposure in humans: a scoping review

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Health effects of non-persistent EDCs, characterised by short half-lives and fast metabolism, are challenging to be detected in the general population due to EDC intra-individual variability, general ubiquity and latent effects. Omics are becoming increasingly common to detect subtle early biological changes before the apparition of clinical symptoms and to explore EDC-related toxic mechanisms increasing the biological plausibility of epidemiological associations.
This scoping review systematically summarises the application of omics technologies in epidemiological studies that assessed biological effects associated with non-persistent EDC exposure, in order to identify potential gaps and set priorities for future exposome research planning to use omics.
Ninety-eight human studies (2004-2021) were identified through database searches (PubMed, Scopus), and citation chaining. Most of the studies focused on one family of EDCs, including phthalates (34 studies), phenols (19), and PFASs (17), while PAHs and pesticides were studied less frequently (12 and 3, respectively). The sample sizes ranged from 10 to 12,476 (median = 160), involving non-pregnant adults (42 studies) or pregnant women (34), or children/adolescents (27). Several studies included occupational workers (12) and/or high-exposed groups (10) focusing on PAHs, PFASs, and pesticides while studies on phenols (30) and phthalates (46) were performed on the general population only. Omics measured included metabolic profiles (44, including targeted analyses), gene expression (31) and DNA methylation (12).
Overall, studies had common limitations, in particular the small sample size, the cross-sectional designs, and single sampling for exposure biomonitoring that could explain the lack of replication across studies. We also identified clear research gaps such as the lack of omic studies on currently used pesticides (organophosphate pesticides or pyrethroids).
Standardising research methods and reporting are recommended to facilitate result comparison. Future studies should consider differences in study methodology, use of prospective design, influence from co-exposure confounding and measurement errors.

KEYWORDS: scoping review, endocrine disruptors, omics

P-0811 The urban exposome profile of Limassol, Cyprus: integration of biomonitoring data with drinking water and quality of life indicators

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BACKGROUND AND AIM: Cities currently host the majority of the global population and generate more than 80% of the global gross domestic product. Societal changes, e.g., urbanization and migration shape population health, quality of life and urban exposures. Extending the human exposome framework, the urban exposome can be defined as the totality of environmental and health indicators that shape quality of life and urban populations' health, using the city and smaller, intra-city areas as measurement units. The aim of this study is to describe the urban exposome profile of Limassol in summer 2017.

METHODS: A cross-sectional study was conducted in the municipality of Limassol, Cyprus with collection of household tap water samples, urine samples and questionnaire data from residents. We integrated data on drinking water and quality of life indicators with urinary data on untargeted metabolomics and biomarkers of pyrethroid and neonicotinoid pesticides. We mapped the urban exposome parameters (i.e., water quality, urinary pesticides, green space access) across the urban center and explored associations among them.

RESULTS: Overall, 132 residents participated in the study, 83% of which provided two urine samples (different days). 89% of the participants self-reported very good or good health. 64% reported living close to green spaces, which based on their assessment were not well-maintained, and thus, not used. Overall, 2% of households' tap water exceeded 100 μg/L of total trihalomethanes and less than 1% were outside the parametric values for E. coli and Enterococci spp (zero CFU/100 mL). Correlations between all parameters were explored and linear-mixed effect models described associations among the urban exposome variables.

CONCLUSIONS: The application of urban exposome concept and its exposomic tools allowed continuous monitoring of urban health indicators to inform policy makers for the development of public health interventions for healthier living in sustainable societies.

KEYWORDS: urban health; exposome; metabolomics; epidemiology;

P-0814 Multi-omics signatures of exposure to disinfection by-products in swimming

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BACKGROUND AND AIM: Untargeted HRMS metabolomics provides an agnostic global profiling of small molecules in a biological system capturing an overview of exposure to exogenous compounds, and their effects on metabolic pathways, rendering an essential tool for characterising the exposome. Disinfection by-products (DBPs) are a complex mixture of halogenated organic compounds present in drinking and swimming pool water. Although several epidemiological studies have pointed their potential to induce adverse health outcomes such as bladder cancer, their mixture effect and the downstream molecules perturbed by their exposure have been poorly explored. In this work, we aim to identify molecular signatures of exposures to mixtures of DBPs in individuals with measured exposures.

METHODS: In PISCINA-II study, metabolomics, transcriptomics, proteomics in serum, and levels of DBPs in exhaled breaths, were measured in 60 subjects before and after swimming. Pre-processing of HRMS data from PISCINA-II study was customised to include more halogenated compounds. Multivariate normal (MVN) and partial least square (PLS) models were used to identify metabolic features associated with DBP exposures. Conditional correlation networks were constructed to understand the holistic relationship amongst the metabolic features and their relationship with proteomics and transcriptomics.

RESULTS: 98 metabolic features were identified to be associated with exposure to DBP mixture, of which 39 were not identified in the previous analysis without specific reprocessing and inclusion of halogenated compounds. In conditional network analysis, the 98 features showed cluster structures, suggesting they could contribute to different downstream biological pathways. Multi-omic networks showed that transcriptomic and proteomic signals were differentially connected to the different clusters of the metabolic signatures.

CONCLUSIONS: New data processing approach allowed identification of novel metabolic signatures of DBP mixture exposure. Conditional correlation network implied the functional proximity of these signatures with other measured omic signals.

KEYWORDS: Disinfection by-products, PLS, network analysis, omics, exposome, statistical analysis

THEMATIC 14: Health Impact Assessment, Risk communication and Participatory Epidemiology

P-0905 Environmental health competence in Basque health workers. Analyzing the soil before sowing the seed

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BACKGROUND AND AIM: Modifiable environmental factors account for the 23% and 22% of mortality and morbidity respectively. However, it is unclear whether health practitioners – especially those in primary care – are sufficiently aware of the connections between environmental exposures and health and able to intervene in this domain. The objective of this study was to assess environmental health (EH) literacy and competences among health professionals working in the Basque Public Health System.

METHODS: We recruited a sample of 366 (85% females) including nurses, family doctors, paediatric doctors, gynaecological doctors and advanced university students of nursery and medicine. The online questionnaire measured 1) general and specific EH competences, 2) use of exposure clinical history, 3) perceived competence to deliver medical advice on several exposures, and, 4) perceptions of Basque Public Health Services. Data were analysed with descriptive statistics, chi-squared tests and ANOVA with post-hoc comparisons.

RESULTS: Overall, we found low to moderate general and specific EH competence and found that nurses and nursery students reported higher perceived general and specific competences than the rest of the profiles at the $p < .001$. These differences were small to large in size according to the Hedges' g statistic. The sample was scarcely educated in the use of exposure clinical history and only 6 participants confirmed its use. The EH topics that more frequently appeared in the consultation room (e.g. passive smoke exposure or sun protection) were the ones for which the professionals reported a higher competence level and vice versa (least frequent topics were biomarkers and industrial emissions). Finally, even though Basque Public Health Services were highly regarded, participants rarely contacted them.

CONCLUSIONS: Interventions addressing environmental health knowledge and competences among health professionals in the Basque Health System are needed to improve population's health.

KEYWORDS: Environmental health competence, Health practitioners, Public health

P-0906 Indicators of psychosocial and physiological effects of forest therapy: A systematic review

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BACKGROUND: Current research on forest therapy and its health outcomes involves various health indicators without unification of measure. Information on the therapeutic elements of forest and forest-therapy programs is insufficient. We investigated forest-therapy programs, therapeutic elements of the forest environment, and health-outcome measures to standardize health indicators of forest therapy.
METHOD: A systematic review was conducted on the health outcomes of forest therapy from 2010 to 2021. We summarized therapeutic elements, forest-therapy sites, characteristics, and health outcomes. Additional cross tabulation was performed by using SAS software

RESULTS: Twenty-nine articles were analyzed. Among them, walking and physical activity were conducted most frequently as forest therapy. Also, meditation was used frequently in Pinales environments and viewing sessions in Fagales environments. In Fagales and Pinales environments, stress, psychological status, depression and endocrine function were improved. Apart from the forest therapy environment, stress and depression were most frequently observed psychological outcome. Cardiovascular and endocrine function were most frequently measured physiological outcome which reported positive result. functions were improved. Walking, five-senses stimulation, physical activities, and meditation benefited psychological (stress and depression) and physiological (cardiovascular and endocrine function) outcomes. Viewing sessions benefited both sentiment and cardiovascular function, and meditation benefited both stress and endocrine function.
CONCLUSION: We evaluated therapeutic elements of the forest-environment program and health outcomes. This systematic review can be used as a reference for planning and operation of forest-therapy programs.

KEYWORDS: Systematic literature review, forest bathing, Shinrin-yoku, forest elements, health promotion, therapeutic effect, health-related indicators, cross-tabulation

P-0907 Developing an environmental health knowledge questionnaire for health practitioners

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BACKGROUND AND AIM: Environmental health (EH) is a crucial public health aspect, usually overseen by health-care practitioners. Partly, this is due to a lack of awareness and knowledge on this area. The few existing tools available for measuring EH knowledge focus on specific health profiles (nurses) or population groups (children). Currently no tools evaluating the competence of different health specialties on EH issues concerning the general population exist. The objective of this work was to develop such a tool.

METHODS: A group of public health-care professionals and epidemiologists developed an initial pool of 38 EH related items. After a pilot study, a reduced version of this instrument was derived. Items had 3 response options (correct/incorrect/doesn´t know). Rasch analysis was applied with acceptable fit statistics: KR-20>0.80, separation>2, reliability>0.80, infit and outfit<2. Participants were mainly health practitioners of the Basque Public Health System-Osakidetza, or health students studying at the University of the Basque Country. Statistical analyses were performed with the SAS and Winsteps softwares.

RESULTS: Initially 38 EH questions were established, covering the areas of environmental risk factors for childhood/adolescence, air pollution, urban pests, drinking water problems, among others. The n=151 pilot participants had a mean age of 31.9 (SD: 13.2) years, 87% females. of those 48% were health-care university students, 31% nurses and 21% medical doctors. at this stage, several too easy and too difficult items were identified, while others evaluated more than one concept. The second 33-item version was tested in n=366 health professionals and students, 85% females, 54% working in primary care. KR-20 was 0.82 and all fit statistics were adequate. Item targeting had improved and unidimensionality of the tool was sustained.

CONCLUSIONS: The developed questionnaire can be used as a means of assessing EH competences and knowledge, detecting areas of improvement.

KEYWORDS: Environmental health, health-care professionals, Rasch analysis

P-0908 Lithuanian Refugee Crises: Comparing Middle Eastern/African and Ukrainian Migrants

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BACKGROUND AND AIM: Recently, Lithuania has received a large number of Ukrainian refugees fleeing the war, in addition to refugees from Middle Eastern and African (MEA) countries. Refugees have unique clinical and mental health needs, including anxiety, depression, and post-traumatic stress disorder. Culturally relevant access to care and language skills are essential for responding to health problems. We aim to contrast the MEA and Ukrainian refugees' situation in Lithuania.

METHODS: This comprehensive literature review examined the refugee situation in Lithuania, focusing on physical and mental health, living conditions, and integration into Lithuanian society, including published research studies. R.B conducted direct conversations with refugees and with organizations that provide assistance to migrants.

RESULTS: The Lithuanian government and private sector assistance provided to Ukrainian and MEA refugees differed vastly. While the MEA refugees struggled to obtain the minimum standard of health care in Lithuania, the Ukrainian refugees received free primary and emergency care, and psychological support. MEA were housed in refugee camps, some of which used to serve as correctional facilities. Many Ukrainian refugees were hosted by Lithuanian families inviting them to their homes. There is an ongoing concern about the health needs of both of these groups, particularly physical health, and overall mental health conditions arising from being a refugee. A shared issue is finding employment and integrating into Lithuanian society.
CONCLUSIONS: National policies should be standardized to provide the same assistance to refugees regardless of the country of origin. Lithuania demonstrated that it can welcome Ukrainian refugees and provide excellent care by mobilizing the entire nation's efforts. Immigrants from other countries should not be discriminated against or treated differently. Health professionals need to play leadership roles in the continuum of care and to provide culturally competent assessments to identify the refugee needs.

KEYWORDS: Refugees, Mental Health, Discrimination, Traumatic Immigration

P-0909 A health risk matrix for assessing the impacts of heat and cold exposure in residential buildings

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BACKGROUND AND AIM: With people in developed countries spending 70% of their time at home, the impact of the built environment on human health is vital. Although there has been ample epidemiological evidence on the relationship between high/low outdoor temperature exposures and adverse health impacts, there is a paucity of research investigating how residential characteristics and human behaviours might affect temperature-related health risks. This research aims to fill this gap.

METHODS: A health risk matrix was obtained by applying a four-stage spatiotemporal health risk assessment framework (comprising hazard identification, exposure assessment, exposure-response assessment and risk characterization) to estimate the temperature-cardiovascular mortality relationship in Greater Taipei, Taiwan, using paired observations of outdoor-indoor temperatures and PM2.5 concentrations in dwellings.

RESULTS: Residential characteristics and household energy use acted as moderators, and indoor temperature functioned as a mediator in the temperature-mortality relationship. A three-dimensional matrix projected outdoor temperature, human vulnerability and dwelling type along three axes to visualise the cardiovascular mortality risk. Human vulnerability represents the interaction between outdoor temperature and household energy use. By multiplying the risk levels (1-3) of each of the three axes, a total of 27 levels of health risk are obtained.
CONCLUSIONS: This study encourages carefully-planned climate change mitigations and adaptations to achieve healthier indoor environments: (1) Strategies for reducing temperature-related cardiovascular mortality should incorporate the energy use for heating/cooling, which may affect human vulnerability and be affected by the household income, prevalence of air conditioning systems, green area, and population rate of older people. (2) Building retrofits for improving energy efficiency should carefully consider dwelling thermal types, which may vary with occupants' behaviours and cause unintended health consequences when indoor temperature closely follows outdoor temperature and makes dwellings overheat or excessively cold.

KEYWORDS:
Health risk assessment, Health matrix, Temperature-related mortality, Dwellings, Human behaviours

P-0910 Increased risk of osteoporotic fractures after long-term exposed to high levels of perfluoroalkyl substances through drinking water in a Swedish population

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BACKGROUND: Several studies have reported inverse associations between perfluoroalkyl substances (PFAS) and bone mineral density, but there are fewer studies on its relationship with osteoporosis and fractures, especially in highly exposed populations. This study aimed to investigate the risks of osteoporotic fractures in a Swedish population with long-term exposure to PFAS through drinking water.

METHODS: We used Ronneby Register Cohort that included 61504 individuals who have ever lived in Ronneby from 1985-2013. PFAS exposure was assessed based on the yearly residential address and categorized as 'never-high' and 'ever-high' exposure. The latter was further divided into 'early-high' and 'late-high' depending on whether the exposure was before or after 2005. Diagnoses of various fractures were retrieved from the National Patient Register. Primary outcomes were major osteoporotic fractures (MOF) including fractures located in the hip, vertebrae, proximal humerus or distal forearm, and hip fractures themselves. Cox proportional hazard models were used to estimate the hazard ratios (HRs). Stratified analyses were performed in sex and age groups (<50 or ≥50).

RESULTS: Elevated risks of MOF (HR 1.11, 95% CI 1.03 – 1.19) and hip fractures (1.12, 1.00 – 1.24) were observed when comparing 'ever-high' to 'never-high' exposure. The HRs were even higher for 'late-high' (MOF: 1.29, 1.16 – 1.44; hip fractures: 1.22, 1.01 – 1.47), but less evidence for 'early-high' exposure. Further adjusting for the highest achieved education only slightly attenuated the estimates. People above age 50 showed higher HRs. Similar patterns were found for all fractures.

CONCLUSIONS: Our findings provided more evidence supporting the adverse effects of PFAS on bone, shown by the clinically relevant outcome, osteoporotic fractures. Senior people (above age 50) were more susceptible. The findings are concerning and call for a better understanding of dose-response relationships as a basis for risk assessment.

KEYWORDS: Perfluoroalkyl substances, osteoporotic fractures, cohort study

P-0916 Pesticide Residue Trends in Fruits and Vegetables from Farm to Fork in Kampala Metropolitan Area, Uganda - A Mixed

METHODS: Study

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BACKGROUND: Improper agricultural use of pesticides in Uganda results in elevated residues in fruits and vegetables. This study examined pesticide residue trends in produce and handling and processing practices for fruits and vegetables from farm to fork in the Kampala Metropolitan area in Uganda.

METHODS: We used pesticide laboratory d, semi-structured questionnaires, and in-depth interview data collected from stakeholders along the farm to fork chain. We present descriptive summaries of quantitative data and pesticide residue trends along the farm to fork chain using the nptrend test. Qualitative data was inductively coded and analysed using conventional content analysis for sub and overarching themes.

RESULTS: of the 50 farmers visited, 34 (68.0%) sold their fruits and vegetables to transporters, 11 (22.0%) to market vendors, and 4 (8.0%) homes and restaurants. Majority 42 (93.3%) of the consumers (home/restaurant) purchased their fruits and vegetables from market vendors and transporters. Washing with water or vinegar, wiping with a cloth, peeling the outer layer, blending and cooking were the most common post-harvesting processing methods used by stakeholders along the supply chain. Some farmers and market vendors reported spraying fruits and vegetables with pesticides either prior-or post-harvest to increase shelf life. Statistically significant decreasing pesticide residue trends along the farm to fork chain were observed for dioxacarb, likely due to degradation or washing, peeling, cooking, blending, or wiping by consumers. Increasing trends were observed for methidathion and quinalphos possibly due to pesticide applications.
CONCLUSION: Overall, pesticides concentration in fruits and vegetables significantly decreased (dioxacarb) and increased (methidathion, and quinalphos) from farm to fork chain. The decreasing and increasing trends were due to processing measures including washing, peeling, cooking, blending, wiping and applications of pesticides. There is a need in Uganda to promote practices that minimize pesticide use and exposure through diet, while maintaining food integrity.

P-0919 Effect of Heavy Metal Leaching on Elemental Composition of Rice commonly consumed in the USA

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BACKGROUND AND AIM: Exposure to Arsenic (As), Cadmium (Cd), and Lead (Pb) in rice is associated with adverse health effects. Studies have shown that soaking can decrease As content in rice and potentially reduce poor outcomes. This study aims to measure elemental composition of soaked rice and determine the optimum rice: water ratio that allows for maximum and minimum loss of toxic and essential elements in rice, respectively.

METHODS: Two rice brands with high As concentrations were soaked at different rice: water ratios (1:1, 1:3, 1:6, 1:9, 1:12, 1:15), various time intervals: 10 seconds, 1, 3, 6, 12, 18, and 24 hours. Filtered rice leachates and samples were analyzed using inductively coupled plasma mass spectrometry (ICPMS) for As, Cd, and Pb. Mann Whitney U-test, and Two-Way Anova assessed differences in elemental composition of soaked vs unsoaked samples.

RESULTS: for all ratios and rice brands, elemental loss of As ranged from (0.96% to 29%), Cd and Pb loss ranged from (10% to 72%), and (8% to 100%), respectively. Essential elemental loss ranged from (3%-70%). The pH values of the leachates decreased with increasing soaking time for all the ratios. This is probably because of adsorption of As, which led to its quicker dissolution and decreased pH levels. Significant differences were found for As and Cd concentrations by each brand $p < 0.05$.

CONCLUSIONS: Soaking rice at different time intervals and rice: water ratios had varying effects on As, Cd and Pb and essential elements in the samples. The reduced pH is indicative of leached Arsenate which is more favorable under aerobic conditions. Future work will explore probabilistic risk analysis from soaked rice, pollution index calculation and principal component analysis. This research informs approaches of decreasing dietary exposure to toxic metals.

KEYWORDS: pH, Rice, Heavy metal leaching

P-0920 Behavioral determinants of arsenic-safe water use among Great Plains Indian Nation private well users: results from the Strong Heart Water Study

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BACKGROUND AND AIM: Long-term arsenic exposure in potable water remains a serious public health challenge in the USA. Rural communities with a high reliance on private wells, including American Indian communities, are disproportionately impacted by arsenic contaminated water. However, efforts to decrease arsenic exposure are limited. The objective of this study is to evaluate the behavioral determinants associated with exclusive arsenic-safe water use in the Strong Heart Water Study (SHWS).

METHODS: The SHWS is a randomized control trial designed to reduce arsenic exposure in American Indian Great Plains communities. All households received point-of-use arsenic filters installed at baseline and were followed for up to two years. at each visit questionnaires were administered evaluating water use and behavioral determinants based on the RANAS (risks, attitudes, norms, abilities, and self-regulation) model of behavior change.

RESULTS: Among 75 participants, exclusive use of arsenic-safe water for drinking and cooking at follow-up was associated with higher baseline levels of perceived disapproval from friends and family for using arsenic-unsafe water for drinking (OR: 0.06, 95% CI: 0.01-0.34) and cooking (0.13, 0.02-0.72) (injunctive norms), greater concern for getting sick from arsenic exposure (0.17, 0.04-0.65) (perceived vulnerability), more self-efficacy to use the arsenic filter for drinking (10.5, 1.49-73.2) and cooking (12.5, 1.88-83.1), and higher arsenic knowledge (6.88, 1.07-44.4). Higher commitment to using the arsenic filter was also a significant predictor of exclusive arsenic-safe water use for drinking (11.7, 1.63-83.5) and cooking (8.43, 1.17-60.8) at follow-up. Exclusive arsenic-safe water use was not associated with sex, age, or education. From baseline to follow-up, the SHWS trial significantly increased perceived vulnerability, self-efficacy, and injunctive norms, and decreased concern about the cost of arsenic filters.

CONCLUSION: Future arsenic interventions in our partner communities should target these behavioral determinants of use of arsenic safe water.

KEYWORDS: arsenic, health behavior, water treatment, water

P-0923 Achieving the WHO Air Quality Guidelines brings benefits to the health and economy of Member States across the Western Pacific Region

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BACKGROUND AND AIM: Air pollution continues to greatly burden population heath worldwide, and this burden is over-represented in the Western Pacific Region (WPR). As a risk communication exercise, we quantified the number of avoidable annual deaths and associated economic impact among WHO WPR Member States by meeting current (2021) WHO Air Quality Guideline (AQG) ambient annual concentration levels for fine particulate matter (PM2.5: 5 µg/m3).

METHODS: We performed a health impact assessment comparing latest (factual) and 2021 WHO AQG (counter-factual) PM2.5 levels among individual Member States, using AirQ+ (v.2.1.1). PM2.5 data was obtained from the WHO Global Health Observatory platform for the latest annual estimate available (2016). Population and all-cause mortality (standardized to 100,000 population) data were obtained from the UN World Population Prospects database for the latest 5-year period available (2015-2019) averaged to 1-year (annual) estimates. Global meta-analyses provided mortality risk estimates (all-cause: Chen & Hoek, 2020) and integrated exposure-response functions (COPD, lung cancer: Burnett et al., 2018) within AirQ+. Our economic evaluation used World Bank values of statistical life adjusted to Member-State-specific Gross Domestic Product in USA Dollars (US$).

RESULTS: Data was complete for 21 of 27 Member States. Amongst those 21, achieving the 2021 WHO AQG for PM2.5 avoids an estimated total of 3.1 million premature deaths annually; ranging from 2094 (People's Republic of China) to 5 (Brunei Darussalam) per 100,000 population. COPD and lung cancer exposure-response functions gave generally higher and lower estimates, respectively. Total avoidable deaths translated to economic savings ranging from 583 (Singapore) to 14 (Solomon Islands) million US$ per 100,000 population.
CONCLUSIONS: Implementing effective policy and regulations to reduce PM2.5 emissions and exposure, meeting current WHO AQG, is essential to save thousands of lives and millions of US$ across the WPR.

KEYWORDS:
air quality guidelines; PM2.5; health impact assessment; mortality; Western Pacific

P-0924 The Health Burden of Outdoor Air Pollution in Lagos, Nigeria, between 2020 and 2021

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BACKGROUND AND AIM: Air pollution, especially particulate matter is the leading environmental risk factor worldwide. According to the latest Global Burden of Disease (GBD) study, 6.7 million deaths, primarily NCDs, are attributable to the joint effects of ambient and household air pollution, with the largest share occurring in low and middle income countries. We compute the air pollution health burden in Lagos during 2020–2021.

METHODS: A health impact assessment was carried out to quantify premature mortality in infants and adults plus evaluate respiratory and circulatory morbidity. Measured $PM_{2.5}$, PM_{10} and lead concentrations across the city of Lagos between August 2020 and July 2021 were used. Alternative population compositions were estimated using data from Lagos and Nigeria statistical bureaus. Baseline data were derived using national and international databases. Cause-specific mortality was calculated with the GBD 2019 risk functions. Infant mortality was calculated using an African-derived risk function, while the Global Exposure Mortality Model provided death estimates in the broader category of NCDs. Morbidity effects were quantified using WHO HRAPIE risk functions.

RESULTS: 1. Ambient population-weighted $PM_{2.5}$ exposure in Lagos was 47μg/m³.
2. Morbidity was high amongst children (180,000–350,000 respiratory infections in <5yr), and infant mortality contributed one-half of total mortality (8,000–15,000 deaths).
3. For one industrial-residential area, lead exposure contributed 6.2 IQ-points lost in children (<6yr), or 1 million IQ-points lost district-wise.
4. $PM_{2.5}$ mortality was 16,000–30,000 deaths (18% of natural deaths) plus 250–500 PM_{10} deaths from exposure to Harmattan winds, and 300–400 adult cardiovascular deaths due to lead.
5. Achieving WHO IT1 target (35 μg/m³) would avert 4,300 deaths (28% reduction), and prevent 64,000 childhood respiratory infections.

CONCLUSION:
$PM_{2.5}$ poses a serious health hazard in Lagos, particularly amongst children, and urgent action is needed to address this preventable environmental risk.

KEYWORDS: Mortality, Infants, Health impact assessment, Lagos (Nigeria), $PM_{2.5}$

P-0926 Agent-based Modeling of Urban Exposome Interventions: Prospects, Methodological Considerations and Challenges

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BACKGROUND AND AIM: With ever more people living in cities worldwide, it becomes increasingly important to understand and improve the impact of the urban habitat on health behaviors and health outcomes. However, implementing interventions that tackle the exposome in complex urban systems can be costly and have long-term, sometimes unforeseen, impacts. Hence, it is crucial to assess the health impact, cost-effectiveness, and social distributional impacts of possible urban exposome interventions before implementing them. Spatial agent-based modeling (ABM) can capture complex behavior-environment interactions, exposure dynamics, and social outcomes in a spatial context. This paper discusses methodological architectures and challenges for successfully modeling urban exposome interventions using spatial ABM.

METHODS: We review the potential and limitations of the method; model components required to capture active and passive exposure and intervention effects; human-environment interactions and their integration into the macro-level health impact assessment and social costs benefit analysis; strategies for model calibration.

RESULTS: Major challenges for a successful application of ABM to urban exposome intervention assessment are (1) the design of realistic behavioral models that can capture different types of exposure and that respond to urban interventions, (2) the mismatch between the possible granularity of exposure estimates and the evidence for corresponding exposure-response functions, (3) the scalability issues that emerge when aiming to estimate long-term effects such as health and social impacts based on high-resolution models of human-environment interactions, (4) as well as the data- and computational complexity of calibrating the resulting agent-based model.
CONCLUSION: This paper suggests possible strategies for addressing these challenges and provides a roadmap for further implementing spatial ABM for urban exposome intervention assessment. Future work should analyse the level of detail that is needed and the short-cuts that can be made.

KEYWORDS: Urban Exposome, Agent-based Modeling, Scenario Modeling, Urban Health Interventions, Complex Systems

P-0928 Assessing the environmental urban exposure to high tech-metals (Co, Li) in a healthy group of Spanish adolescents

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BACKGROUND AND AIM: Demand for high-technology metals is increasing in green technology development, which can have potential effects on human health. The aim was to determine the environmental presence of cobalt (Co) and exposure to Co and lithium (Li) in topsoils and a teenage population group living in Alcalá de Henares (Spain).

METHODS: Scalp hair was collected from 97 adolescents (13-16 years-old; 68 girls) from Alcalá. Metals were analysed by ICP-MS after appropriate removal of exogenous contamination. Co was monitored in 97 topsoil samples randomly collected from different urban parks. Data was processed using statistical methods applied to censored data available in the 'NADA' statistical package. Non-carcinogenic risks to Co were also characterised.

RESULTS: Limits of detection in hair of Li (0.019928) and Co in hair/soils, respectively, were (in µg/g): (0.001488; 0.059271). Co was non-detected in only one topsoil sample [median and percentiles in mg/kg: 1.577 (1.092, 2.584)], meanwhile Co was detected in 73/97 hair samples. Li had a high percentage of censored data (98.97%), detected (0.024091 µg/g) in one female participant. Co showed sex dependency, with significantly higher ($p<0.001$) concentrations in hair of female participants samples [median and percentiles in µg/g: 0.0051 (0.0028, 0.0103) vs. 0.00217 (<0.00149, 0.00333)], as reported in similar studies. Our findings could indicate that females could be more vulnerable to exposure to Li and Co, which would contradict the common belief that boys spend more time outdoors and therefore would be more exposed, although the endocrine system may play a significant role in the detoxification of both elements.

CONCLUSIONS: Alcalá's teenage population would not have been significantly exposed to these high tech-metals, especially Li, as hair has been suggested as a good matrix to assess environmental exposure. Non-carcinogenic risks derived from the ingestion/inhalation/dermal contact to Co in soils and resuspended soils in Alcalá were negligible.

P-0930 The impact of urban environmental exposures on health: An assessment of the attributable mortality burden in Sao Paulo city, Brazil

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BACKGROUND:
Currently, more than half of the global population lives in cities. Contemporary urban planning practices result in environmental risk factors (e.g. air pollution, noise, lack of green space, excess heat) that put health and well-being of city dwellers at risk and contribute to chronic diseases and premature death. Despite a growing body of evidence on adverse health impacts related to current urban and transport planning practices, especially for cities in the Global North, not much is known about associated health impacts in South American cities. Therefore, we estimated the mortality burden attributable to breaching internationally-recommended or locally-preferable exposure levels of urban planning-related environmental exposures in Sao Paulo, Brazil.

METHODS: We carried out a health impact assessment study, following the comparative risk assessment framework, to assess preventable mortality impacts of breaching exposure recommendations for air pollution, green spaces, and temperature at the census tract (CT) level (n = 18,363). We also assessed the distribution thereof by the socioeconomic vulnerability.

RESULTS: We estimated that annually 11,372 (95% CI: 7921; 15,910) attributable deaths could be prevented by complying with recommended exposure levels. The largest proportion of preventable mortality was due to breaching air pollution limits (i.e. 8409 attributable deaths), followed by insufficient green space (i.e. 2593), and excess heat (i.e. 370). Adverse health impacts were larger in CTs of lower socioeconomic vulnerability, due to demographic profile, traffic density, and residential area configurations.
CONCLUSIONS: Not complying with the health limits for air pollution, green space, and temperature exposures resulted in a considerable preventable mortality burden (i.e. 17% of total expected deaths) in Sao Paulo. This burden can be reduced by improving current urban and transport planning practices.

KEYWORDS:
Health impact assessment; Mortality; Air pollution; Green space; Urban planning.

P-0931 Air pollution and health impact of population living in industrial areas in Italy: SENTIERI project

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BACKGROUND AND AIM: We estimated the impact of PM2,5 and PM10 in the Italian industrial areas included in the SENTIERI project characterized by industrial plants with combustion processes deriving from point emissions (chimneys).

METHODS: Using satellite data, the Population Weighted Exposure to PM2.5 and PM10 for 2011 and 2015 was estimated. for the selection of industrial plants, the European database on emissions of the European Pollutant Release and Transfer Register was used. Residents in areas of 1km x 1km, 4 km x 4 km from the industrial plants under study were considered. The concentration-response functions available were used to estimate the number of premature deaths from non-accidental causes, cardiovascular and respiratory diseases, lung cancer attributable to exposure to industrial emissions. The counterfactual levels recommended by the new WHO AQGLs were used.

RESULTS: Residents were exposed to PM2.5 values of 17.3 µg / m3 (north 23.3) and to 24.3 µg / m3 (north 30.3) of PM10. PWE for both pollutants tends to increase as the size of the area under study is reduced and is generally higher everywhere in 2011 than in 2015 with values that are always higher than the average (overall) in the north of Italy. In 2011, we estimated 1,709 (IC 1,309-1,903) and 1,611 (IC 1,225-2,353) non accidental premature deaths attributable to PM2.5 and PM10, respectively in residents close to the industrial plants (1km x 1km). Deaths attributable to exposure to PM2.5 and PM10 tend to follow a north-central-south gradient for all observed causes and for both years of analysis.
CONCLUSION: The results of the study are suggestive of an impact on health from PM exposure in the industrial areas considered, with a greater impact in the vicinity of the plants, recommending the implementation of urgent impact reduction actions.

P-0932 Benefits of Increasing Greenness on All-Cause Mortality in the Largest Metropolitan Areas of the USA within the Past Two Decades

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BACKGROUND AND AIM: Across the globe, cities are creating sustainability and climate action plans (CAPs) that call to increase local vegetation. Greening initiatives have the potential to benefit the environment and human health. In epidemiologic literature, greenness has a protective association with mortality through various direct and indirect pathways. We aimed to longitudinally quantify how many deaths could be prevented by increasing greenness in urban areas in the US across two decades.

METHODS: Using publicly available county-level mortality data from the CDC, Landsat 30m 16-day satellite imagery from April to September for 2000, 2010, and 2019, and a recently published exposure-response function, we estimated the age-adjusted reduction in all-cause mortality for those 65 years and older associated with trends in greenness in the most populated US metropolitan areas. County-level data were downscaled to estimate census tract mortality rates. Normalized Difference Vegetation Index (NDVI) was processed to calculate cloud-free mean seasonal greenness for each census tract.

RESULTS: On average, greenness increased across time with a 2.86% increase from 2000 to 2010 and 11.11% from 2010 to 2019. Most metropolitan areas had an increase of 0.05 NDVI across twenty years, with El Paso, TX having the lowest increase in greenness (0.02) compared to Austin-Round Rock, TX that had the highest increase in greenness (0.13). We estimated that that over 34,000 deaths could be prevented according to 2000, 2010, and 2019 data, with an increase in green vegetation by 0.1 unit across the most populated metropolitan areas.

CONCLUSIONS: These results can be used to support CAPs by providing a quantitative assessment to the impact local greening initiatives can have on mortality. Urban planners and local governments can use these findings to calculate the co-benefits of local CAPs through a public health lens and support policy development.

KEYWORDS: greenness; all-cause mortality; built environment; greenspace

P-0935 Lead Exposure Through Food: An Observational Study of Glazed Ceramics within Oaxaca and Mexico City

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BACKGROUND & AIM:
Lead-Oxide (PbO) is used to create beautiful pieces of ceramic art and cookware in México. Substituting lead-free glazed ceramics poses an issue due to the marketability of traditional Mexican ceramics even with government legislation supporting lead free glazes. The aim of our study was to estimate the frequency of street and market food stands that offer prepared and served food from lead-glazed ceramics.

METHODS: We visited three types of market stalls in touristic areas in Mexico City and Oaxaca. We used a handheld counter and registered the total number of stalls at the given date and location. The number of stalls in markets was followed by a count of those with using ceramics for food and beverages as well as stalls with ceramics being sold as artwork/kitchenware (PbO product). We calculated the prevalence of PbO stalls and products for each market and for the overall study.

RESULTS: The market stalls classified as Permanent (n=2), Semi-Permanent (n=2), and Weekly (n=2) in Mexico City and Oaxaca. Both Permanent and Weekly market stalls showed the highest prevalence rates. Oaxaca had a period prevalence of 2.00% (Permanent), 0.20% (Semi-Permanent), and 26.00% (Weekly) for stalls selling prepared food in ceramics. for comparison, Mexico City's period prevalence was 27.50% (Permanent), 13.10% (Semi-Permanent), and 36.40% (Weekly).

CONCLUSION: Permanent Market Stalls throughout México have a higher prevalence of lead-glazed ceramics, representing a possible major source of lead exposure than Semi-Permanent and Weekly Market Stalls. Non-lead glaze is not commonly used in Mexican ceramic work. Although we did not test the ceramics, lead-glazed ceramics are still those most frequently produced and marketed in Mexico, suggesting that residents of México and tourists alike can be exposed to lead in popular public marketplaces serving prepared food.

KEYWORDS: lead, ceramic, food, potter, Oaxaca, Mexico City, market, stall, exposure, glaze

P-0936 Health impact assessment of urban and transport developments in Barcelona: a case study

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BACKGROUND AND AIM: Urban areas are drivers of climate vulnerability and a key public health concern due to their increasing population. However, they can also provide the adequate setting for adaptation and mitigation strategies for tackling these challenges. Barcelona already started rethinking urban spaces, such as superblocks, an urban development which have proven health benefits. The aim of this study is to explore urban and transport developments in Barcelona and estimate the health impacts of their related exposures.

METHODS: On our first phase, we reviewed secondary data such as policy documents (urban and mobility plans), publicly available health and population data on Barcelona Metropolitan Area. We approached stakeholders involved in the development of these activities for environmental data review.
The second stage of this study would be to implement a health impact assessment focused on the health impacts of the air pollution, greenspace, and physical activity that these scenarios bring.

RESULTS: As preliminary findings there are short and mid-term planning scenarios. On the urban transport scenario, we found the combined effect on air pollution as NOx of three different interventions: the low emission zone area, tactical urban planning (reducing car traffic lanes), and eight superblocks. The three interventions combined have an estimated 25% private car use reduction and a NOx emission reduction of 30%. The reduction in private car use also implies a change in mode of transport of: increases of 15.7% for public transport, 7.5% for walking and 129.4% for cycling. Another scenario is the implementation of new green infrastructures on peri-urban areas of the Metropolitan Area of Barcelona and their effect on air pollution as NOx and PM2.5.
CONCLUSION:
Barcelona is focusing different transport activities that reduce private car use, promote change in mode of transport and increase green areas.

KEYWORDS:
health impact assessment, urban planning, transport, mobility

P-0937 A Pilot Study of an Usability of a Mobile Application to target Neglected Skin Diseases in Côte d'Ivoire

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This study investigated the usability of a mobile phone-based system, "eSkinHealth", for healthcare providers in Côte d'Ivoire. The eSkinHealth can be used both online and offline to address the poor Internet connectivity of these rural settings. Data recorded in the mobile application were synchronized with an online database, and specialists in Abidjan, Côte d'Ivoire and in Japan advised local healthcare providers on difficult cases. In this pilot study, 21 healthcare providers used the eSkinHealth and completed questionnaires assessing the usability. The average score of a system usability scale for eSkinHealth was 84.2 (SD 11.7), which can be interpreted as excellent. The average registration for patient information (e.g., name, sex, age, area of residence) was 8.6 (SD 15.5). Further studies with more targeted areas and participants are needed to evaluate the usability of eSkinHealth in rural Côte d'Ivoire

P-0940 Evidence synthesis of Observational Studies in Environmental Health: Lessons Learned from a Systematic Review on Traffic-Related Air Pollution

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BACKGROUND: There is a long tradition in environmental health of using frameworks for evidence synthesis. Recently, frameworks were developed for evidence synthesis in clinical medicine, including Grading of Recommendations Assessment, Development and Evaluation (GRADE). The US Office of Health Assessment and Translation (OHAT) elaborated a GRADE type protocol for evidence synthesis in environmental health to assess the "quality in a body of evidence".

METHODS: We describe lessons learned in synthesizing evidence from observational studies of environmental health effects, drawing on our experience of applying the OHAT approach in a large systematic review on traffic-related air pollution and health outcomes.

RESULTS: We outlined key elements of and suggested improvements to the GRADE/OHAT approach. To maximize what can be learned from observational studies in environmental health, a "narrative" approach is needed to complement the mechanistic up-and-downgrading of certain factors in the evaluation of the quality of a body of evidence. This "narrative" approach links more directly to current and widely accepted evidence synthesis frameworks, such as from the US EPA and IARC. We argue that observational studies can offer high confidence evidence in environmental health, where randomized controlled trials are generally not feasible. All relevant studies should be included in evidence synthesis, beyond the subset of the available evidence often included in meta-analyses. Sources of heterogeneity can both strengthen and weaken the confidence in the evidence. Consistency of associations across study designs, populations, and exposure assessment methods provides additional confidence in the results. Publication bias should be explored beyond statistical methods and is not necessarily expected in large and collaborative studies. We call for identifying and quantifying possible key biases, their most likely direction, and their potential impacts on the results.

CONCLUSIONS: GRADE-type frameworks require substantial modification to align better with features of environmental health questions and the studies that address them.

P-0942 Contamination by mercury in Alcalá de Henares (Spain): temporal and spatial variability and risk assessments

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BACKGROUND AND AIM: Data on mercury (Hg) in urban topsoils in Europe are limited despite its involvement in extensive air-soil exchange, which increases the likelihood of the population being exposed to this metal. The aim was to assess the temporal variation and distribution of Hg in Alcalá de Henares (Madrid region, Spain), and its risks for the population.

METHODS: Ninety-four topsoil samples were collected in July 2017: 66 urban, 24 industrial and 4 public garden. Hg was analysed by ICP-MS after acid digestion in a microwave system. Data was processed using the 'NADA' statistical package, and compared with topsoils collected in the same locations in 2001 (97 urban, 22 industrial; 18 garden). Non-carcinogenic risks were also characterised.

RESULTS: Hg was only detected in topsoil samples collected in 2017 (7 urban, 3 garden, 1 industrial; LoD=0.1598 mg/kg), suggesting a recent emission, as soil is an important reservoir in the biogeochemical cycling of Hg. Potential emissions could be related to technological devices (fluorescent lamps, thermostats, electrical switches and pressure sensing devices), meanwhile the high presence detected in the garden might be explained by application of fertilisers/fungicides. A higher contamination in urban>garden>industrial soils was observed, respectively (ranges; mg/kg): (0.1753-5.0575>0.1833-0.2230; 0.2038 concentration in industrial sample); meanwhile higher levels were detected in the topsoil samples collected within urban areas with more presence of industries. Lower levels of total-Hg were found in topsoils in Seville (0.11-1.6 vs. 0.1753-5.0575 mg/kg), supporting the anthropic input observed in Alcalá. All Hg values detected fell below the regulatory guidance value set by Madrid Government, for urban (7 mg/kg) and industrial (15 mg/kg) areas.

CONCLUSIONS: Health risks for the population of Alcalá from the ingestion/inhalation of Hg in soils and resuspended soils seem to be small. However, the recent contamination of Hg detected highlights the need of performing future monitoring studies.

P-0944 Characterisation of risks from lanthanum and europium in topsoils from the East Midlands (UK)

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BACKGROUND AND AIM: Light-group rare earth elements (LREEs) are increasing their environmental presence, with unknown implications for human health. The aim was to determine the risks to lanthanum (La) and europium (Eu) in urban/rural topsoils from Leicestershire (UK).

METHODS: A total of 850 soil samples were collected (2017-18); 26 composite samples were appropriately prepared per park/location (18 urban, 8 rural), which were further processed in duplicate. Both LREEs were measured in triplicate in the 52 composite samples by ICP-MS. Provisional reference doses were used to characterise noncarcinogenic risks following US EPA methods.

RESULTS: Slightly higher levels were found in the rural area (data presented as median and ranges, in mg/kg) for La [19.245 (11.395-28.493) vs. 18.121 (11.711-28.144)] and Eu [0.786 (0.369-1.141) vs. 0.725 (0.486-1.137)], which might be attributed to the agricultural use of La and Eu in fertilisers. The technological uses of Eu in flat screen displays, optical fibres, phosphors and La in catalytic converters and phosphors could be important sources of these LREEs. The urban mean concentrations of La (18.7 vs 3.9 mg/kg) exceeded the soil screening level (SSL) value for non-carcinogens established by the US EPA for residential soils (there is currently no SSL proposed for Eu). However, the non-carcinogenic risks for La and Eu for ingestion/dermal contact were lower than the unit, with the highest non-carcinogenic risks quotients found for La (HQs; 0.735 and 0.0261, respectively).

CONCLUSIONS: The presence of La in Leicester's topsoils is similar to those reported in other similar European cities. Our results would suggest a minimal risk to both LREEs present in Leicester's urban topsoils, although the soils monitored may require decontamination, specifically for La. Further toxicological studies are required to investigate whether the levels of Eu found in the urban soils would also require decontamination.

KEYWORDS: Lanthanum, Europium, Leicester, topsoils, risks.

P-0947 Ambient Fine Particulate Matter reduction and mortality benefit during the COVID-19 Crisis in Korea

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The COVID-19 outbreak forced into diverse measures such as social distancing and increased telecommuting in Korea and the stringent lockdown measures of China, which led to an improvement in air quality.
This study estimated the change of PM2.5 and health benefits of PM2.5 reduction during the COVID-19 crisis in Korea.
To calculate the mortality burden attributable to PM2.5, we obtained population data, mortality data, and air pollution monitoring data for Korea from publicly available databases. We calculated the avoided mortality attributable to decreases in daily PM2.5 on the basis of CRFs from Krewski et al. study.
The average PM2.5 concentration from January to December in 2020 (11.90~29.52 μg/m3) was the lowest in the last 5 years. We found that decreases of average PM2.5 concentration ranged from 0.01 $\mu g/m^3$ to 10.35 $\mu g/m^3$ was observed in 2020 compared to the previous year.
We estimated that PM2.5 reduction during the mitigation period lowered air pollution-related total deaths. An estimated 6,639(95% CI 4,514~8,749) PM2.5-related prematrue deaths were alverted throughout Korea.
Our estimates suggest that diverse measures to control the COVID-19 outbreak led to improvements in air quality that brought health benefits in non-COVID-19 deaths.
Our findings show the health benefits related to morbidity and mortality that can be achieved when aggressive control measures for air pollution are taken to reduce emissions.
when efforts to reduce measures for air pollution are taken to reduce emissions.

P-0949 Effectiveness of community and household level Interventions for reducing impact of air pollution on health outcomes - A systematic review

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BACKGROUND AND AIM: We aimed to synthesize scientific evidence about effectiveness of various community and household level interventions on improving air quality and its impact on health outcomes using systematic approach.

METHODS: Comprehensive strategy using key words and MeSH terms was used to carry out literature search in PubMed, Cochrane and Google scholar by two independent investigators. Research articles published till year 2021 focusing on interventions for improvement in air quality and health were selected using pre-specified eligibility criteria. All abstracts and full text articles for inclusion were reviewed independently by two investigators. Disagreements resolved by discussion with the third investigator. Quality of the studies was assessed using Joanna Briggs Institute critical appraisal tool and Cochrane Risk of Bias tool. PRISMA guidelines were used and review was registered in PROSPERO (CRD42022295393).

RESULTS: The search resulted in identification of 79,742 studies and 25 (trials and quasi experimental trials) were finally included in the review. The community level interventions (7 studies) were traffic rationing system, diesel emission control policies and industrial reforms. Household interventions (18 studies) were use of air purifiers/electric heaters, improved cookstove and behavioral change practice. Community based interventions resulted in reduction in all-cause mortality by 6% to 11%, cardiovascular mortality by 11% to 17.9%, respiratory mortality by 22% to 22.8%, infant mortality rates by 20% and number of asthma acute events by 41.6%. Household interventions resulted 0.8% change in lung function. PM 2.5 was most commonly reported air pollutant, its concentrations reduced in the range from 31% to 53% across the studies. Most of the studies scored higher in quality assessment.
CONCLUSION: Our review provided robust evidence for substantial improvements in morbidity and mortality related to air pollution due to household and community level interventions.

KEYWORDS: - Air pollution; community; interventions; household; health impact

THEMATIC 15: Mechanisms and Molecular Biomarkers

P-0950 Genome-wide SNP-by air pollution interaction and airflow obstruction development in the Dutch population-based Lifelines cohort

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BACKGROUND: Research has shown that exposure to air pollution is associated with the development of airflow obstruction (AO). However, not everybody is equally susceptible and individual risk may depend on genetics.
Aim: To identify single nucleotide polymorphisms (SNPs) that carry higher odds to develop AO upon exposure to air pollution.

METHODS: We included 25,506 participants of the Lifelines cohort study without AO (FEV1/FVC < lower limit of normal) at baseline. AO development was determined after 4.5 years of follow-up. Black carbon (BC), NO2, PM10, and PM2.5 exposure at the baseline home-address was estimated using land-use regression models. Logistic regression analyses including genome-wide SNP-by air pollution interactions for 2,769,714 SNPs and each air pollutant were performed. Different p-value thresholds were checked and independent loci were identified by LD-pruning (R2 < 0.8).

RESULTS: at follow-up, 2,464 (9.7%) subjects had developed AO. Depending on the p-value thresholds, 3 (p<1*10-6) to 202 (p<5*10-5) independent interacting loci were identified. The lowest p-value was found for rs16825276-by-PM2.5 interaction (p=1.7*10-7, annotated to ECE1 gene). Rs0183947394 (CD53 gene) significantly interacted with PM10 (p=4.6*10-7). SNPs in the LEMD1 gene significantly interacted with both BC and PM10. The lowest interaction p-value for NO2 was found for rs79787553 (p=5.3*10-6, SCL28A1 gene).

CONCLUSIONS: This study identified up to 202 significant independent SNP-by-air pollution interactions for AO development. Future studies will focus on analyzing the function of the identified genes and SNPs.

P-0955 Mediation effect of DNA methylations in the association between bisphenol A exposure and blood pressure

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BACKGROUND AND AIM: Bisphenol A (BPA) has been known to induce hypertension. However, BPA-related hypertension mechanism remains unclear. Our study aim was to explore epigenetic mechanism for how BPA exposure increases blood pressure (BP).

METHODS: We obtained information including urinary BPA levels, genome-wide DNA methylation levels, and blood pressure (BP) from an clinical trial study conducted with Korean elderly and evaluated the relations among them. Because the dataset had repeated measures, we analyzed the relations using mixed-effect model after adjusting for age, sex, body mass index, drinking status, a diabetic history, the round of visits, and visit date.

RESULTS: We found a positive association between BPA exposure and BP ($\beta = 1.28$ and $p = 0.0241$ for SBP; and $\beta = 0.58$ and $p = 0.0527$ for DBP) and the mediation effect of 285 DNA methylation sites in the association. Furthermore, downstream target genes of the 285 DNA methylation sites were significantly related with KEGG pathways including oxytocin signaling, calcium signaling, circadian entrainment, and amphetamine addiction as well as disease classes including immune and pharmacogenomic ($p < 0.05$ for all pathways and disease classes).

CONCLUSIONS: Our results indicate that BPA exposure could increase BP through DNA methylation changes and further this BPA-related methylation changes could affect several pathways, resulting in the development of various diseases.

KEYWORDS: bisphenol A, DNA methylation, blood pressure.

P-0956 Traffic-related air pollution in utero modifies cytokine responses to stimuli of umbilical cord blood cells: results from the NELA cohort

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BACKGROUND AND AIM: Effects of prenatal exposure to air pollution on offspring cytokine responses to stimuli have been poorly studied. We examined the associations between in utero exposure to traffic-related air pollutants (TRAP) and cytokine responses to stimuli in newborns.

METHODS: Data come from 235 participants of the NELA cohort. Inflammatory cytokines (IL-6, IFN- α, IL1-β and TNF-α), Th1-related (IFN-γ and IL-2), Th2-related (IL-4, IL-5 and IL-13), Th17-related (IL-17 and IL-23) and Treg-related IL-10 were assessed by Luminex technology in umbilical cord blood cultured with mitogens, pathogen associated with molecular patterns (PAMPs) stimuli and common allergens. In utero residential exposure to traffic-related nitrogen dioxide (NO_2), particulate matter ($PM_{2.5}$ and PM_{10}) and ozone (O_3) was estimated using dispersion/chemical transport modelling. Multivariable linear regression models were performed.

RESULTS: for every 10μg/m³ increase in prenatal exposure to NO_2, we found an increased IL-6 response to mitogens Concanavalin A (12.5%, 95% CI: 3.6, 21.4) and Phytohemagglutinin (PHA) (14.9%, 95% CI: 7.3, 22.5); to PAMPs Lipopolysaccharide (11.6%, 95% CI: 3.8, 19.5), Peptidoglycan (PG) (12.0%, 95% CI: 4.1, 20.0) and p:IC (13.0%, 95% CI: 4.9, 21.2); and to allergens Der p 1 (11.6%, 95% CI: 3.4, 19.9) and olive extract (9.7%, 95% CI: 0.4, 19.0). IL-6 response to PHA also increased in relation to PM (19.0% per 5μg/m³ increase in $PM_{2.5}$, 95% CI: 5.5, 32.5; and 20.2% per 10μg/m³ increase in PM_{10}, 95% CI: 6.0, 34.4). Per 10μg/m³ increase in NO_2, IFN-α responses to PHA and PG increased by 7.5% (95% CI: 0.6, 14.5) and 7.6% (95% CI: 0.1, 15.1), respectively. In utero NO_2 also induced an increased Th1-related IFN-γ response to mitogen Concanavalin A (7.5% per 10μg/m³ increase in NO_2, 95% CI: 0.1, 14.9).

CONCLUSIONS: Prenatal exposure to TRAP may promote higher proinflammatory and Th1-related cytokine responses to stimuli in the offspring.

P-0957 Oxidative potential in the exhaled air (OPEA): a candidate biomarker for respiratory diseases screening

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BACKGROUND AND AIM: OPEA is a physiological-related metric measured with a photonic sensing system, OPEA analyzer. OPEA must be corrected for the oxidative potential in ambient air (OPAA) as a dimensionless ratio OPEA/OPAA (cOPEA). In a hospital setting, OPEA allowed us distinguishing patients with and without chronic obstructive pulmonary disease, particularly among non-smokers. Using the setting of the Swiss health study, we aimed to assess whether OPEA would be increased in participants with abnormal spirometry parameters and in those who demonstrated an immunity against SARS-CoV-2. We also aimed to estimate OPEA reference interval (RI) necessary for interpreting clinical biomarker values.

METHODS: Swiss adult residents of the Vaud Canton randomly selected from the Federal Statistical Office's registries, speaking French or German were included and examined between 1.10.2020 and 31.12.2021. General health status and presence of respiratory diseases were assessed by questionnaire and spirometry. Spirometric results were compared with predicted values and their lower limits of norms for spirometric parameters (LLN) of the Global Lung Function Initiative. Seroprevalence was assessed using Luminex-based test of IgG. cOPEA means were compared using univariate t-test and multivariable regression. RI (lower and upper limit of OPEA values with associated 90%-confidence interval (90%CI) were estimated for the sub-sample of healthy adults by bootstrap, after excluding outliers.

RESULTS: The study sample included 247 participants. A borderline statistically significant difference in cOPEA was observed in participants with an obstructive syndrome. SARS-CoV-seropositive participants had a significantly higher cOPEA than seronegative participants did. After outlier exclusion, the reference sample included 184 participants and RI partitioning appeared unnecessary. Estimated RI was: 0.88 (90%CI=0.85;0.92); 0.97(90%CI=0.93;1.00).
CONCLUSION: OPEA could predict some respiratory affections, but needs further validation as a disease predictive biomarker in different settings. Our study sample was small and the estimated RI should be considered as preliminary and further confirmed.

P-0958 Metal exposure and oxidative stress biomarkers in subway workers

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BACKGROUND AND AIM: Rich in metals, subway particles could induce more oxidative stress (OS) than ambient PM. We aimed at investigating relationships between subway particle exposure and OS biomarkers measured in urine and exhaled breath condensate (EBC).

METHODS: Nine subway workers (station agents, locomotive operators and security guards) were monitored during their 6-h shifts over two consecutive weeks. Time-weighted average mass concentrations expressed as PM10, PM2.5 and their metal concentrations were determined. Urine and EBC samples were collected pre- and post-shift to measure metals, malondialdehyde, 8-isoprostane, and 8-hydroxy-deoxyguanine concentrations. Associations were first explored using correlation and hierarchical cluster analysis. The identified clusters were then investigated using linear mixed regression models adjusted for age and sex, with participant's ID as random effect.

RESULTS: PM concentrations varied significantly between jobs. Locomotive operators had the highest exposure (189 and 137 µg/m3 for PM10 and PM2.5, respectively). The most abundant metals in PM were Fe, Cu, Al and Zn; in EBC, Zn, Cu and Ni; and in urine, Si, Zn, Mo, Ti, and Cu. Regarding OS biomarkers, in EBC, only malondialdehyde was detected. Urinary malondialdehyde and 8-hydroxy-deoxyguanine concentrations varied according to the weekday and workers' age. Zn or Ni exposure clusters were identified. Modeled urinary Zn concentration was negatively associated with urinary malondialdehyde and positively associated with malondialdehyde in EBC. PM10 Zn was also negatively associated with urinary malondialdehyde and 8-isoprostane, but with borderline significance. PM10 Ni was negatively associated with urinary 8-hydroxy-deoxyguanine. In models adjusted for all exposure metrics of a given metal, associations remained between urinary Zn and malondialdehyde and between urinary Ni and 8-hydroxy-deoxyguanine.
CONCLUSION: These findings suggest Zn and Ni influence in OS reflected by urinary malondialdehyde and 8-hydroxy-deoxyguanine concentrations. Further investigations based on larger datasets and in-depth time-series analysis are needed to understand the underlying mechanism of these associations.

P-0959 A modern biodosimetric re-assessment of three mile island exposures using whole genome directional genomic hybridization (DGH)

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BACKGROUND AND AIM: About 22,000,000 Curies of radioactive xenon-133 escaped into the environment following the 1979 accident at the Three Mile Island nuclear power station in Pennsylvania. Anecdotal evidence of symptoms consistent with radiation exposure were contemporaneously reported, and a limited biodosimetric investigation performed in 1994 produced evidence consistent with significant radiation exposure. Subsequent epidemiological investigations have produced equivocal findings. We aim to re-assess the impact of the unique TMI exposure using a state-of-the-art method of cytogenomic analysis by joining, for the first time, the recently proposed physics of radiobiological shot noise with environmental epidemiology.
METHODS: We employ a modern cytogenomics technology for evaluation of radiation-induced DNA damage. Our innovative technology is known as directional genomic hybridization (dGH). The dGH methodology enables high-resolution detection of both translocations and inversions, which when symmetrical are stable biomarkers of prior radiation exposure. The strand-specificity of the dGH methodology enables detection of inversions at much higher resolution than was possible previously, while simultaneously also detecting translocations. Inversions are induced at a greater rate than are translocations, creating a more sensitive "biodosimeter". The detection power of the approach is enhanced by employing five colors to paint all twenty-three chromosome pairs, while adding automation using artificial intelligence and machine learning to speed aberration scoring.

RESULTS: AND CONCLUSIONS: Based on preliminary data from four exposed and four unexposed individuals, matched for location, age, and sex, we have demonstrated the feasibility of our approach. Although at the present time no inference regarding the degree of exposure can be supported, representative images demonstrating the resolution of the dGH technology will be presented. We have laid the foundation for a larger study of TMI-exposed individuals to come. Our approach may evolve to become the new standard for quality and sensitivity in retrospective biodosimetry.

KEYWORDS: biodosimetry, cytogenetics, ionizing radiation

P-0960 Newborn Metabolomic Signatures of Maternal Serum Per- and Polyfluoroalkyl Substance Levels and Reduced Length of Gestation: A Prospective Analysis in the Atlanta African American Maternal-Child Cohort

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BACKGROUND AND AIM: Preterm birth (PTB; 22–<37 gestational weeks) and early term birth (ETB; 37–38 gestational weeks) disproportionately affect marginalized populations. Exposure to per- and polyfluoroalkyl substances (PFAS) has been reported to reduce length of gestation, but the underlying mechanisms are unknown. Our aim was to characterize the molecular signatures of prenatal PFAS exposure and gestational age at birth outcomes in the newborn dried blood spot (DBS) metabolome.

METHODS: This prospective cohort study included 267 African American pregnant people who gave birth to a singleton in Atlanta, Georgia between 2016 and 2020. Maternal PFAS concentrations were measured in serum samples obtained between 6–17 gestational weeks. Linear and logistic regression was used to assess associations between PFAS concentrations and gestational weeks at birth or PTB and ETB compared to full-term birth, respectively. Molecular signatures of the exposure-outcome relationships were phenotyped in newborn DBS samples with high-resolution metabolomics.

RESULTS: The mean gestational age was 38.7±2.0 weeks. Relative to the lowest quartile, the second quartile of serum perfluorooctanoic acid (PFOA) concentration was significantly associated with increased odds of ETB (odds ratio (OR), 2.85; 95% CI 1.16, 7.02) and the second quartile of perfluorohexane sulfonic acid (PFHxS) concentration was significantly associated with medically-indicated PTB or ETB (OR, 6.39; 95% CI 1.20, 34.09) versus healthy full-term birth. After false discovery rate correction, 8 pathways and 52 metabolites were associated with PFAS exposure and gestational age at birth outcomes.
DISCUSSION: In this study, pregnant people with higher PFOA and PFHxS concentrations had increased odds of an early birth prior to full-term. The effect of prenatal PFAS exposure on reduced length of gestation was associated with perturbed tissue neogenesis, neuroendocrine function, and redox homeostasis in the newborn DBS metabolome. These mechanisms may be translated into strategies for addressing maternal and child health disparities affecting African Americans.

P-0961 Epigenetic biomarkers of lead exposure and cardiovascular disease: prospective evidence in the Strong Heart Study

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BACKGROUND AND AIM: Lead is a cardiotoxic metal associated with adverse health effects. Data on lead exposure, however, is difficult to collect and often missing from population-based studies of cardiovascular disease (CVD) and risk factors. In the absence of lead data, epigenetic biomarkers can serve as indicators of lead exposure. Here, we leveraged novel epigenetic biomarkers of lead exposure to investigate their association with CVD incidence and mortality in the Strong Heart Study (SHS), a study of CVD in American Indian adults.

METHODS: Blood DNA methylation was measured using the Illumina MethylationEPIC BeadChip among 2,231 SHS participants at baseline (1989-1991). Epigenetic biomarkers of lead concentrations in blood, patella, and tibia were estimated using previously identified CpG sites developed in the Normative Aging Study, a study of aging in adult men. Cox proportional hazards models were performed to estimate the risk of incident CVD and CVD mortality.

RESULTS: Median concentrations of lead epigenetic biomarkers were 13.8 µg/g, 21.3 µg/g, and 2.9 µg/dL in tibia, patella, and blood. In fully adjusted models, the hazard ratio (HR) (95% CI) of CVD mortality per doubling increase in lead epigenetic biomarkers were 1.42 (1.07-1.87) for tibia lead, 1.22 (0.93-1.60) for patella lead, and 1.57 (1.16-2.11) for blood lead. The HRs for incident CVD were 0.99 (0.83-1.19), 1.07 (0.89-1.29), and 1.06 (0.87-1.30), respectively. The association between the tibia lead epigenetic biomarker and CVD mortality was modified by sex (interaction p-value: 0.014), with men at increased risk (1.42, 1.17-1.72) compared to women (1.04, 0.89-1.22).

CONCLUSIONS: Tibia and blood epigenetic biomarkers were associated with increased risk of CVD mortality, potentially reflecting the cardiovascular impact of cumulative and recent lead exposures. These findings support that these epigenetic biomarkers may capture some of the CVD disease risk associated with lead exposure.

KEYWORDS: lead, epigenetic biomarkers, DNA-methylation, American Indians, cardiovascular disease.

P-0962 Associations between air pollution, residential greenness, and glycated hemoglobin (HbA1c) in the three prospective cohorts of U.S. adults

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BACKGROUND AND AIM: While studies suggest impacts of individual environmental exposures on type 2 diabetes (T2D) risk, the biological mechanisms remain poorly characterized. Glycated hemoglobin (HbA1c) is an important biomarker for diagnosing prediabetes and predicting T2D risk. We explored associations between multiple environmental exposures and HbA1c.

METHODS: HbA1c was assessed in 12,698 non-diabetic women and men in three U.S.-based prospective cohorts: the Nurses' Health Study (NHS) in 1990, the Nurses' Health Study II (NHSII) in 1998, and the Health Professionals Follow-up Study (HPFS) in 1993. Residential greenness data within 270m and 1,230m (normalized difference vegetation index, NDVI) was obtained from Landsat. Fine particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2) were estimated from nationwide spatiotemporal models. Three-month and one-year average exposures prior to blood draw were assigned to participants' addresses. We used single and multi-exposure linear regression models, as well as mixture methods such as models with component scores from Principal Components Analysis (PCA), to assess associations with HbA1c. We first applied basic models adjusted for age and year at blood draw, BMI, alcohol use, and neighborhood socioeconomic status (nSES). In fully-adjusted models, we included overall diet quality, race, family history, smoking status, postmenopausal hormone use, population density, and season. We assessed potential modification via stratification.

RESULTS: Based on HbA1c thresholds, 19% of participants had prediabetes. In basic models, we observed a small negative association between $PM_{2.5}$ and HbA1c: an IQR increase was associated with a 0.28% (95% CI: 0.54%, 0.02%) lower HbA1c. In fully-adjusted models, we did not find any associations between the individual exposures or the component scores and HbA1c. There was no evidence of differing associations by sex, nSES, or population density.

CONCLUSIONS: In this study of adults, environmental exposures were not associated with HbA1c. More work is needed to elucidate biological pathways between the environment and prediabetes.

P-0963 Associations between Oxidative/Nitrosative Stress and Thyroid Hormones in Pregnant Taiwanese Women- A Birth Cohort Study

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BACKGROUND AND AIM: Thyroid function has been related to oxidative and nitrosative stress in both animal and human studies. In this study, we investigated the link between oxidative and nitrosative stress and thyroid hormones in pregnant women.

METHODS: During the first, second, and third trimesters, 97 Taiwanese pregnant women were measured. Levels of five oxidative and nitrosative stress biomarkers (8-hydroxy-2'-deoxyguanosine [8-OHdG], 8-nitroguanine [8-NO2Gua], 4-hydroxy-2-nonenal-mercapturic acid [HNE-MA], 8-isoprostaglandin F2α [8-isoPGF2α], and malondialdehyde [MDA]) were measured using urine samples, and levels of five thyroid hormones (triiodothyronine [T3], thyroxine [T4], free T4, thyroid-stimulating hormone [TSH], and T4-binding globulin [TBG]) were measured in blood samples. The correlations between oxidative or nitrosative stress biomarkers and thyroid hormones in pregnant women were investigated using multiple linear regressions and linear mixed model regressions.

RESULTS: We found that TSH was negatively and significantly correlated with 8-NO2Gua and HNE-MA levels. However, T4 and free T4 levels were positively and significantly correlated with 8-NO2Gua. The T4 to TBG and free T4 to TBG ratios were positively and significantly correlated with 8-NO2Gua level. But, the TSH to T4 ratio was negatively and significantly correlated with 8-NO2Gua level. The T3 to TSH ratio was positively and significantly correlated with HNE-MA level. Nevertheless, the TSH to T4 and TSH to free T4 ratios were negatively and significantly correlated with HNE-MA level.

CONCLUSIONS: Our findings imply that an imbalance of oxidative and nitrosative stress during pregnancy might affect thyroid hormone homeostasis. During pregnancy, disruption of the maternal thyroid homeostasis might have an impact on embryonic and fetal development.

KEYWORDS: oxidative stress; nitrosative stress; thyroid hormone; lipid peroxidation; pregnancy

P-0964 Mediation Effects of Thyroid Function in the Associations between Phthalate Exposure and Glucose Metabolism in Taiwanese Adults

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BACKGROUND AND AIM: The mediating influence of thyroid function on the association of phthalate exposure with glucose metabolism, including insulin resistance, remains unclear. We explored the mediating influence of thyroid hormone levels on the phthalate exposure-insulin resistance association.

METHODS: This cross-sectional study of 217 Taiwanese adults assessed insulin resistance (Homeostatic Model Assessment for Insulin Resistance, HOMA-IR scores) and the levels of 11 urinary phthalate metabolites and 5 thyroid hormones. Multiple regression models were used to analyze the associations among serum thyroid hormone levels, urinary phthalate metabolite levels, and HOMA-IR scores. The mediation analysis assessed the influence of thyroid function on the phthalate exposure-HOMA-IR association.

RESULTS: Our data indicated urinary mono-ethylhexyl phthalate (MEHP) levels was negatively associated with free thyroxine (T4) (β=-0.018; 95% confidence interval [CI]: -0.031, -0.005) and positively associated with HOMA-IR scores (β=0.051, 95% CI: 0.012, 0.090). The study also revealed urinary mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP) levels was negatively associated with free T4 (β=-0.036, 95% CI: -0.056, -0.017) and HOMA-IR (β=0.070, 95% CI: 0.013, 0.126). Free T4 and HOMA-IR had a negative association (β=-0.757, 95% CI: -1.122, -0.392). In the mediation analysis, free T4 mediated 24% and 35% of the associations of urinary MEHP and MEOHP with HOMA-IR, respectively.

CONCLUSIONS: Our findings revealed the mediating role of thyroid function in the phthalate exposure-glucose metabolism association in adults.

KEYWORDS: Phthalates; Thyroid hormones; Insulin resistance; Glucose metabolism; Mediation effects

P-0969 Solar activity and urinary melatonin levels in the US-based Nurses' Health Study, Nurses' Health Study II, and the Growing Up Today Study

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BACKGROUND AND AIM: The Sun's magnetic field flips over the course of an 11-year period, oscillating between increased and reduced solar activity, referred to as a solar cycle. These fluctuations in solar activity during the solar cycle are reflected in variation of solar electromagnetic radiation and of geomagnetic disturbances. Solar activity has been linked to adverse health effects, potentially due to circadian disruption. We evaluated the associations between urinary melatonin (6-sulfatoxymelatonin) and solar activity exposures (sunspot number, Kp index, and interplanetary magnetic field strength (IMF)) in the prospective US-based Nurses' Health Study (NHS), Nurses' Health Study II (NHSII), and Growing Up Today Study (GUTS) cohorts.

METHODS: From 1996 to 2017, 7,936 participants from NHS, NHSII, and GUTS provided urinary samples that were assayed for 6-sulfatoxymelatonin (aMT6). Daily exposures to sunspot number, Kp index, and IMF were estimated from NASA Goddard Space Flight Center. We used Spearman correlations and linear regression to estimate the beta coefficients for a one standard deviation increase in each solar activity exposure on log-transformed aMT6 adjusted for creatinine. We examined same day and 7-day moving average exposures, and adjusted for age, sex, BMI (body mass index), time of urine collection, seasonality, if the urine was a first morning sample, and UV (ultraviolet) exposure.

RESULTS: There were statistically significant negative correlations between all of the solar exposures and aMT6. However, after adjustment for potential confounders, there were no associations between same-day exposures to sunspot number (0.28; 95% CI: -0.072, 0.016), Kp index (0.012; 95% CI: -0.019, 0.044), or IMF (-0.005; 95% CI: -0.036, 0.025) and aMT6. Similarly, we found no associations with 7-day moving averages.

CONCLUSIONS: In these three prospective US-based cohorts, we did not find evidence of an association between solar activity exposures and urinary melatonin after adjustment for potential confounders.

KEYWORDS: Solar activity, melatonin

P-0970 PFAS concentrations associate with placental transcriptomic activity: a pilot study

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BACKGROUND AND AIM: Endocrine-disrupting chemicals (EDCs) such as environmentally ubiquitous per- and polyfluoroalkyl substances (PFAS) likely contribute to the obesity epidemic. The prenatal period is a critical window for EDC exposures and the placenta is a potential target due to its plethora of endocrine-activities and roles in supporting fetal growth. Yet, the placenta is an understudied target of PFAS. In this pilot study, we aimed to examine whether placental concentrations of PFAS were associated with placental gene expression profiles.

METHODS: Study participants were enrolled in the Glowing study, and the placental transcriptome was assessed with mRNA-sequencing. Concentrations of PFBS, PFOS, PFNA, PFOA, and PFHxS were measured in 29 term placental samples using ultra-performance liquid chromatography-tandem mass spectrometry. We tested for differential gene expression associated with increasing placental PFAS concentrations while adjusting for surrogate variables and other potential confounders.

RESULTS: In placental samples, PFOS had the highest median concentration (5.54 ng/g), followed by PFHxS (3.0 ng/g), PFNA (0.89 ng/g), PFOA (0.72 ng/g) and PFBS (0.45 ng/g). PFOA exhibited the strongest associations, with 13 genes (FAM38D, TTK, DDIAS, CDC20, CDCA3, BUB1B, EME1, TOP2A, BRCA2, RAD51, CCDC18, E2F2, and ESPL1) having decreased expression associated with increased PFOA (FDR < 10%). The other PFAS were not significantly associated with gene expression levels at FDR < 10%, which may be due to the limited sample size of this pilot study.

CONCLUSIONS: PFAS may influence placental function via altered gene-expression, which requires further study. Interestingly, of the 13 genes whose expression levels decreased with higher PFOA concentration, 7 have been implicated for having roles in obesity, cholesterol levels, and anthropometric characteristics via prior GWAS. Ongoing analyses are underway to encompass the entire Glowing study, and to investigate the relationships between prenatal PFAS, placental molecular activity, postnatal growth and adiposity.

KEYWORDS: Placenta, PFAS, Transcriptome, Gene Expression

P-0971 Metabolic signatures associated with diet quality in young adults

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BACKGROUND/AIM:
Poor diet is a known risk factor for many noncommunicable diseases, including cancer and type 2 diabetes. Metabolomics is an emerging exposure assessment method that may improve nutrition assessment and identify biomarkers related to diet and disease. The purpose of this study was to identify metabolites and metabolic pathways associated with diet quality.

METHODS: We used untargeted metabolomics, determined using liquid chromatography-mass spectroscopy, to evaluate the relationship between metabolic pathways and diet quality in young adults from the Metabolic and Asthma Incidence Research (Meta-AIR) cohort (n=124). Four diet quality indices were evaluated: Dietary Approaches to Stop Hypertension (DASH) score, Healthy Eating Index 2015 (HEI-2015), Mediterranean diet score (MDS), and the Diet Inflammatory Index (DII). Functional pathway analysis was performed with MetaboAnalyst version 5.0, using effect estimates generated from metabolome-wide association studies to identify metabolic pathways with significant ($p<0.05$) enrichment. Analyses were performed for each diet index separately and adjusted for age, sex, ethnicity, and body mass index.

RESULTS: MDS, HEI-2015, DASH, and DII were associated with 13, 8, 6, and 5 pathways, respectively. Enriched pathways related to lipid metabolism were associated with DASH (arachidonic acid metabolism, $p=0.030$), HEI-2015 (carnitine shuttle, $p=0.0078$), and MDS (de novo fatty acid biosynthesis, $p<0.001$; fatty acid activation, $p<0.001$; fatty acid metabolism, $p=0.034$). These three were additionally significantly associated with vitamin B6 metabolism (DASH: $p=0.043$, HEI-2015: $p=0.0026$, MDS: $p=0.036$) and the metabolism of other vitamins and cofactors. Enriched pathways related to amino acid metabolism were also identified for all four diet indices.
CONCLUSIONS: Diet quality was associated with biological pathways related to the metabolism of important nutrients, some of which are involved in inflammatory responses. These associations may be used to identify biomarkers indicative of diet quality or describe the metabolic effects of higher quality diets.

KEYWORDS:
Food/nutrition, exposure assessment, biomarkers of exposure, metabolomics

P-0973 Using Follicular Fluid Metabolomics to Investigate the Association between Air Pollution and Oocyte Quality

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BACKGROUND AND AIM: Our objective was to use metabolomics in a toxicological-relevant target tissue to gain insight into the biological processes that may underlie the negative association between air pollution exposure and oocyte quality.

METHODS: Our study included 125 women undergoing in vitro fertilization at an academic fertility center in the northeastern USA (2005-2015). A follicular fluid sample was collected during oocyte retrieval and untargeted metabolic profiling was conducted using liquid chromatography with ultra-high-resolution mass spectrometry and two technical columns (C18 negative, HILIC positive). Daily exposure to nitrogen dioxide (NO2), ozone, fine particulate matter, and black carbon was estimated at the women's residence using spatiotemporal models and averaged over the period of ovarian stimulation (2-weeks). Multivariable linear regression models were used to evaluate the associations between the air pollutants, number of mature oocytes, and metabolic feature intensities. A meet-in-the-middle approach was used to identify overlapping features and metabolic pathways.

RESULTS: of the air pollutants, NO2 exposure had the largest number of overlapping metabolites (C18:105, HILIC:91) and biological pathways (C18:3, HILIC:6) with number of mature oocytes. Key pathways of overlap included vitamin D3 metabolism (both columns), bile acid biosynthesis (both columns), C21-steroid hormone metabolism (HILIC), androgen and estrogen metabolism (HILIC), vitamin A metabolism (HILIC), carnitine shuttle (HILIC), and prostaglandin formation (C18). Three overlapping metabolites were annotated with level-1 evidence. for example, hypoxanthine, a metabolite that protects against oxidant-induced cell injury, was positively associated with NO2 exposure and negatively associated with number of mature oocytes. Minimal overlap was observed between the other pollutants and number of mature oocytes retrieved.

CONCLUSIONS: Higher exposure to NO2 during ovarian stimulation was associated with many metabolites and biologic pathways involved in endogenous vitamin metabolism, hormone synthesis, and oxidative stress that may mediate the associations with lower oocyte quality.

KEYWORDS: Air pollution, Fertility, Metabolomics, Ovary

P-0974 Prenatal exposure to outdoor air pollution and miRNA expression in cord blood at birth: the NELA study

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BACKGROUND AND AIM: Air pollution is a complex chemical mixture known as a risk factor for non-communicable diseases. Mechanisms underlying its adverse effects could involve changes in miRNA expression. We aimed to identify the effects of maternal exposure to air pollution during pregnancy on miRNAs expression in cord blood at birth; and to unravel windows of vulnerability across gestation.

METHODS: Data came from 362 participants of the Nutrition in Early Life and Asthma (NELA) study, a prospective population-based birth cohort from Spain. RNA samples were isolated from umbilical vein cord blood samples at birth; miRNAs were hybridized and analyzed using SurePrint miRNA microarrays. Residential exposure to outdoor air pollution was estimated using dispersion/chemical transport modelling. Exposures showed high correlation coefficients, so a cluster analysis was performed to reduce dimensionality and avoid multi-collinearity. Associations between groups of exposure and miRNA expression were studied using multivariate linear regression models and over-representation analysis. Air pollutant mixture analyses were performed using the Bayesian Kernel machine regression model, to assess mixture effects and the relative contribution of each pollutant, and the Lagged kernel machine regression, to identify specific windows of vulnerability.

RESULTS: Exposure to PM_{10} and O_3 levels during the first and third trimesters of pregnancy showed changes in 32 miRNAs in cord blood, and two enriched pathways were found: Alzheimer's disease and adherens junction. Mixture analysis estimated that maternal exposure to O_3 altered hsa-miR-30a-5p and hsa-miR-30c-5p expression, in the second and third trimester of pregnancy, respectively.

CONCLUSIONS: Prenatal exposure to air pollution alters miRNA expression in the offspring at birth. Our results suggest that windows of vulnerability vary depending on the specific pollutant affecting distinct miRNA

P-0977 Prenatal Bisphenol S and Postnatal High-Fat Diet Influence DNA Methylation of the Mest Gene in F1 Male Mice

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BACKGROUND AND AIM: Exposure to environmental chemicals during development may increase the susceptibility to adiposity/obesity in adolescence and adulthood. Bisphenol S (BPS) has been suspected as an obesogen after perinatal exposure. Previously, we reported adipocyte hypertrophy in the gonadal white adipose tissue (gWAT) of F1 male mice after the prenatal exposure to BPS followed by high-fat diet (HFD) in adulthood. The expression of the mesoderm-specific transcript (Mest) gene is shown to correlate with adipocyte size and adiposity. Our study aimed to investigate the environmentally induced epigenetic modulation, such as DNA methylation changes in Mest, leading to gonadal adiposity of male offspring.

METHODS: The mRNA expression of Mest in the gWAT of F1 male mice (C57BL/6N) was analyzed by reverse transcription-quantitative PCR (RT-qPCR). We performed bisulfite amplicon sequencing (BSAS) analysis to identify the CpG dinucleotides at the differentially methylated region (DMR) of Mest that were associated with adiposity phenotype. The DNA methylation levels of the site-specific CpGs were quantified by targeted bisulfite pyrosequencing.

RESULTS: The Mest mRNA levels in the gWAT increased in a dose-dependent manner, compared to the BPS-unexposed control. Three CpG loci exhibiting significant differences in DNA methylation were identified through BSAS analysis of the Mest DMR. Consistent with BSAS data, each site-specific CpG at the Mest DMR was found to be differentially methylated among extreme groups with both gWAT/body weight ratio and the Mest expression levels.

CONCLUSIONS: Our study suggests that prenatal BPS and postnatal HFD might induce epigenetic influence, i.e., DNA methylation changes, on the Mest DMR, and consequently contribute to the gonadal adiposity in F1 male mice. Furthermore, the distinct epigenotype of Mest could be utilized as a biomarker of the exposure to potential adipogenic epigenotoxicants.

KEYWORDS: Bisphenol S, high-fat diet, gonadal adiposity, Mest, epigenetic modulation, DNA methylation

P-0980 Metabolomic Changes Associated With Chronic Arsenic Exposure in a Bangladeshi Population

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Our understanding of the pathways underlying the effects of arsenic (As) remains incomplete, in part because studies historically focused on individual targets. High-resolution metabolomics can capture changes more proximal to disease and integrates changes in multiple regulatory processes, providing a systems biology approach that will facilitate a more comprehensive understanding of the biological impacts of As exposure.

We selected 60 adults from the Folic Acid and Creatine Trial (FACT). Inorganic (AsIII, AsV) and organic (monomethylarsonous acid [MMAs], dimethylarsinous Acid [DMAs]) As species were measured in blood and urine collected at baseline and 12 weeks follow-up. Untargeted metabolomic profiles were measured by dual column liquid chromatography interfaced to a high-resolution mass spectrometer. We estimated the associations of blood and urinary As species with 170 confirmed metabolites and >26,000 untargeted metabolite features using a metabolome-wide association study (MWAS) approach. Models were adjusted for age, sex, visit, and BMI and corrected for multiple testing. Biological response was characterized using pathway enrichment analysis.

MWAS using identified metabolites detected 17 associated with ≥1 blood As species ($q<0.05$), the majority of which were fatty acids, neurotransmitter metabolites, and amino acids. Model results were consistent across As species and between blood and urine species. The full MWAS using all metabolite features identified 423 features associated with ≥1 blood As species. Unlike the confirmed metabolites, the results were not consistent across different As species, with AsV and DMAs showing distinct association patterns. Pathway analysis revealed 12 enriched metabolic pathways that overlap with the 17 identified metabolites, including one carbon metabolism, tricarboxylic acid cycle, fatty acid metabolism, and purine metabolism.

Our MWAS was able to recapitulate expected metabolomic alterations associated with As and identify novel metabolites and pathways not previously known to associate with As.

KEYWORDS: arsenic, metabolomics, one carbon metabolism, TCA, krebs, purine metabolism, uric acid, urate, neurotransmitter

P-0981 Maternal blood pressure associates with placental DNA methylation both directly and through alterations in cell-type composition

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BACKGROUND AND AIM: Blood pressure levels are markedly affected by numerous environmental factors including temperature levels and drastic changes, ambient air pollution and noise. During pregnancy, maternal hypertension is associated with impaired placental development and an increased risk for children to suffer from cardiovascular and respiratory diseases later on. Alterations in placental state and functions, induced by the maternal and fetal environment, can be reflected by changes in DNA methylation levels and cell-type composition.
This study aims to discover epigenetic biomarkers of placental stress related to maternal blood pressure during pregnancy.

METHODS: Relying on a large cohort of 666 participants, we investigated the association between epigenome-wide DNA methylation in the placenta, measured using the Infinium HumanMethylation450 BeadChip, and maternal steady and pulsatile blood pressure indicators during pregnancy.

RESULTS: Our analyses highlighted 64 differentially methylated regions significantly associated with at least one blood pressure indicator which are enriched for genes implicated in lung development and diseases. Moreover, maternal blood pressure levels were significantly associated with placental cell-type composition. In particular, elevated blood pressure levels were associated with a decrease in the ratio between stromal cells and syncytiotrophoblasts. Further mediation analyses show that a significant part of the influence of steady blood pressure - but not pulsatile pressure - over placental methylation is mediated by perturbations in placental cell-type composition.

CONCLUSIONS: Our study provides the first evidence that maternal blood pressure during pregnancy has both direct and indirect effects, through cell-type composition alterations, on placental DNA methylation. These results could hint at molecular mechanisms linking maternal hypertension to lung development and early origins of childhood respiratory problems.

KEYWORDS: Blood Pressure, DNA methylation, Epigenetics, Placenta

P-0985 Air Pollution Exposure and Human Endogenous Retrovirus Methylation in the School Inner-City Asthma Intervention Study

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BACKGROUND AND AIMS: Human endogenous retroviruses (HERVs) are transposable genomic elements. Usually repressed through DNA methylation, HERVs can be demethylated in response to environmental stimuli, and their expression may lead to dysregulation of the immune system. More research is needed to understand the influence of environmental exposures on HERV methylation, and as air pollutants are commonly linked with immune system dysregulation, our objective was to examine the association of air pollutant exposure with HERVs demethylation.

METHODS: The sample included 180 students with asthma from the School Inner-City Asthma Intervention Study (SICAS-2) recruited from 2015 to 2020. SICAS-2 is a controlled, group randomized trial evaluating the use of classroom HEPA air filters and school-wide integrated pest management (IPM) on air pollutant/allergen exposure and asthma outcomes. Air pollutants (CO2, NO2, PM2.5, coarse PM, and black carbon) were measured in classrooms before and after intervention. Buccal swabs were collected pre- and post-intervention, and methylation levels from 9 transposable genomic elements (HERV-E, -FRD, -K, -L, -R, -W, -9, and HRES and LINE1) were measured. Generalized estimating equations were used to estimate associations between HERV methylation and intervention. Multivariable linear regression analyses were run to assess associations with air pollutant exposure.

RESULTS: Neither intervention (HEPA/IPM), nor intervention-induced changes in air pollutants were associated with HERV methylation. However, after adjusting for intervention and plate number, pre-intervention PM2.5 was associated with a decrease in log-transformed post-intervention HERV-9 methylation (β =-0.22, 95% CI: -0.34, -0.11). Furthermore, pre-intervention black carbon (β = 0.87, 95% CI: 0.30, 1.4) and PM2.5 (β = 0.035, 95% CI: 0.004, 0.07) were associated with an increase in log-transformed post-intervention HERV-W methylation.

CONCLUSIONS: These results suggest that exposure to PM2.5 and black carbon may be associated with HERV methylation in children with asthma. This is the first report of air pollutant exposure on HERV methylation.

P-0986 Smoky coal exposure is associated with increased white blood cell DNA Alu retroelement copy number

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BACKGROUND: The lung cancer rate for never-smoking women in Xuanwei, China, where coal is used extensively for home heating and cooking, is among the highest in the world. This excess is due almost entirely to household air pollution (HAP) from smoky (bituminous) coal used for home heating and cooking, which produces multiple toxic constituents including polycyclic aromatic hydrocarbons (PAHs). Alu retroelements, which are repetitive mobile DNA sequences that can multiply and affect genomic stability, have been associated with diesel engine exhaust exposure and prospectively linked to lung cancer risk. To explore the relationship between genotoxic carcinogens and Alu repeats, we assessed the association between HAP and Alu copy number.

METHODS: A cross-sectional study of 158 never-smoking women with repeat sampling of 48 subjects was conducted in Xuanwei, China. Quantitative PCR was used to measure Alu repeat copy number relative to albumin gene copy number (Alu/ALB ratio), reflecting the average quantity of Alu repeats per cell, in white blood cell DNA. Exposure models were used to predict levels of current exposure to 43 individual household air pollutants. Hierarchical clustering of the air pollutants was conducted to address collinearity, and generalized estimating equations were used to take into account Alu copy number measured in repeat samples.

RESULTS: A cluster of 31 PAHs was associated with increased Alu copy number (β:0.03(95% confidence interval:0.01,0.04) per SD;P-value=0.001). One compound within this cluster, 5-methylchrysene, which has been associated with lung cancer risk in Xuanwei and was selected a priori for analysis, was also associated with increased Alu copy number (P-value=0.0097).

CONCLUSIONS: Our findings suggest that exposure to PAHs from HAP due to household smoky coal combustion may contribute to genomic instability. Future work in larger studies and among those exposed to other types of coal, wood, and biomass combustion is warranted.

KEYWORDS: Solid fuel use, Alu, PAHs

P-0987 Associations between prenatal PM2.5 exposure and placental long non-coding RNA expression

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KEYWORDS: PM2.5, placenta, lncRNA

BACKGROUND/AIM: Few studies have examined placental long non-coding RNA expression in relation to maternal PM2.5 exposure during pregnancy. We addressed this gap by investigating overall and infant sex-specific associations of placental lncRNA expression with prenatal maternal PM2.5 exposure during several exposure windows in two birth cohorts.

METHODS: Placental samples were collected from maternal-infant dyads recruited to the CANDLE (Memphis, TN) (n=776) and GAPPS (Seattle and Yakima, WA) (n=200) cohorts. Average PM2.5 exposure was estimated using a spatiotemporal model for six exposure windows: the first month, first, second and third trimesters, last month, and the full duration of each pregnancy. Cohort-specific linear models were fit by exposure window for >6,000 lncRNA transcripts and adjusted for potential confounders and experimental variables. We assessed infant sex interaction using interaction terms and sex-stratified models. All models used FDR<0.10.

RESULTS: No lncRNA transcripts were significantly associated with PM2.5 exposure in main or interaction models in GAPPS. In CANDLE, first trimester PM2.5 levels were associated with lower expression of AC113410.5 (logFC=-0.163, FDR=0.014) and higher expression of LINC00702 (logFC=0.108, FDR=0.093), and third trimester PM2.5 levels were associated with higher expression of LINC02280 (logFC=0.180, FDR=0.016). Additionally, offspring sex interacted significantly with final-month PM2.5 on ACO92268.2 expression and with full-pregnancy PM2.5 on LINC00339 (interaction FDR=0.002 and 0.012, respectively). Sex-stratified analysis indicated both transcripts were upregulated in male infants and downregulated in females with higher PM2.5 exposure, though associations were not statistically significant in these models.

CONCLUSIONS: PM2.5 exposure was not significantly associated with lncRNA expression in GAPPS. However, it was associated with altered expression of five lncRNA transcripts in CANDLE, including two associations that varied sex-specifically. While three of these transcripts (LINC00702, LINC02280 and LINC00339) are potentially linked to cancer etiology, further analysis is required to understand their functional significance in the placenta during pregnancy.

P-0988 Associations between metals and metabolomic profiles related to diabetes among adults in a rural region

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BACKGROUND AND AIM: Exposure to metals is associated with increased risk of type 2 diabetes (T2D). Putative mechanisms involve oxidative stress and disruption of insulin-regulated glucose uptake. Here we present findings from a pilot study evaluating the hypothesis that the associations between metal exposure and diabetes are mediated by alterations in endogenous metabolite profiles.

METHODS: We analyzed urinary metal concentrations and plasma metabolites from 29 adults enrolled in the San Luis Valley Diabetes Study in rural Colorado. Concentrations of arsenic, cadmium, cobalt, lead, manganese, tungsten, and uranium were measured in urine, and plasma metabolites were analyzed using untargeted high-resolution mass spectrometry. To assess metabolic effects of metal exposure, we evaluated bivariate associations between each metabolite feature present in more than 50% of samples and metal levels with a 20% FUntargeted metabolite features were evaluated using Mummichog for pathway enrichment analysis for metabolites associated ($p < 0.05$) with each metal. Altered pathways were identified using a significance level < 0.05.

RESULTS: Participants had a mean age of 58.5 years (standard deviation = 9.20.), 48.3% were female, 48.3% were Hispanic, 13.8% were current smokers, and 65.5% had diabetes. Detected mass spectral signals included 786 metabolite features associated with at least one metal, including 133 associated with arsenic, 147 with cadmium, 7 with cobalt, 325 with lead, 92 with manganese, 5 with tungsten, and 77 with uranium. The metabolite features were linked to 35 pathways including butanoate metabolism, arginine and proline metabolism, aspartate and asparagine metabolism, lysine metabolism, and urea cycle/amino group metabolism. Several of these pathways have been previously associated with diabetes.

CONCLUSIONS: Our pilot results support the hypothesis that metals exposure may be associated with biological processes related to diabetes burden.

KEYWORDS: metabolomics, metals, diabetes, rural health, pathway enrichment

P-0989 Harnessing Extracellular Vesicle's for Elucidating Racial/Ethnic Disparity in Alzheimer's Disease and Related Dementia Risk in Light of Air Pollution Exposure

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BACKGROUND AND AIM: Extracellular Vesicle's (EVs) are involved in the physiological function of neurons in the brain, but also the pathological spread of proteins that contribute to neurodegeneration (ND) and Alzheimer's Disease (AD). Exposure to components of ambient air pollution has been associated with ND/AD and can alter EVs mechanisms. This study aims to determine whether racial/ethnic disparities in AD risk might be explained by differences in EVs production and neurotoxic protein cargo, and whether ambient air pollution exposure has a modifying effect.

METHODS: EVs isolated from plasma samples (NOMEM cohort) were immunoprecipitated to capture neuron-derived EVs (NDEVs). NDEVs Tau, Aβ42, apolipoprotein E (APOE), and TNF-α were quantified using single-molecule analysis or ELISA. Exposure to ambient NO2 and PM2.5 was assigned based on participant's residential address at the time of blood draw using US EPA AQI measurements. Data was analyzed using linear regression and Pearson correlations in R.

RESULTS: NDEVs concentrations didn't differ between racial/ethnic groups, but the relationship between EVs concentration and cargo did. Analysis of NDEVs concentration showed no association or correlation with NDEVs cargo, in Hispanics; a positive association and correlation with APOE and TNF-α, but a negative association and correlation with Aβ42, in Whites; and a negative association and correlation with tau, in African Americans. Preliminary analysis of air pollution exposure using NO2 did not modify these relationships, except the association between EV concentration and Aβ42 was lost in Whites. No significant differences in NO2 exposure were found, but NO2 comparison with NDEVs protein cargo displayed different patterns of association between groups.

CONCLUSION:

Functional differences in the clearance, via EVs, of proteins involved in the development of neurodegenerative disorders exist between racial/ethnic groups, which may influence brain response to air pollution exposure resulting in disparate AD outcomes.

KEYWORDS: Extracellular Vesicles
Neurodegeneration
Alzheimer's Disease
Racial/ethnic Disparities

P-0993 Prenatal exposure to di-2-ethylhexyl phthalate (DEHP) affects metabolic disorders: results of a novel strategy for integrative assessment of endocrine disrupters

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BACKGROUND AND AIM: Endocrine-disrupting effects caused by exposure to chemicals represent one of the most critical public health threats. In line with the regulatory framework implemented within the European Union to reduce the levels of endocrine disruptors (EDs) for consumers, new and effective methods for ED testing are needed. Here we present an integrated approach for testing and assessment (IATA) that combines in vitro (3D HepaRG cells), in vivo (zebrafish at five days post fertilisation), epidemiological and human biomonitoring studies applied on di-2-ethylhexyl phthalate (DEHP).

METHODS: The effective concentrations of the chemical in vitro and in vivo were extrapolated from human biomonitoring data using the INTEGRA exposure modeling platform. Global untargeted metabolomics analysis was performed using an Agilent G6540A UHD Accurate-Mass Q-TOF LC/MS with 1260 HPLC System in positive and negative ionisation modes. Moreover, the samples were analysed using Reversed Phase (RP) and HILIC analytical columns to increase the coverage of the detected metabolites. Bioinformatics analysis, including spectra processing, statistical analysis, and metabolic pathway analysis, was performed using R/Bioconductor based packages.

RESULTS: Our study showed that the majority of the common metabolites between the three different systems (human, in vivo, and in vitro) are lipids, and more specifically, fatty acyls, glycerolipids, glycerophospholipids, sphingolipids, and sterol Lipids. Significant dysregulation of lipid and Sphingolipid metabolism was observed. Some of these metabolites are: 3-dehydroteasterone, lysoPC(15:0), PE(20:4(5Z,8Z,11Z,14Z)/0:0), PS(22:1(11Z)/0:0), PC(15:0/22:6(4Z,7Z,10Z,13Z,16Z,19Z)), PT(18:0/18:1(9Z)), PS(16:0/22:1(11Z)), and sphingosine 1-phosphate. Many experimental and clinical studies have described the importance of lipids, especially sphingolipids, in developing and pathogenesis of insulin resistance and metabolic syndrome. Still, our study provides mechanistic evidence regarding their (dys)regulation from endocrine disrupters and their effect on metabolism.

CONCLUSIONS: Data generated following our proposed integrated testing and assessment approach (IATA) will reveal the impact of EDs on metabolic disorders by developing novel Adverse Outcome Pathways (AOPs).

P-0998 Comparing and validating current methods for isolating and characterizing brain-derived extracellular vesicles as central nervous system biomarkers of environmentally linked neurodegenerative diseases

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BACKGROUND AND AIM: Many environmental exposures (e.g., metals, pesticides) accumulate in central nervous system (CNS) tissues and are associated with adverse neurological outcomes. There is a great need for peripheral biomarkers that could provide insight into the CNS burden of these exposures to confirm the etiologic role of neurotoxic exposures. Our research group has observed CNS cells extruding toxicants via extracellular vesicles (EVs) and is characterizing the viability of CNS-derived EVs isolated from peripheral blood draws as potential biomarkers of environmental exposures. Several protocols for isolating EVs originating from the CNS via immunoprecipitation (IP) can be found in the literature, and these protocols are often replicated with only superficial validation. Here, we thoroughly validated and contrasted current EV isolation methods, tested optimal protease inhibition conditions, and compared IP efficiency and normalization techniques.

METHODS: We compared a one-step direct IP protocol with the widely used two-step Exoquick-based IP protocol for isolating CNS-EVs from human plasma using antibodies against CNS cell surface markers: EAAT1 for astrocytic EVs and L1CAM for neuronal EVs. EVs were characterized according to the Minimal Information for Studies of Extracellular Vesicles guidelines, including transmission election microscopy, nanotracking particle analysis, and protein ELISAs.

RESULTS: Our results show that a direct IP protocol is more effective for isolating CNS-derived EVs than commonly used Exoquick-based two-step protocols. These results demonstrate that EAAT1 antibodies are more effective than L1CAM in isolating-CNS-EVs even in conditions that are expected prevent L1CAM cleavage by metalloproteases. Results confirmed CD81 to be the best normalization factor for CNS-EV IP efficiency.

CONCLUSIONS: These data add to the ongoing controversy that L1CAM and Exoquick may not consistently isolate EVs of neuronal origin. This may be partly due to variability in immunoreagent quality. These data strongly demonstrate the importance of rigorous method validation before beginning cell-specific EV-based biomarker studies.

P-0999 Bringing TRAP and NLRP3 into focus to Save EJ Populations

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BACKGROUND AND AIMS:
Whole city studies, especially in cooler climates in advanced economies, have found profoundly large chronic health effects for those living short distances from large regional transportation related air pollution and noise sources, such as busy roadways, relative to similar populations living a kilometer or more from these exposures. (Oslo, Stockholm, Vancouver, Toronto, Boston, Copenhagen).
While primary pollutants like ultrafine particles and noise have steep gradients next to large TRAP sources, akin to these health effects, regional pollutants like PM2.5 and ozone have flat or inverse gradients. The spatiotemporal granularity of research required to show these TRAP relationships is more challenging than regional studies keyed on PM2.5 or Ozone (Six Cities vs CAFEH).

METHODS: We conducted a literature review of NLRP3 inflammasome and particulates.

RESULTS: and CONCLUSIONS: Both ambient particulate matter and NLRP3 inflammasome biology, specifically, have been shown to accelerate many major diseases of inflammation – sterile and pathogenic. Inflammasomes generate Interleukin 1 family cytokines such as IL-1beta. of the 21 human inflammasomes, only NLRP3 reacts strongly to exogenous and endogenous particles.
NLRP3 drives the health effects of a broad array of exogenous particles, including manufactured adjuvants, medical imaging agents, mineral fibres and ambient TRAP. and of endogenous particles such as crystalized uric acid, amyloid tau tangles, cholesterol and high molecular weight fatty acids.
Environmental justice (EJ) populations tend to concentrate in locations with high TRAP exposures. Without more focused research into environmental justice exposures, that integrates spatiotemporal knowledge of TRAP with NLRP3 immunology, we will be unable to protect these EJ populations. NLRP3 inflammasome biology may be the missing link between TRAP and EJ populations.

KEYWORDS:
Near source exposures, transportation related air pollution, NLRP3 inflammasome biology, high exposure environmental justice populations

P-1000 Evidence of epigenetic age acceleration among adults with prenatal and early life arsenic exposure in Northern Chile

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BACKGROUND: Prenatal arsenic exposure influences epigenetic programming. The long-term influence on epigenetic age acceleration (EAA), a biomarker of morbidity and mortality, is unknown. We tested associations between prenatal and early-life arsenic exposure and epigenetic age acceleration in adulthood.

METHODS: Peripheral blood mononuclear cells (PBMCs) and buccal cells were collected from adults with high prenatal and early-life arsenic exposure (median = 555 µg/L in drinking water) and adults never exposed in Northern Chile (N = 40, age range: 44-53 years). Six measures of epigenetic age and EAA were calculated (Horvath age, Hannum age, PhenoAge, skin and blood age, GrimAge, and DNA methylation telomere length). Associations between high arsenic exposure or estimated water arsenic concentrations at birth and EAA were evaluated using linear models adjusted for sex and smoking.

RESULTS: In PBMCs, chronological age was strongly correlated with all epigenetic clocks (rPearson = 0.62-0.86) and DNA methylation telomere length (rPearson = -0.69); in buccal cells, correlations were significant but weaker. On average, adults with prenatal and early-life arsenic exposure had six-year greater PhenoAge acceleration in PBMCs [B (95% CI) = 6.01 (2.60, 9.42); adjusting for average lifetime water arsenic concentrations in adulthood: B (95% CI) = 6.65 (1.91, 11.38)]. Associations with Hannum EAA [B (95% CI) = 2.51 (-0.81, 5.83)] and extrinsic EAA [B (95% CI) = 3.66 (-0.91, 8.23)] in PBMCs, and with PhenoAge acceleration [B (95% CI) = 4.88 (-1.60, 11.36)] in buccal cells were positive but statistically significant. Associations with arsenic concentrations at birth were similar; PBMC PhenoAge increased by 0.32 (95% CI: 0.003, 0.63) years for each doubling in arsenic concentrations.

CONCLUSIONS: This study suggests that arsenic exposure limited to early-life stages is associated with accelerated epigenetic aging in adulthood, particularly biomarkers developed to predict morbidity and mortality. EAA might serve as a risk biomarker of early-life exposures.

E-POSTER GALLERY

P-0007 Epigenome-wide DNA methylation assists early intervention of Coronary Heart Disease with machine learning models

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BACKGROUND AND AIM: Studies have shown American Indian communities have a disproportionally high rate of coronary heart disease (CHD) compared with other ethnic groups. Microarrays for epigenome-wide DNA methylation data have enabled researchers to model a large number of methylation sites to investigate their associations with incident CHD. However, accurate prediction of CHD from high-dimensional epigenome-wide DNA methylation data is challenging. We aim to develop a workflow to accurately predict CHD up to 30 years prior to diagnosis assist early disease intervention.

METHODS: The associations of CHD with epigenome-wide DNA methylation data were first screened using elastic-net penalized cox proportional hazard models based on a previous epigenome-wide association study to identify noteworthy CpG sites. The selected significant CpG sites were then input into our autoencoder deep learning model to learn the latent space representation (embeddings). The learned embeddings were then input to multiple machine learning models (i.e., logistic regression, support vector classifier, random forest, gradient boosted decision tree, and fully connected neural networks) to predict CHD. We also performed the same prediction on raw features.

RESULTS: Using our developed method, we achieved the state-of-the-art prediction accuracy of binary CHD outcome (best AUROC=0.872) with DNA methylation and clinical features using autoencoder combined with support vector classifier model (AE-SVC_DNAm+clinical), which is better than previous studies. Results showed that DNA methylation features alone had high prediction accuracy (best AUROC=0.867), clinical features alone had poor performance (best AUROC =0.692), and that AE-SVC_DNAm+clinical only increased the prediction results incrementally. Additionally, using the learned embedding increased the overall stability of our prediction results over raw input features.

CONCLUSIONS: Our data-driven method is highly effective in accurately predicting CHD up to 30 years in the Strong Heart Study population. We suggest using this workflow in future disease predictions from the high-dimensional DNA methylation data.

P-0022 Stratification score matching: Assessing the association of phthalates on asthma using the Human Health Exposure Analysis Resource (HHEAR) Data Repository

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BACKGROUND AND AIM: The role of certain environmental exposures may be related to the onset, severity, or progression of disease, or any combination. The assessment of exposures in relation to severity may suggest unanticipated inverse associations, perhaps due to complex confounding issues. Such was the case when assessing phthalates on asthma control among children ages 4-14, all diagnosed with asthma. To better disentangle the potential role of phthalates on asthma, we sought to use stratification score (SS) methods to find comparable controls.

METHODS: Publicly available data from the HHEAR Data Repository were used to identify studies with 9 specified phthalates measured in children ages 4-14 between 2014-2018. Multivariate control charts (MCCs) were used to determine if phthalates measured in common quality control samples were comparable across studies. SSs were calculated as the probability of having asthma, conditioned on age, sex, race, ethnicity, and body mass index percentile. Controls were matched to cases using 1:1 SS matching and differences in log2 transformed specific-gravity corrected phthalate concentrations within pairs were assessed using paired t-tests. We repeated our matching algorithm 50 times and reported the distribution of effect estimates.

RESULTS: MCCs indicated phthalate measures from our studies of interest fell within acceptable bounds of variability and thus were combinable. On average, 101 of 139 eligible cases were matched across repetitions of matching. Compared to controls, cases had significantly higher concentrations for 7 phthalates, borderline significantly higher concentration for 1 phthalate and a significantly lower concentration for 1 phthalate. Consistent with the original study findings, differences between pairs tended to be higher or no different among well controlled asthmatics pairs compared to differences among poorly controlled asthmatics pairs.

CONCLUSIONS: Most phthalates were higher among asthmatic compared to non-asthmatic children. This study warrants further investigation into phthalate exposure sources used to reduce asthma symptoms.

KEYWORDS: phthalates, asthma, matching

P-0023 Exploring exposure-outcome relationships inside the VA Normative Aging Study using graph learning

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BACKGROUND AND AIM: Contemporary health sciences draw on large-scale longitudinal studies to understand the impact of lifestyle factors and environmental exposures on the risk of disease and identify potential underlying mechanisms. While there are extensive studies on associations between exposures and outcomes, the relationships among different studies within a single cohort are less studied. A database that summarizes those relationships is important towards unifying existing knowledge and inferring new information. In this study, we aim to construct an exposure-outcome network database across multiple publications in the Veterans Affairs Normative Aging Study (NAS) to explore its various applications including discovering core exposures/outcomes and hypothesis generation.

METHODS: NAS is a well-studied ongoing longitudinal study of aging in men followed since 1963. A network or a graph G can be constructed consisting of n nodes V and edges W, with each node representing an exposure E, or an outcome O. Two nodes are only connected by an edge w if their association has been studied. The core exposures/outcomes and communities of the network are retrieved with graph learning methods. Finally, we studied the dynamic changes of network structures.

RESULTS: We collected over 130 peer-reviewed exposure-outcome related publications in the last decade with title/abstract keyword “Normative Aging Study” in PubMed. We then constructed a network database describing the exposure-outcome relationship. We identified key exposures of interest, such as short- and long-term air pollution and its components, and key outcome nodes such as DNA methylation and lung function through network analysis. We also demonstrated the possibility of using the constructed network towards hypothesis generation.

CONCLUSIONS: We constructed a graph/network database to describe the relationship between exposures and outcomes across multiple studies inside the NAS cohort. Utilizing the graph learning methods, we demonstrated various applications including identifying key exposure/outcomes as well as hypothesis generation.

P-0026 The PFAS-Tox Database: A systematic evidence map of health studies on per- and polyfluoroalkyl substances

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BACKGROUND AND AIM: PFAS (per-and polyfluoroalkyl substances) is a large class of synthetic chemicals used widely in consumer products and industrial processes. Health and toxicology literature on PFAS has increased dramatically in the last decade, and many key stakeholders could benefit from efficient access to the data. We aimed to create a systematic evidence map (SEM) of health and toxicological research on 29 PFAS that would be easily accessible for diverse audiences.

METHODS: We published a protocol a priori and conducted a PubMed database search of peer-reviewed literature through January 25, 2021. Studies were screened for inclusion and exclusion according to the Populations, Exposures, Comparators, and Outcomes (PECO) statement. Inclusion criteria were intentionally broad and included any human, animal, and/or in vitro study that investigated exposure to one of the 29 PFAS of interest and a human health or toxicological effect. Study details were extracted, with meta-data made freely available in the online, interactive SEM at https://pfastoxdatabase.org.

RESULTS: Over 15,000 studies were retrieved from the literature search. After manual screening, 1,067 studies (505 human, 385 animal, and 220 in vitro) were identified and included as investigating health or toxicological effects of one or more PFAS of interest. Most human studies were cross-sectional (48%) or cohort (39%), with body weight/size/growth (n=195), reproductive (n=158), endocrine (n=149), and metabolic/digestive systems (n=143) examined as the most common health outcome categories.

CONCLUSIONS: The PFAS-Tox Database is a useful tool for searching, filtering, and identifying peer-reviewed research on the health and toxicological effects of PFAS. The SEM provides examples of data gaps and clusters revealed by the database and will support scientists, regulatory agencies, and individuals with tools to advance future research efforts, systematic reviews, regulatory risk assessments, and cross-disciplinary coordination on the health effects of PFAS exposure.

KEYWORDS: PFAS, epidemiology, toxicology, systematic review, risk assessment

P-0040 Longitudinal Associations of Air Pollution with Body Size and Composition in Midlife Women: The Study of Women's Health Across the Nation

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BACKGROUND AND AIM: Exposure to air pollution has been suggested to be associated with obesity recently; however, epidemiologic evidence is still limited and has heavily focused on body mass index (BMI). We examined associations of fine particulate matters (PM2.5), nitrogen dioxide (NO2), and ozone (O3) with longitudinal measures of body size and composition including weight, BMI, waist circumference, fat mass, lean mass, and proportion fat mass in midlife women.

METHODS: The study population included 1,654 White, Black, Chinese and Japanese women from the Study of Women's Health Across the Nation, with the median age of 49.6 years and a total of 10,370 repeated observations followed from 2000 to 2008. Annual air pollution exposures were assigned by the residential addresses linked with hybrid estimates of air pollutant concentrations at 1-km2 resolution. Body size was measured objectively and body composition was measured using the dual-energy X-ray absorptiometry (DXA) at approximately annual visits. Linear mixed effects models were used to examine the associations between air pollution and body size and composition measures.

RESULTS: After adjusting for potential confounders, an interquartile range (IQR) increase in PM2.5 concentrations (4.5 μg/m3) was associated with 4.53% (95%CI:3.85%,5.22%) higher fat mass, 1.10% (95%CI:0.95%,1.25%) higher proportion fat mass, and 0.39% (95%CI:-0.77%,-0.01%) lower lean mass. An IQR increase in NO2 (9.5 ppb) was associated with 3.39% (95%CI:2.68%,4.10%) higher fat mass, 0.94% (95%CI:0.78%,1.10%) higher proportion fat mass, and 0.86% (95% CI:-1.26%,-0.45%) lower lean mass. Similar associations were also observed for O3. Physical activity was found to modify the associations of PM2.5 and NO2 with body size and composition: weaker associations were observed in participants who engaged in more physical activity.

CONCLUSIONS: PM2.5, NO2, and O3, are adversely associated with body composition, including higher fat mass, higher proportional fat mass, and lower lean mass, highlighting its potential role in contributing to obesity.

P-0043 Associations between traffic-related air pollution and cognitive function in Australian urban settings: the moderating role of diabetes status

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BACKGROUND: Traffic-related air pollution (TRAP) is associated with poorer cognitive function and higher incidence of diabetes in older adults, but little is known about whether diabetes moderates the impact of TRAP on older adult cognitive function.

METHODS: We analysed cross-sectional data from 4141 adults who participated in the Australian Diabetes, Obesity and Lifestyle (AusDiab) study in 2011-2012. TRAP exposure was estimated using major and minor road density (100m/km²) within residential buffers: 200, 300, 500, 1000 and 1600 metres. Cognitive function was assessed with validated psychometric scales: California Verbal Learning Test (memory) and Symbol–Digit Modalities Test (processing speed). Diabetes status was measured using an oral glucose tolerance test. Missing data were imputed. Associations of TRAP with cognitive function and the moderating effects of diabetes on these associations were estimated using generalised additive mixed models adjusted for age, sex, English-speaking background, socioeconomic status, education, living arrangement, employment status, neighbourhood self-selection indices, urban density, neighbourhood greenspace and land-use mix. Results are reported as regression coefficients, β, per single unit increase in TRAP measures.

RESULTS: We observed positive associations between 200, 1000 and 1600m TRAP and memory (β=0.003, p=0.008; β=0.003, p=0.018; β=0.004, p=0.015 respectively) but not processing speed. Minor road density was not associated with cognitive function, while major road density showed positive associations with memory and processing speed among 1000 and 1600m buffers (β=0.010, p=0.038; β=0.014, p=0.026). Within a 300m buffer the relationship between TRAP and memory tended to be positive in people without diabetes (β=0.005; p=0.062), but negative in people with diabetes (β=-0.013; p=0.026); and negatively associated with processing speed in people with diabetes only (β=-0.047; p=0.059).

CONCLUSIONS: In Australian urban areas, higher TRAP exposure may be positively associated with cognitive function in urban dwelling people, but this benefit may not extend to people living with diabetes in urban settings.

P-0045 Short-term exposure to PM2.5 and daily all-cause dementia and Alzheimer´s disease mortality in Connecticut: a time-stratified case-crossover study

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BACKGROUND: While emerging studies have examined long-term exposure to fine particulate matter ($PM_{2.5}$) and its association with various measures of morbidity of dementia and Alzheimer´s disease (AD), evidence on short-term $PM_{2.5}$ exposure and mortality caused by dementia or AD is sparse.

METHODS: We applied a time-stratified case-crossover design using conditional logistic regression to assess the association between ambient $PM_{2.5}$ concentrations and daily all-cause dementia and AD mortality in Connecticut between 2005 to 2016, while adjusting for mean air and dewpoint temperature. Our analysis included cases whose principal cause of death was all-cause dementia or AD. The daily 24-hour average $PM_{2.5}$ concentration was obtained from a well-validated model and the individual-level exposure was assigned based on the modeled $PM_{2.5}$ level in a 1 × 1 km^2 grid which contains the residential address. We also explored potential effect modification by age and sex groups.

RESULTS: A total of 28,736 all-cause dementia deaths occurred during our study period, among which 9,826 were specially coded as AD deaths. A 10 $\mu g/m^3$ increase in the 2-day moving average of ambient $PM_{2.5}$ was significantly associated with all-cause dementia (Odds Ratio [OR] =1.06, 95% confidence interval [CI]: 1.03, 1.09) and AD (OR=1.07, 95% CI: 1.02, 1.12). We did not find effect modification by age (<80 years vs. ≥ 80 years) in all-cause dementia or AD. The estimated effect of $PM_{2.5}$ was higher among the female subgroup compared to the male subgroup (P-value = 0.03) for mortality caused by all-cause dementia but not for AD.

CONCLUSIONS: Our study suggests a significant association between short-term exposure to $PM_{2.5}$ and an increase in mortality risks of all-cause dementia and AD. Further research is warranted on mechanisms that can explain the relationship between short-term $PM_{2.5}$ exposure and mortality risks of dementia.

KEYWORDS: $PM_{2.5}$; dementia; Alzheimer´s disease; mortality; short-term; case-crossover

P-0047 Para-dichlorobenzene exposure and serum α-Klotho levels among US participants in their middle and late adulthood

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BACKGROUND AND AIM: Para-dichlorobenzene (p-DCB) is a volatile compound commonly used as pest repellent and air deodorant in the home and public buildings. There has been an increasing concern about its metabolic and endocrine effects. The aim of the present study was to explore the relation between p-DCB exposure and serum levels of soluble α-Klotho, an anti-aging hormone, in US adults.

METHODS: A nationally representative subsample of 1485 adults 40-79 ages in the 2013-2016 National Health and Nutrition Examination Survey was analyzed for the association between urinary concentrations of 2,5-dichlorophenol (2,5-DCP), the major metabolite of p-DCB, and serum α-Klotho levels using multiple general linear models, adjusting for potential confounders. Age- and sex-specific analyses were further conducted.

RESULTS: The weighted geometric mean of urinary 2,5-DCP was 2.43 μg/L and the weighted mean of serum α-Klotho was 831.97 pg/mL in the study participants during 2013-2016. After adjusting for potential confounders, urinary 2,5-DCP was significantly associated with decreased serum levels of α-Klotho (regression coefficient β=-9.88; p=0.0133) in the total study population. When age- and sex-specific analyses being conducted, a significantly inverse association was found in older adults aged 60-79 years (β=-20.52; p<0.0001) and in males (β=-13.81; p=0.0097), but not in the middle ages (40-59 years) and in females. The strongest association was observed in older (60-79 years) male participants, with a 25.25 pg/mL reduction of α-Klotho levels per 1-unit increase of 2,5-DCP concentrations (p=0.0007). No statistically significant associations with α-Klotho levels were observed for urinary 2,4-dichlorophenol, another dichlorophenol pesticide.

CONCLUSIONS: Our study demonstrates a relation between p-DCB exposure, measured as 2,5-DCP, and decreased α-Klotho levels in older men. Additional studies would further explore these interactions and elucidate the pathogenesis of the potential effects of p-DCB exposure on aging.

KEYWORDS: 2,5-dichlorophenol, α-Klotho; middle and late adulthood, NHANES; para-dichlorobenzene exposure

P-0048 Associations between Air Pollution and Gait Speed in Older Adults

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BACKGROUND AND AIM: Air pollution is widely recognized as a threat to public health, particularly among older adults. Long-term exposure to air pollution may impact gait speed trajectories over time, as gait speed is a marker of physical and cognitive decline. This study examined the relationship between long-term air pollution exposure and gait speed decline among older adults and evaluated whether cardiovascular disease (CVD) status modified the effect.

METHODS: We analyzed data from 3,022 older adults residing in the US followed from 2000 to 2008. Long-term exposure to fine particulate matter (PM2.5) and nitrogen dioxide (NO2) prior to study enrollment was estimated using state-of-the-art prediction models. Gait speed at usual and rapid pace was assessed annually using a 15-foot timed walk test. Mixed-effects models were fitted adjusting for sociodemographic variables overall and in those with and without CVD.

RESULTS: Greater long-term PM2.5 and NO2 exposure was related to faster gait speed decline. One interquartile range (IQR) higher 5-year PM2.5 exposure (2 μg/m3) prior to the study enrollment was related to 0.048 m/s decline in usual gait speed (95% CI: -0.084, -0.024) and an IQR higher 5-year NO2 exposure (6.5 ppb) was associated with 0.078 m/s decline in usual gait (95% CI: -0.120, -0.042) and 0.042 m/s decline in rapid gait (95% CI: -0.078, -0.006) over the 6-year period. Longitudinal association between air pollution (5- and 10-year average PM2.5 and NO2) and rapid gait speed decline was significant only in individuals with CVD.

CONCLUSIONS: Long-term exposure to air pollution appears to be associated with faster gait speed decline among older adults in the US. Policies to reduce the emission of air pollutants and interventions to avoid air pollution exposure could contribute to the reduction in the burden of preventable institutionalization and hospitalization.

KEYWORDS: Air pollutants, Walking speed, Aged, Dementia, cognitive decline

P-0050 Incident Dementia and Long-Term Exposure to Constituents of U.S. Fine Particle Air Pollution: A National Cohort Study

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BACKGROUND: Growing evidence suggests that PM2.5 likely increases the risks of neurological disorders, yet little is known about the relative contributions of different constituents. Understanding constituent-specific effects are critical to targeting emission reductions of specific sources with the greatest health protection.
METHOD: We conducted a nationwide population-based cohort study (2000-2017), by integrating the Medicare Chronic Conditions Warehouse database and two sets of high-resolution, multiple-species, air pollution datasets to investigate the impact of long-term exposure to PM2.5 constituents on incident dementia and Alzheimer's disease (AD). and home health-care claims. Hazard ratios for dementia and AD were estimated using single- and multi-constituent Cox proportional hazards models, and penalized splines were used to evaluate potential nonlinear concentration-response relationships.

RESULTS: of the 18.5 million dementia and 19.2 million AD individuals within these cohorts, 31.5% and 14.6% developed dementia and AD events, respectively. From the single-pollutant models, an interquartile range (IQR) increase in PM2.5 mass was associated with an increase in dementia incidence ranging between 6-7% using two exposure datasets. for different PM2.5 constituents, associations remained significant in black carbon (BC), organic matter (OM), sulfate (SO42−), and ammonium (NH4+). Incident dementia was observed to have the strongest association with increases in exposure to SO42− and BC (10-11% increase and 4-6% per IQR increase, respectively). Effect estimates for AD were even larger. for both endpoints, all constituents had largely linear concentration-response relationships in the low exposure range, but most tailed off at high exposure concentrations, particularly for AD.

CONCLUSIONS: Our study suggests that long-term exposure to PM2.5 is significantly associated with increased incident dementia and AD, and that the different PM2.5 constituents may elicit differential neurotoxicity. Reduction of PM2.5 emissions, especially for the main sources of BC and SO42−, may reduce the burden of dementia or AD in the aging US population.

P-0058 Long-term Ozone Exposure and Incident Frailty in Older Adults: Findings from a Prospective Cohort Study in Chinese Elderly

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BACKGROUND AND AIM: Studies have linked elevations in short-term ozone exposure to acute adverse health outcomes. In this study, we aimed to explore whether long-term ozone exposure was linked to the development of frailty in older adults.

METHODS: A total of 15,734 participants aged ≥65-year-old and were free of frailty were included in Chinese Longitudinal Healthy Longevity Survey (CLHLS) from 2005 to 2018. Frailty was defined by a frailty index (FI) ≥0.25, which was measured by 39 health deficits. Personal ozone exposures were estimated using full-composition annual ozone covering all of China at a 0.05° resolution. County-level ozone-related burden of frailty in China was calculated by warm season hazard ratio of frailty.

RESULTS: During 78,588 person-years follow-up, 3587 incident frailties were documented. In competing risk models, each 10-μg/m³ increase in baseline warm-season (May to October) and yearly ozone exposure corresponded to 6.9% and 12.1% higher risk of incident frailty, the hazard ratios were 1.069 (1.035-1.104) and 1.121 (1.063-1.182), respectively. Monotonically increasing dose-response of warm-season and yearly ozone exposure with incident frailty and FI score were observed. With the dramatic population aging and increasing ozone exposure simultaneously in China, it was estimated that the burden of warm season ozone related incident frailty among the population aged ≥65-year-old in China were 1,818,729 and 3,700,237 cases in 2010 and 2020, respectively, and there will be 4,806,037 incident frailties in 2030.

CONCLUSIONS: This nationwide prospective cohort study established that long-term ozone exposure was associated with incident frailty and contributed to an enormously significant and increased disease burden for the older adults, suggesting that controlling ozone exposure may be a priority area for air quality regulations in China in next decade that may yield substantial health benefits.

KEYWORDS: ozone; older adults; frailty; CLHLS; disease burden

P-0059 Associations of peak season ozone with blood pressure among older adults without hypertension in a high exposure country: evidence from the Chinese Longitudinal Healthy Longevity Survey from 2005 to 2018

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BACKGROUND AND AIM: Evidence based on long-term prospective cohort studies is lacking to investigate the association between ambient ozone (O3) and blood pressure among older adults. We aim to evaluate the associations of peak season O3 with change of blood pressure in a long-term cohort study among older adults without hypertension.

METHODS: We included 5940 older adults aged ≥65 years and with repeated measurements of blood pressure from 2005 to 2018 in 23 provinces of China, estimated monthly O3 exposures at 0.05 ° ×0.05 ° resolution were matched to each participant. Peak season O3 exposure was measured as the average from April to September. Outcomes include blood pressure measurements of SBP, DBP, PP and MAP. Linear mixed models were performed to evaluate the associations between O3 exposures and blood pressure. Natural splines were applied to explore the potential non-linear concentration-response associations.

RESULTS: In this study, peak-season O3 ranges from 72.6 to 151.7 μg/m3 in China. In fully adjusted model, per 10 μg/m3 increase in peak season O3 was associated with increases of 2.46 mmHg (95% confidence interval [CI]: 1.85-3.06) in SBP, 2.46 mmHg (95%CI: 1.94-2.99) in PP and 0.74 mmHg (95%CI: 0.38-1.11) in MAP, but non-significant decrease in DBP. Female, ethnic minorities, and older adults who were not in marriage, underweight, with medium or low income levels were susceptible to O3 exposure. Non-linear curves indicated that the effect of O3 exposure on SBP, PP and MAP were monotone increasing, with faster increase in risk magnitude before WHO interim target 1 at 100 μg/m3, but slow down thereafter.

CONCLUSIONS: The study added evidence to support the World Health Organization interim targets for peak-season O3, however, lower interim targets should be set to maintain healthy blood pressure among populations in countries with high O3 concentrations.

KEYWORDS:Ozone; blood pressure; older adult; cohort study

P-0060 Association of blood mercury exposure with depressive symptoms in the Chinese oldest old

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Background:Depressive symptoms have a significant impact on the quality-of-life among the oldest old. Current research on the association of blood mercury with depressive symptoms has mainly targeted the general population. However, it is unclear whether this association is present at the oldest old.

Objective:The aim of this study was to investigate the association of blood mercury exposure with depressive symptoms in the oldest old.

Methods:We used data from the Healthy Aging and Biomarker Cohort Study carried out in 2017-2018, with 1567 participants aged ≥80 years were eligible for analysis. Blood mercury levels were measured by inductively coupled plasma mass spectrometry (ICP-MS). The CES-D10 depression scale was used to assess depressive symptoms. Multivariable logistic regression models were used to examine the association between blood mercury levels and depressive symptoms. We also used restricted cubic splines (RCS) to assess the linear or nonlinear association of blood mercury with depressive symptoms.

Results:The mean age of the 1567 participants was 91.8 years, while the geometric mean concentration of blood mercury was 1.17 μg/L. Multivariable logistic regression analysis showed a statistically significant positive association of blood mercury with depressive symptoms after adjustment for covariates. The odds ratios of blood mercury for depressive symptoms in the second and third tertiles were 1.88 (1.37-2.56) and 1.51 (1.11-2.04), respectively, compared with that measured in the first tertile. The RCS model showed that there was a non-linear association between blood mercury level and depressive symptoms.

CONCLUSIONS: Among the oldest old, we found blood mercury levels are associated positively with depressive symptoms, highlighting the importance of appropriately managing their exposure to mercury.

KEYWORDS: depressive symptoms, blood mercury, the oldest old, restricted cubic splines, multivariate logistics

P-0061 Accelerated aging modifies impact of ozone on QT interval and markers of inflammation in healthy humans

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BACKGROUND AND AIM: Older individuals often have increased health risks from environmental exposures, but this has been rarely investigated using molecular measurements of biological age. DNA methylation can be used to measure biological age and epigenetic age acceleration (EAA) in subjects. EAA accurately predicts mortality and chronic disease risk; however, it is unknown whether EAA modifies responses to environmental exposures. Here, we investigated whether cardiovascular and inflammatory responses to ozone are modified by EAA.

METHODS: LAMARCK was a controlled exposure study where 17 healthy participants were exposed to 0.3-ppm ozone or to clean air for two hours in a randomized single-blind crossover study design. Functional cardiopulmonary measures (n=3) and inflammation biomarkers (n=5) were collected immediately before and 24-hours after exposures. Epigenetic age was estimated using the Horvath method on cells that were collected from BALFs 24 hours after exposure. All outcomes were normalized to their pre-exposure values. We used mean and quantile regression to examine if EAA (calculated as epigenetic age – chronological age) measured during clean air exposure is associated with the estimated causal risk difference (CRD; Ozone – Clean Air) of cardiopulmonary and inflammatory outcomes. Regression models were evaluated with and without outliers to determine model consistency. Results are presented as percentage change relative to the mean value measured during air exposure.

RESULTS: Mean and median regression results were concordant. for mean regression, one-year higher EAA was associated with a 0.44% (95% confidence interval = 0.13%, 0.75%) increase in the CRD for QT interval in response to ozone exposure. One-year higher EAA was also associated with a -15.3% (95% confidence interval = -23.2%, -7.41%) change in the CRD for C-reactive protein in response to ozone. No other associations were observed.

CONCLUSIONS: Accelerated aging in the lung is associated with prolonged QT interval and depressed inflammatory response during short-term ozone exposure.

P-0064 Air Pollution and Trajectories of Positive and Negative Affect in Older Women

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BACKGROUND AND AIM: Exposure to ambient air pollution, including PM2.5 (particulate matter <2.5 μm) and NO2 (nitrogen dioxide), is associated with depressive symptoms in older adulthood. Depression is characterized by low positive affect and high negative affect. Elucidating how exposure may differentially impact the emotional dimensions underlying depressive symptoms will deepen our understanding of the link between air pollution neurotoxicity and emotional health of older adults. Here we examined associations between air pollution and longitudinal trajectories of positive and negative affect in older women.

METHODS: Women (N=2,114; baseline age=73.3±3.8 years), enrolled in the Women's Health Initiative Study of Cognitive Aging (2000-2010), completed up to nine annual assessments with the Positive and Negative Affect Schedule (PANAS). Three-year average annual mean concentrations (scaled by interquartile range [IQR]) of ambient PM2.5 (in μg/m3; IQR=3.64 μg/m3) and NO2 (in ppb; IQR=10.35 ppb) before baseline were estimated at participants' addresses via spatiotemporal models. Latent-class mixture models were constructed to identify subgroups of women with similar trajectories of positive or negative affect over time. Multinomial logistic regressions were used to examine whether exposures predicted latent-class membership, adjusting for sociodemographic, lifestyle, and clinical characteristics.

RESULTS: Two latent trajectories of positive affect (PA) were identified: (high-stable PA: 95% and decreasing PA: 5%). Higher exposure to NO2 (OR = 1.55, p=.008), but not PM2.5 (OR=1.23, p=.212), was significantly associated with increased odds of being classified as having decreasing PA relative to high-stable PA. Four latent trajectories of negative affect (NA; minimal-stable: 27%; mild-stable: 46%; moderate-stable:21%; and moderate-decreasing: 6%) were identified. Neither NO2 nor PM2.5 was predictive of latent class membership of NA trajectories.

CONCLUSIONS: Exposure to NO2 may contribute to reduction of PA in older adulthood. Future studies should examine brain structures and neural networks as well as behavioral mechanisms underlying PA changes associated with air pollution neurotoxicity in late life.

P-0066 Narrative Review of Long-Term Exposure to Traffic-Related Air Pollution on Dementia and Related Outcomes in Older Adults

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BACKGROUND AND AIM: As part of an extensive systematic review on the associations of important clinical health outcomes with exposure to traffic-related air pollution (TRAP), an independent Panel appointed by the Health Effects Institute considered the emerging literature on dementia-related outcomes and Parkinson's disease, two areas of significant public health interest.

METHODS: The Panel systematically searched the PubMed and LUDOK electronic databases for observational epidemiological studies from 1980 through 2019 on long-term exposure to TRAP and dementia-related outcomes and Parkinson's disease prevalence in the general population. Study selection and data extraction were conducted according to a defined protocol, and a novel framework was used to identify which studies provided information on TRAP exposure. Conclusions regarding the level of confidence in the presence of an association were based on a narrative assessment. The Panel decided a priori not to conduct formal confidence and risk of bias assessments and meta-analyses because this is an emerging area of research.

RESULTS: The Panel reviewed 15 studies on dementia-related outcomes and six studies of Parkinson's disease. Evidence for an association of dementia-related outcomes with TRAP was mixed; studies of cognition and incident dementia generally found adverse associations while findings on cognitive decline were null. Evidence for an association of TRAP with Parkinson's disease was inconsistent with some potential for systematic bias. Limitations of the body of literature included its small size, potential for bias due to outcome misclassification, selection and attrition bias, and adjustments for confounding that did not align with plausible pathways between TRAP exposure and outcomes.

CONCLUSIONS: The Panel's confidence in the association of TRAP with dementia-related outcomes was low to moderate, while confidence in the association with Parkinson's disease was low. Future systematic reviews will benefit from the continued growth in this literature.
KEYWORKS: narrative review, traffic-related air pollution, dementia, cognitive decline

P-0067 Long-Term Air Pollution Exposure and Loss of Independence in the U.S.

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KEYWORDS: Air pollution, personal help, disability

BACKGROUND AND AIM: Disabilities, especially those that result in lost independence, can result in high emotional and economic burdens to individuals and families. Although air pollution is a well-established risk factor for chronic disease, its impacts on disability are only recently being considered and current studies have not focused on lost independence. We examined associations between air pollution and receiving help for disability, in a nationally representative cohort, focusing on the highest degree of limitations.

METHODS: We used biennial self-reported data between 2006 and 2016 on receiving personal help with six activities of daily living (ADL) and five instrumental activities of daily living (IADL) or living in the nursing home due to health and memory problems from participants>50 years in the Health and Retirement Study. Using spatiotemporal models, we predicted 10-year average PM2.5, PM10-2.5, NO_2, and O_3 concentrations at participant addresses before each interview. Associations with first receipt of help due to disability were estimated with Cox models, adjusting for individual demographics, area-level characteristics, and temporal and geographic trends.

RESULTS: During 6.8±3.0 years of follow-up, 31.7% of our 20,800 participants reported newly receiving help due to disability. We observed a 4% (HR: 1.04 per 3.2 μg/m³, 95%CI: 0.99, 1.10) and 6% (HR: 1.06 per 6.73 ppb, 95%CI: 1.02, 1.11) greater rate of receiving help due to disability per inter-quartile range higher long-term PM2.5 and NO_2 concentrations, respectively. In contrast, PM10-2.5 and O_3 concentrations were not associated with increased rates of receiving help.

CONCLUSIONS: This prospective study of older U.S. adults provides evidence that air pollution is associated with an increased need for help due to disabilities, though this association varied across pollutants. Controlling air pollution might potentially divert or delay individuals from needing care in late life and prolong/enhance their ability to live independently.

P-0069 Heterogeneous impact of air pollution exposures on cognitive trajectories in Women's Health Initiative Memory Study in Younger Women

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BACKGROUND AND AIM: Late-life exposure to ambient air pollutants is a risk factor for dementia, but little is known about the associations between midlife exposure and cognitive aging. We examined the effects on trajectories of general cognitive ability and episodic memory in older adulthood, comparing midlife and late-life exposures.

METHODS: Using regionalized universal kriging models applied to the residences of women (n=881; aged 62-71) enrolled in the Women's Health Initiative Memory Study in Younger Women (WHIMS-Y) in 2009, we estimated the annual PM2.5 (particulate matter<2.5μm) and NO2 (proxy for traffic-related pollutants) aggregated exposures to 3-year averages for midlife (aged 50-59, 12 years before WHIMS-Y inception) and late-life (at WHIMS-Y inception). General cognitive ability and episodic memory were assessed annually (2009-16) respectively by modified Telephone Interview for Cognitive Status (TICSm) and California Verbal Learning Test (CVLT). Linear mixed effect models were used to examine exposure effects adjusting for socio-demographic, lifestyle, and clinical covariates and time-varying propensity scores.

RESULTS: The average performance in TICSm and CVLT improved over time (both slope=0.15/year, p<0.001). Women with higher midlife exposures had worse baseline CVLT scores, with associations statistically significant for PM2.5 (β0,midlifePM2.5=-0.58 per IQR=3.43μg/m3, p=0.02), but not for NO2 (β0,midlifeNO2=-0.44 per IQR=9.23ppb, p=0.13). Women with higher midlife exposures had less improvement in CVLT performance over time, but the associations were non-significant. Associations between late-life exposures and CLVT trajectories and between both midlife or late-life exposures and TICSm trajectories were non-significant.

CONCLUSIONS: Among women aged 62-71 with positive trajectories suggesting considerable cognitive resilience, greater midlife PM2.5 exposure was associated with lower episodic memory with no appreciable impacts on trajectory afterwards. However, recent late-life exposures were not associated with cognitive trajectories. Results suggested the adverse midlife exposure effects may not contribute to the neuropathological processes underlying cognitive decline in late-life.

KEYWORDS: Air pollution, midlife exposure, cognitive trajectory

P-0071 Residential green space, air pollution, public facility and mortality among older adults in Beijing: a longitudinal cohort study

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BACKGROUND AND AIM: Urban environment is influential towards healthy aging in China. We aimed to describe trends of greenness and air pollution in Beijing, and explore their association with mortality among the elderly.

METHODS: This study included 800 participants (mean age=88.7, SD=11.1) in China Longitudinal Healthy Longevity Survey (CLHLS) who entered the cohort in 2000, 2002, 2005 and 2008 and lived in Beijing. Residential greenness was measured as satellite-derived Normalized Difference Vegetation Index (NDVI) in 1250m-radius-buffer around individual residence; cumulative NDVI was used. Last-one-year residential PM2.5, NO2 and last-peak-season O3 were obtained from both monitors and estimating models. Counts of medical, recreational and sports facilities in 5km-radii-buffers around residence were calculated. We examined the association of NDVI, PM2.5, NO2, O3, and 10-year change in NDVI and PM2.5 with mortality using Cox models, adjusted for demographic, socioeconomic and lifestyle covariates, and counts of public facilities.

RESULTS: NDVI in Beijing increased from 0.38 in 2000 to 0.45 in 2019. PM2.5 and NO2 concentration showed an inverse-U trend, with a turning point in 2013. In fully-adjusted models, 0.1-unit increase of NDVI was associated with lower mortality (HR[95%CI]: 0.656[0.485,0.885]), and similar association was found with per 10μg/m3 increase of O3 (HR[95%CI]: 0.882[0.781,0.995]). Moreover, living with increasing NDVI in the past decade was beneficial for health (HR[95%CI]: 0.402 [0.231,0.698]). Living with decreasing PM2.5 had 88% lower mortality (HR[95%CI]: 0.121[0.039,0.372]), while increasing PM2.5 had an increase of risk by 783% (HR[95%CI]: 8.831[4.688,16.635]), comparing with those living with stable exposure in the past decade. PM2.5, NO2 and accessibility to facilities were inconsistently associated with mortality.

CONCLUSIONS: In Beijing, greenness increased over decades, and air pollution started to reduce in recent years. Besides level of residential greenness and air pollution, change in these factors also matter to elderly health.

KEYWORDS: greenness, PM2.5, healthy aging, urban environment

P-0073 Association of exposure to multiple essential trace elements with frailty in Chinese elderly

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BACKGROUND AND AIM: Deficiency and excessive intake of essential trace elements can cause a variety of adverse outcomes. This study aims to describe the levels of 6 essential trace elements, to analyze the combined and interactive effects of 6 essential trace elements on frailty and to evaluate the association between essential trace elements and frailty in the elderly in a community in Zhejiang province, China.

METHODS: Frailty was assessed by FRAIL Scale. Essential trace elements including chromium (Cr), manganese (Mn), iron (Fe), copper (Cu), zinc (Zn) and selenium (Se) were analyzed in whole blood after acid dilution pretreatment using inductively coupled plasma mass spectrometry (ICP-MS). Ordinal logistic regression models and restricted cubic spline (RCS) were used to analyze the independent association between elements and frailty. Bayesian kernel machine regression (BKMR) models was used to examine combined and interactive effects of 6 essential trace elements on frailty.

RESULTS: Participants were determined following inclusion and exclusion criteria, and 4.2% of them were considered frail. Ordinal logistic regression models indicated that Se was inversely associated with frailty while Cu was positively associated with it. RCS showed U-shaped association between Cr, Mn and Zn and frailty, showed L-shaped association between Se and frailty, while the risk of frailty increased in a Cu dose-dependent manner, decreased in a Fe dose-dependent manner. BKMR models showed similar results, the inverse association between Cr and frailty was stronger when the remaining at lower levels. Exposure to all 6 trace elements was negatively associated with frailty.

CONCLUSIONS: Deficiency and excessive intake of Mn and Cr would increase the risk of frailty, and all 6 essential trace elements mixed exposure was negatively associated with frailty.

KEYWORDS: Essential trace elements, frailty, BKMR, multiple-exposure

P-0074 Associations of cumulative exposure to metal mixtures with metabolic dysfunction-associated fatty liver disease in a Chinese aged population

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BACKGROUND AND AIM: Few studies have demonstrated the potential effects of metal mixtures on metabolic dysfunction-associated fatty liver disease (MAFLD). Here, we examined the associations between whole blood metal mixtures and prevalence of MAFLD among an aged population in China.

METHODS: a cross-sectional study of community-dwelling elderly adults were conducted in China. Whole blood concentrations of fourteen metals were measured by inductively coupled plasma mass spectrometry (ICP-MS). MAFLD was ascertained based on ultrasonographic evidence of hepatic steatosis and the presence of overweight/obesity, type 2 diabetes mellitus, or metabolic dysregulation. We performed logistic regression and restricted cubic spline (RCS) models to independently estimate the associations between metal concentrations and MAFLD prevalence. Environmental Risk Score (ERS) constructed by adaptive elastic net (AENET) and Bayesian kernel machine regression (BKMR) analysis were utilized to examine joint effects of metal mixtures and metal interactions on MAFLD.

RESULTS: In the models adjusting for multiple covariates, lower blood copper and higher selenium, iron and mercury were significantly associated with the elevated prevalence of MAFLD. Non-linear effects of copper, iron, magnesium, manganese and selenium on MAFLD were observed in RCS models. Similar metals (copper, selenium, zinc, iron, cadmium and mercury) were selected as crucial predictors for MAFLD prevalence by AENET and BKMR models. The association between ERS and MAFLD was estimated and the ERS was significantly associated with the elevated OR for MAFLD.

CONCLUSIONS: Our findings provide evidence that exposure to blood copper, iron, selenium and mercury are associated with the prevalence of MAFLD. Multiple metals exposure may adversely affect MAFLD, with copper, selenium, zinc, iron, cadmium and mercury being the major contributors. Further researches are needed to clarify the cumulative effects of metal mixture in a larger population.

KEYWORDS: Metals; Mixture; Metabolic dysfunction-associated fatty liver disease; ERS; BKMR analysis

P-0075 Association between whole blood essential trace elements and cognitive function in the elderly

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BACKGROUND
Essential trace elements (ETEs) are important for keeping nervous system function. The evidence of associations between ETEs and cognitive function among the elderly was limited. Therefore, we aimed to investigate the individual and joint association between ETEs and cognitive function among the elderly.

METHODS: An elderly population from Yiwu cohort in China was available for this study. Whole blood chromium (Cr), manganese (Mn), copper (Cu), and selenium (Se) concentrations were measured by inductively coupled plasma mass spectrometry (ICP-MS). Cognitive function was assessed using the Mini-Mental State Examination (MMSE), consisting of five specific-cognitive domains of orientation, registry, attention and calculation, recall, and language and praxis. Linear regression, restricted cubic spline (RCS) analysis, and Bayesian kernel machine regression (BKMR) were performed to explore the individual and joint associations between ETEs and cognitive function.

RESULTS: Linear regression showed that high-level Cr was positively associated with MMSE score compared to the lowest quartile, especially with recall. Further RCS analysis found an inverted-U-shaped association between Cr and MMSE score. Se was positively associated with MMSE score and particularly with registry. BKMR model showed that ETEs mixture was positively associated with cognitive function, and Se was the most important contributor within the mixture. Therefore, Se demonstrated a positive additive effect on the associations for other ETEs with cognitive function.

CONCLUSIONS: Low and high levels Cr were associated with poor cognitive function, indicating that exploring an appropriate range of Cr concentration is important. Se was positively associated with cognitive function and was the most important contributor to the association between ETEs mixture and cognitive function. Moreover, Se presented the additive effect for other ETEs. Thus, it should be considered the joint effect of ETEs mixture. Our findings provided the evidence to protect cognitive function by supplementing ETEs.

KEYWORDS: Cognitive function; Essential trace element; The elderly; BKMR.

P-0076 The Interactive Effects of Ambient Air Pollution and Residential Greenness on Overweight and Obesity in Older Adults: Findings from the Chinese Longitudinal Healthy Longevity Survey

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BACKGROUND AND AIM: Air pollution [e.g., Fine particulate matter < 2.5 μm (PM2.5)] is a risk factor for frailty, while there were limited ways to overcome it. Currently, cross-sectional studies of the European population found an inverse association of residential greenness with body mass index (BMI). However, in older Chinese adults, there was inconsistent evidence regarding the association between residential greenness and overweight/obesity. Additionally, the interaction of residential greenness and PM2.5 concentration on overweight/obesity remains unknown. This cohort study aimed to evaluate the interactive effects of normalized difference vegetation index (NDVI) and PM2.5 exposure on overweight/obesity among older Chinese adults.

METHODS: The study included a total of 23,431 participants aged ≥65-year-old from 2000 to 2018 wave of the Chinese Longitudinal Healthy Longevity Survey. The baseline NDVI for each participant was calculated, based on a region within 1000 m radius around their residence. PM2.5 concentration was calculated using 3-year average concentrations in 1 km×1 km grid resolution. The overweight/obesity was defined based on BMI ≥24.0 during follow-up. Cox proportional hazards models were used to estimate the effects of NDVI, PM2.5, and their interaction on overweight/obesity.

RESULTS: During 117,240 person-years follow-up, 2622 incidents of overweight/obesity were documented. The hazard ratio of overweight/obesity was 0.95 [95% confidence interval (95% CI): 0.92~0.99] for each 0.1-unit increase in baseline NDVI, 1.16(1.13~1.19) for each 10 μg/m³ increase in 3-year average PM2.5, and 1.04 (1.02~1.06) for the interaction term. In the sensitivity analyses, the interaction of NDVI and PM2.5 on BMI remained significant.

CONCLUSIONS: This nation-wide prospective cohort study revealed the interaction effect of greenness and air pollution on overweight/obesity, which deserve the potential to lead to the lobbying of governments to determine new ways to reduce the burden of PM2.5 air pollution for older Chinese adults.

KEYWORDS: Air pollution; Greenness; obesity; Older adults; Interactive effects; cohort

P-0081 Multiple air pollutants co-exposure and health among the older adults in China

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BACKGROUND AND AIM: We aim to examine the association between ambient air pollutants defined by the WHO guideline AQG (PM2.5, NO2, O3) and mortality, cognitive function, and activities of daily living (ADL) disability in Chinese older adults.

METHODS: We used the 2008-2018 cohort of the Chinese Longitudinal Healthy Longevity Study (CLHLS). We included 11 835 participants, covering 23 provinces of China. We ran the Cox proportional hazards model to examine the association between the ambient air pollutants exposure and all-cause mortality, generalized estimating equation to test the association between air pollutants and repeatedly measured cognitive function and ADL disability.

RESULTS: The participants had a mean age of 87 (SD:11) and 57% were females. The annual average PM2.5, NO2, and O3 were higher in northern China than in southern China. The proportion exposed under the AQG level in the last year was 0% for PM2.5, 23.7% for NO2, and 0.7% for O3. Each 10 μg/m3 increase in PM2.5 was associated with higher mortality risk in both the single-pollutant and three-pollutant model [hazard ratio: 1.17, 95% confidence interval (CI): 1.15-1.19]. NO2 was not significantly associated with mortality risk and O3 was protective for mortality in three-pollutant model. Each 10 μg/m3 increase in O3 was associated with higher odds of cognitive impairment [Odds ratio (OR): 1.04, 95% CI: 1.01-1.07] in three-pollutant model. Each 10 μg/m3 increase in PM2.5 and NO2 were both associated with higher odds of ADL disability [OR (95% CI): 1.03 (1.01, 1.06) and 1.24 (1.20, 1.28) respectively] in three-pollutant model.
CONCLUSION: China has diverse air pollution levels depending on geographical areas, and do not meet WHO AQG in the majority of regions. PM2.5 was dominant for mortality outcome, while O3 and NO2 were dominant for cognitive impairment, and ADL disability outcomes, respectively.

KEYWORDS: Air pollution, mortality, cognitive function, ADL, China

P-0082 Interactive effects of physical activity and air pollution on incident dementia

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BACKGROUND AND AIM: Accumulating evidence suggests that physical activity reduces dementia risk, but the extent to which this can be offset by residential air pollution is unknown. The aim is to determine whether residential air pollution attenuates the beneficial effects against the risk of incident dementia induced by regular physical activity.

METHODS: A population-based longitudinal study that included adults aged between 40 and 74 years without dementia at baseline. Participants were recruited to the UK Biobank study between 2006 and 2010 and followed up for an average of 9.0 years. Physical activity was categorized into regular and non-regular and residential overall air pollution with Q1 (lowest quartile, 25.6-43.6 µg/m3) to Q4 (highest quartile, 60.8-280.1 µg/m3) exposure categories. Associations between physical activity and air pollution and risk of incident dementias were assessed using Cox proportional hazards regression models.

RESULTS: 502 222 individuals (mean [SD] age, 56.5 [8.1] years; 45.6% were women) were included in the study, among which 2 502 individuals were subsequently diagnosed with all-cause dementia. Results of main effects indicate that not engaging in regular physical activity was associated with a 15% increase in dementia risk (adjusted hazard ratio, 1.15; 95%CI, 1.05-1.26) while exposure to the highest level of air pollution was associated with a 29% increase in the risk (adjusted hazard ratio, 1.29; 95%CI, 1.14-1.46). Hazard ratios associated with no regular physical activity decreased as air pollution increased; however, there was no significant interaction between the two factors (p = .05).

CONCLUSIONS: Among mid-age adults without dementia, regular physical activity was significantly associated with lower dementia risk and higher air pollution were significantly associated with higher risk. Although the benefit of physical activity was smaller among participants exposed to higher air pollution, we found no significant interaction effects.

KEYWORDS: air pollution; physical activity; incident dementia

P-0083 Mapping the complex systems that connects the urban environment to cognitive decline in older adults: a group model building study

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BACKGROUND AND AIM: The number of people living with dementia and Mild Cognitive Impairment (MCI) is increasing. A supportive urban environment can prevent or delay the progress of cognitive decline. There is evidence for the existence of mechanistic pathways between the urban environment and cognitive decline, but the interrelations between these pathways are unclear. In this study, we aimed to map the mechanistic pathways by which urban environment factors impact cognitive decline in older adults.

METHODS: This study was part of the Supportive environments for Physical and social Activity, healthy ageing and CognitivE health (SPACE) project. A 2-day workshop with the SPACE investigators was conducted based on the Group Model Building (GMB) methodology. The workshop aimed to create a causal-loop diagram (CLD) that identifies established and potential urban environment, lifestyle, health, and physiological determinants of cognitive decline in older adults. A facilitation team guided the activities. The workshop was held online following appropriately adapted scripts. After the workshop, the modelling team reviewed the CLD to ensure that main potential causal pathways and mechanisms were captured.

RESULTS: During the workshop, 12 experts from 10 different disciplines identified 83 factors and 221 connections between them. After review, the CLD presented 50 factors and 154 connections. All factors were classified in 10 main groups: urban design, social environment, travel behaviours, urban design by-products, lifestyle, disease/physiology, mental health conditions, exogenous factors, and cognitive decline outcomes. The main output was a CLD of the complex system of how the urban environment can influence cognitive decline in older adults.

CONCLUSIONS: The CLD detailed the plausible causal pathways between the urban environment and cognitive decline. Our findings suggested that GMB can engage experts and help them view problems through the lens of complex systems.

KEYWORDS: cognitive decline, urban environment, group model building

P-0085 Air pollution protective measures at personal-level affecting health outcomes: A systematic review and meta-analysis

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BACKGROUND: Evidence for the effect of health-protective measures from air pollution at the individual level is relatively scarce. We performed a systematic review and meta-analysis to investigate the effect of personal protective measures for air pollution on various health outcomes.

METHODS: We searched PubMed, Scopus, and Web of Science to find randomized controlled trial studies investigating the effect of personal protective measures for air pollution on health outcomes. Two authors independently searched and selected studies, extracted information, and assessed each study's quality and risk of bias. Meta-analyses were performed when three or more studies were available for specific pair of protective measure and health outcome.

RESULTS: Lung function was higher in groups applying air purifiers than control groups with sham/no filter: forced expiratory volume in 1 second (FEV1) by 0.25 L [95% confidence intervals (CI): 0.01, 0.49]. The application of air-purifying respirators was associated with increased heart rate variability: the root mean square of successive differences between normal heartbeats (rMSSD) by 0.36 (95% CI: 0.13, 0.59). for other pairs of measures and health outcomes, evidence was insufficient.
CONCLUSION: Our findings suggest that air purifiers and air-purifying respirators can serve as an efficient protective measure for respiratory and cardiovascular health, respectively.

KEYWORDS: air pollution, personal-level protective measures

P-0092 Association between Long-Term Ambient PM2.5 Exposure and Cardiovascular Outcomes among U.S. Hemodialysis Patients

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BACKGROUND AND AIM: Ambient PM2.5 is a ubiquitous air pollutant with established adverse cardiovascular (CV) effects. However, quantitative estimates of PM2.5 exposure associations on CV outcomes in susceptible populations are limited. This study assessed the impact of long-term PM2.5 on CV events and cardiovascular disease (CVD)-specific mortality among patients receiving maintenance in-center hemodialysis (HD).

METHODS: We conducted a retrospective cohort study with 314,079 adult kidney failure patients initiating HD between 2011 and 2016 identified from the United State Renal Data System. Estimated daily ZIP code-level PM2.5 concentrations were used to calculate each participant's annual-average PM2.5 exposure based on the dialysis clinics visited during the 365 days prior to the outcome. CV event and CVD-specific mortality were ascertained based on ICD-9/ICD-10 diagnostic codes and recorded cause of death from form 2746. Discrete time hazards models were used to estimate hazards ratios (HRs) per 1 µg/m3 in annual-average PM2.5 adjusting for temperature, humidity, day of the week, season, age at baseline, race, employment status, and geographic region. Effect measure modification was assessed for age, sex, race, and baseline comorbidities.

RESULTS: Annual-average PM2.5 of 1 µg/m3 was associated with increased hazard rates in CV events (HR: 1.02, 95% CI: 1.01, 1.02) and CVD-specific mortality (1.02, 95% CI: 1.02, 1.03). The association was more pronounced for people who initiated dialysis at an older age, had COPD at baseline, or were Asian. Evidence of effect modification was also observed across strata of race, and other baseline comorbidities.

CONCLUSIONS: Long-term ambient PM2.5 exposure was positively associated with CV outcomes among patients receiving maintenance in-center HD. Patients who had advanced age, COPD, or reported to be Asian, appeared to be more susceptible to long-term PM2.5 adverse effects.

KEYWORDS: Air pollution, long-term, vulnerable population, dialysis patients

P-0095 Short-Term Coarse Particulate Exposure and Daily Cardio-Respiratory Hospital Admissions in the Helsinki Capital Region

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BACKGROUND AND AIM: Short-term exposure to coarse inhalable particles (2.5 µg/m3>PMcoarse<10 µg/m3) has been suggested to increase the risk of respiratory disease independently of fine particles, but studies present mixed findings which are even less clear for other outcomes.
This study aims to assess the relationship between short-term exposure to PMcoarse and total admissions for cardio-pulmonary diseases.

METHODS: We conducted a seventeen-year (01/2001-12/2017) time-series study of the daily admissions for cardio-respiratory disease in relation to the mean levels of coarse particles. We obtained air pollution data from the Helsinki Region Environmental Services Authority, meteorological data from the Finnish Meteorological Institute, and hospital exit records from the Finnish Institute for Health and Welfare. We modelled the association between particles and cardiorespiratory admissions using log-linked quasi-Poisson regression. Penalised splines were used to adjust for the time-trend and the meteorological variables. These models were also adjusted for the weekday, pollen concentration, and influenza outbreaks. Different lag structures were explored in both single-pollutant and multipollutant models. The multipollutant models were simultaneously adjusted for PM2.5, NO2, and O3.

RESULTS: The mean(standard deviation) concentration of PMcoarse was 6.6(5.9) (µg/m3), while the mean (standard deviation) daily numbers of cardiovascular and respiratory admissions were 25.9(7.3) and 21.3(7.4), respectively. A 10 µg/m3 increase in the same day PMcoarse was associated with a 1.7% (95% CI, 0.4%—3.1%) and a 1.9% (95% CI, 0.5%—3.4%) excess daily risk of respiratory admissions in the single-pollutant and multipollutant models, respectively; same-day excess cardiovascular admissions risks were 0.6% (95% CI, -0.5%—1.7%) and 0.3% (95% CI, -0.9%—1.4%) in similar models.

CONCLUSIONS: Short-term exposure to PMcoarse can increase respiratory admission risks independently of co-pollutants but has a less determinate effect on cardiovascular admissions. A guideline framework should be considered for PMcoarse.

KEYWORDS: Coarse Particles, Cardiovascular Admissions, Respiratory Admissions, Time-Series, Fine Particles

P-0096 Particulate matter, albumin/creatinine ratio, and chronic kidney disease in a prospective cohort study

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BACKGROUND: Many studies have investigated the association between exposure to particulate matter (PM) and kidney dysfunction, but the relationship is inconsistent due to the variations in exposure assessment, the use of renal-function indices, and study design.
OBJECTIVES: This study elucidated the associations between exposure to PM10, PM2.5, and PM1 with albumin/creatinine ratio (ACR) and the incidence of chronic kidney disease (CKD) in a community-based cohort in Taiwan.

METHODS: A total of 704 residents living in Taichung were recruited as study subjects at the baseline of 2004 and followed up to the end of 2018. Questionnaire and health examination was used to collect personal information and renal-function indices at baseline and follow-up. Land-use regression models were established to predict individual levels of PM10, PM2.5, and PM1 annually during studying periods. The multivariable linear regression and Cox regression were conducted to investigate the associations between PM exposures, ACR, and the incident CKD (creatinine-based estimated glomerular filtration rate, [eGFRcr] < 60ml/min/1.73m2).

RESULTS: We found that an increase of 1 μg/m3 in PM10, PM2.5, and PM1 was associated with the decreased ACR of 1.10±1.14 mg/g (p=0.080), 4.66±2.17 mg/g (p=0.032), and 6.05±2.82 mg/g (p=0.032), respectively. The similar associations were identified for the cumulative exposure of 1 μg/m3-year to PM10, PM2.5, and PM1, which decreased the ACR of 0.14±0.10 mg/g (p=0.157), 0.55±0.27 mg/g (p=0.040), and 0.72±0.35 mg/g (p=0.040), respectively. Per 1 μg/m3 increase in PM10, PM2.5, and PM1 was associated with the elevated risk of 1.07-fold (95% confidence interval [CI]=1.00-1.15, p=0.055), 1.19-fold (95% CI=1.04-1.37, p=0.011), and 1.26-fold (95% CI=1.05-1.50, p=0.011) in the incident CKD, respectively.

CONCLUSIONS: The present study showed that exposure to PM2.5 and PM1 was associated with the decreased renal function to increase the risk of developing CKD.

P-0097 Fine particulate matter infiltration at skilled nursing facilities during wildfire season in the Western USA

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BACKGROUND AND AIM: Wildfire air pollution is a growing public health concern as wildfires increase in size, intensity, and duration in the USA (US). Residents of skilled nursing facilities (SNFs) are vulnerable to wildfire smoke due to common pre-existing health conditions and advanced age of these populations. We assessed the impact of wildfire smoke on SNFs by estimating ambient fine particulate matter ($PM_{2.5}$) infiltration into SNFs during wildfire season.

METHODS: We measured continuous outdoor and indoor $PM_{2.5}$ concentrations from July-October 2021 at six SNFs in the US states of Idaho and Montana using PurpleAir monitors. We calculated infiltration efficiency (range 0-1; higher values indicate more ambient $PM_{2.5}$ infiltration to the indoor environment) at each facility using paired outdoor/indoor $PM_{2.5}$ samples in a validated recursive modeling approach. Analyses were conducted separately for each facility, by time of day (8am-5pm work hours versus after hours), and by days impacted by wildfire smoke.

RESULTS: Median outdoor $PM_{2.5}$ at the SNFs ranged from 7.9 μg/m³ (25th percentile=4.4, 75th percentile=21.6) to 16.0 μg/m³ (25th percentile=7.4, 75th percentile=30.6). Median indoor $PM_{2.5}$ at the SNFs ranged from 2.1 μg/m³ (25th percentile=1.7, 75th percentile=3.9) to 8.4 μg/m³ (25th percentile=2.0, 75th percentile=15.8). Infiltration efficiency at the facilities ranged from 0.13 (95% Confidence Interval: 0.10, 0.18) to 0.74 (95% Confidence Interval: 0.64, 0.85). Infiltration efficiency was similar during work hours versus after hours, but was higher during wildfire-impacted days than non-wildfire-impacted days for all but one facility.

CONCLUSIONS: The high variability of indoor $PM_{2.5}$ and infiltration efficiency across the facilities suggests that indoor exposures to wildfire smoke may be a modifiable risk factor for SNF residents. Future work will assess building characteristics and behavioral factors among residents and staff that may be related to wildfire smoke infiltration.

KEYWORDS: smoke, wildfires, indoor air pollution, vulnerable populations, infiltration efficiency, $PM_{2.5}$

P-0099 Educational intervention to promote air pollution knowledge and personal exposure mitigation strategies using wearable sensors

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BACKGROUND AND AIM: Although strategies to reduce air pollution have focused on policy regulations and population-level controls, personal exposure mitigation is an approach that has not been well-explored. The aim of this study was to determine the feasibility of conducting an educational intervention to promote knowledge regarding air pollution, its health effects, and preventive behaviors.

METHODS: We recruited participants from Seattle, Washington from September-November 2021 for a 5-week study. Participants were asked to use Plume Labs Flow 2 wearable air pollution sensors, watch educational videos (intervention at week 3), and receive Air Quality Index (AQI) alerts. Questionnaires were administered pre- and post-intervention to assess air pollution knowledge and Health Belief Model (HBM) constructs for perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy. McNemar and signed-rank tests were used to determine pre- and post-intervention differences.

RESULTS: A total of n=20 participants were included in this study (n=18 were never-smokers). Participants were knowledgeable regarding air pollution (≥35% of participants responded correctly to any given knowledge item at baseline). There was an increase in knowledge of AQI (of the 7 participants who answered incorrectly at pre-intervention, 6 answered correctly at post-intervention; p=0.01). There were no differences in HBM constructs, although pre-intervention responses showed participants perceived air pollution as a personal health threat (perceived severity mean score 8.7 ± 1.3; score range 1-10). Post-intervention personal NO2 levels (mean 11.62 ppb ± 5.89) were lower compared to pre-intervention levels (mean 13.49 ppb ± 3.00) (p=0.02). There were no differences in VOCs, PM1, PM2.5, or PM10 exposures at post-intervention.

CONCLUSIONS: This study demonstrated high feasibility in conducting an educational intervention to promote air pollution knowledge and reduce NO2 exposure. Future research could scale this intervention to subgroups disproportionately impacted by air pollution (e.g., vulnerable populations).

KEYWORDS: intervention; air pollution; sensors; wearables; behavioral science

P-0107 A hybrid model for estimating number concentrations of ultrafine particles in central Taiwan

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BACKGROUND AND AIM: The epidemiological studies for assessing ultrafine particles (UFP) and health effects are scarce. The reasons are that the instrument for measuring UFP is expensive and the previous studies generally relied on a small number of fixed monitoring stations or short-term measurements. Modeling is a cost-effective measure to precisely estimate personal concentration in large-scale epidemiological studies, while the previous UFP estimation generally relied on the land-use regression model (LUR) and lacked temporal resolution. In this study, we conducted in-situ measurements for UFP in Taichung city, Taiwan, and developed a UFP estimation model by using machine learning algorithms.

METHODS: A scanning mobility particle sizer (SMPS Model 5.500, GIMM Aerosol Technik, Gmbh, Germany) was used to measure UFP number concentrations hourly in two sites (urban and rural sites) from 2017 to 2021. Random forest, XGBoost, and deep neural network were used to build the model. Ten-fold cross-validation was used to evaluate model performance. Coefficient of determination (R^2) and normalized root mean square error (nRMSE) were utilized to compare models.

RESULTS: A total of 1488 observations were collected. The average number concentrations of UFP was 23505.4±14643.9 (mean±sd). The XGBoost model had the best performance with a fitting R^2 of 1.00 (nRMSE: 0.20%) and a cross-validation R^2 of 0.63 (RMSE: 3.84%). The top important variables were temperature, surface pressure, Julian date, nitrogen dioxide, wind direction (X direction), fine particulate matter, sulfur dioxide, relative humidity, ozone, year, and aerosol optical depth (AOD).

CONCLUSIONS: Our results provided basic descriptions of UFP in Taiwan and identified several important features for UFP. Although the XGBoost model displayed overfitting, it still outperformed the previous models and provided accurate estimates. These estimates can be used to assess both the short-term and long-term effects of UFP on health outcomes.

KEYWORDS: Aerosol optical depth, estimation model, machine learning, ultrafine particles

P-0113 Household Cooking Fuel Choices and Associated Factors in a Rural and Peri-Urban Community in Western Kenya

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BACKGROUND AND AIM
Polluting fuels such as biomass and kerosene are used for cooking by approximately 85% of the population in sub-Saharan Africa (SSA) despite the well-known associated adverse health effects. Many governments across SSA aim to scale up domestic use of liquefied petroleum gas (LPG), a cleaner-burning fuel in terms of black carbon and fine particulate matter emissions, to promote public health and protect the environment by reducing deforestation. We sought to determine factors associated with household fuel choice in-order to make recommendations that could promote uptake of LPG in rural and peri-urban settings within Uasin Gishu County.

METHODS: The study was part of the CLEAN-Air(Africa) project designed to address barriers to transitioning populations way from reliance on polluting biomass for cooking. A quantitative survey was administered to over 2000 households in peri-urban and rural sub-counties of Uasin Gishu County, West Kenya, to determine cooking characteristics and factors associated with the primary cooking fuel choice (biomass versus LPG).

RESULTS: We found that the majority (72%) of the households still use biomass as a primary fuel while about one third use clean fuels. Predictors for use of clean fuel include; residing in a peri-urban area (aOR 2.5,C.I: 1.933-3.162), education (aOR: 1.9, C.I 1.095-3.602), connection to electricity (aOR: 2.2, C.I: 1.649 -3.189), regular income (aOR:1.4,C.I: 1.117-1.886). Supply factors such as the ease of accessing refills affects duration of LPG use.

CONCLUSIONS: Urbanization at a sub-county level may lead to increases in the use of LPG for cooking. Socio-economic factors and LPG supply factors also predict LPG use. Policies that would increase the availability of LPG to rural communities need to be enacted in order to reduce the time and transportation costs that are likely to affect access and hence low usage.

KEYWORDS: Cooking fuel, factors associated, peri-urban and rural, Western Kenya

P-0121 Particle Radioactivity: A potential driving factor for PM2.5 toxicity

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BACKGROUND AND AIM: Fine particulate matter (PM2.5) is associated with adverse human health outcomes. However, little is known about the mechanism(s) for the toxicity or which components of the PM2.5 cause the health effects. The ability of particles to cause oxidative damage may play a role.

METHODS: We evaluated the associations between the oxidative potential (OP) of PM2.5 particles (N=60) as measured by the dithiothreitol (DTT) assay, and different properties of these particles, including α- and β-activity, PM2.5 mass, and chemical components.

RESULTS: We found that Pearson correlation coefficients (r) between OP and the different variables were the strongest for α- and β-activities (Pearson's r=0.49 and 0.47, respectively), with a weaker correlation for PM2.5 mass (Pearson's r=0.33). Correlations between OP and the 25 PM2.5 elemental concentrations were weaker, ranging from 0.32 for Zinc to -0.21 for Barium. Bivariate regression models including radiation (either α- or β-activity) and one other variable (mass or chemical component) showed that only the radiation component was a significant predictor ($p<0.001$). None of the PM2.5 mass and elemental concentrations were significant.

CONCLUSIONS: The findings here suggest that radionuclides play a role in the toxicity of the particles. Gross α- and β-activity may help explain the association found between PM2.5 and detrimental health outcomes. This is the first study to link particle radioactivity to an oxidative stress assay.

KEYWORDS: particulate matter; radioactivity; oxidative potential; PM2.5; dithiothreitol assay; particle toxicity

P-0124 Causal relationship between PM 2.5 and diabetes mellitus: Two sample Mendelian Randomization using MR-Base platform

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BACKGROUND AND AIM: Many studies have shown air pollution has emerged as one of the major environmental risk factors for diabetes mellitus; however, studies on the causal relationship between air pollution and diabetes mellitus based on genetic approaches are scarce. The study estimated the causal relationship between diabetes and fine particulate matter (PM2.5) using Mendelian randomization (MR).

METHODS: We collected genetic data from European ancestry publicly available genome wide association studies (GWAS) summary data through the MR-BASE repository. The IEU GWAS information output (PM2.5) from the Single nucleotide polymorphisms (SNPs) GWAS pipeline using pheasant-derived variables (Consortium=MRC-IEU, sample size: 423,796). The annual estimates of PM2.5 (2010) were modeled for each address using a Land Use Regression model developed as part of the European Study of Cohorts for Air Pollution Effects. Diabetes GWAS information (Consortium=MRC-IEU, sample size: 461,578) were used, and the genetic variants were used as the instrumental variables (IVs). We performed three representative MR

METHODS: Inverse Variance Weighted regression (IVW), Egger, and Weighted median for causal inference using genetic variants. Furthermore, we used a novel method called MR Mixture to identify outlier SNPs.

RESULTS: From the IVW method, we revealed the causal relationship between PM2.5 and diabetes (Odds ratio [OR]: 1.041, 95% CI: 1.008-1.076, p=0.016), and the finding was substantiated by the absence of any directional horizontal pleiotropy through MR-Egger regression (β=0.016, p=0.687). From the IVW fixed-effect method (i.e. one of the MR Mixture methods), we excluded outlier SNP (rs1537371) and showed the best predictive model (AUC=0.72) with a causal relationship between PM2.5 and diabetes (OR: 1.028, 95% CI: 1.006-1.049, p=0.012).

CONCLUSIONS: We identified the hypothesis that there is a causal relationship between PM2.5 and diabetes in the European population, using MR methods.

KEYWORDS: Causal relationship; Particulate matter; Diabetes; Mendelian Randomization

P-0125 Short-term effects of fine particulate matter constituents on pulmonary function among adolescents

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BACKGROUND: Expose to fine particle matter (PM2.5) has been associated with adverse effects on pulmonary function. Especially, it has been recently focused on the effects of PM2.5 constituents on human health. However, it is unclear whether healthy adolescents are affected by the expose to PM2.5 constituents in daily life. We investigated the association between PM2.5 constituents and pulmonary function in healthy adolescents.

METHODS: We conducted a panel study for about one month, in every spring and fall from 2014 to 2016, in Yuge Island, Japan. Pulmonary function measurements were conducted every morning in 48 healthy adolescents. PM2.5 samples were collected every 24 h during the study period, and the concentrations of 27 constituents in PM2.5 were analyzed. Mixed effects model were used to estimate the associations of pulmonary function with the average concentrations of PM2.5 constituents for 24h before a pulmonary function measurements.

RESULTS: The mean (SD) of PM2.5 mass concentration was14.9 (7.5) µg/m3 during the study period. A total of 4155 pulmonary function measurements were conducted by 48 healthy students. The peak expiratory flow (PEF) decreased significantly in relation to increases in concentrations of 12 constituents in PM2.5. The largest decrease of PEF with an interquartile range increase was observed for potassium (-4.01L/min [95% confidence interval: -6.07, -1.94]). The force expiratory volume in 1 s (FEV1) also decreased significantly in relation to increases in 11 constituents in PM2.5, and potassium had the most prominent effects among the constituents in PM2.5.

CONCLUSIONS: Our results suggest that many constituents in PM2.5 were associated with significant reduction in pulmonary function among healthy adolescents. Further studies are needed to clarify the source of the constituents in PM2.5 that affect respiratory system, and the reduction of the substances is desired to prevent the health effects of PM2.5.

P-0128 Triggering of ST-elevation myocardial infarction by ultrafine particles in New York: changes following Tier 3 vehicle introduction

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BACKGROUND AND AIM: Previously, we found increased rates of ST-elevation myocardial infarction (STEMI) associated with increased ultrafine particle (UFP; <100nm) concentrations in the previous few hours in Rochester, New York. Rates were higher after air quality policies and a recession reduced pollutant concentrations (2014-2016 versus 2005-2013), suggesting PM composition had become more toxic. Tier 3 light duty vehicles, which should produce less primary organic aerosols and oxidizable gaseous compounds, likely making PM less toxic, were introduced in 2017. Because of this, we hypothesized we would observe a lower relative STEMI rate in 2017-2019 than 2014-2016.

METHODS: Using STEMI events treated at the University of Rochester Medical Center (2014-2019), local UFP and other pollutant concentrations, a case-crossover design, and conditional logistic regression models, we separately estimated the rate of STEMI associated with increased UFP and other pollutants in the previous hours and days in the 2014-2016 and 2017-2019 periods.

RESULTS: An increased rate of STEMI was associated with each 3121 particles/cm3 increase in UFP concentration in 2014-2016 (lag hour 0: OR=1.23; 95% CI = 1.08, 1.41), but not in 2017-2019 (OR=0.93; 95% CI = 0.79, 1.09). There were similar patterns for black carbon, UFP11-50nm, and UFP51-100nm. In contrast, increased rates of STEMI were associated with 0.6ppb increases in SO2 concentrations in the previous 120 hours in both periods (2014-2016: OR=1.25, 95% CI = 1.00, 1.36; 2017-2019: OR=1.22, 95% CI = 0.88, 1.68).

CONCLUSIONS: Greater rates of STEMI were associated with short term increases in concentrations of UFP and other motor vehicle related pollutants before Tier 3 introduction (2014-2016), but not afterwards (2017-2019). This change may be due to changes in PM composition, to increased exposure misclassification and greater underestimation of effects from 2017-2019, and/or changes in therapeutic approaches such as preventive aspirin use.

KEYWORDS: myocardial infarction, air pollution, ultrafine particles, case-crossover

P-0129 Ambient fine particulate matter exposure and risk of incident breast cancer in the NIH-AARP Diet and Health Study

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BACKGROUND AND AIM: Fine particulate matter (PM2.5) has been inconsistently associated with breast cancer risk, however few studies have considered historic exposure levels which may be more relevant given the long latency of breast cancer.

METHODS: Outdoor residential PM2.5 concentrations were estimated using a nationwide spatiotemporal model for women in the NIH-AARP Diet and Health Study, a cohort located in 6 states (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and 2 metropolitan areas (Atlanta, Georgia, and Detroit, Michigan) and enrolled in 1995-1996. Annual average PM2.5 concentrations were estimated for a 5-year historical period 10 years prior to enrollment (1980-1984). We used Cox regression to estimate adjusted hazard ratios (HRs) and 95% confidence intervals (95% CIs) for the association between a 10µg/m3 increase in PM2.5 and incident breast cancer risk overall and by estrogen receptor (ER) status and extent of the tumor (invasive vs. ductal carcinoma in situ (DCIS)). Models were adjusted for age, body mass index, race/ethnicity, smoking status and catchment area. We also conducted analyses stratified by catchment area.

RESULTS: With follow-up through 2011, 13,246 breast cancer cases were diagnosed. A 10ug/m3 increase in PM2.5 was significantly associated with overall breast cancer risk (HR=1.07, 95% CI:1.01-1.13). No significant differences were observed between invasive tumors and DCIS (p-for-heterogeneity=0.40). The association was evident for ER+ tumors (HR=1.09, 95% CI:1.02-1.17), but not ER- tumors (HR=0.97, 95% CI:0.80-1.17; p-for-heterogeneity=0.31). Overall breast cancer HRs were >1 across all cohort catchment areas; ranging from a HR=1.47 (95%CI: 0.73-3.00) for Georgia to a HR=1.04 (95% CI:0.97-1.11) for California (p-for-heterogeneity=0.66).

CONCLUSIONS: In this large U.S. cohort with historical air pollutant exposure, PM2.5 was associated with ER+ breast cancer risk. Future work should consider region-specific associations and the potential contribution of PM2.5 chemical constituency in modifying the observed association with breast cancer.

KEYWORDS: breast cancer, outdoor air pollution

P-0135 Source apportionment of ambient PM2.5 using positive matrix factorization (PMF) model in Cape Town, South Africa

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BACKGROUND AND AIM: Particulate matter (PM) with an aerodynamic diameter <2.5µm (PM2.5) is an indicator of air pollution that threatens global population health. In 2017, exposure to PM2.5 was attributed to 2.9 million premature deaths and 83 million DALYs globally. The dearth of data on PM2.5 sources and quantification presents a significant gap in knowledge for Africa and South Africa in particular. This study identified the sources and their contributions to ambient PM2.5 in Cape Town, South Africa.

METHODS: PM2.5 samples were collected every third day for 121 days in an urban background site in the Kraaifontein suburb in Cape Town. Filters were analyzed for black carbon, organic carbon, and trace elements using Model OT21 Optical Transmissometer and a Xepos 5 Energy-dispersive x-ray fluorescence (EDXRF) spectrometer, respectively. Concentration and uncertainty data for PM2.5, BC, OC, and trace elements (S, Cl, Si, K, Ca, Ti, V, Fe, Ni, Cu, Zn, As, Se, Br, Sr, Sb, Ba, Pb, U) were used in the PMF, version 5.0 from the US Environmental Protection Agency to identify sources by markers.

RESULTS: The mean PM2.5 concentration was 13.4 ± 8.2 µg/m3 (1.2 to 39.1µg/m3) above the stipulated WHO air quality guideline of 5µg/m3. The PM2.5 mean seasonal concentration were 17.37µg/m3 (spring), 16.1 µg/m3 (winter), 11.25 µg/m3 (autumn) and 9.12 µg/m3 (summer). Sulfur had the highest mean concentration of 346.95ng/m3 followed by chlorine (288.21ng/m3) then silicon (204.52ng/m3). Uranium had the lowest mean concentration of 0.62ng/m3. Seven sources of PM2.5 were quantified including point source emission (24.6%), biomass burning (22.3%), traffic emission (16.8%), secondary sulphate (13.1 %), sea salt (9.3%), diesel combustion (8.4%) and crustal sources (5.5%).

CONCLUSIONS: The main PM2.5 emitters are combustion sources. Therefore abatement strategies should focus on improving the combustion processes.

KEYWORDS: Air pollution, PM2.5, Trace elements, Source apportionment, South Africa

P-0139 Chronic exposure to air pollution and semen quality in an Asian population

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BACKGROUND AND AIM: Evidence concerning the association between air pollution and semen quality is sparse, and findings in previous studies remain inconsistent. This study aims to investigate the associations between exposure to ambient air pollution and semen quality in Asia.

METHODS: A cross-sectional study was conducted among 7,658 male participants (aged ≥15 years) who participated in a standard medical examination program in Taiwan and Hong Kong between 2000 and 2018. The 2-year average concentration of $PM_{2.5}$, NO_2, and O_3 was estimated at each participant's address using satellite-based spatial-temporal models. Semen quality was assessed according to the WHO 1999 guidelines, including sperm concentration, total motility, progressive motility, and morphology. Generalized linear mixed models were used to examine the association between air pollution and sperm quality, with a region-level random intercept used in all models to control within-region clustering effects.

RESULTS: Every 10 ug/m^3 increase in NO_2 was associated with a decrease of -1.72% [95% confidence interval (CI): -2.68% to -0.75%] in sperm concentration. However, each 10 ug/m^3 increase in $PM_{2.5}$ and O_3 was associated with an increase of 3.13% (95%CI: 0.76% to 5.55%] and 2.88% (95%CI: 0.75% to 5.05%) in sperm concentration, respectively. In addition, each 10 ug/m^3 increase in $PM_{2.5}$ was associated with a lower percentage of normal sperm morphology, with a coefficient of -1.54 (95%CI: -2.41 to -0.68). There were no consistent associations between air pollution and other semen parameters.

CONCLUSIONS: We found that exposure to ambient NO_2 was associated with a lower level of sperm concentration and exposure to ambient $PM_{2.5}$ was associated with a lower level of normal sperm morphology. Further studies are warranted to validate our findings.

KEYWORDS: Air pollution, ozone, male infertility, semen quality

P-0145 Associations between long-term air pollution exposure and physical function in older adults

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BACKGROUND AND AIM: Epidemiological studies concerning the relations between exposure to air pollutants especially in ozone and disability in older adults were limited. Thus, this study aims to investigate the associations between exposure to long-term air pollution and the risk of disability among the community-dwelling older adults.

METHODS: Study participants were adopted from the third to sixth wave surveys (1996, 1999, 2003 and 2007 year) in Taiwan Longitudinal Study on Aging (TLSA) (n=2241). We estimated 1-year and 2-year exposure window for ozone levels from 1994 to 2007 by using daily concentration data at air quality monitoring stations in the administrative zone of participants' residences. The status of disability for each participant was evaluated on the activities of daily living scale (ADLs) and instrumental activities of daily living scale (IADLs). Generalized linear mixed models were used to investigate the associations between long-term ozone exposure and disability after adjusting for covariates.

RESULTS: We found that long-term (1-year moving average or 2-year moving average) ozone exposure was positively associated with the risk of disability in the elderly. for example, when the average concentration of ozone increased 1 ppb in 1-year exposure window, the risk of disability for ADL scores ≥1 and IADL scores ≥7 in the elders increased 5.4% (OR=1.054, 95% CI:1.022-1.086) and 4.3% (OR=1.043, 95%CI:1.016-1.071), respectively. As compared to quartile 1 (Q1) of 1-year moving average for ozone levels, quartile 4 (Q4) of ozone exposure was significantly associated with the risk of disability for ADL scores ≥1 and IADL scores ≥7 in older adults (OR=1.858, 95% CI:1.404-2.459 for ADL scores ≥1; OR=1.700, 95%CI:1.331-2.171 for IADL scores ≥7).

CONCLUSIONS: Our results indicated that the long-term exposure to ozone could be a risk factor of disability in older adults. More researches on the biological mechanism of ozone-disability associations are required in the future.

P-0146 Adoption of innovative energy efficiency pots to enhance sustained use of clean cooking with gas in resource-poor households in Kenya: perceptions from participants of a randomized controlled trial

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BACKGROUND AND AIM: Initial equipment purchase and recurrent fuel costs, as well as cultural cooking preferences (including perceived fuel wastage for long cooking duration foods) are recognized barriers to adoption and use of gas and electricity for clean cooking. Scaling clean cooking is now a priority for many sub-Saharan African countries to address the substantial health burden from exposure to household air pollution from reliance on polluting solid fuels.
METHOD: To facilitate transition to clean cooking with liquefied petroleum gas (LPG) innovative cooking pots with a revolutionary new fuel saving design were tested by LPG using cooks in an informal settlement in Nairobi, Kenya who currently also used polluting fuels for their cooking. Semi-structured interviews (SSIs) were conducted with 22 of 200 cooks who took part in a randomized control trial of the pots to test the impacts of the pots on exclusive clean cooking with LPG. The SSIs explored positive and negative perceptions of the technology in aiding clean cooking and potential time savings.

RESULTS: Universal appreciation of the benefits of the pots for cooking, fuel and time saving and prestige were reported by the cooks with all cooks reporting advantages over their traditional locally available pots (Sufurias). Willingness to pay for the pots and the potential for scale in the local community was a key outcome from the thematic analysis.

CONCLUSIONS: This study highlights the potential role for energy-efficient pots as a solution to sustained /exclusive clean cooking with LPG in resource poor settings. The documented positive impacts on time and fuel savings are substantiated and contextualized through the results of this qualitative study. In addition, the findings are directly relevant to scale of the cooking pots in local markets through both import and local manufacturing.

KEYWORDS: Household Air pollution, energy-efficient pots, LPG, adoption, enhanced cookware, gas.

P-0150 Malodour and health risks in the surroundings of an animal rendering plant

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BACKGROUND AND AIM. Volatile Organic Compounds (VOCs) emitted from animal rendering processes, may be hazardous and/or malodorous. This study was conducted in the vicinity of a rendering plant in Southwest Greece, during operation and after its compulsory cessation. The aim was to assess the odour annoyance and the possible carcinogenic and toxic risks, derived from VOCs in ambient air.

METHODS: VOCs were absorbed onto Tenax TA/Sulficarb sorbents via active sampling and analyzed by Thermal Desorption-Gas Chromatography-Mass Spectrometry. Odour Activity Values (OAVs) were calculated for odorants. Health risks were determined by probabilistic risk assessment. Past and present odour nuisance perceived by residents was assessed through a questionnaire.

RESULTS: A substantial reduction in ambient air concentrations of VOCs (47 %) was found after closure of the plant. Seventeen compounds totally disappeared, of which four (propanoic and butanoic acids, dimethyl trisulfide, 2-nonenal) were immensely malodorous. The total odour burden, as expressed by the sum of OAVs, decreased by 70 %. Residents reported a definite drop in the frequency, intensity, duration and annoyance of the odour. Non-specific health symptoms (nausea, respiratory problems, etc.) that participants were experiencing in the past, no longer occur. During the operation period, the cumulative Lifetime Cancer Risk (LCR) for the general population was calculated to be 10 times higher than the acceptable risk. The cumulative mean Hazard Quotient (HQ = 3.3), indicated a high risk of adverse health effects. After activity termination, LCR decreased by 3-fold, while HQ remained almost the same.

CONCLUSIONS: Three major issues, odour disturbance, cancer and toxic risks were imposed on the surrounding population by a rendering plant, which was not operating under the Best Available Techniques framework. A significant amelioration of life quality was reported by residents after activity termination.
Keywords Odorous compounds; Health risk assessment; Rendering; VOCs; Residents' perception

P-0156 Pregnant women's exposure to 1-hydroxypyrene predicted by airport-related source indicators in an area with low ambient air pollution

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BACKGROUND: Gestational exposures to polycyclic aromatic hydrocarbons (PAHs) are associated with adverse health effects among mothers and infants. Although outdoor air pollution is a known contributor to the general population's exposures to PAHs, it is unclear whether residential proximity to local pollution sources predict PAH exposure in pregnant women, especially in areas with low-level pollution.
AIM: To determine the associations of residential proximity to vehicular traffic and a nearby airport with urinary 1-hydroxypyrene (1-OHP) among pregnant women living in Rochester, New York.

METHODS: We used 743 urine samples measured for 1-OHP (once per trimester) from a pregnancy cohort study of 313 women. We calculated the distance between participants' residences and the Rochester Airport and annual average daily traffic volumes (AADT) within different buffer distances from the residence (100m increments). Associations between 1-OHP and these proximity measures were examined using linear regressions, adjusting for age, body mass index, and smoking status.

RESULTS: Residential proximity to the airport and AADT within a 300m buffer distance were associated with 1-OHP concentrations. One IQR increase in log-distance (i.e., from 6.3 to 14.0 km) was associated with an 11.0% increase in 1-OHP concentration (95%CI: 4.4%, 17.2%), while each IQR increase in the square root of AADT was associated with an 8.3% increase in 1-OHP concentration (95%CI: 1.41%, 15.73%). We found greater increases in 1-OHP levels associated with IQR increases in residential proximity to the airport when participants lived downwind (15%) than upwind (12%) of the airport, suggesting a substantial contribution of airport-related sources to PAH exposures.

CONCLUSIONS: Emissions from an airport and local traffic activities likely contributed to increased PAH exposures among pregnant women living in a Northeastern US city with low air pollution levels (average participant exposure PM2.5 = 6.1 μg/m3).

KEYWORDS: PAH, 1-hydroxypyrene, pregnant women exposure

P-0161 Hospital admission risks and costs for neuropsychiatric disorders attributable to fine particulate matter in New York State: a community-level cross-sectional study

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BACKGROUND AND AIM Neuropsychiatric disorders are a huge and growing public health concern during the recent years. However, evidence is limited for air pollution and related excess medical costs for neuropsychiatric disorders. We aimed to investigate excess risks and costs of hospital admission for neuropsychiatric disorders associated with long-term exposure to fine particulate matter (PM2.5) in New York State and examine disproportionate impact of PM2.5 on neuropsychiatric disorders by individual characteristics.

METHODS: We collected non-elective annual hospital admission counts and costs for six neuropsychiatric disorders—fatigue, headache, behavior disorder, mood disorder, Parkinson's diseases, and epilepsy— from the Statewide Planning and Research Cooperative System (SPARCS) database from 2010 to 2016. We also obtained county-level annual average of PM2.5 from the high-quality prediction model. We performed a generalized linear mixed model to estimate the association between annual average PM2.5 and the number of annual hospital admissions for neuropsychiatric disorders and calculated the excess medical costs attributable to PM2.5 based on the estimated association.

RESULTS: We found that higher exposure to PM2.5 was associated with higher hospital admission risks of neuropsychiatric disorders, and the risk was more evident in behavior disorder and Parkinson's disease, RRs: 1.08 (95% CI: 1.02, 1.16) and 1.08 (95% CI: 1.00, 1.17). Meanwhile, the excess medical cost attributable to annual PM2.5 was the highest in mood disorder (309.8 million dollars with 95% CI: -48.4, 599.4 million dollars) and epilepsy (255.5 million dollars with 95% CI: 55.9, 405.2 million dollars).

CONCLUSIONS:This study provides the excess hospital admission risks due to exposure to long-term PM2.5 for neuropsychiatric disorders, together with the excess costs attributable to PM2.5 which have a different pattern from the estimated risks.

KEYWORDS: Fine particulate matter, PM2.5, Neuropsychiatric disorders, Economic burden.

P-0167 Individual and regional vulnerability for hospitalization with cardiovascular and respiratory diseases in association with short-term ambient PM2.5 exposure

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BACKGROUND AND AIM: Short-term effect of ambient $PM_{2.5}$ exposure on cardiovascular and respiratory hospitalization has a high scientific evidence. However, further evaluation for the vulnerability in terms of individual and regional characteristics is still needed.
METHOD: We covered 166 municipalities, in which has ambient $PM_{2.5}$ monitoring sites, in Republic of Korea from 2015 to 2019. We used daily means of $PM_{2.5}$ concentration, temperature, relative humidity data, and daily hospitalization [ischemic heart disease (IHD), stroke, chronic obstructive pulmonary disease (COPD), and asthma] count data from the National Health Insurance Sharing Service. Quasi-Poisson generalized additive models for overall population and the strata [individually identified; sex, age, social economic status (SES)] in each municipality and meta-analyses using regional-level variables (over aged 65, obesity, current smoker, and greenspace rate, Gross Regional Domestic Product(GRDP) per capita, employment rate, and untreated medical need rate) were implemented.

RESULTS: The pooled risk according to increase of 10 $\mu g/m^3$ of $PM_{2.5}$ concentration was increased by 0.62% (95%CI, 0.44–0.81), 0.16% (95%CI, -0.09–0.40), 0.75% (95%CI, 0.49-1.02) and 0.59% (95%CI, 0.32–0.86) based on the model with 0-1 lag day exposure, for IHD, stroke, COPD, and asthma, respectively. We found higher risks in female for IHD (0.76%), male for COPD (1.19%), in lower SES for IHD (0.88%) and stroke (0.47%), and in older group aged 65 or more for IHD (0.97%), stroke (0.36%), COPD (1.31%), and asthma (1.85%). In the regions with higher rates of older group over aged 65, obesity,and GRDP per capita, the higher risks were shown for IHD, stroke, and asthma, while in the regions with lower employment rate, those were for IHD, stroke, and COPD.

CONCLUSIONS: We explored to identify the vulnerable factors in terms of individual and regional characteristics.

KEYWORDS: Short-term exposure, $PM_{2.5}$, susceptibility, multi-city time-series, meta-regression

P-0171 Impact of the wood-burning Justa stove on Fractional Exhaled Nitric Oxide: A stepped-wedge randomized trial in Honduras

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BACKGROUND: In 2019, household air pollution from combustion related to household energy needs (e.g., cooking) was estimated to be responsible for 2.3 million premature deaths globally, including nearly 400,000 from chronic respiratory diseases. In rural Honduras, we demonstrated substantially reduced personal fine particulate matter [PM2.5] concentrations following a 3-year wood-burning Justa stove (engineered combustion chamber and chimney) intervention (e.g., 24-hour PM2.5 median [25th, 75th percentiles]: Justa, 43 [27, 73]; traditional stove, 81 [50, 141] µg/m3). We evaluated the impact of the intervention and PM2.5 and black carbon (BC) concentrations on fractional exhaled nitric oxide (FeNO), a noninvasively collected biomarker of eosinophilic airway inflammation previously associated with exposure to ambient air pollution.

METHODS: With 6 visits per household over 3 years, the individual-level, stepped-wedge randomized controlled trial was conducted among 230 primary female cooks aged 24-59 years and using traditional stoves at baseline. In addition to 24-hour gravimetric personal and kitchen PM2.5 and BC concentrations, we longitudinally assessed FeNO levels with the NIOX Vero device at each visit in a random sample of 90 participants. Among participants reporting no use of anti-inflammatory medications, we explored FeNO impacts of the intervention in intent-to-treat (adjusted for time trends) and exposure-response (adjusted for potential confounders) linear mixed effect models (n=414 observations).

RESULTS: We did not observe an effect of the intervention on FeNO levels (3% higher geometric mean among those assigned to the Justa compared to the traditional stove, 95% confidence interval [CI]: -12%, 21%). Associations between pollution concentrations and FeNO were consistent with the null association (e.g., we observed a difference of 4% lower FeNO per 1-unit higher log-transformed personal PM2.5, 95% CI: -9%, 1%).

CONCLUSIONS: Evidence from ambient and HAP studies regarding associations with FeNO is inconsistent, and may be attributable to differing study populations, exposures, and FeNO measurement procedures.

P-0173 Long-term trends in mortality risks associated with short-term exposure to air pollution in 10 Japanese cities between 1977 and 2015

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BACKGROUND AND AIM: Short-term associations between air pollution and mortality have been well reported in Japan, but the historical changes of mortality risks remain unknown while Japan undergoes rapid aging. We examined temporal changes in the mortality risks associated with short-term exposure to four criteria air pollutants in selected Japanese cities.

METHODS: We collected daily mortality data for non-accidental causes (n=5,748,206), cardiovascular (n=1,938,743) and respiratory diseases (n=777,266), and air pollutants – SO_2, NO_2, suspended particulate matter (SPM) and oxidants (Ox) – of 10 cities from 1977 to 2015. We performed a two-stage analysis with 5-year stratification to estimate the relative risk (RR) of mortality per 10 unit increase in 2-day moving average of air pollutant concentrations. In the first stage, city-specific associations were assessed using a quasi-Poisson generalized linear regression model. In the second stage, the city-specific estimates were pooled using a random-effects meta-analysis. Ratio of relative risks (RRR) was computed to examine temporal changes.

RESULTS: Average concentrations in each stratified period decreased for SO_2, NO_2, and SPM (14.2–2.3 ppb, 29.4–17.5 ppb, 52.1–20.6 μg/m³, respectively) but increased for Ox (29.1–39.1 ppb), over the study period. When stratifying the analysis by every 5 years, the estimated risks of non-accidental mortality with these pollutants remained positive but did not show any clear trend. Meanwhile, the risk of respiratory mortality with SPM had increased (RRR of the latest period to that of the earliest period: 1.008, 95% CI: 1.002–1.015). The risks posed by these pollutants were slightly to moderately heterogeneous for the different cities.

CONCLUSIONS: The respiratory mortality risk per 10 unit increase of SPM concentration was significantly higher in the latest period than in the earliest period. Other pollutant–mortality associations indicated either decrease or non-significant risk change in Japan between 1977 and 2015.

KEYWORDS: air pollution, daily mortality, time-varying effects, long-term trend

P-0174 Long-Term Association of Air Pollution and Incidence of Lung Cancer in American Elderly Population: A National Study in Medicare Cohort

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BACKGROUND AND AIM: Despite growing evidence of the association of fine particulate matter [PM2.5] to an increased risk of lung cancer mortality, few studies have investigated associations of multiple pollutants simultaneously. We aim to investigate the long-term effects of PM2.5, nitrogen dioxide [NO2], and warm-season (i.e. May to October) ozone [O3] on lung cancer incidence in a large national cohort.

METHODS: We conducted a prospective study in a nationwide cohort with Medicare beneficiaries (aged ≥ 65 years) enrolled in the fee-for-service program in the contiguous US from 2000 to 2016. Air pollution exposure was averaged across three years and assigned to each subject based on their ZIP code of residence. We fitted single-, bi-, and tri-pollutant Cox proportional hazards models to estimate the hazard ratios (HRs) for lung cancer incidence, adjusted for potential confounders.

RESULTS: Over the study period, we identified 172,371 lung cancer cases (n= 12,827,068). We found a significant increase in lung cancer risk for all three pollutants in the single-pollutants model. HRs associated with 1 μg/m3 increase in PM2.5 (μg/m3) was 1.015 (1.013, 1.018), and with 1 ppb increase in NO2 and O3 was 1.013 (1.012, 1.014) and 1.007 (1.006, 1.009) respectively. In bi- and tri-pollutant models, we observed potential confounding by NO2 on PM2.5¬, which was no longer significantly associated with lung cancer incidence. Subgroup analysis revealed significantly stronger effects for PM2.5 for those who were men, aged ≥ 75 years, black, eligible for Medicaid, and living in neighborhoods at the lowest quartile of median household income.

CONCLUSIONS: Long-term exposure to elevated concentrations of PM2.5, NO2, and O3 was significantly associated with an increased risk of lung cancer incidence among the Medicare population. Improving air quality in the US could yield substantial health benefits for the aging American population.

KEYWORDS: air pollution, lung cancer, Medicare

P-0177 Estimate High-Spatial Resolution of Ground-Level Ozone in Korea during 2001-2020 using Ensemble Model

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BACKGROUND AND AIM: Estimating ground-level ozone concentrations with high spatial resolution is crucial to assess the adverse health effects associated with exposure to ozone. Despite its importance, there is no study estimating high spatial resolution of ozone concentration in Korea. This study aims to estimate monthly average of daily maximum 8 hours (8 h) ozone at a resolution of 1 km × 1 km across Korea from 2001 to 2020.

METHODS: This study used an ensemble model that integrated multiple machine learning algorithms (random forest, light gradient boosting, and neural network) to estimate monthly average of daily maximum 8 h ozone at a resolution of 1 km × 1 km across the contiguous Korea. We used a generalized additive model that accounted for geographic difference to combine ozone estimates from random forest, light gradient boosting, and neural network. The three machine learning models include multiple predictors with satellite data, meteorological variables, spatially weighted ground-level air pollutants, land-use variables, reanalysis datasets for meteorological variables, and others.

RESULTS: Total number of monitoring stations for ozone was 480 during the period 2001-2020. In the total area, our ensemble model showed a 10-fold cross-validated R2 of 0.840 during the entire study period. Urban areas showed the better prediction performance (R2 of 0.842), compared to the non-urban areas (R2 of 0.764).

CONCLUSIONS: This study can provide the high-resolution ozone prediction estimates with excellent performance, and our estimates can be used to estimate the more precise health impacts attributable to ozone.

KEYWORDS: Ground-level Ozone, High spatial resolution, Machine learning model, Republic of Korea

P-0178 Long-term and short-term exposures to ambient ozone and sleep quality in China

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BACKGROUND: Compelling evidence has documented that ground-level ozone has various adverse health impacts, causing elevated mortality and morbidity. However, few studies have focused on the effect of ozone on sleep quality.
METHOD: We assessed the causal relationship between short-term and long-term exposure to ozone and sleep quality in a national representative sample from the China Family Panel Study, using a difference-in-difference study design. We further followed ninety healthy Chinese adults from September 2020 to June 2021, ascertained their daily ozone exposure, and measured average daily accelerometer-based sleep architecture and resting-state EEG signals in 4 one-week-long sessions.

RESULTS: In the national sample, we found that every 1-□g/m3 increase in yearly and monthly ozone exposure was causally associated with 0.0047 (p = 0.047) and 0.0021 (p = 0.014) hours decline in night-time sleep duration, respectively. In the small sample with objective sleep measurements, we found that every 1-□g/m3 increase in daily ozone exposure was associated with 0.19 minutes decrease in night-time sleep duration (p = 0.031), 0.058 percentage decrease in sleep efficiency (p < 0.001), 0.071 minutes increase in sleep latency (p = 0.007) and 0.20 minutes increase in wake after sleep onset (p = 0.0016) in a quasi-linear pattern. Interestingly, we also found that short-term ozone exposure was directly associated with altered EEG pattern, with sleep quality playing as a potential mediating role.

CONCLUSIONS: This study indicates that long-term and short-term ozone exposure has adverse impact on sleep health and might impair brain functioning. More hidden adverse health effects of ozone are worth exploring.

P-0179 Exposure to outdoor $PM_{2.5}$ and Risk of Upper Gastrointestinal Cancers in a Large Prospective U.S. Cohort

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BACKGROUND AND AIM: Studies of outdoor air pollution and upper gastrointestinal (UGI) cancers are limited, and few have evaluated heterogeneity in effects by histologic subtype. We investigated the relationship between ambient fine particulate matter ($PM_{2.5}$) and UGI cancer risk in a large prospective cohort.

METHODS: Our analysis included 456,472 participants of the NIH-AARP Diet and Health Study in 6 U.S. states (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and 2 metropolitan areas (Atlanta, Georgia and Detroit, Michigan). We used annual estimates from a historical spatiotemporal model to assess average residential $PM_{2.5}$ concentrations during a 15-year period (1980-1994) prior to enrollment in 1995-1996. We used Cox regression to estimate hazard ratios and 95% confidence intervals (HR [CI]) for risk of incident UGI (esophageal and gastric) cancers overall and by histologic subtype per 10µg/m3 increase in $PM_{2.5}$. Models were adjusted for age, smoking, alcohol intake, body mass index (BMI), race/ethnicity, and catchment area and separately adjusted for residential nitrogen dioxide (NO_2) concentrations. We ran models stratified by smoking status, sex, and BMI, and evaluated statistical interaction via Wald tests.

RESULTS: We found no overall $PM_{2.5}$-UGI cancer association in follow-up through 2011 (N=2,352 cases). Increased risk of esophageal squamous cell carcinoma (N=244) was suggested (HR:1.50 [0.95-2.37] per 10µg/m^3) and stronger among men (HR=1.80 [1.06-3.07]) than women (HR=1.01 [0.50-2.09]), although the interaction was non-significant (p-interaction=0.4). There was no association with esophageal adenocarcinoma (n=774). We observed a small, nonsignificant increased risk for gastric noncardia adenocarcinoma (n=898; HR=1.06 [0.84-1.35]); risk of gastric cardia adenocarcinoma (N=577) was increased only among never smokers (p-interaction=0.01). There were no differences in relationships by BMI, and NO_2 adjustment did not change associations.

CONCLUSIONS: Our novel investigation provides evidence of a relationship between $PM_{2.5}$ and specific UGI cancer subtypes. Stratified findings suggest important areas for future research.

KEYWORDS: gastrointestinal cancer, air pollution

P-0184 Long-term air pollution exposure and the incidence of cardiovascular diseases among American elderly population

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BACKGROUND AND AIM: Numerous studies have linked PM2.5, NO2, and ozone with cardiovascular diseases. Fewer studies have examined the multi-pollutant effects and effects at low pollutant levels, as well as potential effect modifications.

METHODS: Our study population included all Medicare enrollees continuously enrolled in the fee-for-service (FFS) program and both Medicare part A and part B in the contiguous U.S. from 2000 to 2016. We looked at the association between population-weighted ZIP code level annual average PM2.5, NO2, and warm-season ozone (May-October) and the first diagnosis of atrial fibrillation (AF), congestive heart failure (CHF), and stroke using Cox proportional hazards models. We adjusted for individual demographic characteristics and area-level covariates. We further examined these associations at low pollutant levels (PM2.5: <10 µg/m3¬, <8 µg/m3; NO2: <25 ppb, <18 ppb; warm-season ozone: <50 ppb, <40 ppb) and potential modifications by race and comorbidities (diabetes, hypertension, hyperlipidemia).

RESULTS: In the full cohorts, elevated PM2.5 and NO2 levels were associated with increased incidence of AF, CHF, and stroke. for each µg/m3 increase in annual PM2.5, HRs were 1.0059 (95%CI: 1.0054, 1.0064), 1.0260 (95%CI: 1.0256, 1.0264), and 1.0279 (95%CI: 1.0274, 1.0284), respectively. for each ppb increase in annual NO2, HRs were 1.0057 (95%CI: 1.0056, 1.0059), 1.0112 (95%CI: 1.0110, 1.0113), and 1.0095 (95%CI: 1.0093, 1.0096), respectively. Each one ppb increase in warm-season ozone was associated with an increased risk of CHF (HR=1.0035, 95%CI: 1.0033-1.0037) and stroke (HR=1.0026, 95%CI: 1.0023-1.0028). The effect estimates were stronger when we restricted the analyses to low pollutant levels. We also found generally higher risks for enrollees who are black or have diabetes.

CONCLUSIONS: Long-term exposure to PM2.5, NO2, and warm-season ozone were associated with risks of cardiovascular diseases, even at low pollutant levels. These associations were modified by race and several comorbidities.

KEYWORDS: Air Pollution, PM2.5, NO2, Ozone, Cardiovascular Diseases

P-0187 Fine particulate matter (PM2.5) levels in Brits, North West province, South Africa

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BACKGROUND AND AIM: Air pollution is a major threat to human health globally. In 2021, the World Health Organization (WHO) reported that 7 million premature deaths, mainly from non-communicable diseases are due to air pollution. Air quality studies on PM2.5 and its composition are lacking in South Africa and Africa. In order to find ways to reduce PM2.5 sources and its associated health impact in Brits, South Africa, it is necessary to determine PM2.5 levels and its chemical composition, followed by a source apportionment study.

METHODS: 24-hour PM2.5 filter samples were collected on the roof of a home in Brits every sixth day. In total, 61 samples and 10 duplicate samples were collected during 10 May 2020 and 5 May 2021. GilAir5 pumps and PM2.5 cyclones were used in the sampling. PM2.5 levels were determined with gravimetric analysis at the Air Quality Laboratory, School of Health Systems and Public Health, University of Pretoria. The yearly average was compared to the Averages were compared across seasons.

RESULTS: The average PM2.5 level during the sampling period was 17.7 µg/m³ (range: 3.6 -52.7 µg/m³), which is higher than the yearly WHO guideline (5 µg/m³), but lower that the yearly South African standard (20 µg/m³). The 24-hour PM2.5 levels exceeded the daily WHO guideline (15 µg/m³) and daily South African standard (40 µg/m³) on 17 and 2 occasions, respectively. The highest PM2.5 levels were observed during dusty spring season (52.7 µg/m³: September 2021) and winter (43.4 µg/m³: June 2021). Possible outdoor sources include industrial and mining activities. The lowest PM2.5 level (3.6 µg/m ³) was observed in May 2021 (autumn).

CONCLUSIONS: The PM2.5 levels in Brits exceeded the yearly and daily WHO guidelines on several occasions. This may pose a public health risk to the population.

KEYWORDS: PM2.5, outdoor air pollution, South Africa.

P-0188 Source apportionment of PM2.5 and PM2.5-bound trace elements in Pretoria, South Africa

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BACKGROUND AND AIM: Source apportionment studies are an important step in understanding primary sources and contributions of fine particulate matter (PM2.5). However, there is still research needed on the topic in South Africa. The aim of this study was to identify the possible sources of PM2.5 in Pretoria, during a 46-month study period.

METHODS: PM2.5 samples were collected on the roof of the School of Health Systems and Public Health (SHSPH), University of Pretoria in Pretoria from 18 April 2017 to 12 February 2021. Gravimetric analysis was done at the SHSPH Air Quality Lab. The trace element composition was determined with X-ray fluorescence at the University of Gothenburg, Sweden. Source apportionment was conducted using the US EPA 5.0 software.

RESULTS: The average PM2.5 concentration during the 46-month study period was 21.8±17.9 µg/m3 (range 0.29–138.9 µg/m3). The identified sources and their contribution to PM2.5 were mining (43.2%), biomass/coal burning (14.2%), secondary sulphur (12.1%), road traffic (11.3%), industry/base metal (8.7%), resuspended dust (8.5%) and vehicle exhaust (2.0%). Mining and biomass burning contributed to over half of the PM2.5 and higher contributions were observed during cold winter months. South Africa primarily depends on fossil fuel burning (i.e. coal) for energy through mining and production.

CONCLUSIONS: Reduction of PM2.5 at both local level in Pretoria can be implemented through the adjustments of the national air quality management act. Particularly introducing more safe national air quality standards that could lead to lower PM2.5 levels in Pretoria.

KEYWORDS: source apportionment, air pollution, PMF, South Africa

P-0192 Patterns of fuel use, cooking practices and factors associated with the use of LPG for cooking in peri-urban Cameroon

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BACKGROUND AND AIM: Over three billion people, mostly living in low and middle income countries (LMICs), are exposed to household air pollution from reliance on polluting fuels (e.g. wood, charcoal). There is a dearth of information on barriers to adoption and sustained use of clean cooking fuels, (e.g. liquefied petroleum gas (LPG)) in remote locations in sub-Saharan Africa.

METHODS: A cross-sectional demographic and fuel use survey was completed by approximately 1500 household cooks from peri-urban Mbalmayo in Central Cameroon. Stratified random sampling was conducted to identify approximately 200 clean (LPG) and 200 polluting (e.g. wood) cooking fuel users who completed in-depth surveys on individual and household characteristics that were potentially associated with cooking behavior and fuel choice.

RESULTS: Among households using solid fuels (n=196), the main reported barrier to LPG adoption included the initial cost of LPG equipment (n=87; 59%). Concerns over LPG safety were a significant concern in both users and non-users of LPG (n=366; 83.6% perceived LPG to be dangerous). Decision making over choice of cooking fuel was approximately equally split between the main cook (typically women) and the head of household (usually men); men were in charge of decision making regarding cooking fuel adoption among 41.4% (n=121) LPG users and 56.2% (n=82) of biomass users. Stacking was universal (100%) amongst LPG users, with 70% LPG use. Free secondary fuel and a distance 20-30minutes from retail point reduced LPG use by 20% and 10% respectively. Household head unemployed (O.R 2,057, p-value .000), No formal education (O.R 15.200,p-value .006), and Cost (O.R 2.489, p-value 0.000) were all associated with the non-adoption of LPG.

CONCLUSIONS: Addressing safety concerns through education, and financially supporting households (e.g. through microfinance) will considerably scale LPG adoption in peri-urban Cameroon. Policies to facilitate LPG adoption should be targeted to both genders.

KEYWORDS: LPG, clean cooking, adoption

P-0193 Long-term Total and Source-specific PM2.5 in Relation to Incident Dementia in the U.S.

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BACKGROUND AND AIM: Emerging, but sometimes inconsistent, associations have been observed between PM2.5 and incident dementia. One possible explanation for differing associations across studies could be differing toxicity by source. We investigated the associations of long-term exposures to total and source-specific PM2.5 with incident dementia in a national, population-based cohort.

METHODS: We used biennial data between 1998 and 2016 from participants >50 years in the Health and Retirement Study. Incident dementia was identified using a validated algorithm based on cognitive testing and informant information. We predicted 10-year average total PM2.5 at participant residences before each interview using spatiotemporal modeling. Then, we derived source-specific PM2.5 by leveraging spatially refined fractions of PM2.5 from agriculture, traffic, energy, industry, open-fire and windblown dust as estimated by GEOS-Chem. Associations with incident dementia were estimated with Cox models, adjusting for individual demographics, area-level characteristics, time, and geographic trends.

RESULTS: Among 27,857 participants, 4,105 (15%) developed dementia during follow-up. Mean PM2.5 levels were 11.5+3.7 µg/m3 overall, with the largest contributing individual sectors of agriculture (1.6+0.6) and the smallest of windblown dust (0.2+0.4). In single-source models, we observed a hazard ratio of 1.16 (95% CI: 1.05 to 1.29), 1.20 (1.01 to 1.41), 1,65 (0.98 to 2.77), 1.07 (0.94 to 1.22) and 1.07 (1.02 to 1.13) for incident dementia per 1-µg/m³ greater PM2.5 from agriculture, road traffic, non-road traffic, energy coal, and open fires, respectively. These associations remained after adjustment for the sum of PM2.5 from other sources. Associations corresponding to PM2.5 from other sources were inconsistent with adverse effects.

CONCLUSIONS: We found evidence that specific emission sources may be more important in the relationship between PM2.5 and dementia risk, suggesting the possibility of targeted interventions to reduce the burden of dementia in the future.

KEYWORDS: Air Pollution, Source-specific PM2.5, Dementia

P-0195 Forecasting greenhouse gas emissions from road traffic in 2040 across the Greater Montreal Region of Canada

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BACKGROUND AND AIM: Road traffic is a major source of ambient air pollution and greenhouse gas (GHG) emissions in urban areas and is linked with human health impacts and climate change. Urban land-use planning and travel behavior greatly influence on-road traffic. The aim of this study was to map the spatial distributions of on-road traffic and its associated GHG emissions across the Greater Montreal Region (Canada) for the year 2040 under different population growth and land-use scenarios.

METHODS: A random forest model was developed to estimate the annual average daily traffic (AADT) for each road segment based on the 2018 traffic count data collected from in-situ monitoring stations and Google aerial images, an origin-destination travel survey, points of interest from OpenStreetMap, and sociodemographic census data. The spatial distribution of the population in 2040 was then predicted under three population growth scenarios. According to the forecasted population distributions in 2040, we modified the population-related predictors in the 2018 random forest model to map AADT distributions for 2040. Finally, vehicle induced GHG emissions in 2040 were estimated based on AADT.

RESULTS: Our random forest model performed well for AADT prediction, resulting in an R2 of 0.66 in leave-one-out cross-validation. Vehicle induced GHG emissions will increase 13.28% in 2040 compared to 2018 if population growth maintains past trends. GHG emissions will only increase 4.30% and 2.36% with 60% of the new population located within one kilometer of subway stations and with telecommuting increasing by 12.5% and 40% respectively.

CONCLUSIONS: Allocating new population in areas with transportation infrastructure and increasing telecommuting can reduce traffic-associated GHG emissions. Our modelling work demonstrates the potential influences of travel behaviors and land use planning on human health and climate change.

KEYWORDS: greenhouse gas emission, traffic count, air pollution, population, land use.

P-0197 A Review of studies using Air Q software for prediction of Air Pollution Health effects in Iran

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BACKGROUND AND AIM: Exposure to air pollutants may lead to various health effects and is a major public health issue. Concerns about these effects exist in both developed and developing countries. The Air Q software was developed to estimate the health impacts of air pollution based on reported levels of air pollutants in real world studies. In Iran several studies have been conducted to estimate human morbidity and mortality based on this software. We conducted this review to summarize articles which have predicted the effects of air pollution on human health in Iran using Air Q.

METHODS: We conducted a systematic search for relevant studies published until 24 April 2021 in Web of Science, PubMed, Scopus and SID (Scientific Information Database which includes articles in Farsi language). We applied no time or language restrictions.

RESULTS: 44 studies out of 525 identified articles met our inclusion criteria. The main air pollutants under investigation were particulate matter (PM), NO2, O3 and SO2. Most studies were conducted in metropolitan areas, such as Ahvaz (9 studies), Tehran (9 studies), and Shiraz (7 studies). In all studies the levels of most air pollutants were higher than the 2005 WHO guideline levels and were predicted to be related to considerable health effects. However, it was not possible to aggregate the results and report the total number of casualties during these years, because studies were done in different cities with fluctuating levels of multiple pollutants and in different years and time frames.

CONCLUSIONS: This systematic review showed that air pollution remains at unacceptably high levels resulting in substantial detrimental health effects in various Iranian cities. Using clean renewable energies, increasing human capital and increasing green spaces and vegetation can help improve air pollution and decrease human casualties in Iran.

KEYWORDS: Air Pollution, Air Q, Iran

P-0200 Ambient air pollutants and pulmonary function in children after COVID-19 pandemic

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BACKGROUND AND AIM: The acute effects of air pollutants on pulmonary function remain unclear. After COVID-19 spreads, fear drives patients away from hospitals. Smartphone applications may help asthma care. This study investigated the acute effects of ambient air pollution on pulmonary function among asthma in children by smartphone applications.

METHODS: We designed a smartphone app to provide timely support for patients with asthma. Peak expiratory flow (PEF) recordings were made twice daily and was corrected by age and gender. The severity of asthma by GINA guideline and asthma control test (ACT) test score were also monitored. Ambient air pollution parameters of particulate matter (PM), ozone(O3), oxides of nitrogen (NO2),carbon monoxide (CO), and sulfur dioxide (SO2) were measured from each nearby air monitoring station at each time while PEF recordings by linking to Global Positioning System. Allergen-specific IgE were also measured by MAST. Effects of exposure to pollutants on PEF were assessed in person-days of observations by GEE model.

RESULTS: In lag 0 (the same day), PM10, NO2, CO, and SO2 were negatively correlated with PEF (p=0.030, 0.031, 0.008, 0.017). In lag1 (one day before), NO2, CO, and SO2 were found to be correlated PEF (p=0.005, 0.010, 0.025). In lag2, PM2.5, PM10, NO2, and SO2 were associated with PEF (p=0.031, 0.023, 0.031, 0.005). Analyses stratified by mite allergen sensitization revealed that PM10, NO2, CO, and SO2 air pollutant levels negatively correlated with PEF only in mite sensitization children.

CONCLUSIONS: Exposure to air pollutants can lead to acute effects on the pulmonary function in children with asthma. Pollutants may reduce lung function and have different effects over time. Mite sensitization might modify the effect of air pollutant exposures on lung function on asthma. Smartphone applications are readily available tools to help individual air monitoring and asthma care after COVID-19 pandemic.

P-0202 Measurement of indoor and outdoor SO2 and NO2 and indoor BTEX/VOC concentrations at pre-schools in Mabopane Township, Tshwane Metropolitan Municipality, Gauteng Province, South Africa

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INTRODUCTION: Children spend approximately 7 hours a day at pre-schools, mostly indoors. The aim of the study was to assess indoor and outdoor SO2 and NO2 and indoor BTEX/VOC at pre-schools situated in Mabopane, Tshwane Metropolitan Municipality, Gauteng Province, South Africa
Methodology: Six pre-schools in the study area were purposively selected to participate in the study. Indoor and outdoor levels of SO2 and NO2, and indoor BTEX/VOC were assessed over 24hrs for two weeks using Radiello passive samplers. Indoor temperature and relative humidity were also monitored using temperature data loggers. The outdoor temperature and relative humidity data was provided by South African Weather Services.

RESULTS: The indoor and outdoor SO2 median levels were 0.22 µg.m-3 and 1.12 µg.m-3 The indoor and outdoor NO2 median levels were 21.10 µg.m-3 and 17.22 µg.m-3, respectively. The indoor/outdoor ratios for NO2 and SO2 were 0.20 and 1.07, respectively. The infiltration factor parameter estimates of NO2 and SO2 were 0.48 and 0.01. The indoor and outdoor temperature and relative humidity levels were 2.11 °C and 22.4 °C, and 43.14% and 57%. The median concentrations of BTEX ranged from 0.5µg/m3 to 43.19µg/m3. The Kruskal-Wallis test showed that the level of benzene in the six schools differed significantly - $\chi^2=13.87$,p-value=0.016. The levels of toluene at the six school did not differ significantly - $\chi^2=5.96$,p-value=0.310. There was no statistically significant difference between the six schools in terms of ethylbenzene - $\chi^2=6.30$,p-value=0.2710. The p-value for Xylene showed there was no statistically significant difference between the six schools - $\chi^2=6.01$,p-value=0.2967..

CONCLUSIONS: The levels of outdoor NO2, SO2 and BTEX/VOC were below the South African National Ambient Air Quality Standards and WHO Air Quality Guidelines. However, they still pose a health risk for children attending pre-school in the area.

KEYWORDS: Air pollution; SO2, NO2, BTEX/VOC, Temperature; Relative humidity; South African

P-0203 Health Risk Assessment and Projection of Municipal Solid Waste Disposal in China

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BACKGROUND: China's Municipal solid waste (MSW) is growing rapidly. Incineration and landfill are two main approaches of MSW disposal and both of them emit different types of ambient pollutants and threaten human health. There lacks systematic health risk assessment and projections of MSW incineration and landfill in China.

METHODS: We established the historical MSW incineration and landfill emission inventories from 2015 to 2017 and used the Gaussian Diffusion Model to simulate the spatial distribution of ambient pollutants. We then used Risk Quotients Model to assess the non-carcinogenic and carcinogenic health risks through inhalation exposure. Besides, we set seven possible MSW incineration development scenarios to predict health risk levels in 2035, considering the effect of population growth, incineration rate, waste classification and recycling, and technology progress.

RESULTS: The results show that non-carcinogenic risk caused by MSW incineration from 2015 to 2017 was lower than landfill at the national level. Both of them were meet the maximum acceptable level (HI ≤ 1). From 2015 to 2017, carcinogenic risks caused by landfill were 9.42 × 10-6, 9.40 × 10-6, 9.37 × 10-6, nine times larger than the maximum acceptable level (CR ≤ 1×10-6). Carcinogenic risks caused by incineration were 5.71 × 10-6, 7.92 × 10-6, 9.44 × 10-6, five to nine times larger than the maximum acceptable level. Projection results show that compared to the baseline scenario, through classification and recycling, changing incinerator furnace, and improving, national health risk levels will be decreased by 24%, 94% and 97%.

CONCLUSIONS: We assessed the health risks caused by MSF disposal and found MSF incineration a relatively low risk alternative disposal approach compared to waste landfill. In the future, local government should reduce MSF disposal health risks by optimizing the selection of incinerators locations, improving the garbage sorting recycling system, and strengthening information disclosure and communications.

P-0214 Demonstration project to transition from gas to electric induction stoves in affordable housing units: the 'Out of Gas' pilot study

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BACKGROUND: Natural gas-fueled stoves are a major source of indoor residential NO_2, which has been associated with asthma exacerbations. WE ACT for Environmental Justice launched 'Out of Gas' in 2021 to investigate the feasibility of transitioning from fossil fuels to renewable energy in affordable housing. 20 families in New York City Housing Authority units in the Bronx, New York City were selected to receive electric induction stoves to replace existing gas stoves. Air pollution (primarily NO_2 and PM2.5) and stove usage are being monitored before and after the transition. The pilot will be repeated in Buffalo, NY.

METHODS: In-kitchen stationary monitoring of NO_2, PM2.5, CO_2, and CO was conducted for 7 days at baseline and after stove switch-out using the Home Health Box (Access Sensor Technologies, Fort Collins, CO). Cooking events were identified using temperature loggers (Wellzion Electronics Technology Co, China). Pollutant concentrations were analyzed during cooking vs. non-cooking times and compared to ambient levels from nearby New York Department of Environmental Conservation stations.

RESULTS: Mean (SD) [median] NO_2 kitchen concentrations at baseline (before appliance switch-out) were 47.0 (60.6) [34.6] ppb, 27.8 ppb higher than ambient levels during the monitoring period. PM2.5 concentrations were 17.2 (40.1) [7.3] $\mu g/m^3$, 7.9 $\mu g/m^3$ higher than ambient levels. Levels of both pollutants were higher during cooking, with NO_2 averaging 117.5 (125.5) [82.3] ppb during cooking versus 35.5 (25.8) [32.5] ppb otherwise. The corresponding values for PM2.5 were 33.4 (63.7) [11.5] $\mu g/m^3$ during cooking and 14.5 (33.8) [7.0] $\mu g/m^3$ otherwise. On average, cooking was associated with an increase of 63.3 ppb NO_2 and 18.3 $\mu g/m^3$ PM2.5 above baseline levels.

CONCLUSIONS: Cooking with gas stoves contributes substantially to indoor residential NO_2 and PM2.5 concentrations. Switching to efficient electric induction stoves could reduce the exposure of potentially vulnerable populations to these pollutants.

KEYWORDS: NO_2, PM2.5, cookstoves

P-0217 “[Classes] are highly affected because of the smoke”: Impacts of cooking on air pollution and health among three schools in Nairobi, Kenya

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BACKGROUND AND AIM: Links between cooking with polluting fuels (e.g., wood, charcoal), air pollution and health are well-established. However, few studies have been conducted in schools that rely on such fuels for catering. This study presents the first investigation of air pollution, cooking, and health in schools in Nairobi, Kenya.

METHODS: We carried out an in-depth study in three schools (two primary schools and a college) in an informal settlement using wood and/or charcoal for catering. 24-hour air pollution measurements (particulate matter (PM2.5) and carbon monoxide (CO)) were collected to assess concentrations in the main kitchen and a nearby classroom, and personal exposure of the main cook. Surveys with catering staff collected data on the health impacts on air pollution. Focus groups with catering staff, teachers and senior management were used to understand impacts on health and the school environment, perspectives, and pathways for clean fuel transitions.

RESULTS: Mean 24-hr PM2.5 cook exposures ranged from 97.6 -343.7 µg/m3, and 24hr concentrations ranged from 64.9-171.7 µg/m3 and 66.3-903.9 µg/m3 in classrooms and kitchens, respectively –all exceeding WHO 24-hr air quality guidelines. Reported impacts from the pollution by catering staff included eye irritation, wheezing and headaches, leading to the frequent avoidance of smoke. Focus groups highlighted disturbance to teaching from smoke and how students experienced coughing and sneezing. While the impact of cooking with polluting fuels was understood, opportunities for fuel transitions were limited by catering needs and external organisations’ agendas.

CONCLUSIONS: Despite cooking not occurring in classrooms, minimum concentrations were similar to kitchens, suggesting students are exposed to unhealthy air pollution levels. Transitions in schools to clean fuels can likely advance health and minimize disturbances to teaching. Building awareness on links between cooking, air pollution and health and developing solutions that support schools catering needs is vital to support transitions.

P-0221 Correlation between extreme/unusual ozone events and corona effect from electric power transmission & distribution grids. Assessing the health and environmental impact of high-voltage direct current (HVDC) grid on ozone ground levels in Sao Paulo metropolitan area, Brazil.

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BACKGROUND AND AIM: 1- Ozone ground levels pose a risk for public health
2- The increasing ozone levels measured in parts of the metropolitan area of Sao Paulo have brought the attention of researchers. Proposed mechanisms do not provide a clear outcome for establishing root causes, and for clarifying sources of ozone. Spatial distribution of ozone also depends on wind patterns.
3- As an alternate hypothesis for explaining unusual high levels of ozone, the corona discharge from electric transmission grid, known as corona effect, can play a significative role in the absence of, or in coincidence with other concomitant factors, to explain ozone (O3) and nitric oxide (NO) unusual levels. Negative coronas emits more ozone than Positive coronas.
4- The Environmental Protection Agency- EPA, found in a report of 1973 (EPA-650/4-73-003), following a research carried out in areas of high concentration of transmission lines that "under minimal wind conditions, such transmission line concentrations can produce sizeable local ozone levels."
5- Research applies geospatial and statistical analysis with the aim of better understanding correlations between exposures and ozone levels.

METHODS: Geographic Information System (GIS)-based systems with average grid cell edge length of 10 km minimum. Global InMAP (Intervention Model for Air Pollution) with a variable resolution grid (4 km horizontal grid cell widths) in combination with GEOS- Chem simulations. Data analysis by machine-learning model.

RESULTS: Applying Predictive Machine Learning algorithm as regression models, research found that coronas could generate significant ozone levels downwind of the power line.

CONCLUSIONS: Evidence of correlation between unusual ozone measurements and location of key power electric grid transmission lines and distribution centers with potential for corona effect are found in Sao Paulo state and Sao Paulo city metropolitan area.

KEYWORDS: Corona effect, ozone, electric grids, spatial simulation, wind patterns, air pollution

P-0222 Exposure to Household Air Pollution (HAP) and measures of central hemodynamic parameters among Bangladeshi population- A cross-sectional study.

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Household Air Population (HAP) has been linked to an array of adverse health hazards, including cardiovascular mortality and morbidity. We have assessed whether household air pollution (HAP) is associated with hemodynamic parameters as part of the Bangladesh Global Environmental and Occupational Health (GEO Health) project.

We assessed central hemodynamic parameters-Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart rate (HR) using a standard cuff sphygmomanometer (Omron) and Mean Arterial Pressure (MAP) and Pulse Pressure (PP) using the standard formula. The exposures to particulate matter < 2.5µm (PM2.5) and Black Carbon (BC) from biomass fuel were measured for 24 hours using a personal monitor, RTI MicroPEM (RTI International, NC), among healthy, non-smoking women (n=400) and men (n=200). A multiple linear regression model adjusted for potential confounders was used to examine the association between HAP exposures and hemodynamic outcomes.

The average 24-hour PM2.5 concentration was 167.7 µgm-3 for females and 98.0µgm-3 for males. The average 24-hour concentration of BC was 14.1µgm-3 for females and 10.3µgm-3 for males. In the adjusted multivariable regression model, an 1% increase in BC resulted in a 1.6 mm of Hg reduction in MAP (95% CI: -3.24, -.03 mm of Hg, P=0.04), 2.8 mm of Hg increase in PP (95% CI: 1.55, 4.22 mm of Hg, P=0.00) and 2.6 mm of Hg reduction in DBP (95% CI: -4.09, -1.10 mm of Hg, P=0.00). No association was observed between BC and SBP as well as BC and HR. PM2.5 was not associated with any of the hemodynamic parameters even after adjusting for age, cooking duration, household income, and Body mass index (BMI).

This population-based study provides evidence that exposure to HAP (BC) is linked with central hemodynamic parameters, especially MAP and PP, which have negative implications for cardiovascular health when they become high and low.

HAP, Hemodynamics, Bangladesh

P-0228 Fine particulate matter shown to influence cytokine and chemokine levels during pregnancy

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BACKGROUND AND AIM: Pregnancy is a period vulnerable to environmental exposures like air pollution that disrupt immune regulation or induce inflammatory responses.

METHODS: Participants were 148 mother–child pairs from MARBLES (Markers of Autism Risk in Babies – Learning Early Signs), a high familial risk ASD cohort. Self-reported maternal address history was obtained for the entire pregnancy period and the 3 months prior to pregnancy. Daily PM2.5 (particulate matter < 2.5 μm in diameter) exposure values were spatially interpolated from the U.S. Environmental Protection Agency's (EPA) Air Quality System (AQS) monitoring stations' locations to the residence locations using inverse distance-squared weighting. Trimester-specific PM2.5 averages were assigned. Maternal plasma samples from each trimester were quantified for 29 cytokines and chemokines using Luminex multiplex analysis technology. Cytokines and chemokines were natural log transformed and standardized. Betas and 95% confidence intervals (CIs) for an interquartile range (IQR) change in PM2.5 were estimated using confounder-adjusted linear regression.

RESULTS: Pre-pregnancy PM2.5 was associated with a statistically significant increase in first trimester IL-8, IL-1β, MIP-1β, and TNFα values and in second trimester IL-7 and EGF values, and with a statistically significant decrease in third trimester IL-10. Trimester 2 PM2.5 was associated with a statistically significant decrease in second trimester IL-12 (p40) and EGF and with third trimester GM-CSF, IL-10, and IL-15. Trimester 3 PM2.5 was associated with a statistically significant decrease in third trimester IFN-γ, IL-2, IL-1ra, and IL-5.

CONCLUSIONS: PM2.5 appears to be associated with a shift from typical cytokine and chemokine levels that differs by trimester. Future studies should examine the ramification of such changes in cytokine and chemokine profiles associated with air pollution exposure.

P-0229 Ultrafine particulate matter exposure during second year of life associated with increased risk of autism spectrum disorder in mixtures model

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BACKGROUND AND AIM: Prenatal and early life exposure to air pollution has been shown to be associated with autism spectrum disorder (ASD) risk, but the results have been mixed and to our knowledge, no study has reported on effects of combined exposures to multiple air pollutants using a mixtures approach. We applied a multidomain, multipollutant approach to assess the association between ASD and air pollution.

METHODS: The study consisted of 484 TD children and 707 children with ASD from the CHARGE case-control study. Air pollution exposures for NO2, and Ozone, fine (PM2.5) and ultrafine (PM0.1) particles were predicted using a chemical transport model with statistical bias adjustment based on ground-based monitors. Averages were calculated for each pregnancy period (pre-pregnancy, each trimester of pregnancy, and first and second year of life) for all births between the year 2000 and 2016. The air pollution (AP) variables were natural log transformed and then standardized. We estimated individual and joint effects of AP exposure with ASD and evaluated potential interactions among AP variables for each pregnancy period, using component-wise and hierarchal Bayesian Kernel Machine Regression (BKMR) models.

RESULTS: In component-wise BKMR models that included PM0.1, NO2, and Ozone, we found a strong increasing risk of ASD in year 2 of life with increasing PM0.1 (Posterior inclusion probability, PIP, = 0.99). This held true in hierarchal models when grouped by time or by pollutant. In component-wise BKMR models that included PM2.5, NO2, and Ozone, we found that NO2 and Ozone in years 1 and 2 were associated with ASD in an inverted U shape. No robust associations were observed in the prenatal or pregnancy periods.

CONCLUSIONS: PM0.1 appears to be associated with an increased risk of ASD in year 2 of life. Future research should examine ultrafine particulate matter in relation to ASD.

P-0231 Evaluation of adult and pediatric burns from domestic fuel use at the Douala General Hospital, Cameroon

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BACKGROUND AND AIM: Burns have a significant contribution to the global burden of death and disability accounting for over 300,000 deaths occurring yearly, with majority in low-and middle-income countries where solid fuels are widely used for cooking. The aim of this study was to characterize burns from domestic fuel among burns patients received at the Douala General Hospital (DGH), Cameroon

METHODS: A descriptive study involving adult and paediatric burn patients admitted in the burn unit during a 6 months period at the DGH was conducted. A consecutive sampling was used to include the participants. The Global burn registry data collection tool with closed and open ended questions was used for data collection between September 2021 and February 2022.

RESULTS: A total of 61 patients participated, with a mean age of 25.8±20.3 years; majority were aged 1 to 10 years (31.1%) and 31 to 40 years (24.6%). Majority of the participants were males with 41(67.2%) participants. Majority of the burns were due to electrical causes (n=21; 34.4%) while flame from cooking were involved in 10 subjects (16.4%). The main parts of the body involved were the trunk (75%), arms (67.2%) and legs (67.2%). Among the participants with burns from cooking, the main sites were head (90%), arms (80%) and legs (70%). The total body surface was less than 20% in 29 participants (47.5%) and 21-40% in 16 (26.2%). The mortality rate was 24.6%, although insignificant (P=0.21), this rate was higher for burns from flame cooking than burns of other causes.

CONCLUSIONS: Burn injuries are frequent in Cameroon, with cooking fuels being responsible for 16.4% of them. The related mortality rate remains very high. It is therefore necessary to create awareness and reinforce strategies to reduce the burden of burn accidents.

KEYWORDS: Burns, cooking fuel, Africa, epidemiology

P-0244 Multiple Air Pollutants Exposure and Leukemia Incidence in Tehran, Iran

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BACKGROUND AND AIM: Leukemia is one of the most common cancers and may be associated with exposure to environmental carcinogens, especially outdoor air pollutants. The objective of this study was to investigate the association of ambient air pollution and leukemia in Tehran, Iran.

METHODS: In this ecological study, data about the residential district of leukemia cases diagnosed from 2010 to 2016 were inquired from the Ministry of Health cancer database. Data from a previous study was used to determine long-term average exposure to different air pollutants in 22 districts of Tehran. Latent profile analysis (LPA) was used to classify pollutants in two exposure profiles. The association between air pollutants and leukemia incidence was analyzed by negative binomial regression.

RESULTS: The districts with higher concentrations for all pollutants were near the city center. The incidence rate ratio (IRR) was positive but non-significant for most of the air pollutants. However, annual mean NOx was directly and significantly associated with total leukemia incidence in the fully adjusted model (IRR (95% CI): 1.03 (1.003, 1.06) per 10 ppb increase). Based on LPA, districts with a higher multiple air-pollutants profile were also associated with higher leukemia incidence (IRR (95% CI): 1.003 (0.99, 1.007) per 1 ppb increase).

CONCLUSIONS: Our study shows that districts with higher air pollution (nitrogen oxides and multi-pollutants) have higher incidence rates of leukemia in Tehran, Iran. This study warrants conducting further research with individual human data and better control of confounding.

KEYWORDS: Air pollution; multiple pollutants; pollutant profile; Leukemia; Latent profile analysis

P-0253 Association between historical redlining and neighborhood deprivation in North Carolina

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BACKGROUND AND AIM: In the late 1930s, the Home Owners' Loan Corporation created maps that ranked neighborhoods considered high risk for mortgage lending; these ratings denied residents, usually racial, ethnic, and religious minorities, the opportunity to become homeowners and accumulate wealth. We explored whether historical designation as a redlined neighborhood predicted contemporary (2010) neighborhood-level deprivation in North Carolina (NC) cities (Asheville, Charlotte, Durham, Greensboro, Winston-Salem).

METHODS: We examined 142 NC census tracts with historical redlining data. Because neighborhoods can be disadvantaged in many ways, a composite index representing poverty, occupation, housing, employment, and education was used for determining the relationship between neighborhood deprivation and having been previously redlined. To create the exposure, we overlayed a census tract shapefile layer on high-resolution digital maps of historical redlining, assigning a redlining rating of Best (N=15), Still Desirable (N=14), Declining (N=73), or Hazardous (N=40). The ratings were further combined to create exposure categories as follows: Best or Still Desirable (BSD, referent), Declining, Hazardous, and a combined redlined areas category that included both Declining and Hazardous (DH). Linear models estimated the associations between historical redlining ratings and contemporary neighborhood deprivation.

RESULTS: Neighborhood deprivation scores ranged from -1.78 to 2.72, with a higher score indicating worse neighborhood deprivation. When comparing the combined redlined areas (DH) to BSD areas, we observed increasing neighborhood deprivation (1.34 increase in index score [95% CI: 1.01, 1.67]). We observed increasing neighborhood deprivation score when comparing Declining or Hazardous ratings individually to BSD areas (1.24 increase in score [95% CI: 0.93, 1.55]; 1.57 increase in score [95% CI: 1.15, 1.98], respectively).

CONCLUSIONS: Results suggest that redlined neighborhoods are associated with increased neighborhood deprivation 70 years later and may contribute to disparities in exposure to detrimental environments and associated effects on health and well-being.

KEYWORDS: Redlining, neighborhood deprivation, built environment

P-0261 Reduction of noise-induced change in cardiovascular functions and subjective sensations when using passive and active hearing protection devices

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Impulse and continuous noise occur frequently in the workplace and harm the physiological and psychological capability of the workers. This study investigated how the exposure to noise of varying acoustic pressure and frequency influenced cardiovascular functions and subjective sensations of people and how the use of passive and active hearing protection devices (HPDs) reduced the impacts.
Twenty participants (10 males and 10 females) were exposed to three levels of sound for 5 min each level in the order of ascending acoustic pressure, 65, 85, or 100 dBA. The participants used either foam earplugs or electronic earplugs that compressed noise while allowing transmission of speech. The experiment was first conducted at a noise frequency of 200 Hz and repeated at 1,000 Hz. Changes in cardiovascular functions (blood pressures, heart rate, and metabolic rate) and those potentially involved in local hemodynamics (skin capillary blood flow and transepidermal water loss) of the participants were measured intermittently. Subjective perceptions of noise intensity, harshness, annoyance, and reduction in attention and short-term memory were also evaluated.
The noise exposure significantly increased the blood pressures and heart rate and the sensations of noise intensity, annoyance and sharpness. The most prominent increase was observed in the first 5 min of exposure, even though the acoustic pressure during this stage was the same as that of the background (white noise). The cardiovascular functions of the participants returned to the baseline 15 min after the exposure ended. The foam earplugs provided better reduction in sounds of low frequency whereas the electronic plugs performed better against those of high frequency.
The physiological impacts of noise exposure were determined by the physical characteristics of the noise. On-site evaluation of the acoustic environment and job requirements should be performed before HPDs were selected to manage the exposure.

KEYWORDS: Noise exposure, hearing protection devices.

P-0279 Heat Policies and AC Availability in US Prison Systems

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BACKGROUND AND AIM: Climate change will increase the number of hot days and heatwaves leaving incarcerated populations particularly vulnerable to extreme heat due to their lack of agency and control over their heat exposure. Previous prison heat policy analysis has not utilized Heat Index to provide context for the implementation of policies or had access to air-conditioning data. We aimed to examine the coverage and gaps of US prison system heat policies and air-conditioning access.

METHODS: Prison heat policies were identified using 52 prison system (50 states, DC, and Federal Bureau of Prisons) websites and complemented by state legislation. Heat policies were analyzed using the National Weather Service's (NWS) Heat Index Calculator on maximum reported temperature values. Facility-level air-conditioning data for 18 prison systems were public or received through public records requests by UCLA's COVID-19 Behind Bars, with facility function, capacity, and heat risk collected from federal, state, and the Intercept's Climate and Punishment datasets.

RESULTS: Half of the prison systems had publicly-available heat policies (n=52), of which 81% included temperature values (n=21). 64% of heat indices using maximum indoor temperature (n=14) would be classified as "caution" and 63% of heat indices using temperatures when respite resources would be provided (e.g. extra water) (n=8) were classified as "extreme caution" by the NWS assuming 50% relative humidity. 18% of facilities (n=374) lacked AC access completely. Among these, 55% of non-air-conditioned facilities (41,000 operational capacity) are at "severe or extreme heat risk". Overall, 23% of facilities whose function includes serving heat-sensitive populations (n=202), lack any air-conditioning despite their heat risk.

CONCLUSIONS: This study emphasizes the need for national correctional temperature policies and air-conditioning requirements to protect the thermal health of those who live and work in carceral facilities.

KEYWORDS: environmental justice built environment prison

P-0287 Modeling energy and exposure benefits through integrated ventilation upgrades and rooftop gardens in a high school in Boston, MA

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BACKGROUND AND AIM: Many U.S. schools have poor indoor ventilation, impacting air quality (IAQ), which is associated with adverse learning outcomes for children (e.g. reduced cognition, academic performance). However, increased ventilation results in increased energy consumption, which conflicts with goals to lower utility bills and carbon emissions. Addressing these challenges requires innovative and sustainable solutions. We propose a novel approach to simultaneously implement indoor ventilation upgrades and rooftop gardens, and model the impacts on energy use, financial costs, and carbon cycling in a Boston, MA high school.

METHODS: We measured CO2 concentrations continuously for a week in 13 classrooms and at exhaust rooftop vents during a two-month period in Spring 2019. We calculated baseline school-level average ventilation rates and estimated the energy needed to increase indoor ventilation to reduce CO2 to recommended indoor values (i.e. <1000 ppm). We then compared to yearly modeled energy savings and carbon emissions reductions occurring through plant carbon capture at a rooftop garden.

RESULTS: The baseline median classroom CO2 concentration was 840 ppm and exceeded 1000 ppm 33% of the school day. The estimated ventilation rate during occupancy was 4 L/s/person, below the recommended 7 L/s/person. Increasing ventilation to recommended levels would increase yearly total energy, cost, and carbon emissions (1-4%). A rooftop garden would provide net decreases of energy (12%), cost (13%), and carbon emissions (23-46%) with the higher end of this range attributed to plant growth enhancement.

CONCLUSIONS: Our analyses demonstrated the potential for integrated interventions in school buildings that can improve IAQ while capturing carbon through rooftop gardens. We found that CO2 levels of concern persist in schools, but could be vented to rooftops to reduce exposures and benefit plant growth. Future studies should evaluate alternative rooftop garden configurations that yield maximal energy and carbon reduction benefits.

KEYWORDS: Schools, CO2, energy, rooftops

P-0292 The changes of lipid profiles among Chinese adults may be associated with legacy and emerging per- and polyfluoroalkyl substances: Evidence from China National Human Biomonitoring

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BACKGROUND AND AIM: In the past decade, the levels of cholesterol and lipid profiles have drastically changed. Whether these changes may be associated with legacy and emerging PFASs is worth exploring. In this study, we aimed to explore the associations of single and mixed exposure to legacy and emerging PFASs with lipid profiles in general Chinese adults.

METHODS: A total of 10855 adults aged 18 and older from China National Human Biomonitoring (CHBNM) were recruited. Weighted multiple linear regression was used in single-pollutant models to explore the associations of PFAS with lipid profiles. Qgcomp was used to explore the joint associations of 8 PFAS mixtures (PFOA, PFNA, PFDA, PFUnDA, PFHxS, PFHpS, PFOS, 6:2Cl-PFESA) with lipid profiles.

RESULTS: Single and multiple pollution models showed that legacy and emerging PFASs were positively associated with lipid profiles. The adjusted β (95% confidence intervals: CI) of log(10) transformed PFOA, PFOS, PFNA and 6:2 Cl-PFESA with TC were 0.123 (0.058, 0.187), 0.214 (0.151,0.277), 0.227 (0.159, 0.295) and 0.115 (0.066, 0.164). The adjusted estimated changes (95%CI) of PFAS mixtures with TG, TC, LDL-C, HDL-C, and non-HDLC were 0.023 (0.009, 0.037), 0.253 (0.225,0.281), 0.149 (0.125,0.174), 0.081 (0.07,0.092), and 0.172 (0.145,0.199), respectively. Qgcomp model showed that PFNA (67.7%) contributed the most to TG, PFUnDA (30.2%) contributed the most to TC, PFHpS (36.7%) contributed the most to LDLC, PFUnDA (74.8%) contributed the most to HDLC, and PFHpS (38.6%) contributed the most to non-HDLC. However, compared with legacy PFASs, 6:2 Cl-PFESA contributed less to the lipid profiles.

CONCLUSIONS: The changes of lipid profiles among Chinese adults may be associated with legacy and emerging PFASs. Compared to legacy PFASs, emerging PFASs such as 6:2 Cl-PFESA may be less harmful to lipids.

KEYWORDS: Per- and polyfluoroalkyl substances, Lipid profiles, Joint effects, emerging PFAS.

P-0297 Greenspace exposure and depressive symptoms: findings from the French CONSTANCES cohort

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BACKGROUND AND AIM: The association between greenspace exposure and different dimensions of depression is yet to be established. We aimed to explore this association in a large population-based cohort.

METHODS: Data from the enrollment phase of the French CONSTANCES cohort (2012-2020) were analyzed cross-sectionally. Depressive symptoms were measured by the Centre of Epidemiologic Studies Depression (CES-D) questionnaire allowing to compute a total CES-D score (≥19 used as a cutoff score to identify individuals at risk for clinical depression), and including four dimensions (depressed affect, disturbed interpersonal relations, low positive affect, somatic complaints). Residential surrounding greenspace exposure was quantified using the satellite-based Normalized Difference Vegetation Index (NDVI) at 300m buffer during the enrollment year. Adjusted multiple logistic and linear regression models were developed, reported as odds ratio [OR] for dichotomized total depressive symptoms, and ß for dimension-scores, with a 95% confidence interval [CI] for an interquartile range [IQR] increase in exposure. Analyses stratified by personal and socioeconomic variables were performed.

RESULTS: In total 185,781 participants were included (age: 46.80±13.61 years, 53.5% women). Residential surrounding greenness (average NDVI: 0.53; IQR=0.28) was significantly associated with lower odds of having depressive symptoms (OR [95%CI]: 0.94 [0.90-0.99]). This exposure was also associated with a lower scores for all dimensions (ß [95% CI]: -0.043 [-0.053: -0.033]; -0.016 [-0.026:-0.006]; -0.020 [-0.030:-0.010]; and -0.019 [-0.029:-0.009] for depressed affect, disturbed interpersonal relations, low positive affect, and somatic complaints, respectively). We found suggestions for potentially stronger protective associations in men and participants with lower income.

CONCLUSION: Residential surrounding greenspace was associated with lower depressive symptoms in general, and all four dimensions especially depressed affect and somatic complaints. Considering depression prevalence, its burden, and the increasing trend of urbanization, our finding is of importance for policymakers.

KEYWORDS: Nature; Greenspace; Mental health; CONSTANCES Cohort

P-0302 Comparing greenspace metrics and buffer methods in Metro Vancouver, Canada: Implications for environmental health research

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BACKGROUND AND AIM: Access and exposure to greenspace has been shown to promote mental and physical health; however, not all studies have found these benefits, with some studies reporting no association and others reporting associations with adverse health outcomes. It has been suggested that the use of diverse greenspace metrics, the varied quality of these metrics, and the specific methods used to quantify exposure or access, may contribute to these inconsistent findings. This project sought to compare the results of using different metrics in Metro Vancouver, Canada.

METHODS: Greenspace metrics were calculated from the centroid of each 6-digit postal code. Average buffer normalized differences vegetation index (NDVI), green landcover, tree canopy cover, and park count were calculated using circular and network buffers, at both 400m and 1000m. Pearson's correlation coefficients were calculated to compare the results for each metric and method.

RESULTS: The number of parks was only weakly positively correlated with each of the other three greenspace metrics for 1000m circular buffers (NDVI $r = 0.12$; green land cover $r = 0.07$; tree canopy $r = 0.14$, $p < .01$). for 1000m network buffers (NDVI $r = -0.34$; green landcover $r = -0.12$; tree canopy $r = 0.05$, $p < .01$) two of the correlations became negative. Circular and network buffer were most highly correlated for the tree canopy (1000m $r = 0.92$; 400m $r = 0.86$, $p < .01$), whereas park count had the weakest correlation (1000m $r = 0.66$; 400m $r = 0.66$, $p < .01$).

CONCLUSIONS: The associations between greenspace metrics vary. Selection of buffering method may be particularly influential when using park count data. These findings support the importance of intentional selection of greenspace metric and measurement method in environmental epidemiological research.

KEYWORDS: greenspace metrics, NDVI, tree canopy cover, parks, network buffers, and circular buffers

P-0311 Source tracking swine fecal waste on household surfaces proximal to swine concentrated animal feeding operations in southeastern North Carolina, USA

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BACKGROUND AND AIM: In North Carolina, swine industrial livestock operations (ILOs) are located disproportionately in low-income and communities of color. Swine ILO neighbors have raised concerns about emissions from ILOs. We aim to compare the detection frequency and quantity of a swine-specific Bacteroides fecal microbial source-tracking marker (pig-2-bac DNA) contamination on outdoor and indoor household surfaces at ILO worker (ILO) compared to ILO neighbor (ILO-N) and metropolitan resident (metro) homes in North Carolina.

METHODS: at enrollment, ILO, ILO-N, and metro participants collected 2 outdoor and 2 indoor household surface settled dust samples wiping a Copan flocked swab across a 10 cm2 area. Using quantitative real-time PCR, pig-2-bac DNA copy number per area was estimated in household samples. We used logistic and linear regression to evaluate differences in pig-2-bac prevalence and quantity between the three household groups and on outdoor compared to indoor surfaces.

RESULTS: Ninety-one households (354 swabs) were sampled: 30 ILO (113 swabs), 31 ILO-N (119 swabs) and 30 metro (122 swabs). Prevalence of Pig-2-bac detection on >=1 household surface was 33%, 39%, and 0% among ILO, ILO-N, and metro households, respectively. Compared to metro households, higher log-10 pig-2-bac DNA copy number per 10 cm2 was observed at ILO (beta=0.5; 95% confidence interval [CI]=0.2, 0.7) and ILO-N households (beta=0.2; 95% CI=0.06, 0.4). Compared to indoor surfaces, higher log-10 copy number per 10 cm2S was observed on outdoor surfaces (beta = 0.181, 95% CI=0.02, 0.3).

CONCLUSIONS: Swine-specific fecal contamination was detected at a higher prevalence in ILO-N compared to ILO workers and metro resident homes. Both ILO and ILO-N groups had statistically significant increases in copy number compared to the metro group.

KEYWORDS: microbial contamination, pig-2-bac, industrial livestock operations, concentrated animal feeding operations

P-0312 Trends and Patterns in Industrial and Commercial Sources of Lead (Pb) in the US

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BACKGROUND AND AIM: Lead (Pb) exposures in the US have declined over the last 40 years due to phaseout of Pb in gasoline, residential paint, and plumbing. However, Pb still circulates in commerce (batteries, ammunition, glass, pigments, e-waste). While the Environmental Protection Agency (EPA) tracks large industrial movements of Pb (>25,000lbs), modest Pb movements are not identified and may translate to substantial cumulative exposure and public health significance due to proximity to residences, schools, or places of work. This research aims to identify and evaluate trends in commercial sources of Pb in the US.

METHODS: Peer-reviewed literature was used to identify relevant commercial sources of Pb and link to corresponding Standard Industrial Classification (SIC) codes. Counts of each SIC code were calculated per census tract, using geolocations from Dun and Bradstreet (D&B) from 1990-2018. Data capturing measurable Pb emissions (Toxics Release Inventory (TRI)) and area-level socioeconomic measures (CDC's Social Vulnerability Index) were further linked by census tract. Data were analyzed using R and ArcGIS.

RESULTS: A total of 31 unique SIC codes were identified, corresponding to >1,300 potential Pb-emitting businesses in 1,265 census tracts. The most common commercial businesses represented shooting ranges (n=838) and refuse systems (n=221). Preliminary analyses data indicate widespread current Pb-emitting industries are widespread but further socioeconomic and Pb-emission data will be analyzed. Preliminary data show a decline in some identified industries over time.

CONCLUSIONS: Preliminary results show the number of Pb-emitting industries has decreased over time in the US. However, certain geographic areas of the USA yield higher densities of Pb-emitting industries and commercial businesses, which could have a profound public health significance. The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

KEYWORDS: Lead (Pb) exposure, environmental justice

P-0320 Case-cohort study of the association between PFAS and cancers of the kidney and bladder among participants in the American Cancer Society's Cancer Prevention II cohort

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BACKGROUND AND AIM: Some per- and polyfluoroalkyl substances (PFAS), including perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), have been associated with genitourinary system cancers in some, but not all previous studies. Many studies did not consider histology. We examined associations between PFAS exposure and risk of histologic subtypes of kidney and bladder cancer.

METHODS: We conducted a case-cohort study within the American Cancer Society's prospective Cancer Prevention Study II (CPS-II) LifeLink cohort for which serum specimens were collected during 1998-2001 (ages ≥54 years). This study included a subcohort (500 men, 499 women) randomly selected from cohort members without prior cancer diagnoses at serum collection, and all persons with incident (after serum collection) first cancers of the kidney (n=158, including 109 renal cell carcinoma/adenocarcinomas [RCC] and 47 transitional cell carcinomas [TCC]) and bladder (n=401, including 390 TCC). Concentrations of PFOA, PFOS, perfluorohexane sulfonic acid, perfluorononanoic acid, perfluorooctane sulfonamide and perfluoroheptanoic acid were measured in stored serum. Multivariable Cox proportional hazards regression was used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for associations between PFAS concentrations and risk of RCC and TCC. Models accounted for the study design and controlled for sex (using stratification), age and year at blood draw, education, race/ethnicity, smoking and alcohol use, and occupational exposures (coal dust/tar, dyes, and diesel/gasoline; TCC only).

RESULTS: Serum PFOA concentrations were positively associated with RCC among women [HRs (95% CIs) for PFOA quartiles 2-4, respectively, vs. quartile 1: 1.33 (0.42-4.19), 1.66 (0.54-5.13), 3.14 (1.02-9.65)] but not men. TCC (bladder or kidney) was not significantly associated with the measured PFAS, although PFOS-TCC HRs were elevated among men.

CONCLUSIONS: This study provides additional evidence for an association between PFOA and RCC. Consideration of histologic types might help clarify inconsistencies in the literature on PFAS exposure and cancer.

KEYWORDS: PFAS, cancer

P-0321 Biomonitoring Legacy and Emerging Contaminants and Local Fish Consumption in Susceptible Great Lakes Populations, 2010-2020

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BACKGROUND AND AIM: Over the past century, the Great Lakes, the world's largest fresh surface water system, has been contaminated with numerous chemical pollutants. From 2010 to 2020, the Agency for Toxic Substances and Disease Registry conducted the Biomonitoring of Great Lakes Populations program to assess exposure to legacy and emerging contaminants in susceptible populations who consumed fish caught in contaminated waterbodies.

METHODS: The Program consists of a series of cross-sectional studies conducted collaboratively with health departments in Michigan, Minnesota, New York, and Wisconsin. The target populations–including various angler and refugee populations in different areas with known contamination–were sampled and recruited independently using sampling strategies that were tailored for the specific populations. Participants completed questionnaires focusing on fish consumption and provided biological samples. Selected blood metals and polychlorinated biphenyls (PCBs) were measured in all participants. Some chemicals of emerging concern, such as per- and polyfluoroalkyl substances (PFAS), were also measured in several studies.

RESULTS: Body burden levels of mercury, lead, and perfluorooctane sulfonic acid (PFOS) in most target populations were elevated compared to the U.S. population. Locally caught fish consumption was associated with blood mercury and serum PFOS in most cohorts. Serum PCB was elevated only in the Detroit shoreline angler cohort and was associated with eating locally caught fish.

CONCLUSIONS: Most target populations in this program had higher exposures to some metals and PFOS, and the exposures were generally associated with eating fish caught in local, contaminated waterbodies. The results generated from this program helped guide public health actions to reduce chemical exposures in vulnerable Great Lakes populations, including updated fish advisories and targeted education and outreach on risk and benefit of fish consumption.

KEYWORDS: Fish consumption, exposure, metals, PFAS, susceptible populations, Great Lakes

P-0326 Exposure to four metals and depressive symptom in adults: NHANES epidemiological study

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BACKGROUND AND AIM: Although some of the heavy metal are known to have an adverse effect on neurobehavioral symptoms, studies on the exposure to multiple metal and depression are limited. This study purposed to evaluate the association between individual and multiple heavy metal and depression in the adult population by using National Health and Nutrition Examination Survey (NHANES) dataset.

METHODS: This study used the data from the U.S. NHANES between 2007 to 2014 to examine cross-sectional relationships between metal exposure and depression in adult over 20 years. After applying exclusion criteria, 6021 subjects were included in the final analysis. We used four urinary metals including mercury, cadmium, lead, and arsenic as exposure variables. Patient Health Questionnaire (PHQ-9) was used to assess the depression symptom of the participants. Multivariate linear regression (MLR) for each heavy metal exposure and quantile g-computation model for multiple exposure to four heavy metals were applied. Stratification analysis according to the alcohol habit of the subjects was also performed.

RESULTS: MLR models indicated that urinary cadmium was positively associated with continuous depression score (β = 0.39, 95% confidence interval (CI): 0.24-0.53). Other urinary metals showed positive relationship with continuous depression score, but it was not significant. In the quantile g-computation model, statistically significant positive association were found between the mixture of urinary metals and depression score (Difference in PHQ-9 score increase: 0.32, 95% CI: 0.14-0.50). When stratified the model by alcohol consumption habit, a stronger association was found in a heavy alcohol consumption group.

CONCLUSIONS: When comparing the results from different models, not only individual urinary heavy metal was related to depression score, but also four heavy metals mixture was positively associated with a depression. Future cohort studies are needed to clarify the effect of metal mixture.

KEYWORDS: Heavy metal, depression, quantile g-computation, alcohol consumption

P-0330 Predicting Cumulative Lead (Pb) Exposure Using the Super Learner Algorithm

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BACKGROUND AND AIM: Chronic lead (Pb) exposure causes long term health effects. While recent exposure can be assessed by measuring blood lead (half-life 30 days), chronic exposures can be assessed by measuring lead in bone (half-life of years to decades). Bone lead measurements, in turn, have been measured non-invasively in large population-based studies using x-ray fluorescence techniques, but the method remains limited due to technical availability, expense, and the need for licensing radioactive materials. Thus, we developed prediction models for bone lead concentrations using a flexible machine learning approach--Super Learner, which combines the predictions from a set of machine learning algorithms for better prediction performance.

METHODS: The study population included 695 men in the Normative Aging Study, aged 48 years and older, whose bone (patella and tibia) lead concentrations were directly measured using K-shell-X-ray fluorescence. Ten predictors (blood lead, age, education, job type, weight, height, body mass index, waist circumference, cumulative cigarette smoking (pack-year), and smoking status) were selected for patella lead and 11 (the same 10 predictors plus serum phosphorus) for tibia lead using the Boruta algorithm. We implemented Super Learner to predict bone lead concentrations by calculating a weighted combination of predictions from 8 algorithms based on selected predictors.

RESULTS: In the nested cross-validation, the correlation coefficients between measured and predicted bone lead concentrations were 0.58 for patella lead and 0.52 for tibia lead, which has improved the correlations obtained in previously-published linear regression-based prediction models. We evaluated the applicability of these prediction models to the National Health and Nutrition Examination Survey for the associations between predicted bone lead concentrations and blood pressure, and positive associations were observed.

CONCLUSIONS: These bone lead prediction models provide reasonable accuracy and can be used to evaluate health effects of cumulative lead exposure in studies where bone lead is not measured.

P-0331 Interactions between chemical mixtures and the overall antioxidant and inflammatory capacity of the diet in the association between dietary exposure to chemical mixtures and mortality risk in the E3N French prospective cohort

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Since food is contaminated by many chemicals which may interact, resulting in additive, synergistic or antagonistic effects, it is necessary to study the exposure to chemical mixtures. These mixtures can interact with nutrients by targeting the same molecular signalling pathways and biological functions. Chemicals and nutrients may impact oxidative stress and chronic systemic inflammation, both associated with non-communicable diseases.
Our objective was to investigate the association between dietary exposure to chemical mixtures and mortality risk in the E3N (Etude Epidémiologique auprès de femmes de l'Education Nationale) prospective cohort, and to study the interactions between these mixtures and nutrients.
We considered 72585 women from the E3N cohort who completed a food frequency questionnaire in 1993. Using sparse non-negative matrix under-approximation, we identified the six main chemical mixtures to which these women were exposed through the diet. We analysed the association between dietary exposure to these mixtures and all-cause and cause-specific mortality with Cox proportional hazard models. We investigated the interactions between these exposures and the overall antioxidant and inflammatory capacity of the diet.
During the follow-up (1993-2014), 6441 deaths occurred. We observed statistically significant interactions between some chemical mixtures and the overall antioxidant and inflammatory capacity of the diet which modified the relationship between dietary exposure to the mixtures and mortality. for example, when considering a mixture characterised by the exposure to persistent organic pollutants, no association was highlighted with all-cause mortality for women with an anti-inflammatory diet (HR 1.02, CI 0.90-1.15), while a positive association was found for women with a pro-inflammatory diet (HR 1.16, CI 1.02-1.31).
This study highlighted for the first time the existence of interactions between chemical mixtures and the overall antioxidant and inflammatory capacity of the diet in a human-based study. More studies are needed to clarify the underlying biological mechanisms.
chemical mixtures; diet; oxidation; inflammation.

P-0333 Positive association between dietary exposure to polybrominated diphenyl ethers and breast cancer risk in the French E3N cohort: the role of vegetable oil consumption

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BACKGROUND AND AIM: Exposure to endocrine-disrupting chemicals, like Polybrominated diphenyl ethers (PBDE), is suspected to play a role in the occurrence of breast cancer. Moreover, there is growing evidence that food chemical contaminants could interact with different components of the diet, especially lipophilic ones, such as PBDE. In an in-vitro study, vegetable oil has been shown to increase the bioaccessibility of PBDE. The objective of the present study was to assess the association between dietary intake of PBDE and breast cancer risk in the French E3N cohort study, and to investigate the potential modification of this association by vegetable oil consumption or lipid intake.

METHODS: The study included 67 879 women. Intake of individual PBDE were estimated using food consumption data from a validated semi-quantitative food frequency questionnaire. Hazard Ratios (HR) and 95% Confidence Intervals (CI) were estimated for the association between total PBDE dietary intake and breast cancer risk. Interaction measures for vegetable oil consumption were estimated on both additive and multiplicative scales.

RESULTS: The women were followed for a maximum of 21.4 years, and 5 686 developed an incident breast cancer. A positive linear trend was highlighted between dietary intake of PBDE in quintile groups and breast cancer risk, borderline with statistical significance (p-trend=0.06, HRQ5vsQ1 and 95%CI: 1.09 [0.99;1.20]). Interaction measures for vegetable oil consumption were significant both in additive and multiplicative scales. Higher effect sizes of the association were highlighted in high consumers of vegetable oil, i.e. ≥4.6 g/day (HRQ5vsQ1 and 95%CI: 1.23 [1.08; 1.40]), and almost no effect were found in low consumers (HRQ5vsQ1 and 95%CI: 0.97 [0.86; 1.10]).

CONCLUSIONS: Highlighting such interactions between nutrients and chemicals is crucial to develop efficient dietary recommendations to limit the negative health effects associated to exposure to food chemical contaminants.

KEYWORDS: Polybrominated diphenyl ethers; Breast cancer; Endocrine-disrupting chemicals; Interaction

P-0335 Ovarian volume mediates associations of phthalate metabolites with anti-Mullerian hormone in midlife women

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BACKGROUND AND AIM: We previously reported positive associations of phthalates with anti-Mullerian hormone (AMH), a biomarker of ovarian reserve, in midlife women. Growing follicles produce AMH, so we evaluated associations of phthalates with ovarian volume (indicating folliculogenesis), considering whether this relationship explained associations of phthalates with AMH.

METHODS: Midlife women had a transvaginal ultrasound of right and left ovaries to calculate ovarian volume. Women provided one blood sample for AMH quantification and up-to-four urine samples across one menstrual cycle, which we pooled to quantify nine phthalate metabolites. We assessed AMH as a binary variable (above/below the level of detection). Covariate-adjusted linear regression models were used to evaluate associations of phthalates with mean left/right ovarian volumes (both ln-transformed). Using a formal mediation analysis, we estimated the proportion of overall associations between phthalates and high AMH (total association) explained by relationships of phthalates and mean ovarian volume (indirect association).

RESULTS: In 666 midlife women, 65% were non-Hispanic White, 67% were premenopausal, and 33% perimenopausal. Only mono(3-carboxypropyl) phthalate (MCPP) and monobenzyl phthalate (MBzP) were positively associated with mean ovarian volume. In adjusted models, each two-fold increase in MCPP and MBzP was associated with 4.13% (95%CI: -0.75, 9.01) and 7.12% (95%CI: 0.83, 13.40) larger ovarian volume, respectively. These relationships partially explained associations of MCPP or MBzP with high AMH. The indirect association between MCPP and ovarian volume (β=0.03, 95%CI: 0.00, 0.07) explained 19% of the total association between MCPP and high AMH (OR=1.16; 95%CI: 0.96, 1.37). Similarly, the indirect association between MBzP and ovarian volume (β=0.06, 95%CI: 0.00, 0.13) explained 17% of the total association between MBzP and high AMH (OR=1.37; 95%CI: 1.05, 1.70).

CONCLUSIONS: Phthalates may induce folliculogenesis, with implications for midlife hormone production. Future prospective studies are needed and could consider mediation approaches using complex chemical mixtures.

KEYWORDS: phthalates, ovarian volume, AMH

P-0336 Urinary phthalate metabolites and melamine are linked to early renal injury in pregnant mothers in Taiwan

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BACKGROUND: Pregnant women exposed to two regularly encountered toxicants, melamine and phthalate, could potentially be at risk of kidney damage.
AIM
This study investigated the effects of melamine and phthalates, specifically di-(2-ethylhexyl) phthalate (DEHP), alone and interactively, on early renal injury in a nationwide cohort of pregnant women during their third trimester, participants in Taiwan's Maternal and Infant Cohort Study (TMICS).

METHODS: Participants received questionnaires, physical examinations, and blood and one-spot overnight urine tests during regular routine checkups their third trimester between October, 2012 and May, 2015. The specimens were analyzed for melamine, eleven phthalate metabolites, microalbumin and N-acetyl-beta-D-glucosaminidas (NAG), two markers of renal injury. We calculated estimated daily DEHP intake using measurements of three urinary DEHP metabolites. If a participant was found to have urinary albumin/creatinine ratio (ACR) higher than 3.5 mg/mmol, she was defined as having microalbuminuria.

RESULTS: In total, we analyzed data collected from 1433 pregnant women, who were found to have a median urinary melamine value of 0.63 μg/mmol Cr and estimated DEHP intake of 1.84 μg/kg/day. Compared to those in the lowest quartile of estimated DEHP intake, those belonging in the highest quartile had significantly increased urinary ACR ($\beta = 0.095$, $p = 0.043$) and microalbuminuria (adjusted OR = 1.752, 95% confidence interval = 1.118–2.746). A significant interactive effect between urinary melamine and estimated DEHP intake on urinary ACR and NAG was also found.

CONCLUSIONS: There is a strong association between exposure to these two pervasive toxicants, both independently and interactively, and the urinary indicators of early kidney injury we measured in this nationwide birth cohort of pregnant women.

KEYWORDS: Melamine, Phthalates, Urine albumin-creatinine ratio, N-Acetyl-beta-D-glucosaminidas, Renal injury, Pregnancy

P-0340 Urinary biomonitoring of glyphosate exposure among male farmers and non-farmers in the Biomarkers of Exposure and Effect in Agriculture (BEEA) study

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BACKGROUND AND AIM: Glyphosate is the most widely applied herbicide worldwide. Despite potential health effects of glyphosate, biomonitoring data of glyphosate exposure in agriculture and other settings are limited. We measured urinary glyphosate concentrations and assessed their determinants among male farmers and non-farmers from Iowa and North Carolina in the BEEA study.

METHODS: Based on questionnaire-assessed pesticide exposure histories, we selected four groups of BEEA participants: recently exposed farmers with occupational glyphosate use in the last 7 days (n=98), farmers with high cumulative lifetime days of glyphosate use (>80th percentile) but no use in the last 7 days (n=70), farmers with minimal lifetime glyphosate use (n=100), and non-farmers with no occupational pesticide exposure (n=100). We quantified glyphosate in first-morning void urine samples using ion chromatography isotope-dilution tandem mass spectrometry. We estimated geometric mean urinary glyphosate concentrations across groups and evaluated associations with potential determinants using linear regression.

RESULTS: Glyphosate was detected in urine of most recently (91%), high-lifetime (93%), and low-lifetime (88%) exposed farmers, as well as non-farmers (81%); geometric mean concentrations were 0.86, 0.58, 0.44, and 0.37 µg/L, respectively. Compared to non-farmers, urinary glyphosate concentrations were significantly elevated among recently exposed farmers (P<0.0001), particularly those who used glyphosate within 1 day of urine collection [age- and creatinine-adjusted geometric mean ratio (GMR)=6.4, 95% confidence interval (CI)=4.3-9.3] and those not wearing gloves during glyphosate application (GMR=2.6, 95% CI=2.0-3.4).

CONCLUSIONS: Preliminary results suggest that a high proportion of both farming and non-farming populations may be exposed to glyphosate. Substantial exposure contrast between those with and without recent occupational glyphosate use was detectable in urine. Given the short elimination half-life of glyphosate, the exposure differences between groups may be even greater than those reflected by measured urine concentrations. Continued biomonitoring of glyphosate in various settings is warranted.

KEYWORDS: Glyphosate, exposure assessment, pesticide biomonitoring

P-0346 Hazard and risk assessment for indoor air pollutants: dimethylsiloxanes, glycols, butanediol, hydrocarbons, trimethylbenzenes, benzene, naphthalene, and ethyltoluene

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Individuals living in an indoor environment are typically exposed to a greater variety of air pollutants than in an outdoor environment. Numerous sources of chemical emissions are found in the indoor environment, depending on the building materials as well as the lifestyle of the occupants. The quality of the indoor environment considerably impacts public health. Japan has established indoor air quality guidelines for 13 chemicals, including formaldehyde, acetaldehyde, xylene, ethylbenzene, styrene, 1,4-dichlorobenzene, and toluene. However, the types and concentrations of indoor pollutants have not been consistent over time due to alterations in lifestyle and development of novel household products and building materials. Therefore, a comprehensive approach and action plan for the overall reduction of health risks caused by indoor air pollutants are required for public health protection. To determine the high-risk indoor air pollutants that should be reduced, we conducted a preliminary risk assessment using data from nationwide exposure assessments and existing hazard data. In this assessment, identifications of the critical effects and the reference values obtained from reviewing the hazard or toxicological data are crucial. We identified indoor air pollutants that appeared with high frequency and high concentration in the nationwide exposure assessments. We previously reported the critical effects and reference values for acute and chronic effects of eight indoor air pollutants, including ethyl acetate, butyl acetate, propylene glycol monomethyl ether, 3-methoxy-3-methylbutanol, diethylene glycol methyl ether, diethylene glycol ethyl ether, propylene glycol monomethyl ether acetate, and methyl isobutyl ketone. In this study, the critical effects and the reference values of nine indoor air pollutants, including octamethyl cyclotetrasiloxan, decamethyl cyclopentasiloxan, propylene glycol, 1,3-butanediol, aliphatic saturated hydrocarbons (C8–C16), trimethylbenzenes, benzene, naphthalene, and ethyltoluene and the results of risk assessment are reported.

P-0348 Acetylcholinesterase activity and serum lead concentrations in pregnant women enrolled in the Rio Birth Cohort pilot Study, Brazil

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BACKGROUND AND AIM: Lead (Pb) is considered one of the main chemicals of interest to public health, given its potential for neurotoxicity, especially in vulnerable populations such as pregnant women (WHO, 2020). One of the mechanisms proposed for Pb toxic effects on the nervous system is the acetylcholinesterase enzyme inhibition (AChE), considering that this metal mimics and inhibits the action of calcium in this enzyme (Breslller et al. 1991). Despite evidence from experimental studies, little is known about the effects of lead on AChE in humans (Nwobi et al. 2019). We evaluated the association between blood levels of Pb and erythrocyte AChE activity in pregnant women in an urban area of Rio de Janeiro.

METHODS: Cross-sectional study with 139 pregnant women enrolled in the Rio Birth Cohort Pilot Study in the third trimester of pregnancy. Socioeconomic and lifestyle data were obtained from a structured questionnaire. AChE activity was measured by the Ellman (1961) method modified by Oliveira-Silva (2000). Lead concentrations were measured in whole blood using inductively coupled plasma mass spectrometry (ICP-MS). Linear regression and Spearman correlation were used to assess the association between lead levels and erythrocyte AChE activity.

RESULTS: The median of lead concentrations in the whole blood of pregnant women was 3.9ug/dL (n=119). A weak negative correlation was observed between lead levels and AChE activity (rho= -0.289; p= 0.002). Elevated levels of lead seems to inhibit erythrocyte AChE activity (β= -0.30; 95%CI: -0.54, -0.06) in age-adjusted models.

CONCLUSIONS: Our results suggest that lead can inhibit erythrocyte AChE activity in pregnant women. This evidence reinforces the need to investigate a relationship little explored in the literature may indicate mechanisms of lead toxicity in humans.

P-0349 Persistent organic pollutant levels in maternal blood, umbilical cord blood, and breast milk: Results from the Rio Birth Cohort pilot Study, Brazil

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BACKGROUND AND AIM: Environmental exposure to 11 polychlorinated biphenyls (PCB) and 17 organochlorine pesticides (OCP) were evaluated in maternal blood, umbilical cord blood, and breast milk of women living in Rio de Janeiro, Brazil.

METHODS: The concentration of PCBs 28, 31, 52, 101, 105, 118, 128, 138, 153, 156, 180 and the OCPs DDT, chlordane, HCH, dicofol, dieldrin, endosulfan, metoxichlor, mirex, and pentacloroanisol, as well as some isomers and metabolites, were measured in 135 samples of maternal blood, 116 samples of umbilical cord blood, and 40, 47 and 45 breast milk samples during 1st, 3rd, and 6th follow-up months using gas chromatography triple quadrupole mass spectrometry (GC-MS/MS). Women were also asked to answer an enrollment questionnaire that included reproductive, lifestyle, residential, and sociodemographic questions.

RESULTS: The most commonly detected OCPs metabolites in the maternal blood were 4,4'-DDE (22.2%); β (8.9%); ɣ-HCH (7.4%); PCB 28 (4.4%); and PCB 153 (2.2%). In the umbilical cord blood, the most frequently found compounds were 4,4'-DDE (15.6%); 4,4'-DDT (10.4%); 4,4'-DDD (7.9%); β-HCH (11.2%), PCB 28 (4.3%); and PCB 153 (5.2%). In addition, p,p'-DDE was detected in 45, 47, and 13% of breast milk samples of the 1st, 3rd, and 6th follow-up months. Although not statistically significant, ∑DDT levels were higher among women with a pregestational BMI ≥30, non-white, and those older than >40 years. On the other hand, newborns with an Apgar score ≤8 at minute 5 of life showed significantly higher levels of ∑DDT in the umbilical cord blood.

CONCLUSIONS: Several persistent OCPs and PCBs were detected in the umbilical cord and maternal blood, and only p,p'-DDE was quantified during the three follow-ups. Although the concentrations of OCPs and PCBs were relatively low, they still pose a risk to the mothers' health, the pregnancy outcome, and the infants' post-natal development.

P-0350 The role of epidemiology studies in chemical risk assessment to inform risk characterization of vulnerable populations in Canada

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BACKGROUND AND AIM: The enhanced protection of vulnerable populations through the assessment of chemicals was a commitment made by the Government of Canada in 2018. Health Canada considers vulnerable populations in the assessment of existing chemical substances under the Canadian Environmental Protection Act (CEPA) (1999). Vulnerable populations include those in the general population with greater levels of exposure levels and/or increased biological susceptibility, resulting in the need for additional risk characterization. The populations considered in Screening Assessment Reports (SAR) may include infants and children, pregnant females, Indigenous communities and communities in close proximity to point source exposures, including commercial or industrial facilities. The aim of this abstract is to summarize and highlight the use of epidemiology data in risk characterization of chemical substances in vulnerable populations.

METHODS: An exploratory review of both draft and final SARs published by Health Canada and Environment and Climate Change Canada, as well as special publications was conducted. This review investigated the use of epidemiology data in chemical risk assessment, highlighting the use of epidemiology data in the assessment of vulnerable populations.

RESULTS: Several reports were identified that used observational data such as Zinc and Selenium. Observational data is used in numerous ways in these reports including characterizing exposure (concentrations of exposure, identification of exposure scenarios), informing the hazard of a substance (outcomes that cannot be assessed in animal models, populations with increased susceptibility), and characterizing risk (clarifying the mechanism of action, supporting the relevance of animal data to humans).
CONCLUSION: The consideration of epidemiological data in the risk assessment of chemical substances is an emerging area that requires further evaluation and research efforts to address the needs of vulnerable populations.

KEYWORDS: vulnerable populations
Health Canada
risk assessment

P-0353 Exposure to mercury and associated factors in Portuguese adolescents

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Due to its well-known neurotoxicity and endocrine disrupting potential mercury has been recognized as a chemical of concern by governments and citizens alike, leading to the adoption of the Minamata Convention on Mercury in 2017 by 127 countries. This work aimed to evaluate exposure to mercury in Portuguese adolescents and simultaneously to increase their knowledge and awareness about the possible effects of mercury exposure and ways to reduce it. for that, the research team together with a group of teenagers from a school in Lisbon and their teachers developed and implemented a human biomonitoring survey.

Students from the 11th and 12th grades performed recruitment at the school under the supervision of their biology teachers and after having received training from researchers. Hair samples and data on possible mercury exposure sources (e.g. seafood consumption, dental amalgams) were collected. Atomic absorption spectrometry with thermal decomposition and gold amalgamation was used to analyse samples, alongside with human hair certified reference material. The study was approved by the school's Pedagogical Board and the National Data Protection Authority.

A total of 92 students were recruited. They were aged 12-18 years, 56.5% were females, most lived in urban areas (91.3%) and the majority (97.8%) didn't have dental amalgam fillings nor used hair dye. Participants' BMI ranged from 15.1 to 28.4 kg/m2, with a mean of 20.6 ± 2.6 kg/m2. Total mercury in hair ranged from 0.01 to 3.32 µg/g, with a mean of 1.09 ± 0.66 µg/g. Around 40% of the students had mercury levels higher than US-EPA reference limit (1 µg/g), while 9.8% exhibit levels higher than WHO reference dose (2 µg/g). Higher mercury levels were significantly associated with higher consumption of fish, namely seawater fish, and with having dental amalgam fillings, but not with shellfish or seaweed consumption.

KEYWORDS: mercury, students, citizens science, Portugal

P-0358 Low-level cadmium exposure and atherosclerosis in the carotid arteries: results from the Swedish population-based cohort SCAPIS

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BACKGROUND AND AIM: Cadmium exposure is associated with atherosclerosis and cardiovascular mortality. Few studies have, however, examined how cadmium affects the atherosclerotic burden. We investigated the association between cadmium exposure and atherosclerotic burden in a Swedish population-based cohort.

METHODS: We performed a cross-sectional study using data from the Swedish CardioPulmonary bioImage Study (SCAPIS), including 5622 middle-aged men and women, enrolled 2013-2018. Cadmium was measured in whole blood (B-Cd) using inductively coupled plasma mass spectrometry. Presence of atherosclerotic plaque (yes/no, uni-/bilateral), total plaque area (mm²) and presence of large plaques (>25 mm²), all measured in the carotid arteries by high-resolution ultrasonography, were used as outcomes. Associations between B-Cd (in quartiles, Q1-4) and the different outcomes were analyzed using Poisson (for dichotomized outcomes) and linear (for continuous outcomes) regression and adjusted for cardiovascular risk factors and confounders.

RESULTS: Atherosclerotic plaques were present in 57% of the individuals, for whom the median total plaque area was 16 mm² (range: 0.2-222). The median B-Cd concentration was 0.24 µg/L (range: 0.01-8.5). In multivariable-adjusted models, individuals in the fourth quartile of B-Cd (Q4) had a prevalence ratio (PR) for plaque of 1.10 (95%CI: 1.01, 1.19) when compared with the first quartile (Q1). Individuals in Q4 had on average 3.8 mm² larger plaques (95%CI 0.78, 6.7) and a 27% increased risk of having large plaques (95%CI 0.93, 1.74) compared with individuals in Q1. The PR for bilateral plaques for individuals in Q4 vs Q1 was larger than that for unilateral plaques [PR 1.21 (95%CI 1.06, 1.4) and PR 1.09 (95%CI: 0.96, 1.24), respectively]. Estimates were larger for men and for current smokers.

CONCLUSIONS: Our study shows that increasing cadmium exposure is associated with a larger atherosclerotic burden and reinforces the urgent need of public health measures to reduce cadmium exposure in the general population.

KEYWORDS: cadmium, atherosclerosis.

P-0359 Tattoos: a new ancient carcinogen?

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Tattoo prevalence has been rising steeply during the last decades, a development seen worldwide mostly in the younger age groups. However, only few are aware that tattoo inks may contain harmful environmental and chemical contaminants classified as (probably) carcinogenic to humans. Amongst them are polycyclic aromatic hydrocarbons, primary aromatic amines and metals. However, as studies underlying this classification did not consider subcutaneous exposure, it remains to decipher whether tattoos might cause cancer in humans.
As it is known that the largest part of the nano- and microparticle sized injected tattoo pigments travels to the local lymph node and, from there, potentially to other organs, the systemic exposure is not restricted to the skin. Especially in young individuals exposure to tattoo ink is worrisome as they will have a long-term exposure to these substances. To understand the potential relationship of tattoos and certain kinds of cancer, epidemiological studies are needed, which are scarce worldwide. A sound study design needs to assure a long-term follow-up of (young) tattooed cohort participants, prospective and objective recruitment of medically confirmed cancer outcomes and the inclusion of major sociodemographic, medical and lifestyle confounders.
This in mind, the first longitudinal population based cohort study on tattoos and cancer is currently being set-up in the framework of the French national cohort “Constances”. The CRABAT (Cancer Risk Associated with the Body Art of Tattooing) study is led by the International Agency for Research on Cancer (IARC) and leverages the infrastructure of the French national cohort “Constances”. Here we present its conceptual framework, study design and exposure assessment.

P-0360 Detection of 4-hydroxychlorothalonil in human serum

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BACKGROUND AND AIM: Chlorothalonil (CHT) is an organochlorine fungicide that has been widely used, e.g. in agriculture but also as wood protectant and paint additive. It has recently been banned in the European Union due to its potential impact on the environment and human health. The transformation product 4-hydroxychlorothalonil (4-OH-CHT) was recently identified using nontargeted analysis in human serum and breastmilk samples. Large knowledge gaps exist, but there are indications that 4-OH-CHT is more toxic and has a higher environmental persistency than CHT. Our aim was to investigate serum levels of 4-OH-CHT in a large human population.

METHODS: We developed a quantitative method for 4-OH-CHT analysis using liquid chromatography-triple quadrupole mass spectrometry (LC-MS/MS). We measured 4-OH-CHT in 1,815 serum samples collected from pregnant women between 1997-2015, which were originally stored in the Swedish Rubella Screening Program Biobank and analyzed as part of the NIH R01 funded Autism and Prenatal Endocrine Disruptors study. Linear regression models were used to assess time trends of 4-OH-CHT.

RESULTS: The validated analytical method performed well and the LOD was 0.1 ng/ml. 4-OH-CHT was detected in all serum samples with a median concentration of 4.1 ng/ml (range: 0.16-38 ng/ml). Concentrations showed clear seasonality, with higher concentrations in the first half of each year. A linear regression of log-transformed 4-OH-CHT by year showed no linear trend.

CONCLUSIONS: To the best of our knowledge, this is the first study to quantify a chlorothalonil metabolite in human serum. 4-OH-CHT does not seem to degrade after 25 years of storage. Concentrations of 4-OH-CHT were higher than expected and suggest a widespread and continuous chlorothalonil exposure in the general Swedish population. More research is needed to explore possible sources of exposure to CHT and 4-OH-CHT, as well as their persistency.

KEYWORDS: Chlorothalonil, emerging chemicals of concern, human biomonitoring

P-0362 The Use of Potentially Toxic Skin Bleaching Products Among Women In Urban and Rural Areas In Lagos State and Investigation of Active Chemicals In Selected Skin Lightening Products

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BACKGROUND AND AIM: The prevalence of skin lightening SL is higher in African nations especially Nigeria and it cuts across all socio-demographic and geographical characteristics. Studies have reported various regulatory failures that remains unabated. This study was aimed at determining the use of SL products among women in urban and rural areas in Lagos state of Nigeria and assessment of SL compounds in selected SL products.
Methodology:
A comparative cross-sectional study carried out in Lagos State, among 1100 women within the age range 18-65 years who resided in rural and urban areas . Respondents were selected using a multi-stage sampling technique and data was collected using exploratory parallel mixed method. The study also involved laboratory analysis of SL compounds in SL products.

RESULTS: Knowledge of SL was significantly higher among rural (83.1%) than urban (87.9%) women ($p<0.05$). Conversely, about half of the respondents in the urban area (45.8%) had positive attitude to SL than rural respondents (36.2%; $p<0.05$). The reported prevalence (82.9%) was significantly higher in rural area than the urban area.
There were very elevated levels of the SL compounds in all categories of SL products. About 90% of the SL chemical compounds analysed were not declared on the ingredient list of the SL products. Similarly, 75% of the SL products had SL chemicals greater than the permissible limits on laboratory analysis.

CONCLUSIONS: There is outstanding gap in the knowledge and attitude to SL in both rural and urban areas of Lagos though there is a shift in the demography of users of SL products. The reported prevalence however is still higher among the rural women. The study highlights huge regulatory failure in cosmetic products. Advocacy, health information literacy and regulatory reinforcement can contribute to the control of SL in Nigeria.

KEYWORDS: skin lightening, skin bleaching, skin toning, cosmetics, chemicals

P-0368 Per- and polyfluoroalkyl substances (PFAS) exposure and sleep health in U.S. adults, NHANES 2005-2014

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BACKGROUND AND AIM Per- and polyfluoroalkyl substances (PFAS) are synthetic chemicals that may induce oxidative inflammatory responses and disrupt the endocrine and the central nervous systems, all of which can influence sleep. This study aims to investigate the association between PFAS exposure and sleep health in adults using the U.S. National Health and Nutrition Examination Survey (NHANES).

METHODS: We analyzed serum concentrations of four PFAS [perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA)] in 8,015 adults enrolled in five waves of NHANES between 2005 and 2014. Self-reported outcomes include diagnosis of sleep disorder (e.g., apnea, insomnia), insufficient sleep (<6 hours/day), and excessive sleep (>9 hours/day). Weighted multivariate logistic regression was utilized to estimate the association between the sleep outcomes and PFAS (individual compounds and mixtures) modeled continuously (log2) or in exposure tertiles, adjusting for potential confounders. A quantile g-computation was used to estimate the joint effects of PFAS mixtures on the sleep outcomes.

RESULTS: Overall, 8.4% (N=674) of participants had sleep disorder diagnosis, and 14.7% (N=1,177) and 2.8% (N=227) were classified as insufficient or excessive sleep, respectively. A doubling of serum-PFOS concentrations (ng/ml) was associated with lower odds of having diagnosed sleep disorder (OR=0.87, 95%CI: 0.81, 0.93) and experiencing insufficient sleep (OR=0.92, 95%CI: 0.85, 0.99). These inverse associations were also observed for PFAS mixtures, but only among male adults aged 60 and above. Adults with higher exposure tertiles of PFOS, PFOA, and PFNA were associated with higher odds of excessive sleep compared to those in the lowest tertiles.

CONCLUSIONS:PFAS exposure was linked to sleep outcomes in NHANES, but the effect direction varied by the chemical and outcome assessed. Potential influence from reverse causation and selection bias due to pre-existing sleep conditions needs to be considered.

KEYWORDS: Sleep; Chemical Mixtures; Endocrine Disruptors; Exposome

P-0369 Association between lead and cadmium exposure and kidney function and mediation effects of atherosclerosis

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BACKGROUND AND AIM: Environmental lead and cadmium exposure has been associated with reduced kidney function and chronic kidney disease as well as with a higher risk of atherosclerosis. The role of atherosclerosis in the associations between these metals and kidney function has not been studied before. The aim of this study is therefore to assess the associations between lead and cadmium exposure and kidney function and the role of atherosclerosis as a mediating factor.

METHODS: This cross-sectional study used data from the population-based Swedish CArdioPulmonary bioImage Study (SCAPIS) and involved 4804 men and women (50-65 years old), recruited in 2013-2017. Blood cadmium (B-Cd) and lead (B-Pb) concentrations, analyzed using inductively coupled plasma mass spectrometry, were used as exposure biomarkers. Estimated glomerular filtration rate (eGFR) based on serum creatinine and Cystatin C was used as marker of kidney function. Associations between B-Cd and B-Pb (in quartiles, Q1-4) and eGFR was assessed using linear regression models adjusted for known risk factors of renal disease and confounders. Mediation analysis was conducted to evaluate the indirect effect (via atherosclerosis) of lead and cadmium on kidney function.

RESULTS: The median B-Pb and B-Cd was 14µg/L (range: 0.75-178) and 0.24 µg/L (range: 0.0098-8.5), respectively. The median eGFR was 88 ml/min/1.73m2 (range: 17-122). In multivariable-adjusted models, individuals in Q4 of B-Pb had a -1.26 ml/min lower eGFR (95%CI: -2.24, -0.28) compared to those in Q1. This estimate remained unchanged after adjustment for cadmium. In stratified analyses, the effect size was similar for both never and current smokers. The mediation analyses showed that the effect of lead on eGFR is not mediated by atherosclerosis. There were no associations between eGFR and B-Cd.

CONCLUSIONS: Increased lead exposure was associated with a reduced eGFR. This association does not seem to be mediated by atherosclerosis.

KEYWORDS: heavy metals, kidney function, atherosclerosis

P-0370 The association of urinary nickel concentrations with type 2 diabetes and fasting blood glucose levels: A cross-sectional study from the China National Human Biomonitoring

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BACKGROUND AND AIM: Epidemiological studies on the effect of nickel exposure on the prevalence of type 2 diabetes (T2D) in the general population are scarce and remain controversial. We aimed to assess the association of nickel exposure with the odds of T2D and fasting blood glucose (FBG).

METHODS: The study included a total of 10,890 adults aged 18 years or older from the China National Human Biomonitoring conducted in 2017-2018. The urinary nickel concentrations and FBG were measured and lifestyle and demographic data were collected. Weighted multiple regression analyses were used to estimate the associations of urinary nickel concentrations with the odds of T2D and increased FBG.

RESULTS: The weighted median concentration (interquartile range) of urinary nickel was 1.74 μg/L (0.85-3.37 μg/L). After adjusting for potential confounding factors, the urinary nickel concentrations were correlated positively with the prevalence of T2D, and the odd ratios of T2D associated with the highest quartile of nickel concentrations were 1.84 (95% confidence interval (CI), 1.33-2.54) when compared to the lowest quartile. Elevated urinary nickels were associated with higher FBG, each one-unit increase in log10-transformed urinary nickel concentration was associated with a 0.39 (95%CI: 0.20-0.58) mmol/L elevation in FBG in the most adjusted categorical model. In addition, restricted cubic spline analysis showed a significant linear association between nickel exposure and the odds of T2D and FBG levels.

CONCLUSIONS: Our findings suggested that elevated urinary nickel levels may be related to an increase in FBG levels and T2D prevalence in Chinese adults.

KEYWORDS: Urinary nickel levels; type 2 diabetes; fasting blood glucose; China National Human Biomonitoring

P-0377 Exposure to perfluoroalkyl substances, incident Type 2 Diabetes risk and associated metabolic pathway dysregulation in a multiethnic population

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BACKGROUND AND AIM: Growing experimental and epidemiology evidence suggests that exposure to perfluoroalkyl substances (PFAS) increase type 2 diabetes (T2D) risk; however, effects of PFAS-mixtures and underlying mechanisms are unclear. We examined associations of exposure to PFAS-mixture with incident T2D-risk and underlying plasma metabolic-pathways using untargeted metabolomics.

METHODS: We conducted a nested case–control study within BioMe, an electronic health record-linked biobank of >60,000 patients seeking primary care at Mount Sinai Hospital, New York, since 2007. A total of 180 incident T2D cases (33% African Americans, 33% Hispanics, 33% Whites) were matched to 180 controls by age, sex and ancestry. We used liquid-chromatography with high-resolution mass spectrometry, to quantify seven PFAS (PFOS, PFOA, PFHxS, PFHpA, PFDA, PFHpS and PFNA) and measured untargeted metabolomic profiles in prediagnostic plasma. Cases had an average of ~6 years between blood draw and T2D diagnosis. We used (1)Weighted Quantile Sum(WQS) regression to evaluate the PFAS-mixture association with incident T2D risk; (2)performed metabolome-wide association analysis using Hierarchical-Bayesian WQS and logistic regression to separately analyze PFAS-mixture and T2D associations with 656 annotated metabolites, adjusting for confounders. Pathway enrichment analyses were performed using Mummichog. We used inverse probability weighting to account for nested case-control design in PFAS-metabolites analysis. Multiple comparisons were accounted by calculating q-values.

RESULTS: Each tertile increase in PFAS-mixture(ng/mL) was associated with increased odds of incident T2D (OR[95%CI]=1.45[1.01, 2.09]) with PFOS and PFHpA having highest contributions to PFAS-mixture. T2D risk and PFAS-mixture associated top metabolites were aminoadipic acid, cortisol, gamma-glutamylglytamine, sulfolithocholylglycine, n-acetylaspartic acid and top pathways were alanine and aspartate metabolism, C21-steroid hormone biosynthesis and metabolism, androgen and estrogen biosynthesis and metabolism(p-value<0.05;q-value >0.2).

CONCLUSIONS: Exposure to PFAS mixtures may dysregulate pathways of amino acid metabolism and steroid-hormone biosynthesis and metabolism, increasing risk of T2D diagnosis in multiethnic populations.

KEYWORDS: Perfluoroalkyl-substances; Endocrine disrupting chemicals; Type 2 Diabetes; Metabolomics

P-0379 The Breast Milk Perfluorome is Associated with Infant Growth in the First Year of Life

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BACKGROUND AND AIM: Early life exposure to poly- and perfluoroalkyl substances (PFAS) has significant obesogenic effects that are manifested in early life. However, PFAS examined do not include the wide range of PFAS used in commercial applications.

METHODS: This pilot included 56 Hispanic mother-child pairs from Southern California. Maternal and infant characteristics were assessed, including infant weight, length, and fat mass. All mothers were breastfeeding, and breast milk was collected at 1-month postpartum. The perfluorome was characterized using untargeted high-resolution mass spectrometry. Organofluorine compounds were identified using the EPA CompTox Dashboard. Multivariable linear and logistic regression analyses were used to examine associations between PFAS with growth measures (12-months, change in first year, rapid growth) after adjusting for infant age, sex, pre-pregnancy BMI, gestational age, and formula feedings. Results are reported for associations with $p<0.05$ and were considered statistically significant using a false discovery rate (FDR) of 20%.

RESULTS: 484 suspect PFAS compounds were detected in ≥75% of samples. PFAS were associated with 12-month weight [n(%): 10(2.1%) positive, 12(2.5%) negative], change in weight [10(2.1%) positive, 22(4.5%) negative], 12-month length [21(4.3%) positive, 17(3.5%) negative] change in length [22(4.5%) positive, 25(5.2%) negative], 12-month fat mass [9(1.9%) positive, 12(2.5%) negative], and change in fat mass [18(3.7%) positive, 21(4.3%) negative]. Additionally, 12(2.5%) and 13(2.7%) of PFAS compounds were associated with an increased (OR=2.0-3.8) and decreased odds (OR=0.28-0.47) of rapid growth in the first, respectively. After FDR, three compounds, each detected in >98% of samples, were associated with change in length ($q=0.01$; n=2 positive, n=1 negative). Tentative annotations of these compounds identified novel PFAS, including methyl 4,4,5,5,5-pentafluoropent-2-ynoate3,4,4,5,5-Pentafluoro-2-methoxycyclopent-2-en-1-one, ethyl [5-(heptafluoropropyl)-1-methyl-1H-pyrazol-3-yl]acetate, and ethyl 2-acetyl-4,4,5,5,5-pentafluoro-3-oxopentanoate.

CONCLUSIONS: Results from this pilot suggest that a wide range of PFAS are present in human breast milk, which may impact infant growth in the first year of life.

KEYWORDS: breast milk, PFAS, infants

P-0380 Lindane use and the incidence of thyroid cancer in the USA; an ecological study

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INTRODUCTION: The increased thyroid cancer incidence rate may potentially be partially attributable to exposure to chemicals with endocrine disruptive properties. Lindane is an organochlorine pesticide with endocrine disruptive properties that has been classified as carcinogenic to humans. The aim of this ecological study was to evaluate potential correlation between Lindane exposure and thyroid cancer incidence in the USA (US).

METHODS: Data on age-adjusted thyroid cancer incidence rate (per 100,000 people) was obtained from the Centers for Disease Control and Prevention for all US states for 2018. Lindane use was obtained from the US Geological Survey and presented in quintiles for the years 1992 and 2007 to consider latency period. Trend of Lindane use between 1992 and 2007 was calculated using Mann Kendall correlation test. Lindane use estimates per cropland (kg/acres cropland) were overlaid on the map of age-adjusted thyroid cancer incidence rate using ArcGIS. Correlation between statewide Lindane use and age-adjusted thyroid cancer incidence rates was calculated using Spearman correlation.

RESULTS: Overall Lindane use decreased significantly between 1992 and 2007 ($T = -0.617$; $p < 0.001$). Statewide differences in the patterns of Lindane use as well as thyroid cancer were found, with high rates of thyroid cancer and Lindane use reported in several states including Delaware and Georgia. There was no statistically significant correlation between thyroid cancer incidence rates in 2018 and Lindane use in 1992 ($r=0.075$; $p=0.689$) nor Lindane use in 2007 ($r=0.01$; $p=0.935$), among males and females combined.

CONCLUSIONS: Restrictions clearly seem to be effective in reducing Lindane use. While, overall, there was no evidence of a correlation between thyroid cancer and Lindane use, more research is needed to explore this further specifically in highly exposed populations (e.g. rural areas) with longitudinal studies that assess the effects of long-term exposure to Lindane and other organochlorine pesticides.

P-0385 Exposure of adults aged 18 to 44 years to personal care products (PCPs) in Beijing, China: urinary levels, exposure patterns and risk evaluation.

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BACKGROUND AND AIM: PCPs, including parabens, benzophenones and antimicrobials, are a group of typical EDCs that widely applied in various consumer products and industrial applications. Concern for adverse effects on human health arises from results of in vitro and in vivo experiments. The purpose of this study was to assess the characteristics of exposure to PCPs and to provide a preliminary assessment of exposure levels and health risks within typical PCPs in the target population in combination with estimated daily intake (EDI) and risk entropy (HQ).

METHODS: 15 PCPs were measured in 127 spot urine samples collected from Beijing residents aged 18 to 44 years from November 2021 to January 2022. Individual specific gravity (SG) was used to correct for urinary dilution. Since distributions of PCPs concentration were right skewed, non-parametric statistics were used. The relationships between different parabens and benzophenones were determined using the Spearman correlation coefficient. The difference of PCPs concentration in various demographic characteristics, such as gender and age, were compared by Mann-Whiney test.

RESULTS: We found that PCPs were ubiquitous in all urine samples, with methyl paraben(MP), ethyl paraben(EP) and propyl paraben(PP) being the main compounds with median concentrations of 27.08 μg/L, 0.76 μg/L and 1.16 μg/L, respectively. Non-parametric tests showed statistically significant differences in gender for 8 PCPs. There was a significant positive correlation between MP and PP concentrations, Benzophenone-1、Benzophenone-3 and Benzophenone-4 concentrations. The median EDI-urine values of PCPs varied in the range of 20.01~88,295 ng/kg-bw/day. More than 5% of the target population exhibited greater HQs > 1 for individual PCPs.

CONCLUSIONS: The high correlation between the different PCPs suggests that they may have the same and/or similar original sources. Exposure to PCPs might be a critical factor contributing to adverse health effects in Beijing residents.

KEYWORDS: PCPs, EDI, risk assessment

P-0386 Persistent Organic Pollutants and Dysregulation of microRNAs Expression in Humans and Animals - A Systematic Literature Review

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BACKGROUND: MicroRNAs (miRNAs) are key regulators in many physiological processes. Evidence suggests that exposure to persistent organic pollutants (POPs) is associated with miRNA dysregulation. Exposure to POPs is ubiquitous and these chemicals are characterized by their environmental persistence. It is therefore of public health concern to understand the relationship between POPs and miRNA as it relates to health outcomes.
OBJECTIVES: The objective of this systematic review is to evaluate the relationship between exposure to POPs including per- and polyfluoroalkyl substances (PFAS), polychlorinated biphenyls (PCBs), dichloro-diphenyl-trichloroethane (DDT), hexachlorobenzene (HCB), and polybrominated diphenyl ethers (PBDEs), with miRNA expression in both human and animal studies.

METHODS: The systematic search of the literature was conducted in PubMed and Embase. Search results of human and animal studies were included if they included at least one POP of interest in relation to at least one miRNA. Data were synthesized to determine the direction and statistical significance of associations between POPs and miRNA. Finally, a review of disease pathways was conducted for miRNAs that were consistently associated with POPs.

RESULTS: Our search identified 35 studies, 8 of humans and 27 of model organisms. PFAS were associated with decreased expression of miR-144, miR-19 and miR-193, and increased expression of miR-26b, miR-199a-3p, miR-122 and miR-128 across studies. PCBs were associated with increased expression of miR-15a, miR-21, miR-1537 and decreased let-7b in both humans and animals. Pathway review suggested that PFAS-associated miRNAs are all involved in prostate cancer, hepatocellular carcinoma and nonalcoholic fatty liver disease, while PCB-associated miRNA are associated with gastric cancer.

CONCLUSIONS: This is the first systematic review of the association of POPs with miRNAs in humans and model organisms. Large-scale prospective human studies are now warranted to examine the role of miRNAs as mediators between POPs and health outcomes.

KEYWORDS: persistent organic pollutants, miRNAs, systematic review

P-0388 Associations of blood lead and cadmium co-exposure and hepatic dysfunction: A cross-sectional study among Chinese adults aged 18 and older

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BACKGROUND AND AIM: Lead (Pb) and cadmium (Cd) were once toxic metals of occupational importance, but are now more harmful as environmental pollutants. Current evidence on the relationship between Pb and Cd co-exposure on liver function are still limited and findings remain conflicting. This study focused on studying the effects of Pb and Cd alone and co-exposure on liver function among Chinese adults aged 18 years and older.

METHODS: The study used data from the China National Human Biomonitoring (CNHBM) in 2017-2018. Pb and Cd levels were measured in whole blood. Alanine aminotransferase (ALT), Aspartate aminotransferase （AST） and γ-glutamyl transpeptidase （γ-GT） were selected as the hepatic function biomarkers. Combined effect of blood Pb and Cd were assessed using logistic regression.

RESULTS: The median of blood lead and blood cadmium in the population were 23.38 μg/L and 0.83 μg/L, respectively. In the joint association analyses of blood Pb and Cd, significant p-interaction values were found in all elevated hepatic biomarkers, indicating there was an interaction between these two metals. for biomarker ALT, in full adjusted model, the ORs of subjects with low Pb and high Cd, and high Pb/Cd were 1.37(1.03, 1.84) and 1.55 (1.16, 2.07), compared to those with low Pb/Cd, respectively. Similar results were exhibited in the biomarker AST. for biomarker γ-GT, the ORs of subjects with high Pb and low Cd, and high Pb/Cd, were 2.02(1.26, 3.23) and 1.97(1.27, 3.05) after adjusting for confounders.

CONCLUSIONS: Co-exposures of Pb and Cd were associated with hepatic dysfunction, efforts should be made to further reduce environmental Pb and Cd exposure in order to weaken the interaction effect.

KEYWORDS: lead, cadmium, co-exposure, liver, Chinese adults

P-0392 Relationships between urinary phthalate metabolites and lipidomic profile in a Taiwanese elderly population

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BACKGROUND AND AIM: Phthalate exposure has been associated with circulating lipid composition. However, limited epidemiological study has been carried out in elderly people. Therefore, we conducted a cross-sectional study to examine the associations between urinary phthalate exposure and lipidomic profile in Taiwanese elderly people.

METHODS: A cross-sectional survey of the elderly (age >= 65 years) was conducted in Taipei city, New Taipei City, Hualien County, Chiayi County, and Kaohsiung City in Taiwan. A total of 11 urinary phthalates metabolites and 86 lipids (phosphatidylcholines (PCs) and sphingomyelins (SMs)) were assessed. Demographic information was obtained by a structured questionnaire. Serum lipidomic profile was identified using principal component analysis (PCA). A two-step analysis was performed. We first performed multiple linear regressions to evaluate whether urinary phthalate metabolites were related to the PCA-derived components of serum lipid concentrations. Then we performed multiple linear regressions to investigate each of the lipids that were suggestively correlated with some of the phthalates in PCA. Urinary concentrations of phthalate metabolites were log-transformed to normalize distributions.

RESULTS: A total of 886 participants (58.9% women) were included in the final analysis. There were ten components identified by PCA, which accounts for 63.2% of total variance. After adjusting for age, sex, body mass index, urinary creatinine, urinary phthalate metabolites were correlated with 6 components. Among them, component 7 was correlated with the most phthalates metabolites (Bonferroni corrected p-value < 0.007). Monomethyl phthalate (MMP) and monobutyl phthalate (MnBP) were negatively correlated with component 7, whereas monoisobutyl phthalate (MiBP), monobenzyl phthalate (MBzP), and monoisononyl phthalate (MiNP) were positively correlated with component 7. Among component 7, PC(16:0/16:0), PC(16:0/17:1), PC(16:0/18:1), PC(16:0/19:5), PC(16:0/20:5), PC(16:0/22:4), PC(38:0), PC(P-16:1/22:5), PC(P-40:4), and PC(P-40:5) were highly loaded.

CONCLUSIONS: Urinary phthalate metabolites were correlated with the lipidomic pattern. Most of them were diacyl-phosphatidylcholines, which might play a role in hepatic lipid metabolism.

P-0401 Exploratory Analysis of Relationship of Trihalomethane Levels in Water for Human Consumption and Health Profile in Municipalities of Sao Paulo State in Brazil

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Presence of chemicals, heavy metals (such as lead, arsenic) and agrochemicals in various regions are causing environmental and human health impacts. Water used for human consumption has been seen as a serious public health problem in Brazil, like in several countries. High levels of sanitary higienization products have been dumped into our effluents, with chlorine as the main halogen in its composition. The degradation of chlorine with the formation of trihalomethanes has been the object of study in several regions of Brazil, especially for its potential in carcinogenesis. The state of SP has a population of about 50 million people and has the best levels of sanitation in the country. Nevertheless, it does not analyze the relationships between levels of trihalomethanes and their impacts on public health. The objective of this study was to analyze the database referring to the presence of trihalomethanes in water for human consumption in 645 municipalities in the state of São Paulo in the last decade. The information was with exploratory analysis associated to the main pathologies responsible for the mortality profile in each municipality. The information banks of the national health system - DATASUS and the national water information system - SISAGUA were used. In the results we founded specific clusters of some specific groups of pathological, as compared to the international ICD 10 classification. Conclusion : In Brazil, the legislation is in a process of recent change with the confrontation of the current databases, contributing in the discussion on preventive measures in public health

KEYWORDS: Chemicals, Trihalomethanes, Water, Public Health

P-0403 Astrocyte-derived extracellular vesicles: novel biomarkers of CNS metal exposure and elimination with applications in discerning the pathogenesis of neurodegenerative diseases

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BACKGROUND AND AIM: Amyotrophic lateral sclerosis (ALS) is a fatal neurodegenerative condition, and though environmental exposure to metals has been associated with ALS, there are no existing biomarkers for these potentially causal environmental exposures – a biomarker for toxicant load in the central nervous system is greatly needed. Upon exposure to toxic metals in vitro, central nervous system (CNS) astrocytes, critical in metallohomeostasis, were observed to produce extracellular vesicles loaded with metals, potentially as a cellular elimination pathway. Metals are known to bioaccumulate in the CNS; EVs originating from the CNS (CNS-EVs) are readily found in peripherally drawn blood and can be isolated using cell-specific surface proteins. This study examines whether blood-borne CNS-EV metal cargoes can serve as reliable biomarkers of CNS metal exposure and reveal a link between metal metabolism and neurodegenerative disease (i.e., ALS).

METHODS: Precautions were undertaken to ensure EV protocols were completed under metal-free conditions. CNS-EVs were isolated from human whole blood and plasma samples via direct immunoprecipitation using biotinylated antibodies for proteins expressed on astrocytes. Once EVs were isolated, ELISA analysis generated protein concentrations, ViewSizer Nanoparticle Tracking analysis quantified abundance, and Transmission Electron Microscopy visualized particles. EVs were analyzed for metal contents using a Perkin-Elmer NexION 350S via an ICP-MS/MS dynamic reaction cell method.

RESULTS: Results demonstrate that it is feasible to quantify the small quantities of metals within these CNS-derived EVs, particularly in terms of toxic metals known to be associated with neurodegenerative disorders, including copper, zinc, lead, aluminum, manganese, and iron.

CONCLUSIONS: CNS-derived EVs isolated from peripheral blood draws show promise as a potential biomarker of metal exposure and/or elimination in the brain and spinal cord, with promising applications in understanding the potential environmental pathogenesis of neurodegenerative disorders (i.e., ALS) among patients with relevant elevated CNS metal loads.

P-0404 Determinants of exposure to phenols, phthalates, parabens and triclosan in pregnant women, Colombia

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INTRODUCTION: Phenols, phthalates, parabens and triclosan are endocrine disruptors (1) and human beings are exposed daily through contact with skin, water, food and the air they breathe, these compounds are measured in urine (2).
OBJECTIVE: to determine the sources of exposure to phenols, phthalates, parabens and triclosan in pregnant women.

METHODS: study carried out in 400 women with ≤12 weeks of pregnancy from two institutions in Medellín. Demographic, nutritional and environmental exposure characteristics were investigated and 37 metabolites in urine were quantified at the Norwegian Institute of Public Health (NIPH), by means of ultra-high resolution liquid chromatography coupled to tandem mass spectrometry (UPLC-MS- MS) and dilution correction for specific gravity. Using t-student, differences were observed in the geometric measurements according to exposure determinants.

RESULTS: significant differences were found in the geometric means of Propyl Paraben (PRPA) according to the use of floor cleaners (yes: 7.94ng/mL 95% CI: 4.70-13.43; no: 18.76ng/mL 95% CI :9.21-38.21), Mono-iso-butyl phthalate(MiBP) given exposure to second-hand tobacco (yes:12.56ng/mL 95% CI:10.00-15.78; no:19, 94ng/mL 95% CI:14.86-26.76) and from exposure to the use of cosmetics, the GM of some phthalates were, Mono-4-methyl-7-oxooctyl phthalate(oxo-MiNP) [si:3, 03ng/mL 95% CI: 2.35-3.92; no:5.58ng/mL 95% IC:2.28-13.67], Mono-4-methyl-7-carboxyoctyl-phthalate(cx-MiNP) [yes:7.08ng/mL 95% IC:6.24- 805; no:11.28ng/mL 95% CI:5.57-23.26], 6-Hydroxy-Monopropylheptylphthalate(OH-MPHP) [yes:1.68 ng/mL 95% CI:1.51-1.86; no: 2.18ng/mL 95% CI: 1.39-3.41].

CONCLUSIONS: the determinants of exposure to phenols, phthalates, parabens and triclosan in pregnant women in the study were the use of floor cleaners, second-hand tobacco and the use of cosmetics.

KEYWORDS: phenols, parabens, triclosan, endocrine disruptors, urine

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P-0405 Descriptive analysis of victims of poisoning, suicide attempts and deaths from pesticides in Brazil between 2010 and 2020

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Between 2010 and 2021, 3,474 new pesticides were registered and authorized in Brazil, of which 76.5% were only between 2016 and 2021. An increase of 540% in registrations of new pesticides when compared to 2010. As a result of this policy and with the approval in the first vote, in 2022, by the Brazilian Congress of the so-called poison package, this scenario could be even worse in the short and long term, with incalculable impacts on the health of the population and the environment. OBJECTIVES: To describe and analyze the profile of victims of pesticide poisoning, suicide attempts and deaths from agricultural, domestic, public health, rodenticide and veterinary pesticides between 2010 and 2020.

METHODS: Descriptive cross-sectional study. Data were collected from the Ministry of Health database – DATASUS.

RESULTS: There were 135,803 cases of intoxication, 73.2% of intoxications were not due to exposure at work; 71,009 suicide attempts and 3,944 deaths from poisoning, with 48.8% of the deaths being between black/brown and 36% white; 74.6% of intoxications were in urban residents and 21.9% in rural areas and 94.5% of deaths were not related to work. 712 of the victims of attempted suicides were younger than 1 year and 4 years old, 10,834 of the victims were between 10 and 14 years old.

CONCLUSIONS: The results point to higher rates of poisoning, suicide attempts and deaths from pesticide poisoning among black/brown children, with low schooling and, for the most part, living in urban areas and belonging to black/brown color/ethnicity. and no exposure to work.

KEYWORDS: Pesticides, intoxications, deaths, suicide, ethnicity.

P-0407 Mixture effects of gestational synthetic phenol and phthalate exposures on the neuro-behavior of children in the Healthy Start cohort

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BACKGROUND: Simultaneous exposure to multiple endocrine disruptors may be harmful even when individual exposures for which individual effects may be below observable levels. We sought to assess the effects of prenatal exposure to a mixture of phthalates and phenols on the neuro-behavior of preschool-aged children.
METHODOLOGY: In a sample of 293 mother-infant pairs from the Healthy Start pre-birth cohort, sixteen phthalate metabolites and phenols were assessed in maternal spot urine samples from mid-pregnancy. Behavioral outcomes in preschool children (4-5 years) were assessed using the child behavior check list (CBCL). We computed 3 composite scales for total behavioral, externalizing and internalizing problems. Covariate-adjusted weighted quantile sum (WQS) regression was used to estimate associations between the mixture of phenols and phthalates and the behavioral scales.

RESULTS: WQS regression indicated a positive trend with the externalizing scale. We observed a 0.15 points (95% CI: -0.02; 0.33, p-value = 0.09) increase in the externalizing problems' score for one tertile increase in the WQS index. The major contributors to this mixture effect were Di-isononyl phthalate (DiNP) (with a weight of 24%), Benzophenone-3 (22%), triclosan, methyl paraben (11%), MEP (7%) and bisphenol A (6%). No statistically significant (p-values > 0.1) associations were observed with the total (beta = 0.06(CI 95% -0.04; 0.16)) and internalizing (beta = -0.09(CI 95% -0.29; 0.11)) composite scores.

CONCLUSIONS: Exposure to mixtures of phenols and phthalates in utero may induce behavioral problems during early childhood. Future policy guidelines on exposure limits to these compounds should consider mixture effects as they are increasingly being reported in epidemiological studies.

P-0410 The effects of combined exposure of lead and stress during pregnancy on cognitive development in offspring

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BACKGROUND AND AIM: To assess the current exposure levels of lead and stress during pregnancy, and compared the effects of prenatal combined exposure of lead and stress during different stages of pregnancy on the neurodevelopment of offspring.

METHODS: A total of 5270 mother-child pairs were assessed in the Shanghai Birth Cohort, maternal blood lead in early pregnancy and umbilical cord blood lead were measured. Assessments of prenatal maternal stress, the Center for Epidemiological Studies-Depression Scale and the Self-Rating Anxiety Scale during mid-pregnancy, postnatal maternal stress using the Edinburgh Postnatal Depression Scale were conducted, and groups of prenatal single exposure to lead/stress and combined exposure were therefore formed. The Ages-Stages-Questionnaires (at 6- and 12-months-of-age) and the Bayley-III (at 24-months-of-age) were performed to assess the offspring neurodevelopment.

RESULTS: The geometric means of maternal blood lead in early pregnancy and umbilical cord blood lead were 1.45 μg/dL and 1.53 μg/dL, respectively. A total of 1.86% and 0.18% of the mothers were screened positive for depression and anxiety. Adjusting for related confounders, the prenatal combined exposure in early pregnancy was associated with more deficits in infant communication skills and social-emotional skills, especially in social-emotional at 24-month-old (P=0.016); the prenatal combined exposure around birth was adversely associated with infant neurodevelopment levels in multiple domains.

CONCLUSIONS: The prenatal combined exposure to lead and stress may affect offspring neurodevelopment more profoundly (especially on social-emotional development), and the combined exposure in early pregnancy may induce more deficits in offspring social-emotional development than the combined exposure around birth.

KEYWORDS: Lead exposure; Maternal stress; Pregnancy; Prenatal exposure; Cognitive development; Birth cohort;

P-0412 Early life organophosphate ester exposures and bone health at age 12 years: The Health Outcomes and Measures of the Environment (HOME) Study

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BACKGROUND AND AIM: No human studies have evaluated early life organophosphate ester (OPE) exposures with bone health outcomes, despite evidence of osteotoxicity. We assessed associations of urinary OPE metabolites measured across early life with bone mineral content (BMC) and areal bone mineral density (aBMD) at age 12 years.

METHODS: Among 223 mother-child dyads enrolled in the Health Outcomes and Measures of the Environment (HOME) Study, we quantified concentrations of bis-2-chloroethyl phosphate (BCEP), bis-(1,3-dichloro-2-propyl) (BDCIPP), di-n-butyl phosphate (DnBP), and diphenyl phosphate (DPHP) in urine collected from mothers during pregnancy and children at ages 1, 2, 3, 5, and 8 years. at age 12 years, we performed dual energy x-ray absorptiometry and calculated BMC and aBMD z-scores at six skeletal sites. Using a multiple informants framework, we estimated overall and sex-stratified BMC/BMD z-score differences per interquartile range (IQR) increase in OPE concentrations at multiple exposure timepoints: gestation (average) and 1–3 (average), 5, and 8 years.

RESULTS: In adjusted models, overall associations of BCEP and BDCIPP with total hip and 1/3rd distal radius aBMD varied significantly by exposure timepoint, as did BDCIPP with whole body aBMD. for example, differences (95% CI) in total hip aBMD z-score per IQR increase in BDCIPP were 0.33 (0.01, 0.65), -0.10 (-0.34, 0.14), -0.17 (-0.40, 0.05), and 0.14 (-0.09, 0.38) for concentrations during gestation and at 1–3, 5, and 8 years, respectively. Overall DnBP and DPHP associations were generally null at all timepoints. We observed sex-specific associations for some timepoints and skeletal sites. for example, an IQR increase in 8-year DPHP was associated with a 0.24 (0.08, 0.39) greater total hip aBMD z-score among females and a -0.15 (-0.39, 0.08) lower z-score among males.

CONCLUSIONS: Early life OPE exposures may be associated with sex- and exposure period-dependent alterations in early adolescent bone mineral accrual and strength.

P-0422 Prenatal exposure to emissions from a coalmine fire and childhood lung function

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BACKGROUND AND AIM: Studies linking early life exposure to air pollution and impaired lung health have focused on chronic, low-level exposure in urban settings. We have previously shown that early post-natal exposure to an acute, high-intensity air pollution episode was associated with mild impairments in peripheral lung mechanics. We aimed to determine whether in utero exposure to the same pollution event impaired lung function 7-years later.

METHODS: We conducted a prospective study in a cohort of children who lived in the vicinity of a coalmine fire that burned for 6 weeks in 2014. Individual exposure to $PM_{2.5}$ from the fire were estimated using dispersion and chemical transport modelling. Respiratory function was measured in children who were in utero during the fire, or conceived after the fire (unexposed), using the forced oscillation technique. Z-scores for resistance at 5Hz(R5), reactance at 5Hz(X5) and area under the reactance curve(AX) were calculated. Regression models were fitted to compare Z-scores of unexposed and in utero exposed children, and to examine the relationship between in utero $PM_{2.5}$ exposure and lung function.

RESULTS: of the 72 children, 22 who were unexposed and 50 exposed in utero, and had acceptable lung function measurements. Medians (interquartile ranges) for daily average and peak $PM_{2.5}$ for the children exposed in utero were 9.2(7.6–20.2) and 124(74–252) $\mu g/m^3$. There were no statistically significant differences between mean R5, X5 or AX Z-scores of unexposed and in utero exposed children. There were no associations between R5, X5 or AX Z-scores and in utero exposure to daily average or peak $PM_{2.5}$. This lack of association was maintained after inclusion of covariates in the models.

CONCLUSIONS: There was no detectable effect of in utero exposure to $PM_{2.5}$ from a local coalmine fire on post-natal lung function 7-years later.

KEYWORDS: Particulate matter, respiratory function, early life, long-term effects

P-0426 The impact of heat waves on children’s kidney health: Systematic review and meta-analysis

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BACKGROUND: Children are known to be particularly sensitive to heat waves, but still there has been little research interest in this area . In particular, a systematic review and meta-analysis is needed to identify the relationship between climate change-related heatwaves and children's kidney health.
METHOD: Papers published between 2000 and 2022 was identified using keywords in PubMed. 320 of 2406 publications searched for "climate change", "heat wave", "children", "kidney" met the selection criteria.
RESULT: In our study we included kidney stones and urolithiasis as kidney disease. This study lists the consistent definitions of heatwaves in each literature from the perspective of children's health impact. Our study explores detailed outcome measures to quantify the effects of heatwaves on children's kidney health, and analyzes the literature to evaluate the effects of heatwaves

CONCLUSIONS: Through this study, the effect of heat wave on children's kidney health, with regards to age, gender and income, and vulnerability to heat wave between countries can be understood. In addition, it will be helpful in predicting the burden of children's kidney disease due to heat wave with respect to climate change, and developing effective heat wave damage mitigation and adaptation strategies.

P-0427 Comparative Analysis of Health Patterns and Gaps due to Environmental Influences in South Korea and North Korea, 2000-2017

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BACKGROUND AND AIM: Children's metabolism is immature and vulnerable to environmental stressors creating a larger burden of diseases. South Korea and North Korea have been isolated from each other and while sharing the same ethnicity and early history, this provides a rich ground for comparative research. The study aims to conduct a comparative study of children's health in South Korea versus North Korea with a focus on air pollution.

METHODS: The study used mortality rate, prevalence, and environmental indicators data from 2000 to 2017 from the World Bank and World Health Organizations. Comparative analysis and trend analysis of the two Koreas were conducted to evaluate changes in health status over time. Spearman's correlation analysis was used to find out the correlation between environmental indicators and children's health status.

RESULTS: The study found a distinct gap in children's health status. While North Korea reported a higher death rate of children than South Korea, it showed a decreasing trend and the gap in children's health status between them narrowed from 2000 to 2017. The prevalence of overweight and obesity increased and that of thinness decreased in both Koreas. Except for PM2.5 exposure, South Korea reported much higher figures in most indicators of air pollutant emissions (South Korea, mean (SD) = 28.3 (2.0); North Korea, mean (SD) = 36.5 (2.8), p-value=0.002).

CONCLUSIONS: The study empirically discovered the gaps and patterns of children's health between South Korea and North Korea. The findings imply epigenetic modification caused by environmental stressors affects children's health in the two Koreas despite sharing similar genetic characteristics. Considering the gaps in children's health between them, more attention and resources need to be directed towards North Korea because the necessary commodities and services to improve children's health are lacking in North Korea.

KEYWORDS: Children's Environmental Health, Child Health, Public Health, Environment

P-0428 Indoor coal ash and school and social competency among children aged 6-14 years old

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BACKGROUND AND AIM: Coal ash, a waste product generated when burning coal for energy, is comprised of small particles with neurotoxic heavy metal(loid)s found to be risk factors for learning and social problems in school. The purpose of this novel study was to assess the association of coal ash in children's homes with school and social competency.

METHODS: We recruited children aged 6-14 years old from communities located within 10 miles of two coal-burning power plants. In homes of the participants, coal ash was collected on polycarbonate filters using personal modular impactors. We measured school competency and social competency using the validated Child Behavioral Checklist. Using Tobit and linear regression we investigated the relationship of indoor coal ash with school and social competency.

RESULTS: Forty-three percent of children in the study had coal ash in their homes. In Tobit models that were adjusted for age, sex, self-reported race, mother's education, and traffic exposure, children with coal ash in their homes scored on average 2.5 (-4.9 to -0.1) points lower on the school competency scale than peers without ash in their homes (p=0.04). We did not observe that coal ash in homes was related with lower social competency.

CONCLUSIONS: Children with coal ash in their homes had poorer performance in the school setting, compared to peers without coal ash in homes. Coal ash consists of small particles, that contains neurotoxins and may be a contributing factor to poor school performance, which potentially impairs children's academic achievement. There are limited regulations on the storage of coal ash and this study provides impetus for more research.

KEYWORDS: coal ash, fly ash, school competency, social competency, school performance, environmental exposure

P-0441 Early life exposure to coal smoke and hospital visitation: findings from a data linkage cohort study

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BACKGROUND AND AIM: The extent to which air pollution exposure in early life could engender modifications of immune responses with long-term health consequences is still largely unknown. The aim of this study was to analyse emergency department (ED) visits and hospitalisations following prenatal and postnatal exposure to severe smoke from the Hazelwood coal mine fire (9 Feb-25 Mar 2014).

METHODS: The Victorian Emergency Minimum Dataset and the Victorian Admitted Episodes Dataset were linked to the Victorian Perinatal Data Collection to obtain ED visits and hospitalisations of children born in the Latrobe Valley, Australia from March 2012 to December 2015. Exposure to fire-related PM2.5 was assigned from gridded modelled estimates based on residential address at birth. Children exposed in utero and in infancy (<1 year old) were investigated separately. Associations between exposure to fire-related PM2.5 and ED presentations and hospitalisations for any cause, respiratory outcomes, respiratory-related infections, any infections, and allergies/skin rash in the first year of life (in utero) or in the year following the end of the fire (infant) were estimated with logistic regression models. Adjustment for potential confounders was performed through multiple regression in the dose-response analysis, and with propensity score weighting when comparing exposure groups.

RESULTS: A dose-response relationship was found between prenatal exposure to PM2.5 and ED presentations for allergies/skin rash (OR=1.14, 95%CI=1.01-1.27 per 100µg/m³) in the first year of life. A cumulative exposure >25 µg/m³ in infancy was associated with higher risks of presenting to the ED for respiratory causes (OR=1.39; 95%CI=1.06-1.81), respiratory-related infections (OR=1.41, 95%CI=1.07-1.86), and any infections (OR=1.21, 95%CI=0.98-1.49) in the year following the fire.

CONCLUSIONS: Exposure to large concentrations of smoke in early life could be associated with allergic and infectious conditions up to one year after return to normal levels of ambient air pollution.

KEYWORDS: Particulate matter; Long-term exposure; Infections; Allergies;

P-0442 Prenatal and early postnatal exposure to air pollution associations with primary care and prescription usage

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BACKGROUND AND AIM: Health consequences of air pollution in early life have been mostly studied in hospital settings, with less focus put on primary care and prescribed medications. The aim of this study was to investigate general practitioner (GP) consultations and prescriptions dispensed following exposure in utero and in the first year of life to the Hazelwood coal mine fire, a severe air pollution episode lasting six weeks.

METHODS: The Victorian Perinatal Data Collection was linked to the Medicare Benefits Schedule and the Pharmaceutical Benefits Scheme for a cohort of children born in the Latrobe Valley, Australia between March 2012 and December 2015. Modelled estimates of fire-related PM2.5 exposure were assigned at the residential address at birth. The total numbers of GP visits and of prescriptions of antibiotics, asthma inhalers and steroid skin creams dispensed in the first year of life or in the year following the fire were extracted for children exposed in utero and in infancy (<1 year old), respectively. Negative binomial regression models estimated associations between each outcome and exposure to fire-related PM2.5, with adjustment made for potential confounders.

RESULTS: Higher levels of PM2.5 in utero were associated with increased asthma inhalers dispensed (IRR=1.07, 95%CI=1.00-1.14 per 100µg/m³ of cumulative PM2.5; IRR=1.27, 95%CI=1.01-1.58 per 50µg/m3 of peak 24-h PM2.5) in infancy. Surprisingly, a cumulative exposure >25 µg/m³ in infancy was linked to fewer GP visits (IRR=0.83, 95%CI=0.68-0.99) in the year following the fire.

CONCLUSIONS: Our findings indicate that prenatal exposure to time-limited severe air pollution could be linked with increased need of asthma medications in infancy. They also suggest that such exposure in infancy could be associated with less GP consultations following extreme events, which could be due to increased needs of specialised and hospital care.

KEYWORDS: Particulate matter; Long-term exposure; Infections; Asthma;

P-0443 Associations of Prenatal First-Trimester Metal Mixtures and Childhood Adipokines in the Project Viva Cohort

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BACKGROUND AND AIM: The adipokines leptin and adiponectin, mainly produced in adipose tissue, are involved in energy homeostasis and insulin sensitivity. Lower adiponectin and higher leptin correlate with older childhood and adult adiposity, while the relationship in young children is less clear. Higher prenatal heavy metals and lower nonessential metals have been associated with childhood adiposity, but it is unclear if prenatal metals influence childhood adipokines.

METHODS: Six nonessential (As, Ba, Cd, Cs, Hg, Pb) and four essential (Mg, Mn, Se, Zn) metals were measured in first trimester red blood cells from pregnant participants in the Boston MA-area Project Viva cohort. Blood leptin and adiponectin were measured in early-childhood (N=527-526; mean 3.3 (SD 0.3) years), mid-childhood (N=426; 8.0 (0.8) years), and early-adolescence (N=477; 13.1 (0.9) years). Linear regression and quantile g-computation models estimated associations between individual and mixtures of metals and adipokines, adjusting for confounders.

RESULTS: Mean (SD) leptin was 1.9 (1.9) ng/ml in early-childhood, 5.6 (6.8) ng/ml in mid-childhood and 11.9 (14.7) ng/ml in early-adolescence. Mean (SD) adiponectin was 22.4 (5.5) µg/ml in early-childhood, 15.7 (8.5) µg/ml in mid-childhood and 6.4 (2.8) µg/ml in early-adolescence. A doubling in arsenic was associated with lower adiponectin at the early-childhood visit (β=-0.40 µg/ml, 95% CI: -0.73, -0.07), while cesium was associated with higher leptin at the early-adolescence visit (β=2.76 ng/mL, 95% CI: 0.22, 5.30). In mixture analyses, adjusting for metals not in the mixture, a quartile increase in nonessential metal mixture was associated with lower adiponectin (β=-0.18 µg/ml, 95% CI: -0.33, -0.03) at the mid-childhood visit.

CONCLUSIONS: Our findings suggest that certain prenatal metals are associated with adipokines in childhood, which might influence cardiometabolic risk. Future work will evaluate if adipokines mediate associations of prenatal metals with adiposity and cardiometabolic risk.

KEYWORDS: Heavy metals, Mixtures analysis, Children's environmental health

P-0444 Newborn Metabolomics linking prenatal air pollution exposure and autism spectrum disorder risk in children

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KEYWORDS: Metabolomics, Autism spectrum disorder, air pollution exposure, pregnancy, oxidative stress.

BACKGROUND: Prenatal PM2.5 and near-roadway air pollution (NRAP) exposures, particularly nonfreeway NRAP, have been associated with increased autism spectrum disorder (ASD) risk in children. However, the underlying biological mechanism is unclear.

Aim: To investigate neonatal metabolic pathways altered by prenatal PM2.5 and NRAP exposures that increase ASD risk.

METHOD: Using electronic medical records, 50 ASD cases diagnosed before age 5 and 50 controls matched on birth year, medical center, sex, and race/ethnicity were randomly selected from all children born at Kaiser Permanente Southern California between 2007-2009. Weekly PM2.5 and monthly nonfreeway NRAP exposures during pregnancy were estimated based on residential history using spatiotemporal prediction and California line-source dispersion models, respectively. Untargeted, high-resolution metabolomics was analyzed in archived newborn dry blood spots, resulting in 26,578 HILIC-positive and 27,614 C18-negative metabolomic features.

Conditional logistic regression was used to identify metabolomic features associated with ASD diagnosis. Linear regression was used to investigate associations between prenatal air pollution exposure and metabolomic features. Beyond matching factors, maternal age, education level and household income categories were adjusted in the analyses. Mummichog pathway analysis was performed to identify metabolic pathways associated with prenatal air pollution exposure and ASD.

RESULTS: Dysregulated aspartate and asparagine metabolism was associated with increased ASD risk($p=0.01$) and higher PM2.5 exposure during the 1st trimester and the entire pregnancy($p<0.001$). Glutamate metabolism was associated with PM2.5 during pregnancy($p=0.028$) and increased ASD risk($p=0.03$). Prenatal nonfreeway NRAP was associated with altered nitrogen ($p=0.027$) and sialic acid metabolism($p=0.038$), while nitrogen metabolism was also associated with increased ASD risk($p=0.02$).

CONCLUSIONS: Dysregulated metabolism reflected in aspartate, asparagine and glutamate was associated with both prenatal air pollution exposure, particularly PM2.5, and increased ASD risk, suggesting newborn oxidative stress and inflammation may be pathways of effects of prenatal air pollution exposure.

P-0445 Neonicotinoid, pyrethroid and organophosphate urinary metabolites in relation to neurobehavioral performance in Ecuadorian adolescents

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BACKGROUND AND AIM: Insecticides, including organophosphates and pyrethroids, have been found to affect the neurobehavioral development of children, but limited evidence exists among adolescents. These insecticides have been slowly replaced by neonicotinoids, but there is little epidemiological data regarding their effects on neurobehavior. We examined the associations between urinary insecticide concentrations and neurobehavioral performance amongst adolescents living in agricultural communities in Ecuador.

METHODS: This study included 522 participants aged 11-17 years who were examined in 2016. Urinary insecticide metabolites were measured using mass-spectrometry and neurobehavior was assessed using the NEPSY-II (domains: Attention/Inhibitory Control, Language, Memory/Learning, Visuospatial Processing, Social Perception). Associations were adjusted for creatinine and demographic, anthropometric, and socioeconomic characteristics. Multiple imputation was used for values below the level of detection.

RESULTS: The mean(SD) neurobehavior scores ranged from 7.03(2.04) to 8.69(2.28). Among organophosphate metabolites, 3,5,6-Trichloro-2-pyridinol (TCPy) was inversely associated with Language (score difference per 50% increase in metabolite concentration [β] = -0.11 [95%CI: -0.50, -0.02]) and para-Nitrophenol (PNP) was inversely associated with Social Perception (β = -0.26 [95%CI: -1.07, -0.20]). There was also evidence of a threshold: TCPy and PNP had significant inverse associations with Attention/Inhibitory Control only at concentrations above the 60th percentile (β = -0.22 [95%CI: -0.43, -0.00] and β = -0.29 [95%CI: -0.54, -0.04], respectively). The pyrethroid, 3-phenoxybenzoic acid (3-PBA), was inversely associated with Language (β = -0.11 [95%CI: -0.48, -0.05]) and had a negative quadratic association with Attention/Inhibitory Control ($p<0.01$). The neonicotinoid, 5-Hydroxy imidacloprid (OHIM), was positively associated with Memory/Learning (β = 0.21 [95%CI: 0.12, 0.93]). These associations did not differ by gender.

CONCLUSIONS: Organophosphate and pyrethroid metabolites were associated with lower performance on Language, Social Perception and Attention/Inhibitory Control, while neonicotinoids were associated with better Memory/Learning scores. These findings highlight the importance of limiting environmental insecticide exposures during developmental years.

KEYWORDS: Insecticides, adolescents, neurobehavior, pesticides

P-0448 Urinary metabolites of volatile organic compounds and polycyclic aromatic hydrocarbons increases the risk of nonalcoholic fatty liver disease in Korean adolescents: A Korean National Environmental Health Survey (KoNEHS) 2015-2017 analysis

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Non-alcoholic fatty liver disease (NAFLD) is one of the most common liver diseases in adolescents and is an urgent public health issue. Several animal studies have suggested that volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) led to NAFLD. However, few epidemiological studies have confirmed the associations of VOCs and PAHs with NAFLD in the general adolescent population. Therefore, we analyzed 798 adolescents from the Korean National Environmental Health Survey (KoNEHS) 2015-2017 to examine the associations of urinary metabolites for VOCs and PAHs with serum alanine aminotransferase (ALT) activity and NAFLD prevalence. We employed linear, logistic regression, and Bayesian kernel machine regression (BKMR) to evaluate the association of urinary VOCs and PAHs metabolites with ALT activity and NAFLD. After adjusting for all covariates, urinary benzylmercapturic acid level and 2-hydroxyfluorene level increased serum ALT activity and NAFLD prevalence. Additionally, the BKMR analyses showed a significantly positive overall effect on ALT activity and NAFLD prevalence with urinary concentrations of VOCs and PAHs metabolites, and 2-hydroxyfluorene contributed the most. Our study suggests that exposure to low-level VOCs and PAHs may have a detrimental effect on NAFLD risk in adolescents. Given the increasing prevalence of NAFLD in adolescents, future cohort studies are warranted to understand these chemicals' impact on NAFLD risk.

KEYWORDS: volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), adolescents, Non-alcoholic fatty liver disease, Korean National Environmental Health Survey (KoNEHS)

P-0450 Effect of prenatal PM2.5 and its constituents exposure and fetal growth pattern on children's accelerated growth in the first three years

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BACKGROUND: No study investigated the effect of prenatal exposure to PM2.5 and its constituents on accelerated childhood growth, with consideration of fetal growth pattern in utero. We aimed to examine the effect of prenatal PM2.5 and its constituents exposure, fetal growth pattern on children's accelerated growth in the first three years.

METHODS: The study was embedded in a population-based birth cohort in China, including 5,424 mother-child pairs. Prenatal PM2.5 and its constituents [organic carbon (OC), elemental carbon (EC), sulfate (SO42-), nitrate (NO3-), and ammonium (NH4+)] concentrations were estimated. Estimated fetal weight (EFW) Z-score by fetal ultrasound examination in second and third- trimester was calculated and then K-means algorithm was used to cluster the fetal growth pattern. Children's accelerated growth was defined as the change of BMI Z-score from birth to three years >0.67. Generalized logistic regression was used to analyze the effect of prenatal PM2.5 and its constituents exposure and fetal growth pattern on children's accelerated growth.

RESULTS: Compared with higher fetal growth, children with lower fetal growth had 1.706 (95%CI: 1.520, 1.915) times higher risk of children's accelerated growth from birth to three years old. An IQR increase in PM2.5, OC, NH4+, and SO42- was associated with 1.147 (95%CI:1.012, 1.300), 1.360 (95%CI:1.113, 1.662), 1.127 (95%CI:1.017, 1.248), and 1.257 (95%CI:1.012, 1.561) times higher risk of children's accelerated growth, respectively. Prenatal PM2.5 and its constituents exposure and fetal growth had joint effect on children's accelerated growth from birth to three years old, especially for OC (RERI:0.485, 95%CI: 0.018,0.952).

CONCLUSIONS: The study suggested that prenatal PM2.5 and its constituents exposure and fetal growth in utero had individual and joint effect on children's accelerated growth from birth to three years old.

KEYWORDS: PM2.5, constituents, accelerated childhood growth, fetal growth

P-0456 Systematic review in 2000-2020 on early childhood developmental conditions of environmental noise exposure

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BACKGROUND AND AIM: Early childhood is a crucial stage of human development. Exposure to noise can alter their development and affect their health, reducing their quality of life. Information to facilitate decision making in this regard is still scarce in several countries, so the aim of this study was to characterize the developmental conditions in early childhood that have been related to environmental exposure to noise based on population-based studies.

METHODS: An exhaustive systematic review was carried out using Cochrane methodology during the period 2000-2020. Publications were included without restriction of language, country or publication type, with information on adverse developmental outcomes in early childhood (0-8 years of age) due to prenatal or concurrent exposure to environmental noise.

RESULTS: Thirty-four studies were selected that addressed early childhood with prenatal or postnatal exposure, grouping the effects into three groups: fetal period (malformations and miscarriage), neonatal period (premature birth, low birth weight, small for gestational age and physiological alterations) and childhood (physiological, constitutional, learning and behavioral alterations). Information sources for both, outcome and exposure events varied between direct and indirect measurements. Five articles address biological plausibility mechanisms. In Eight articles, no significant findings are reported, and in no study the impact on the quality of subsequent life stages was investigated.

CONCLUSIONS: Sufficient evidence was found to support the presence of conditions in early childhood due to prenatal and concurrent environmental exposure to environmental noise. The need to generate policies that allow routine monitoring of noise levels and their regulation to mitigate exposure and protect children's health is evident.

KEYWORDS: environmental noise, child development, early childhood, child developmental impairment, noise pollution.

P-0470 Multiple air pollutants and renal health in children and adolescents: An 18-year longitudinal study in Asia

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BACKGROUND AND AIM: Few studies have examined the effects of multi-pollutant air pollution on renal health, especially in children and adolescents. This study investigated the association between long-term ambient air pollution exposure and renal health in Asian children and adolescents.

METHODS: This study included 10,942 children and adolescents aged ≤ 25 years from Taiwan and Hong Kong from 2000 to 2017. PM2.5, NO2 and O3 concentrations were estimated using satellite-based spatiotemporal regression models. Two-year average concentrations, those of the year of visit and the preceding year, were used. Linear mixed models were used to examine the association between air pollution and yearly changes in estimated glomerular filtration rate (eGFR). Cox regression models with time-dependent covariates were used to examine the association between air pollution and the development of chronic kidney disease (CKD). Both single- and multi-pollutant models were used.

RESULTS: for the single-pollutant models, each 10μg/m3 increase in PM2.5 was associated with a 0.45μL/min/1.73 m2 [95% confidence interval (CI): 0.28−0.63] reduction in the yearly increase in eGFR and 53% [hazard ratio (HR): 1.53 (95%CI: 1.07–2.2)] greater risk of CKD. Each 10μg/m3 increase in NO2 was associated with a 7% [HR (95%CI): 1.07 (1.00–1.15)] higher risk of CKD, while an equivalent increase in O3 was associated with a 19% [HR (95%CI): 0.81 (0.67–0.98)] lower risk of CKD. for multi-pollutant models, the air pollution–CKD associations were slightly attenuated.

CONCLUSIONS: Long-term exposure to ambient PM2.5 and NO2 was associated with a slower growth of eGFR and a higher risk of CKD in children and adolescents. Our findings suggest that air pollution control in early life is imperative to improve lifelong renal health and alleviate the CKD burden.

P-0471 Prenatal air pollution exposure and infant weight trajectories from 3rd trimester to 2 years of age

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BACKGROUND AND AIM: Prenatal exposure to air pollution is increasingly viewed as harmful to fetal development and leads to childhood obesity. However, few studies have evaluated in utero growth measures and postnatal weight trajectories along a continuum in statistical models. This study aims to evaluate associations between prenatal air pollution and weight trajectories from the 3rd trimester through 2 years of life among infants in the Maternal and Development Risks from Environmental and Social Stressors (MADRES) pregnancy cohort, which comprises a low-income, primarily Hispanic population in Los Angeles, California.

METHODS: Fetal weights during the 3rd trimester were abstracted from maternal ultrasound records. Infant weight measures were abstracted from medical records and measured by staff at study visits. Ambient particulate matter ≤2.5 µm and ≤10 µm in diameter (PM2.5 and PM10) concentrations were assigned using spatial interpolation from the regulatory air monitoring stations. Piecewise linear spline models were used to assess non-linear associations between prenatal air pollution exposure and infant weight trajectories.

RESULTS: Weight increased most rapidly from 3 months prior to birth through 3 months of age, slowing thereafter. Pregnancy-averaged PM2.5 and PM10 were associated with a slower rate of growth from the 3rd trimester until age 2 years. A one IQR increase in PM2.5 (1.65 ug/m3) and PM10 (7.48 ug/m3) exposure were associated with a 0.28 kg and 0.38 kg lower weight at 2 years of age, respectively. In sex-stratified models, the effects of PM2.5 and PM10 were only significant in females.

CONCLUSIONS: Our findings suggest that prenatal exposure to PM2.5 and PM10 could impact infant weight gain trajectories and thus, impact childhood obesity, with potentially more pronounced impacts among females.

KEYWORDS: prenatal air pollution, growth trajectory

P-0480 The Season of Conception and Cerebral Palsy Risk in California

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BACKGROUND AND AIM: Cerebral palsy (CP) is the most prevalent, severe, costly neuro-motor disability in children, and it is permanent. The majority of CP cases have an unknown etiology. This is the first study to investigate whether season of conception is associated with CP in California.

METHODS: We analyzed a California birth cohort of 5,089,216 children born in 2005-2015. A total of 5,508 children diagnosed with CP were identified by linking their California birth records with the diagnostic records from the California Department of Developmental Services. We used multivariate logistic regression analyses to estimate the odds ratio (OR) and 95% confidence interval (CI) for CP according to the month and season of conception, controlling for maternal characteristics (age, race/ethnicity, education), child's sex, and the year of conception. Month of conception was estimated from the child's date of birth and length of gestation and was grouped into seasons (winter: Jan-March, spring: April-June, summer: July-Sept, fall: Oct-Dec). We performed stratified analyses by child's sex (females, males), disease subtypes (spastic, ataxic, hypotonic, other), limb involvement (unilateral, bilateral), and geographical locations of birth (Northern, Central, Southern) in California.

RESULTS: Having been conceived in winter and spring was associated with 9% higher odds of having CP (OR=1.09, 95% CI winter: 1.01-1.18, spring: 1.01-1.17) compared to summer conceptions. When considering months, consistent increases of CP with >10% higher odds were observed for each month from January to June compared to September, except for March. We observed no apparent differences in the stratified analyses.

CONCLUSIONS: This is the first study to show winter and spring conceptions to be associated with higher CP occurrence in the offspring. Environmental factors and/or infections that predominate in winter/spring in California may underly this increased CP risk and need to be further explored.

KEYWORDS: Cerebral Palsy, Seasonal Variation, Environment, Neurodevelopment, Birth cohort

P-0482 Congenital malformations of the male genital system and risk of attention deficit hyperactivity disorder

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BACKGROUND: Accumulating evidence suggests that gestational exposure to environmental anti-androgenic endocrine disrupting chemicals has important neurodevelopmental effects. Specifically, androgens have extensive influence on brain development in regions that are relevant for attention deficient hyperactivity disorder (ADHD), yet their specific involvement in the etiology of this common disorder remains unclear. Hypospadias (abnormal positioning of the urethral opening) and cryptorchidism (undescended testes) are two common male birth defects that are strongly associated with deficiencies in prenatal androgen exposure. Thus, having cryptorchidism or hypospadias is a proxy indicator of atypical gestational androgen exposure, yet the association between these disorders and ADHD has not been extensively studied.

METHODS: We analyzed singleton live births (boys=203,728; girls=199,065) born in 1999-2012 in a large Israeli healthcare organization. Boys with cryptorchidism (n=3,945) or hypospadias (n=2,860) were identified via a validated algorithm based on diagnosis and medical procedure records. ADHD cases (n=59,272) were identified through diagnosis records and verified through review of medication dispensing data. Analyses were conducted using Cox proportional hazard models with robust standard error to account for family clusters.

RESULTS: In multivariable-adjusted analyses, the hazard ratio (HR) for ADHD among boys with cryptorchidism was 1.10 (95% CI:1.02-1.18) and among boys with hypospadias was 1.16 (95% CI:1.07-1.25) compared with boys without these conditions. ADHD hazard was also higher among reproductive condition-free brothers of cryptorchidism cases (aHR=1.15, 95% CI:1.06-1.25) and sisters of hypospadias cases (aHR=1.14, 95% CI:0.99-1.30).

CONCLUSIONS: Boys with cryptorchidism or hypospadias had an elevated ADHD hazard compared with boys without these conditions. Results among unaffected siblings suggest that these associations were potentially partly driven by parental or environmental factors present outside of the pregnancy period. Understanding the links between these congenital malformations, androgen homeostasis, and ADHD could shed light on the etiology of the disorder and allow for early detection and intervention.

P-0490 Early-life exposure to phthalates among infants in Italy: characterization and time trends

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BACKGROUND AND AIM: Human exposure to phthalates, endocrine disruptors, and reproductive toxicants,is ubiquitous. Urine is the matrix of choice for biomonitoring and in utero exposure is well documented. Evidence of early life exposure to phthalates is scarce.
The aim of this study is to assess phthalate exposure and its changes over time in a cohort of healthy infants in the province of Modena, Italy.

METHODS: In this prospective birth-cohort study, we assessed phthalate exposure(8 metabolites of 6 phthalates)in urine samples collected from mothers just after delivery and in infants at birth, 3 and 6 months using phthalate-free bags. Mother-infant pairs were enrolled in a university hospital in Modena(Italy)between January 2019 and May 2020. After solid-phase extraction, samples were analyzed by triple Quad LC/MS Mass Spectrometry.

RESULTS: 188 mother-infant pairs were enrolled. MEP was always detectable and showed the highest levels, increasing over time. MMP and DEHP metabolites showed as well an increasing trend, however, they were detected at lower levels, while MnBP and MBzP showed intermediate concentrations and decreasing trends over time.
Significant associations between mother-infant pairs at birth were found only for a few metabolites(MMP, MEP, and MnBP). Infant levels at 3 and 6 months appeared more related, suggesting a continuative exposure to these chemicals inside the indoor environment.

CONCLUSIONS: Phthalate exposure appears wide and extended over time. Infants were exposed to several phthalates, including those more toxic and strictly regulated in infant toys, personal care products and food contact materials in the European Union. Their unregulated use in other consumers'products, building and decorating materials or home furniture may explain the potential exposure of at-risk groups, such as infants or pregnant women. To effectively protect the most vulnerable subjects, public health preventive and regulatory actions should address this specific issue as well.

KEYWORDS: Phthalates, Biomonitoring, Urine, Newborns, Postnatal Exposure.

P-0491 Prenatal exposure to poly- and perfluoroalkyl substances and serum concentrations of vaccine antibodies in early childhood

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BACKGROUND AND AIM: Prenatal exposure to certain poly- and perfluoroalkyl substances (PFAS) have been associated with a reduced humoral response to tetanus and diphtheria vaccines. Whether this is observed for other childhood immunizations is unknown.

METHODS: In a sample of 120 children in the Healthy Start cohort, we measured semi-quantitative antibody titers to measles, mumps, rubella, and varicella in child serum at 4-6 years old. We employed separate Cox proportional hazards models to estimate associations between maternal serum concentrations of five PFAS and the risk of a non-protective antibody titer, based on time since most recent dose (stratified by number of doses received).

RESULTS: Maternal PFAS concentrations were generally at or below the US median. Most children had protective vaccine titers (rubella 100%, measles 98%, mumps 90%, varicella 80%). Unadjusted associations between individual PFAS and the hazard of non-protective antibody titers had wide confidence intervals including the null [e.g. after two doses, lnPFOA HR, 95% CI: mumps 1.09 (0.21, 5.54); varicella 1.09 (0.33, 3.61): lnPFOS mumps 1.87 (0.22, 16.12); varicella 2.12 (0.55, 8.23): lnPFNA mumps 1.63 (0.21, 12.64); varicella 1.68 (0.36, 7.79): lnPFHxS mumps 6.05 (0.86, 42.75); varicella 1.36 (0.59, 3.13): lnPFDA mumps 1.71 (0.27, 10.84); varicella 2.74 (0.83, 9.07)]. Sensitivity analyses adjusting for the potential confounders of child sex or age at collection did not meaningfully change the effect estimates. We were unable to estimate associations with measles and rubella antibodies due to the small number of children with non-protective titers.

CONCLUSIONS: In this cohort of young children with background levels of PFAS exposure, higher prenatal PFAS concentrations were not significantly associated with greater risk of non-protective mumps and varicella antibody titers. This study demonstrates the utility of time-to-event models for examining associations between environmental chemicals and loss of disease protection.

KEYWORDS: Per- and polyfluoroalkyl substances, vaccines, childhood, immune

P-0495 Air Pollution Exposures and Executive Function in Middle Childhood: A U.S. Multi-Cohort Study

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BACKGROUND AND AIM: Prior studies examining the association between spatiotemporally resolved air pollution and child executive function (working memory, inhibitory control, and cognitive flexibility) are limited. We aimed to fill this gap using data from the ECHO-PATHWAYS Consortium.

METHODS: We included 1,241 children from three U.S. pregnancy cohorts (CANDLE, TIDES, and GAPPS). Exposure to particulate matter ≤2.5µm in aerodynamic diameter ($PM_{2.5}$), nitrogen dioxide (NO_2), and ozone (O_3) at age 0-4 were derived from spatiotemporal models. at age 8-9, child working memory and inhibitory control were assessed using the Digit Span subtest from the Wechsler Intelligence Scale for Children, 5th Edition and the NIH Toolbox Flanker Inhibitory Control and Attention test, respectively. Cognitive flexibility was quantified by percent accuracy and mean latency of the Hearts and Flowers Task mixed block condition. We fitted linear regression models adjusted for sociodemographic, behavioral, and maternal psychological factors, and examined potential modification by child sex, maternal education, and neighborhood education quality.

RESULTS: Mean $PM_{2.5}$, NO_2, and O_3 were 8.9 (SD:1.7) µg/m³, 9.2 (SD:2.8) ppb, and 25.7 (SD:2.8) ppb, respectively. Overall, each 2-ppb increase of NO_2 was associated with a 1.1% lower percent accuracy in cognitive flexibility (95%CI: -1.8%, -0.3%), whereas other associations were all null. We found sex-specific inverse associations of NO_2 with working memory (Pinteraction: 0.019) and cognitive flexibility (Pinteraction: 0.017), and between $PM_{2.5}$ and inhibitory control (Pinteraction: 0.022), only in boys. The positive association between $PM_{2.5}$ and mean latency was stronger in children whose mothers completed high school or less (Pinteraction: 0.045). The protective association between $PM_{2.5}$ and cognitive flexibility was shown exclusively in children residing in neighborhoods with better education quality (Pinteraction: 0.004).

CONCLUSIONS: Our study contributes to a nascent literature on common air pollution exposures, notably NO_2, and child executive function.

KEYWORDS: Air pollution exposures, executive functions, child health

P-0499 Residential green space as a positive influencer on early childhood bone mineral density

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BACKGROUND AND AIM The most crucial contribution to lifelong bone health is attained during the first decades of life by achieving the highest possible peak bone mass. Besides a solid genetic impact, this process is sensitive to environmental and behavioral influences. We explored whether exposure to the surrounding residential green space is related to a change in bone density in young children.

METHODS Within the ongoing Belgian ENVIRONAGE (Environmental influence on Ageing in Early Life) birth cohort, we followed up 471 children aged 4-to-6-years and assessed their radial bone mineral density with ultrasonic speed of sound measurements. Green spaces surrounding their residence were calculated based on high-resolution land cover data within multiple radii (50m to 3000m). Multivariable linear regression modelling was used to explore the association between green space exposure and children's bone density adjusted for relevant confounders.

RESULTS Children's radial bone mineral density was on average (SD) 3682 (112.4) m/sec, and the mean total green space for a 50 to 3000m radius around the residence ranged from 46.20% to 60.02%, respectively. An interquartile range (IQR) increment in high growing (>3m) and total (sum of <3m and >3m) residential green space in a 500m radius was associated with a corresponding increase of 19 m/sec (95% C.I.: 4.3 – 33.0 m/sec) and 17 m/sec (95% C.I.: 3.0 – 31.9 m/sec) in bone density. Moreover, significant results were noted within extended radii with long-term exposure to the surrounding green space, viewed in a subgroup of children who did not relocate between birth and follow-up phase.

CONCLUSIONS We found a positive association between children's bone mineral density and the surrounding residential green space exposure. These results contribute to unravelling factors increasing peak bone mass in early life and improving lifelong bone health.

KEYWORDS: Green Space, Bone Mineral Density, Bone Health, Childhood

P-0502 Study on the concentration of polybrominated diphenyl ethers in serum of teenagers in Zibo, China

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BACKGROUND: Polybrominated diphenyl ethers (PBDEs) can lead to thyroid dysfunction. Teenagers are in a critical period of growth and development. So we should pay more attention to the concentration of PBDEs in the serum of teenagers.
AIM: This study is to evaluate the distribution and concentration of PBDEs in the serum of teenagers and to gain a preliminary understanding of the exposure of PBDEs in teenagers.

METHODS: The 255 serum samples of teenagers (age=15 years) were collected from Zibo in 2018. The 14 PBDEs (including BDE17, 28, 47, 66, 71, 85, 99, 100, 138, 153, 154, 183,190,209) were analyzed with high resolution gas chromatography-high resolution mass spectrometry (HRGC-HRMS) based on CDC method.

RESULTS: The results showed that the PBDEs concentrations were higher in males than in females. The mass concentration of PBDEs in serum was in the range of 2.4-123.9 ng/g lipid, the median concentration of ∑PBDEs was 12.4 ng/g lipid and the geometric mean concentration was 19.2 ng/g lipid. BDE-47 was detected in the serum samples with a relatively high detection frequency, followed by BDE-28 and BDE-99. Although the BDE-209 detection rate was relatively low but contribute the most abundant to the total concentration of PBDEs. There is a correlation between ∑PBDEs and each component, as well as between the components of PBDEs. BDE-28 was correlated to BDE-99 (r=0.558), BDE-47 was correlated to BDE-99 (r=0.599), and BDE-28 was correlated to BDE-47 (r=0.477). ∑PBDEs was correlated to BDE-28, BDE-47, and BDE-99 (r=0.471, 0.423, and 0.484), respectively.

CONCLUSIONS: Compared with other studies, the serum ∑PBDEs levels were close to the level in South China, lower than in America, slightly higher than in Japan and Switzerland. The results imply that there had some PBDEs exposure to teenagers in this region.

KEYWORDS: polybrominated diphenyl ethers, serum, teenagers

P-0504 Launching of CHildren's Environmental health Clinic in Korea (CHECK) and Institute of Ewha-Seoul Clinical Laboratories for Environmental Health (IESEH): The first clinic to research model of pediatric environmental health in South Korea

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BACKGROUND: In recent years, environmental hazards affecting children's health have been a public health concern. Since the 1990s, the Pediatric Environmental Health Specialty Units (PEHSUs) in the USA have provided rigorous research, clinical care, and public health interventions; nevertheless, this systematic network is scarce globally, especially in Asia. Thus, we established South Korea's first integrated "clinic to research" network for protecting children's health.

METHOD

The first children's health and environmental clinic in South Korea, CHildren's Environmental health Clinic in Korea (CHECK), was established. CHECK aims to develop 1) a pediatric-environmental medical examination system with a biobank, 2) a consultation system by specialized pediatricians, 3) medical guidelines for pediatric-environmental diseases, and 4) clinic operation models in this field. Subsequently, we founded the Institute of Ewha-Seoul Clinical Laboratories for Environmental Health (IESEH) to perform multidisciplinary pediatric-environmental research in collaboration with CHECK and medical departments, including Pediatrics, Internal Medicine, Obstetrics and Gynecology, and Environmental Medicine.

RESULTS: CHECK promotes pediatric patients' health by providing medical examinations, laboratory tests (including heavy metals, volatile organic compounds, and endocrine-disrupting chemicals), and specialized counseling and education for patients and parents concerned about environmental risks. IESEH will build a big-data resource by integrating data systematically collected from CHECK, Korea's national health insurance, and the Korean CHildren's ENvironmental health Study (Ko-CHENS)—a nationwide birth cohort. Through this, IESEH undertakes divergent pediatric-environmental studies ranging from data science-based epidemiology to genetics and validation studies for clinical intervention.

CONCLUSION: CHECK is the first pediatric environmental health clinic in Korea. IESEH performs research on pediatric-environmental health in collaboration with multidisciplinary experts, utilizing integrative data from CHECK and national cohorts. CHECK and IESEH will provide a gold standard for pediatric environmental health clinics and laboratories as a standardized and specialized "clinic to research" model.

KEYWORDS: CHECK; IESEH; children; environmental health; clinic to research model.

P-0505 A joint analysis of school neighbourhoods' exposure to urban environment factors in Greater London

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BACKGROUND AND AIM: Schools and their immediate neighbourhoods are places where children spend the most time outside their homes. Depending on the school location, there are variations in exposure to multiple urban environment features that can create and widen health inequality among children. Our aim was to identify and characterize clusters of schools with similar exposure profiles within 400 m (5-10 minutes walking distance) of schools in Greater London. We then explored association between clusters characteristics, ethnicity, and socioeconomic status.

METHODS: We modelled joint exposure to air pollution (NO2 and PM2.5), access to public greenspace, food environment, and road safety for 2,929 schools, employing a Bayesian non-parametric approach based on the Dirichlet Process Mixture (DPM) modelling. We identified clusters with similar exposure profiles, computed the summary statistics for each cluster, and uncovered urban features that were dominant contributory factor to each cluster.

RESULTS: We identified 12 clusters of schools with similar exposure profiles and were able to make probabilistic statements on the magnitude of exposures. We found that schools with relatively high exposures to harmful factors and a low exposure to beneficial factors (greenspace) were located in the most deprived areas.

CONCLUSIONS: Schools have a crucial role in providing equitable and healthy environment for children. We provided a tool to help schools, public health officials, and policy-makers to understand schools joint exposure to specific urban environment features. Our study highlighted the presence of distinct subgroups of schools with respect to exposure. This helps prioritize interventions and design local policies, with the aim of targeting the schools most in need.

KEYWORDS: Air quality; greenspace; food environment; pedestrian child crash; school exposure; Bayesian nonparametrics

P-0506 The association between per-/polyfluoroalkyl substances in serum of teenagers and thyroid function parameters near a Chinese fluorochemical industrial plant: A cross-sectional study

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As the global pollutant, per-/polyfluoroalkyl substances (PFASs) are widely detected in population, inducing some adverse health effects, such as endocrine disruption. However, there are few studies on the exposure characteristics and health effects of PFASs on population with relatively high internal exposure of PFASs. In the current study, 906 teenagers (11-15 years old) living near an industrial plant were included, the concentrations of 18 PFASs had been determined, and the association between PFAS concentrations and thyroid function was explored. PFOA was found to be the predominant PFAS with a median concentration of 138 ng/mL, followed by PFOS (2.08 ng/mL), PFBA (1.12 ng/mL) and 6:2 Cl-PFESA (1.08 ng/mL). for the thyroid function parameters of participants, the abnormal rates of FT3 (29.7%) and FT4 (19.7%) were relatively high, but those of TSH (2.2%), TPO-Ab (2.1%) and TG-Ab (3.3%) were relatively low. Furthermore, logistic regression analysis showed that abnormal FT4 was significantly correlated with higher concentrations of PFOA. Results of multiple linear regression analysis showed that levels of FT4 were significantly and negatively correlated with concentrations of PFOA and PFHpA, and positively correlated with concentrations of PFHxA ($p < 0.05$) by adjusting gender, age, BMI, outdoor activity time and average sleep time. and there was a significantly positive correlation between FT3 levels and concentrations of PFHxA and PFHxS. for TSH, the levels of which were significantly and negatively correlated with PFOA concentrations, but positively correlated with PFHxS concentrations. In conclusion, PFOA may be the risk factor for decreased FT4 for the participants, but the evidence is not enough to demonstrate that other PFASs are the risk factor of thyroid function, local government should pay more attention to the above findings and take measures to reduce the PFASs external exposure of local residents. The present study is of great significance for the epidemiological findings.

P-0509 Clusters of small-scale sources of air carcinogens emissions increase the risks of acute lymphoblastic leukemia (ALL) in children and teenagers at a small area level in urban areas

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Vehicle exhaust emissions, small-scale commercial business (gasoline, paints, or pigments distributers), manufacturing of brick kilns, use of wood or coal for cooking, and hazardous waste management (incinerators, crematories), are some contributors to air carcinogens. Air exposure to benzene, polycyclic aromatic hydrocarbons (PAHs), fine respirable matter, and nitrogen dioxide have been associated with an increased risk of acute lymphoblastic leukemia (ALL) in children. The aim of this study was to identify clusters of ALL cases and examine possible relationships between clustered small-scale sources of carcinogens emissions in the metropolitan area of San Luis Potosi, Mexico.

METHODS: Hospital based-cancer registry (2010-2020) of ALL cases < 19 years old were geocoded. An inventory of fixed sources of air carcinogens emissions was created from governmental data sources. Also, information on air pollutants was taken from community air monitoring stations. ALL clusters' cases were identified through the Kernel density scan test. Multivariable spatial modeling assessed the effect of fixed urban sources and air pollutants controlling for socioeconomic status on ALL risk.

RESULTS: We identified five ALL clusters with excess risk (ranging from 1.1 to 2.3). The downtown area, brick kilns neighborhood, high-density vehicle areas, and vicinity to industrial sites. Clustered sources of brick kilns, crematories, incinerators, municipal landfills, and/or wood-coal commercial businesses were located close to ALL cases (less than 500 meters). Fine respirable matter (PM 2.5), nitrogen dioxide and wood use were contributing sources to the incidence of ALL cases.

CONCLUSIONS: Cumulative and aggregate environmental carcinogens from diverse sources increase the risk for ALL for the youth population. The gaps in our knowledge of the environmental ALL causes pose a major challenge for designing prevention strategies. Until now, pollution reduction has received scant attention in programs for cancer control and has been largely absent from prevention guidelines, which have focused almost exclusively on treatment.

P-0511 Prenatal exposure to Nitrogen Oxides and Waist-to-Height Ratio (WHtR) as a cardiovascular risk factor in school-aged children participants of the POSGRAD Cohort

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BACKGROUND AND AIM: Prenatal exposure to NOx may increase the risk of obesity and cardiovascular risk factors in children. This study aims to evaluate the relationship between prenatal exposure to NOx and its effect on the behavior of the WHtR in school-aged children from the ages of 7 to 12 years old and to determine if the prenatal supplementation with docosahexaenoic acid (DHA) influences the outcome.

METHODS: We included 642 mother-child from the POSGRAD cohort. Land use regression models were performed to estimate exposure to NOx (NO, NO2 and NOx) using the results of passive outdoor monitoring from a representative sample of participant households. Child anthropometrics were taken yearly and WHtR was calculated. The association between prenatal exposure to NOx and WHtR was measured through a logistic random-effects model by tertiles of exposure and considering the prenatal supplementation status.

RESULTS: We found a significant difference in the risk of having a WHtR >= 0.5, on the second tertile of exposure for NOx between the supplemented (OR= 0.59, IC 95%: 0.10-3.49, p = 0.56) and placebo (OR=13.74, IC 95%: 1.94-97.24, p=0.01) groups when compared with the lowest tertile; in the third tertile the ORs were bigger for both groups, however, these were not significant.

CONCLUSIONS: Prenatal exposure to NOx can affect the WHtR outcome in children and prenatal supplementation with DHA can decrease this effect. The lack of protection of DHA at higher levels of exposure could suggest a need for higher doses of supplementation.

KEYWORDS: Prenatal, Waist-to-Height Ratio, Nitrogen Oxides, Cardiovascular Risk

P-0514 Nocturnal temperature range and in children asthma exacerbations in Lima, Peru, 2011-2016

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BACKGROUND AND AIM: Asthma is the most common chronic disease in children <5-years-old, especially in LMIC's as Peru. Although the etiology of asthma is not known, environmental factors are considered one of its main triggers. Different studies have determined that temperature is associated with asthma exacerbations, but there is still low evidence about the effect of temperature variability. Thus, the aim of the study was to evaluate the association between nocturnal temperature range (NTR) and asthma in children <5 years-old in Lima, Peru, 2011-2016.

METHODS: Ecological study. Satellite mean (Tprom), minimum (Tmin) and maximum (Tmax) daily temperature and relative humidity (HR) for Lima were obtained from the NASA POWER platform; daily asthma exacerbation counts per district were obtained from Peru´s CDC; and daily district PM2.5 from WRF-Chem model. PM2.5 was grouped in quintiles, and present-day-Tprom in P5 (reference category), P95 and quartiles. NTR was calculated as present-day Tmin minus the previous day Tmax. The association was evaluated with negative binomial regression models clustered by districts, and adjusted for PM2.5, HR, and interaction terms between NTR and present-day-Tprom categories.

RESULTS: Nocturnal Temperature Range acted as a risk factor in the crude model (RR: 1.06, 95%CI 1.05-1.08, p<0.001). While in the adjusted model, there was a strong interaction effect of Tprom over NTR, in which for hotter days, NTR acted as an asthma risk factor in a semi-monotonic manner: RR 1.06 (95%CI 1.01-1.13) in present-day-Tprom Q1, 1.10 (95%CI 1.04-1.16) in Q2, 1.14 (95%CI 1.09-1.19) in Q3, 1.20 (95%CI 1.15-1.26) in Q4, and 1.09 (95%CI 1.01-1.18) in P95.

CONCLUSIONS: NTR acted as a risk factor for asthma exacerbation in children <5 year-old, with increasing risks for hotter days, since it could be related to airway inflammation thus leading to asthma.

KEYWORDS: Asthma, Nocturnal Temperature Range, Peru, Latin America

P-0517 Combined exposures to air toxics in early-life and academic achievement in childhood

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BACKGROUND: Previous research has found associations between exposure to single air pollutants and children's cognitive health but has often lacked the ability to investigate combined impacts of pollutants. Characterizing the effects of combined exposures can provide a more realistic assessment of health effects for burdened communities, as well as identify interactions between pollutants. Identifying interpretable associations and interactions within the context of high-dimensional exposure data presents a computational challenge. Methods from domains such as data science can be incorporated into our analytic toolbox to address this challenge. Results from these data-driven approaches need to produce interpretable results that can be followed by targeted techniques. The objective of this research is to utilize tree-based methods, such as random forest, to develop an analytic pipeline to discover interpretable combinations of air toxics associated with children's academic outcomes.

METHODS: Residence at birth was used to link EPA data on estimated ambient concentrations of 40 air toxics to an administrative data linkage of public health and education registries for approximately 220,000 children born and raised in New York City. The random forest algorithm was applied to a 1/3 subset of the data to generate a collection of regression trees that identify the combinations of air toxics associated with 3rd grade standardized test scores in math and English language arts. Methods to account for confounding and validation of identified combinations were assessed and compared in a second 1/3 subset, with the remaining data held out for final analyses.

RESULTS: Our results suggest that early-life exposure to air toxics is associated with lower test scores but high correlation between pollutants and with social factors remains a challenge for interpretation.

CONCLUSIONS: Enhancements to the analytic pipeline, including incorporation of toxicological knowledge of pollutants, will be discussed.

KEYWORDS: mixtures, interactions, urban health

P-0518 Thyroid Nodules and Cancers in Fukushima: Analysis with Updated UNSCEAR Thyroid Dose Estimates

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BACKGROUND AND AIM: After the Fukushima–Daiichi nuclear power plant (NPP) disaster, thyroid ultrasound examination (TUE) has been performed on subjects who were aged ≤18 years. In the 1st round of TUE (October 2011 to March 2014) and the 2nd round of TUE, 115 and 71 malignancies were detected, respectively. Following to previous study (Hamaoka 2021), I analyzed the same data with updated thyroid absorbed dose estimates (UNSCEAR 2022) that are about 1/8 lower than the previous estimates (UNSCEAR 2013).
DATA AND

METHODS: The relationship between radiation dose and the number of participants with thyroid nodule or malignancy was analyzed using publicly available municipality-level data without regional grouping (N=59). To analyze two-wave screening data, the multi-level random-effect Poisson regression model was applied. Interaction between dose and screening round dummy (0 for first and 1 for second screening) was also introduced to take into account latency.

RESULTS: UNSCEAR(2022) re-estimated thyroid dose to incorporate the latest information on ingestion of contaminated food, the flow of radiation plumes, and other factors. Although magnitudes were reduced, previous and re-estimated thyroid dose have a positive and significant correlation of 0.314. The number of participants with small nodules (≦5.0mm) was regressed on screening round dummy, estimated thyroid dose, and their interaction term. Although thyroid dose was insignificant (β=-0.017, z=-1.463), the interaction term was positive and significant (β= 0.033, z=4.42). Similar results were obtained for larger nodules (≧5.1mm) and malignancy.

CONCLUSIONS: These robust results are consistent with the conjecture: due to latency, the relationship between radiation exposure and impact on the thyroid will be observed in the later screening. Although this was an ecological study, health follow-up for children in Fukushima is urgent. Since the third screening, municipality-level data has been undisclosed because of privacy concerns. Data disclosure is necessary to understand the effect of the Fukushima disaster.

P-0521 Effect modification of greenspace on the associations between environmental exposures and childhood asthma: an intra-city study

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BACKGROUND AND AIM: Greenspace may have a protective effect against the adverse health effects of non-optimal environmental exposures (EEs) such as temperature extremes and air pollution. However, inter-relations between these EEs and asthma haven't been quantified. This study aimed to examine if greenspace modifies the effects of EEs on childhood asthma.

METHODS: We conducted a population-based cross-sectional study among preschool and primary school children from 13 districts of Shanghai in 2019. The International Study of Asthma and Allergies in Childhood questionnaire was adopted to assess the childhood asthma. We collected the data on annually average climate conditions, air pollutants, and greenspace rate at different districts. Bayesian spatial models were used to evaluate the associations between environmental exposures and childhood asthma and the effect modification of greenspace.

RESULTS: There were 16,606 children aged 3-11 years in this study, including 8,709 (52.4%) boys. The prevalence of ever diagnosed asthma was 14.2%. An interquartile range (IQR) increase in mean temperature was associated with increased odds ratio (OR) of asthma (1.14, 95% confidence interval (CI): 1.04, 1.25). Greenspace rate was negatively associated with the OR of childhood asthma (0.244, 95% CI: 0.067, 0.887), and appeared to modify the associations between EEs and childhood asthma to various extents.

CONCLUSIONS: Non-optimal environmental exposures (e.g., temperature and NO2) could be the triggers of childhood asthma, and greenspace seemed to modify the adverse effects of EEs on childhood asthma.

P-0524 Prevalence of asthma and asthma symptoms among rural and urban pre-school children in Mpumalanga Province, South Africa

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BACKGROUND AND AIM: Asthma is the most common chronic illness in South African children and its prevalence is increasing in both urban and rural areas. Little is known about the prevalence of asthma amongst pre-school children living in Mpumalanga province, South Africa, which forms part of the Highveld region, a priority area in terms of air pollution. The area is known for poor air quality and elevated concentrations of criteria pollutants. The aim of the study was to investigate the prevalence of asthma and asthma symptoms among rural and urban pre-school children and the association with environmental risk factors.

METHODS: This analytical cross-sectional study that included 3145 pre-school children from Mpumalanga Province, South Africa. Parents of the children were requested to complete a modified ISAAC questionnaire. We analyzed the influence of potential risk factors on dependent variables using bivariate analysis. Significant risk factors identified in the bivariate analysis were included in a multiple logistic regression to develop a final model.

RESULTS: Self-reported prevalence of asthma was 2.3% (66/2810), with pre-school children in rural areas reporting a higher rate than pre-school children in urban areas (1.3% vs 1%), $\chi 2=10.86$, $P <0.001$). The prevalence of asthma symptoms was 15.1% (467/3084), with rural pre-school children reporting a higher prevalence of symptoms than urban pre-school children (10% vs 5%), $\chi 2 = 24.45$, $P < 0.001$). Risk factors for asthma and asthma symptoms were vigorous physical activity (odds ratio (OR) 2.31, 95% CI 1.14-4.66), home smoking exposure (OR 2.94, 95% CI 1.40-6.19) and male parent smoking (OR 1.46, 95% CI 1.01-2.12).

CONCLUSIONS: Pre-school children in rural areas reported a higher prevalence of asthma compared to pre-school children in urban areas. Risk factors for asthma included physical activity and smoking exposure in the home.

KEYWORDS: asthma, pre-school children, risk factors

P-0533 Early-life exposure to cadmium and onset of puberty in girls: a longitudinal mother-child cohort study in Bangladesh

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BACKGROUND AND AIM: Cadmium is a toxic metal with endocrine disrupting properties, but there are few studies about its impact on puberty onset. We aimed to evaluate if early-life exposure to dietary cadmium is associated with the timing of female puberty.

METHODS: In a mother-child cohort in rural Bangladesh (n=935), we assessed the exposure to cadmium during pregnancy through concentrations in erythrocytes (half-life 3-4 months) and in the daughters at 5y and 10y through concentrations in urine, a marker of long-term exposure. Cadmium was measured with inductively coupled plasma mass spectrometry. Between the ages of 12 and 15 years, the girls were interviewed twice with a 6-month interval about their date of menarche, and they self-assessed their pubertal development according to Tanner stages. Associations with age at menarche were evaluated with Kaplan-Meier analysis and multivariable-adjusted Cox regression, and associations with pubertal stages with ordered logistic regression.

RESULTS: Median age at menarche was 13.0 years. We found no association between maternal exposure to cadmium during pregnancy and the daughters' age at menarche. Median urinary cadmium concentrations at 10y were 0.25 µg/L. Girls belonging to the highest quartile of urinary cadmium at 10y attained menarche 3.8 months later than girls in the lowest quartile. In multivariable-adjusted analysis, the corresponding hazard ratio of reaching menarche comparing girls in the highest and the lowest quartile of urinary cadmium was 0.77 (95% CI 0.60, 0.98). Similar associations were found for urinary cadmium at 5y. Urinary cadmium at 10y was also associated with delayed breast development; the odds ratio of reaching more advanced breast development stages comparing girls in the highest and the lowest quartile of urinary cadmium was 0.63 (0.40; 0.99).

CONCLUSIONS: Elevated childhood exposure to cadmium was associated with a pubertal delay in girls.

KEYWORDS: Cadmium, early-life, female puberty, menarche, longitudinal

P-0534 Nearby wildfire impacts, social vulnerability, and birthweight in a rural population

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BACKGROUND AND AIM
Wildfires are increasing across the world and are associated with adverse impacts on vulnerable populations including pregnant people and young children. Wildfires may exert their harmful effects by elevating air pollutant exposure and may also fuel stress by disrupting daily activities and, if extreme, threatening or forcing evacuation. We aimed to estimate exposure disparities by social vulnerability and quantify the impact of nearby wildfires during pregnancy on birthweight.

METHODS: Our study population included 139,671 maternal-infant dyads from birth certificate records between 2008 and 2019 in Montana, USA. We classified pregnant people as "exposed" if they had an active, large (≥ 1000 acres) fire within 5 kilometers of their home detected by Moderate Resolution Imaging Spectroradiometer (MODIS) sensors. We characterized the population by neighborhood social vulnerability index (SVI), rurality, and race and estimated associations between nearby fires and birthweight in linear regression analyses adjusted for gestational and maternal age, education, race, parity, prenatal visits, and SVI.

RESULTS: Exposure to at least one large wildfire within 5 km of home occurred for 0.5% (n=712) of births in Montana between 2008 and 2019. Mean neighborhood SVI as well as rates of both rural residence and American Indian/Alaska Native maternal race were all significantly greater in "exposed" pregnancies. . Having at least one large nearby fire during pregnancy was associated non-significantly with a 21 gram (95% CI: -52.2, 10.2) lower birthweight in adjusted analyses.

CONCLUSIONS: Social vulnerability appears greater in those experiencing nearby wildfires during pregnancy. Although wildfire exposure within 5 km of home does not appear to influence birthweight, future work should evaluate whether the effects of nearby fires are felt more strongly in socially vulnerable populations.

KEYWORDS: wildfire, birthweight, social vulnerability, rurality

P-0536 Allergic rhinitis, rhinoconjunctivitis and hayfever symptoms among pre-school children are associated with school transport mode: an analytical cross sectional study

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BACKGROUND: Allergic rhinitis (AR) is a common condition affecting many people in the globally. In addition, the condition is mostly prevalent amongst children. The aim of the study was to investigate the association between the school transport mode and allergic rhinitis symptoms, rhinoconjunctivitis and hayfever among pre-school children living an in Mpumalanga Province, which in an area known for high levels of air pollution in South Africa.

METHODS: An analytical cross-sectional study consisting of 3145 participants was conducted in Mpumalanga South Africa. A modified ISAAC questionnaire was used to collect data. Bivariate analysis was performed between potential risk factors and dependent variables. Risk factors that showed association in the bivariate analysis were included in the multiple logistic regression to develop a final model.

RESULTS: The prevalence of self-reported rhinitis ever, current rhinitis rhinoconjunctivitis and hayfever was 21, 7, 8 and 4 % respectively. Rhinitis ever, current rhinitis, current rhinoconjunctivitis and hayfever were significantly associated with the frequent use of motorcar to school, (OR 1.45 95 % CI: 1.15 − 1.83), (OR 1.62 95 % CI: 1.27–2.08), (OR 1.64 95 % CI: 1.17–2.29) and (OR 3.36 95 % CI: 2.16–5.21) respectively. No associations were observed between trucks/buses/taxis traffic in resident area and allergic rhinitis symptoms in the multiple analyses.

CONCLUSIONS: The study shows a high prevalence of allergic rhinitis symptoms amongst Pre-schoolers. The results have shown that frequent use of motorcar pays a role in the prevalence of allergic rhinitis symptoms in preschool children.

KEYWORDS: Allergic rhinitis, Rhinoconjunctivitis, Hayfever, Traffic, Air pollution, South Africa

P-0540 Prenatal exposure to PM2.5 and childhood cognition assessed using the NIH Toolbox: A pooled analysis of ECHO cohorts in the Northeastern USA

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BACKGROUND AND AIM: Emerging studies investigated the adverse health effects of fine particulate matter (PM2.5) using data from multiple cohorts. However, associations often are not generalizable across cohorts. Our objective was to assess associations between prenatal PM2.5 and childhood cognition in two U.S. cohorts while accounting for between-site heterogeneity.

METHODS: We included 349 mother-child dyads enrolled from the dual-site (New York City and Boston) PRogramming of Intergenerational Stress Mechanisms (PRISM) study and the First Thousand Days of Life (FTDL) study participating in the Environmental influences on Child Health Outcomes (ECHO) consortium. Daily PM2.5 was estimated using satellite-based models linked to each woman's residential address during pregnancy. Children's cognition was assessed using the NIH Toolbox Cognition Battery between ages 3 and 8 years. We used a log-linear model applied to contingency tables formed by cross-classifying covariates by site to examine between-site heterogeneity. Multivariable linear regression was used to estimate the coefficients and 95% confidence intervals for the trimester-specific PM2.5 exposure and age-corrected standardized cognition scores (mean=100, SD=15), stratified by study site, child sex, and urbanicity.

RESULTS: The log-linear model indicated that inter-study associations were similar between PRISM-NYC and FTDL, which were different from those in PRISM-Boston. Accordingly, we combined the PRISM-NYC and FTDL cohorts. Findings showed that 1 μg/m³ increase of 3rd trimester PM2.5 was associated with -4.75 (95% CI= -11.86, -0.50) mean early childhood cognition scores in females in PRISM-Boston. We additionally observed a significant association between PM2.5 and picture vocabulary scores [-3.82, (-13.75, -0.01)] in males in NYC+FTDL non-urban areas.

CONCLUSIONS: We found associations between prenatal PM2.5 and impaired childhood cognition in this pooled analysis. Given that multi-site analyses are increasingly conducted, our findings suggest expanding the awareness of between-site heterogeneity, including site-specific confounders and effect modifiers.

KEYWORDS: air pollution, childhood cognition, log-linear model

P-0542 Air Pollution Mixture and Birth Outcomes: Modification of Placenta Leukocyte Telomere Length and Infant Sex

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BACKGROUND AND AIM: Multiple air pollutants such as fine particles matter (PM2.5), nitrogen dioxide (NO2), and ozone (O3) were associated with adverse birth outcomes, and their associations were potentially modified by the cellular aging of placenta and infant sex. But the joint association of those factors was less examined.
METHOD: This analysis included 310 mother-infant dyads (142 girls and 168 boys) enrolled in the PRogramming of Intergenerational Stress Mechanisms (PRISM) study. We applied Bayesian Kernel Machine Regression (BKMR) to examine the independent and mixed effects of prenatal PM2.5, NO2, O3, and placenta relative leukocyte telomere length (rLTL) on two birth outcomes (i.e., birth weight for gestational age z-score and preterm birth defined as less than 37 gestational weeks). The mixed effect was examined using an exposure index calculated as the summed multiplicities of the quintiles of pollutant and pollutant-specific weights estimated using Bayesian Weighted Quantile Sum (BWQS). The associations between exposure, outcome, and rLTL were examined for boys and girls separately.

RESULTS: NO2 drove the exposure effect on birth weight z-score in girls and on preterm birth in boys. Sex differences were observed. The estimated exposure index was negatively and positively associated with birth weight z-score and preterm birth in girls. These associations were inversed for boys. The observed modification effects of rLTL were varied by pollutant, outcome, and infant sex. for example, the results of the exposure index suggested stronger modification effects in boys, in which mothers with lower rLTL and higher exposure index jointly contribute to the higher birth weight z-scores and preterm birth.

CONCLUSIONS: Co-exposure to elevated air pollution and lower LTL during prenatal may contribute to adverse birth outcomes, especially among boys.

KEYWORDS: air pollution, birth outcomes, mixture analysis

P-0548 Prenatal Ambient Air Pollutant Mixture Exposure and Neurodevelopment in Urban Children in the Northeastern USA

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BACKGROUND AND AIM: Prior studies of prenatal air pollution (AP) exposure on child neurodevelopment largely focus on a single pollutant. We leveraged daily exposure data and implemented novel data-driven statistical approaches to assess effects of prenatal exposure to a mixture of seven air pollutants on cognitive outcomes in children from an urban pregnancy cohort in the Northeastern USA.

METHODS: Analyses included 236 children born at ≥37 weeks gestation. Maternal prenatal daily exposure levels for nitrogen dioxide (NO_2), ozone (O_3), and constituents of fine particles [elemental carbon (EC), organic carbon (OC), nitrate (NO_3-), sulfate (SO_4^{2-}), ammonium (NH_4+)] were estimated based on residential addresses using validated satellite-based hybrid models or global 3-D chemical-transport models. Children completed the Wechsler Intelligence Scale for Children (WISC-IV), Wide Range Assessment of Memory & Learning (WRAML-2), and Conner's Continuous Performance Test (CPT-II) at 6.5±0.9 years of age. Time-weighted pollutant exposure levels were estimated using Bayesian Kernel Machine Regression Distributed Lag Models. Resulting weighted exposures were used in Weighted Quantile Sum regressions to examine AP mixture effects on cognitive outcomes, adjusted for sex, maternal age, education, and temperature. Sex-stratified models were explored.

RESULTS: Mothers were primarily ethnic minorities (81% Hispanic and/or black) reporting ≤12 years education (68%). Prenatal exposure to AP mixture (per decile increase) was associated with decreased WISC-IV IQ (β=-0.94, 95%CI=-1.69 to -0.19), decreased memory-related attention/concentration (β=-1.03, 95%CI=-1.78 to -0.27) and general memory (β=-0.64, 95%CI=-1.40 to 0.00) indices from WRAML-2, and increased CPT-II omission errors (β=1.55, 95%CI=0.34–2.77). When stratified by sex, associations with IQ and omission errors were significant in boys only, while associations with memory-related indices were significant in girls only. Sulfate, NO_2, and EC were major contributors.

CONCLUSIONS: Prenatal exposure to an AP mixture was associated with child cognitive outcomes in a sex- and domain-specific manner.

KEYWORDS: air pollution, mixture, prenatal, neurodevelopment

P-0549 Associations between Exposure to Prenatal Air Pollution Mixtures and Behavioral Problems in Urban Children

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BACKGROUND AND AIM: Previous studies investigating associations between prenatal air pollution and childhood behavior mainly focused on PM2.5, while little is known about the effect of air pollution mixtures and exposure timing throughout pregnancy. We used individual-level daily exposure data and implemented novel weighting approaches to assess effects of prenatal exposure to a mixture of seven air pollutants on behavioral outcomes in children from a Northeastern USA urban pregnancy cohort.

METHODS: Participants included 234 full-term
singleton children (≥37 weeks gestation). Children completed the Behavior Assessment System for Children 2nd Edition (BASC-2) at age 6.5±0.9 years. Daily exposure levels for nitrogen dioxide (NO_2), ozone (O_3), and constituents of fine particles [elemental carbon (EC), organic carbon (OC), nitrate (NO_3-), sulfate (SO_4^{2-}), ammonium (NH_4+)] were estimated based on residential addresses using satellite-hybrid models and 3D chemical-transport models. Time-weighted exposure levels of the seven air pollutants in the mixture were estimated using Bayesian Kernel Machine Regression Distributed Lag Models. We subsequently used in multivariable linear regressions including time-weighted exposures for all pollutants in the mixture., adjusted for sex, maternal age, education, and temperature. Effect modification by sex was also examined.

RESULTS: Participants were primarily Hispanic (59%) and Black (25%), with ≤12 years of education (68%). Time-weighted O_3 level (per one standard deviation increase) was associated with 4.77% increase in External Problems (95%CI= 0.7%–9%), 4.41% increase in Aggression (95%CI=0.9%–8.1%), 4.36% increase in Internal Problems (95%CI=0.5%–8.3%), and 4.18% increase in Anxiety (95%CI=0.1%–8.4%). When stratified by sex, these associations were only significant in boys. Time-weighted OC level was significantly associated with Internal Problems in girls only (4.6% increase, 95%CI=1.7%–7.7%).

CONCLUSIONS: In a prenatal air pollution mixture, ozone is associated with child behavioral problems, and the association is specific to sex and measured outcome scale.

KEYWORDS: mixture, air pollution, prenatal, children behavior

P-0550 Proximity to coal flyash disposal site and infant neurodevelopment in Sri Lanka

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BACKGROUND: Fly ash from coal-fired power plants (CPP) often consist of trace heavy metals such as arsenic and lead which have been linked with deleterious health effects in exposed communities.
Objective. A cross-sectional study examined relationship between proximity to CPP, an indirect measure for environmental exposure to flyash, and neurodevelopment in infants 1- 3 years of age, measured using 'Bayley Scales of Infant and Toddler Development, third edition (BSID-III)'

METHODS: Set in Puttalam District in Sri Lanka, the study enrolled 208 children: 108 from the buffer zones around the CPP with radii of '<5kms' and 100 from '≥10kms', respectively. In a multivariable general linear regression, we analyzed the relationship between proximity to CPP and BSID-III cognitive, motor and language scores, adjusting for maternal age, ethnicity, wealth index, and child's age, sex and birthweight.

RESULTS: On average, children were 23.4 months (±6.4) old and 60.2% were female. Compared to children residing away from the CPP (≥10 kms), children residing in close proximity (<5 kms) had lower composite scores for BSID-III language (adj. means: 93.7 vs. 88.8, p= 0.0057), motor (88.0 vs. 86.0, p=0.2126) and cognitive (84.4 vs. 83.1, p= 0.4395) but only language was significant, after adjusting for covariates.
DISCUSSION. Our findings suggest lower developmental scores among children residing closer to CPP compared to those further away. Results of the study have scientific and policy implications for low- and middle-income countries as well as developed countries like US, where low-income, minority, rural and inner-city urban communities continue to disproportionately be exposed to higher levels of trace heavy metals released from industrial effluents, mining, fertilizers, and pharmaceuticals.

KEYWORDS: Flyash, Coal, Children, Infant neurodevelopment, Bayley

P-0551 The mortality burden of nervous system diseases attributed to ambient temperature: a multi-city study in China

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BACKGROUNDS: Studies on the association between ambient temperature and human mortality have been widely reported, focusing on common diseases such as cardiopulmonary diseases. However, multi-city studies on the association between both high and low temperatures and mortality of nervous disorders were scarce, especially on the evidence of vulnerable populations.

METHODS: Weekly meteorological data, air pollution data and mortality data of nervous system were collected in 5 cities in China. A quasi-Poisson regression with distributed lag non-linear model was applied to quantify the association between extreme temperatures and mortality of nervous system diseases. Multivariate meta-analysis was applied to estimate the pooled effects at overall level. The attributable fractions (AFs) were calculated to assess the mortality burden attributable to both high and low temperatures. Stratified analyses were also performed by gender and age-groups through the above steps.

RESULTS: A total of 12,132 deaths of nervous system diseases were collected. The overall minimum mortality temperature was 23.9 ℃ (61.9th), the cumulative relative risks of extreme heat and cold for nervous system diseases were 1.33(95%CI: 1.10, 1.61) and 1.47(95%CI: 1.27, 1.71). The mortality burden attributed to non-optimal temperatures accounted for 29.54% (95%eCI: 13.45 %, 40.52%), of which the mortality burden caused by low temperature and high temperature accounted for 25.89% (95%eCI: 13.03%, 34.36%) and 3.65% (95%eCI: 0.42%, 6.17%), respectively. The mortality burden attributable to ambient temperature was higher in both males and the elderly (> 74 years old), with the AF of 31.85% (95%eCI: 20.68%, 39.88%) and 31.14% (95%eCI: -6.83%, 49.51%), respectively.

CONCLUSIONS: The non-optimal temperature can increase the mortality of nervous system diseases and the males and the elderly over 74 years have the highest attributable burden. The findings add the evidence of vulnerable populations of nervous system diseases against ambient temperatures.

KEYWORDS: temperature; nervous system diseases; mortality burden; vulnerable population

P-0557 Association of heat wave exposure with increased risk of hospitalization for dehydration or heat-related illness in young children in South Korea: A Time-series study

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BACKGROUNDS
Numerous studies have investigated the association between summer temperatures and increased heat related hospitalizations in the general population. However, little is known about the heat-related morbidity of heat waves in children. We aimed to evaluate the association between hospitalization for dehydration or heat-related illness in children and heat wave exposure in South Korea.

METHODS: We used the National Health Insurance Service (NHIS) database, which provides medical records from 2015 to 2019 in South Korea. We defined daily hospitalizations for dehydration or heat-related illness of children younger than five years of age during the summer period (June to August). A heat wave was defined using a total of six criteria from a maximum temperature 28°C or higher to 33°C or higher per day. A time-series analysis was used to investigate the association between the maximum temperature and a heat wave and hospitalization for dehydration or heat-related illness of children younger than five years of age. We used a two stage design involving a meta-analysis after modeling by each city.

RESULTS: We included 16,879 daily hospitalizations for dehydration or heat-related illness among children younger than five years of age during 2015 to 2019. The relative risk (RR) of hospitalization for dehydration or heat related illness was 1.023 [95% confidence interval (CI): 1.013, 1.034] per 1°C increase in the 3-day moving average maximum temperature during summer. The RR due to heat wave exposure (6 definitions: 28°C to 33°C) was ranged from 1.10 (95% CI: 1.06, 1.15) to 1.05 (95% CI: 0.98, 1.12). In the subgroup, we did not observe statistically significant gender differences.

CONCLUSIONS: Exposure to a heat wave during summer is associated with an increased risk of hospitalization for dehydration or heat-related illness among children younger than five years of age.

KEYWORDS: Climate change, Children, Heat wave, Time-series

P-0559 Seasonal Temperature Variability and Mortality across the USA

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BACKGROUND: Seasonal temperature variability remains understudied and is set to be modified by climate change. Most temperature studies consist of short-term exposures using time series data. These studies are limited by an inability to observe longer-term trends in temperature and mortality along with regional adaptation and short-term mortality displacement. Cohort studies can address these limitations, but no countrywide cohort study has been conducted to study these long-term temperature trends, especially in a cohort with differing climatic zones.
AIM:
We aimed to examine the association between seasonal temperature variability and mortality across the contiguous US with its five defined regional climate zones. Further, we aimed to investigate effect modification by race, poverty, population density, and green space.

METHODS: We carried out this analysis in the US Medicare cohort (age 65+) from 2000-2016 with 622,427,230 years of person time. Our exposure was seasonal temperature variability or the standard deviation of warm (April to September) and cold (October to March) season temperature.
We used adapted difference-in-difference, quasi-experimental methods to reduce unobserved confounding at the ZIP-code level. We employed a clustering approach based on climate zone and socioeconomic factors, combined with a meta-analysis.

RESULTS: We showed that for every 1 °C increase in warm and cold season temperature variability, the mortality rate increased by 1.54% and 0.69% in over 65s, respectively. Over 270 million Americans are exposed to at least one form of seasonal temperature variability. These effects were most pronounced in low-income individuals, low green space residents, and those in lower population density areas such as rural locations. Further, these effects were not modified by one's climate zone of residency.
CONCLUSION: Seasonal temperature variability was associated with an increased risk of mortality in over 65s across the US.

KEYWORDS: Mortality; Temperature Variability; Climate Change; Medicare Cohort; Race; Poverty; Green Space.

P-0564 Is short-term exposure to heat associated with mental health compared to other conditions?

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BACKGROUND AND AIM: Health impacts of heat exposure are increasingly important due to climate change. Anxiety and depression are common and understudied mental health conditions, possibly associated with heat exposure. We examined associations between short-term (5-day) apparent temperature and health visits for anxiety and/or depression in North Carolina.

METHODS: We linked electronic health records from a random sample of adults seen at University of North Carolina Healthcare System hospitals 2004-2018 in the EPA CARES resource with climate data from PRISM Climate Group. We examined 5-day mean apparent temperature (incorporating temperature and humidity) at the ZIP code level for patients diagnosed with anxiety and/or depression compared to first recorded visit for those with any other diagnosis. We used log binomial regression models adjusted for personal (age, sex, race, health insurance status), environmental (season, annual PM2.5 concentration, climate division) and neighborhood (median household income, percent Bachelor's degree or more, percent urban) covariates.

RESULTS: We included 17,145 patients, 2219 of whom were diagnosed with anxiety and/or depression. Those with anxiety and/or depression were, on average, younger (46.4 vs 48.0 years), more likely to be female (69.7% vs 59.7%), and White (74.7% vs 62.4%), compared to those with other diagnoses. Mean five-day apparent temperature was 17.6 degrees C (SD 10.4). The prevalence of having a diagnosis of anxiety and/or depression was 1% higher per degree increase in five-day mean apparent temperature (PR 1.01, 95% CI 1.00, 1.02) compared to other diagnoses. Results were similar when limiting to anxiety, depression, and geographic region.

CONCLUSIONS: We did not observe substantial associations between apparent temperature and anxiety or depression relative to other outcomes. Future studies should expand this work to larger areas with more temperature variability and consider mental health trends independent of other outcomes. This abstract does not reflect EPA policy.

KEYWORDS: climate, heat, mental health

P-0569 Temporal Variation in the Association between Temperature and Cardiovascular and Respiratory Mortality in 15 German cities

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BACKGROUND AND AIM: There is limited evidence of temporal changes in the association between air temperature and the risk of cause-specific cardiovascular [CVD] and respiratory [RD] mortality. We explored temporal variations in the association between short-term exposures to air temperature and cause-specific CVD and RD mortality in the 15 largest German cities from 1993 to 2016.
METHOD: We applied time-stratified time-series analysis using city-specific confounder-adjusted Poisson models and estimated the temperature–mortality associations with distributed lag non-linear models with 14 lag days and then pooled by a multivariate meta-analytical model. We performed age- and sex-stratified analysis. A meta-regression with socioeconomic and demographic effect modifiers is currently being performed. Cold and heat effects are reported as relative risks [RR] at the 1st and the 99th temperature percentile, relative to the 25th and the 75th percentile, respectively.
RESULT: We analyzed a total of 1,003,305 CVD and 173,154 RD deaths. Cold-related RR for CVD mortality was seen to rise consistently over time from 0.98 (95% confidence interval [95% CI] 0.96, 1.01) in the period 1993-2004 to 1.10 (95% CI 1.08, 1.10) in the period 2005-2016. A similar increase in cold-related RR was also observed for RD mortality. The heat-related RR for RD mortality increased from 1.44 (95% CI 1.22, 1.70) to 1.83 (95% CI 1.66, 2.00). Males were particularly susceptible to cold for all causes of death and heat for total and RD mortality. The age group >64 years was susceptible to cold mainly for CVD mortality, whereas the younger age group (0-64 years) showed stronger effects of heat for RD mortality.

CONCLUSIONS: We found evidence of rising population susceptibility to both heat- and cold-related CVD and RD mortality. These findings may be useful to design targeted heat- and cold- adaptation plans in Germany.

KEYWORDS: Cardiovascular mortality, respiratory mortality, temperature, temporal variation

P-0570 Projecting future risk of dengue related to hydrometeorological conditions in mainland China under climate change scenarios

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BACKGROUND AND AIM: Limited knowledge is known about the impact of hydrometeorological conditions on dengue incidence in China, and the associated disease burden in the climate-changing future. This study projects the attributable excess risk of dengue in 365 cities across mainland China under climate change scenarios.

METHODS: The association between Palmer drought severity index (PDSI) and dengue in the historical period (2013-2019) was estimated with a spatiotemporal Bayesian model. We developed a dengue transmission biological model to project the potential risk area of dengue by 2100 under three representative concentration pathways (RCP 2.6, 4.5, and 8.5). The association combined with biological model was then used to project the annual excess risks of dengue related to PDSI by 2100. We further calculated attributable excess risk for dry and wet conditions.

RESULTS: A total of 93,101 dengue cases were reported between 2013-2019 in mainland China. Dry and wet conditions within three months lag were associated with increased risk of dengue. Locations with potential dengue risk in China will expand in the future. The hydrometeorological changes are projected to substantially affect the risk of dengue in regions with mid-low latitude, especially the coastal areas under high emission scenarios. By 2100, the annual average increased excess risk is expected to range from 7.49% (95% empirical CI: 4.55-16.64) in northwest to 71.89% (55.66-123.62) in south under RCP 8.5. Moderate dry is predicted to have the greatest impact on dengue risk across all regions.

CONCLUSIONS: Hydrometeorological conditions are predicted to increase the dengue risk in the future in the south, east, and central areas of mainland China in disproportional patterns. Our findings have implications for the preparation of public health interventions to minimize the health hazards of non-optimal hydrometeorological conditions under climate change context.

KEYWORDS: Climate change; Dengue; Hydrometeorology; Palmer drought severity index

P-0571 The association between ambient temperature and cause-specific cardiovascular disease admissions in Japan: a nationwide study

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BACKGROUND AND AIM: Substantial evidence suggests that non-optimal temperatures increase the risk of cardiovascular disease (CVD) mortality and morbidity. However, limited studies have reported inconsistent results for hospital admissions depending on study locations that also lack investigations on cause-specific CVDs at a national level. We aim to examine the short-term associations between temperature and acute CVD hospital admissions by specific categories [ischemic heart disease (IHD), heart failure (HF) and stroke] in 47 prefectures of Japan from 2011 to 2018.

METHODS: We performed a two-stage meta-regression analysis. First, we estimated prefecture-specific associations between temperature and CVD admissions using the time-stratified case-crossover design with a distributed lag nonlinear model over the lag of 21 days. Then we used a multivariate meta-regression model to obtain national average associations.

RESULTS: During the study period, a total of 2,416,707 CVD admissions were reported. We found significant cold risks on all CVD admissions and cause-specific categories. Compared with minimum hospitalization temperature (MHT) at 95th percentile of temperature, the cumulative relative risks (RRs) of cold (5th) and heat (99th) on all CVD were 1.222 [95% confidence interval (CI): 1.190, 1.255] and 1.003 (95% CI: 0.996, 1.011), respectively. The cold risk for HF [RR=1.566 (95% CI: 1.477, 1.660)] was higher than IHD [RR=1.136 (95% CI: 1.048, 1.231)] and stroke [RR=1.107 (95% CI: 1.057, 1.160)]. The MHTs varied by the specific causes. We also observed significant heat risk of temperature on HF with RR of 1.069 (95% CI: 1.030, 1.110). The subgroup analysis showed the ≥ 85-year age group was more vulnerable to the risk of temperature.

CONCLUSIONS: This study indicated that exposure to cold and heat could increase the risk of CVD hospital admissions, varying depending on the cause-specific, which may provide new evidence to reduce the burden of CVD.

KEYWORDS: Temperature; Morbidity.

P-0574 Childhood cognitive and behavioral effects of high summer temperatures

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BACKGROUND AND AIM: As climate change accelerates, the frequency of high summer temperatures will increase, affecting nearly every domain of health, including behavioral health. Research suggests high temperatures increase aggressive behaviors and decrease cognitive performance in adults, but these effects in children remain poorly understood. Our work addresses this knowledge gap.

METHODS: We derived daily maximum heat indexes using meteorologic data from the PRISM Climate Group and linked them to cognitive and behavioral data from 4,387 children aged 9-10 who completed assessments from June-August in the Adolescent Brain Cognitive Development Study baseline wave, 2016-2018.
At 21 sites in the USA representing 5 climate types identified by the U.S. Department of Energy (Cold, Marine, Mixed-Humid, Hot-Dry, Hot-Humid), children completed NIH Toolbox neurocognitive assessments (age-normed total cognition score; mean=100.5; sd=17.9), and their caregivers completed the Achenbach Child Behavior Checklist (aggressive behavior subscale t-score; mean=52.2; sd=4.0).
We modeled site-specific 6-day lagged relationships using distributed lag nonlinear models adjusted for known confounders, then used meta-regression to estimate climate-specific associations.

RESULTS: for participants living in the Cold climate (n = 1886), the overall cumulative association for heat indexes in the 99th percentile (vs. the 90th percentile) of the site-specific summertime heat index distribution was a -11.5 (95% CI: -21.7, -1.2) unit lower cognition score and a 2.6 (95% CI: -1.0, 6.2) unit higher aggressive behavior score. Both point estimates are more than half a standard deviation from Cold climate means.
In other climate types, which included fewer participants (n = 288 to 1017), we found no consistent evidence of any association.
CONCLUSION: Hot summer temperatures were associated with decreased cognitive performance and increased aggressive behavior in children living in a Cold climate. These results suggest a novel mechanism by which climate change may impact childhood neurodevelopment.

KEYWORDS: Climate change, temperature, children, cognition, behavior

P-0579 Impact of Wildfire Exposure on Preterm Births Identified in MarketScan Claims-Based Cohort, 2010-2015

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BACKGROUND AND AIM: Wildfire smoke is a growing contributor to ambient particulate matter and may lead to elevated risk of preterm birth. Studies that have investigated the effects of gestational wildfire smoke exposure (WSE) on preterm birth are inconsistent and inconclusive. This study aimed to estimate the effect of near-birth and trimester-based WSE on preterm births using a large-scale claims database.

METHODS: We linked IBM's MarketScan Commercial Claims and Encounters database with smoke plume data from NASA MODIS satellites using metropolitan statistical area (MSA) of residence at birth. Children born in an MSA in six Western states between 2010-2015, whose gestational age (GA) and birthdate were estimable from claims data were included (N=115,469); 759 births with <32 weeks gestation were excluded. MSA, GA, and birthdate were used to estimate average weekly days of WSE for each trimester and two near-birth periods (2 and 4 weeks pre-birth). Preterm birth was defined as live birth at GA between 32 and 37 weeks. Odds ratios were estimated using logistic regression models accounting for clustering by MSA and adjusted for maternal age (restricted cubic spline), birth season, and average temperature within each exposure period.

RESULTS: WSE in the first or second trimesters was associated with reduced likelihood of preterm birth (0.96 [95% CI: 0.91, 1.02] and 0.92 [95% CI: 0.87, 0.98], respectively), while WSE in the third trimester was associated with increased risk of preterm birth (1.05 [95% CI: 0.98, 1.12]). There was no evidence of association for the 2- and 4-week periods before birth. Sex-stratified analyses of near-birth and trimester exposures were not different from overall effect estimates.

CONCLUSIONS: We observed evidence of an association between WSE and pre-term birth that varied based on trimester of exposure, with increased risk seen for exposures during the third trimester.

KEYWORDS: Wildfire Exposure, Preterm Birth, Claims-data

P-0583 Comparison of heat-related mortality estimated using ambient temperature and wet-bulb globe temperature in Japan: Supporting evidence for heat health warning system

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BACKGROUND AND AIM: Wet-bulb globe temperature (WBGT) receives attention as a criterion in heatstroke alert system in Japan. However, epidemiological evidence related to its suitability as a heat indicator for all-cause mortality is insufficient. This study compares temperature and WBGT based on (1) their association with all-cause mortality (relative risk; RR) and (2) heat-related mortality burden (attributable fraction; AF) at high percentiles, such that a heat alert is issued. In addition, it evaluates if there are any regional tendency in the suitability of WBGT.

METHODS: A three-stage time-series analysis using data from 47 prefectures in Japan during the warm months (May-October) of 2010-2019 was conducted. First, we performed a time-series regression analysis for each prefecture to obtain prefecture-specific temperature- and WBGT-mortality associations. Second, we quantified prefecture-level RRs and AFs for the 90th percentiles of temperature and WBGT, respectively. Third, the prefecture-level RRs and AFs were pooled into region-level results, and a meta-regression analysis was conducted to compare the differences in prefecture-level RRs and AFs derived from temperature and WBGT.

RESULTS: The RRs for the 90th percentile of WBGT were 0.02% (95% confidence interval [CI]: -0.29%, 0.32%) higher than those for the 90th percentile of temperature. In addition, the AFs above the 90th percentile of WBGT were 0.16% (95% CI: -0.32%, 0.63%) lower than those above the 90th percentile of temperature. In Western Japan, temperature-related risk measures were higher than WBGT-related risk measures.

CONCLUSIONS: We found no evidence that which heat indicator shows higher risk measures for all-cause mortality. As a policy implication, it is advisable to consider practical aspects other than the magnitude of temperature- and WBGT-mortality association for the development of the heat health warning system that targets all-cause mortality.

KEYWORDS: Wet-bulb globe temperature, Heat Health Warning System

P-0585 Meteorological Factors Associated with Visceral Leishmaniasis in São Paulo State, Brazil

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BACKGROUND AND AIM: Human visceral leishmaniasis (VL) is a vector-borne disease of significant public health concern in Brazil. Areas of high prevalence have shifted in recent decades due to rapid development, changing socioeconomic conditions, and climate change. Emerging evidence suggests that incidence is affected by regional weather patterns such as the El Niño-Southern Oscillation, which has profound impacts on local meteorological conditions in Brazil. However, understanding of the effects of short-term weather variability remains inadequate, particularly in the context of VL. Accordingly, we explored the relationship between local weather conditions and VL in São Paulo State, Brazil.

METHODS: We obtained monthly cases of VL in São Paulo State from the Ministry of Health Information System for Notifiable Diseases for each municipality from 2010-2020. We extracted monthly average temperature, precipitation, and specific humidity from ERA5. We used conditional quasi-Poisson regression models to assess the relationship between meteorological variables and VL, conditioning on municipality and adjusting for temporal trends. We assessed lagged effects of meteorological variables from 0 to 6 months, corresponding with the long incubation period for VL in humans.

RESULTS: There were 1,958 documented cases of VL from 2010-2020. We observed higher rates of VL associated with increased precipitation and humidity and decreased temperatures. Specifically, a 1˚C decrease in average monthly temperature was associated with a 4.6% (95% CI: 2.5%, 6.7%) increase in VL cases two months later. A 1 mm increase in precipitation and 1 g/kg increase in humidity led to a respective 2.5% (1.2%, 3.8%) and 3.3% (1.3%, 5.2%) increase in VL cases one month later.

CONCLUSIONS: Local weather patterns are associated with the incidence of human VL in São Paulo State. These results highlight the potential importance of continued climate change on the fluctuating distribution of VL.

KEYWORDS: Climate Change, Visceral Leishmaniasis, Infectious Disease, Meteorology

P-0586 Climate change and migrant workers: Projections of temperatures and mortality in Kuwait

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BACKGROUND–It is uncertain what climate change could bring to populations and countries in the hot desert environment of the Arabian Peninsula. Not only because they are already hot, countries in this region also have unique demographic profiles, with migrant populations potentially more vulnerable and constituting a large share of the population. In Kuwait, two-thirds of the population are migrant workers and record-high temperatures are already common.

AIM–We quantified the temperature-related mortality burdens in Kuwait in the mid- (2050-2059) and end-century (2090-2099) decades under moderate (SSP2-4.5) and extreme (SSP5-8.5) climate change scenarios.

METHODS–We fitted time series distributed lag non-linear models to estimate the baseline temperature-mortality relationship which was then applied to future daily mean temperatures from the latest available climate models to estimate decadal temperature-mortality burdens under the two scenarios.

RESULTS–By mid-century, the average temperature in Kuwait is predicted to increase by 1.80°C (SSP2-4.5) to 2.57°C (SSP5-8.5), compared to a 2000-2009 baseline. By the end of the century, we could see an increase of up to 5.54°C. In a moderate scenario, climate change would increase heat mortality by 5.1% (95% empirical confidence intervals [eCI]: 0.8, 9.3) by end-century, whereas an extreme scenario increases heat mortality by 11.7% (2.7, 19.0). Heat mortality for non-Kuwaiti migrant workers could increase by 15.1% (4.6, 22.8). for every 100 deaths in Kuwait, 13.6 (-3.6, 25.8) could be attributed to heat driven by climate change by the end of the century.

CONCLUSION–Climate change induced warming, even under more optimistic mitigation scenarios, may markedly increase heat related mortality in Kuwait. Migrant worker, who are already vulnerable, could borne a larger impact from climate change.

KEYWORDS: -Climate change; Kuwait; Arabian Peninsula; Gulf; Heat; Mortality

P-0592 Nonlinear Association between summer high Temperature and Mortality in people aged 65 or more: Past and Recent periods

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BACKGROUND AND AIM: Climate change induces extreme weather including frequent heat waves in summer. We aimed to examine how the impact of high air temperature exposure to mortality of older people, a vulnerable group, has been changed from the past to recent periods.

METHODS: Temperature data from the Korea Meteorological Administration and mortality data from Statistics Korea were used. The time-series analysis was performed for the periods 1991–1995 and 2015–2019, in which included the recorded heat wave. We used the distributed lag non-linear models (DLNM) to estimate cumulative relative risks (CRRs) to see an association between daily temperature for July to August and mortality of people aged 65 or more. The CRR was estimated at each province and pooled the CRRs of all provinces using a random effect meta-analysis.

RESULTS: The CRRs on mortality of the daily mean temperature in summer for the population aged 65 or more for the whole 10-year period (1991-1995 and 2015-2019) were 1.098 (1.012, 1.192), 1.124 (1.027, 1.231), and 1.172 (0.986, 1.392) at 90%tile, 95%tile, and 99%tile, compared to 50%tile of the temperature. When the nonlinear associations between temperature and mortality were plotted in the past and recent periods separately, the CRR in the past increased substantially with temperature increases, while the increase of CRR in the recent appeared to be relatively small.

CONCLUSIONS: The effects of high temperatures in summer on mortality of people aged 65 or more have changed from the past to recent periods, and further studies are needed to explore factors potentially related with resilience of the society against climate change.

P-0607 Projections of temperature-attributable suicide under climate change scenarios in Japan

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BACKGROUND AND AIM: Recent studies have projected all-cause mortality attributable to non-optimal temperature under climate change scenarios. However, the impact of climate change on mental health remains to be assessed. The short-term association between suicide and temperature has been reported, but there is a lack of future projections of temperature-attributable suicide. We projected the excess temperature-related suicide mortality in Japan under three climate change scenarios until the 2090s.

METHODS: Daily time series of mean temperature and the number of suicide deaths in 1973-2015 were collected for 47 prefectures in Japan. A two-stage time-stratified case-crossover analysis was used to estimate the temperature-suicide association. We obtained the modeled daily temperature series using five general circulation models (GCMs) under three climate change scenarios from the latest Coupled Model Intercomparison Project Phase 6 (CMIP6) Shared Socioeconomic Pathways scenarios (SSPs): SSP1-2.6, SSP2-4.5, and SSP5-8.5. We projected the excess temperature-related suicide mortality until 2099 for each scenario and evaluated the net relative changes compared with the 2010s.

RESULTS: During 1973-2015, there was a total of 1,049,592 suicides in Japan. Net increases in temperature-related excess suicide mortality were estimated under all scenarios, with the highest increase under the high-emission scenario (SSP5-8.5). The net change in 2090-99 compared with 2010-19 was 0.6% (95% empirical confidence interval [eCI]: 0.1, 1.6) for a low emission scenario (SSP1-2.6), 1.3% (95% eCI: 0.6, 2.4) for an intermediate scenario (SSP2-4.5), and 2.4% (95% eCI: 0.7, 3.9) for a high emission scenario (SSP5-8.5). The increases were greater the higher the emission scenarios were. The increase in excess temperature-related suicide mortality was minimized under the SSP1-2.6 scenario assuming mitigation strategies.

CONCLUSIONS: The comparison of projection results under different scenarios underscores the importance of mitigation, with the higher the emissions, the greater impact on the temperature-related suicide mortality.

KEYWORDS: Climate change, non-optimal temperature, mental health, projections, DLNM

P-0608 Prediction of the impact of climate change on the number of heatstroke patients in Tokyo, Japan with heat-adaptation effects

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BACKGROUND AND AIM: Heatstroke has become a serious issue in Japan. To plan future adaptation measures, it is essential to understand to what extent the number of heatstroke patients will increase. Previous studies have predicted the number of heatstroke patients; however, they did not consider the effect of heat-adaptation. In this study, we conducted a future prediction study taking the effect of heat-adaptation into consideration.

METHODS: Japan, with its long north-south range, has a variety of climates, and it is necessary to explore its heat-adaptation effects. Our previous study showed that there was a positive correlation between the wet bulb globe temperature (WBGT) value at which heatstroke patients start to increase (WBGT threshold) and regional climate (average daily maximum WBGT between May and September: RCWBGT). Using the relationship, we translated this geographical effect of heat-adaptation to temporal adaptation by shifting the WBGT threshold to a higher side when the RCWBGT increases in the future owing to climate change. We focused on the age groups of 65+ yr, constituting the most vulnerable age group. Five future climate change scenarios and RCP8.5 scenario were adopted. All the data utilized in this study were public domain data and are available from the corresponding website.

RESULTS: In Tokyo, the number of heatstroke patients by mid-21st century will be 2.2 times as high as that of heatstroke patients at present and 6.9 times by the end of the century without heat-adaptation; however, the corresponding numbers will be 1.4 times and 2.5 times, respectively, with heat-adaptation.

CONCLUSIONS: The increase in the number of heatstroke patients was projected to substantially reduce owing to the effect of heat-adaptation.
Acknowledgement: This work was supported by the Climate Change Adaptation Research Program of the National Institute for Environmental Studies.

KEYWORDS: Climate change; Wet bulb globe temperature; Heatstroke; Impact assessment

P-0609 Long-Term Exposure to Temperature, Residential Heating and Diabetes Incidence among the elderly population in China

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BACKGROUND: Mounting evidence has shown that short-term exposure to ambient temperature can increase mortality. However, the health effects associated with long-term temperature are less clear. Furthermore, more research has been focused on the mortality instead of prevalence of chronic diseases.

METHODS: We constructed two cohorts using China Family Panel Study (CFPS) and assigned annual means of wet bulb temperature and PM2.5 to study participants based on their ID code of residential. Cox proportional hazards models were used to examine the association between long-term exposure to ambient temperature, residential heating and diabetes incidence, adjusting for potential confounders.

RESULTS: We found a non-linear relationship between the long-term temperature and diabetes in multipollutant model, which is a U-shaped curve ($p<0.001$). The optimal temperature to lower diabetes risk was around 12°C. In addition, spring temperatures were negatively associated with diabetes risk, with warm temperature being protective of diabetes; while autumn temperatures were positively associated with diabetes incidences, with warm temperature being harmful. Apart from the long-term temperature, residential heating was also great threat to the diabetes incidence, with a HR = 1.18 (95% CI: 1.03, 1.36). Finally, we evaluated the extra diabetes cases in China if (1) central heating is installed in Southern China and (2) under different climate change scenarios.

CONCLUSIONS: Using two representative cohorts, we found that either higher or lower annual temperature deviating 12°C is harmful to the diabetes incidence. Therefore, the climate change will contribute different influence in Southern China and Northern China. To our surprise, residential heating is also bad for the diabetes incidence, which alert us that if it is necessary about the installing of residential heating in those areas without residential heating.

P-0616 Seasonal variation in the association between temperature variability and emergency department visits: a multi-site study in China

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BACKGROUND AND AIM: Seasonal variation of temperature variability (TV) on emergency department visits (EDVs) remains unclear. We aimed to quantify the association between TV and cause-specific EDVs in China during 2014-2018, and explore seasonal variation, vulnerable populations, and sensitive diseases.

METHODS: We collected data on EDVs, weather, and air pollution from 20 sites in China. TV was calculated from the standard deviation of the minimum and maximum temperatures during exposure days. We applied a quasi–Poisson regression with a distributed lag nonlinear model to evaluate the TV-EDVs association. We used meta-analysis to pool site-specific estimates. We also conducted seasonal analysis and assessed the effects of modifiers.

RESULTS: A 1 ℃ increase in TV0-1 was associated with 0.36% [95% confidence intervals (CI): 0.24%, 0.48%)] increase in total EDVs. The effects became larger as exposure days increased and reached 0.59% (CI: 0.20%, 0.99%) for TV0-7. Male and people aged 0–17 were sensitive to TV with 0.40% (CI: 0.29%, 0.51%) and 0.58% (CI: 0.27%, 0.89%) increase per 1 ℃ increase in TV0-1. In seasonal analysis, effects of TV on total EDVs were lower in summer. People aged 60+ were vulnerable in winter. A 1 ℃ increase in TV0-1 corresponded to 1.84% (CI: 0.54%, 3.21%) increase of mental disease in spring, 0.43% (0.08%, 0.79%) increase of injury in autumn, and 0.63% (0.04% and 1.24%) increase of circulatory diseases in winter.

CONCLUSIONS: Exposure to TV was associated with increased risk of EDVs in China but varied in different seasons. Our results provided seasonal periods and vulnerable populations to conduct adaptive strategies and preventive measures.

KEYWORDS: Temperature variability; Emergency department visits; Seasonal variation; China

P-0617 Effect modification of diabetes as a comorbidity on temperature variability and hospitalization for cardiovascular disease

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BACKGROUND AND AIM: Evidence has accumulated that large temperature variability (TV) is associated with an increased risk for hospitalization or death. However, no previous studies examined whether the association for TV is modified by diabetes comorbidity, which is particularly vulnerable to cardiovascular disease (CVD). We aimed to explore the short-term association between TV and CVD hospitalization, stratified by presence of diabetes as a comorbidity in 47 prefectures of Japan from 2011 to 2018.

METHODS: A two-stage meta-analysis was used. First, we used a time-stratified case-crossover design to estimate the association between TV and CVD admissions with and without diabetes comorbidity for each prefecture. We then pooled the estimates using a multivariate meta-regression model across the prefectures. The associations were also stratified by sex, age, smoking status, and season.

RESULTS: A total of 4,482,583 hospitalizations for CVD were included in this study. Each 1°C increase in 0–7 days TV exposure was associated with a 0.58% (95% confidence interval, CI= 0.20% to 0.96%) increase in risk for total CVD admission and a 2.07% (95% CI= 1.16% to 2.99%) increase in risk for heart failure admission in subjects with diabetes, while the respective increases in subjects without diabetes were 0.37% (95% CI= 0.12% to 0.63%) and 0.61% (95% CI= -0.02% to 1.23%). These patterns were broadly similar to those stratified by age, sex, and smoking status, while the association for TV was greater in spring in the season-stratified analysis.

CONCLUSIONS: Susceptibility to TV in relation to CVD onset may be stronger in subjects with diabetes than those without. Our findings may suggest that subjects with diabetes should be more cautious to sudden temperature changes.

KEYWORDS: Temperature variability; Comorbidity.

P-0623 The association between ambient temperature and snakebites in Georgia, USA: a case-crossover study

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BACKGROUND AND AIM: The World Health Organization has identified snakebite as a highest priority neglected tropical disease, yet there is a dearth of epidemiologic research on environmental risk factors, including outdoor temperature. Temperature may affect snakebites through human behavior or snake behavior; snakes are ectotherms, meaning outdoor temperatures influence their internal body temperature and thus their behavior. Here we investigate the relationship between short-term temperature and snakebites in Georgia, one of the most biodiverse US states in terms of herpetofauna.

METHODS: We acquired emergency department visit data for Georgia between January 1, 2014 and December 31, 2018. Visits for venomous and non-venomous snakebites were identified using diagnosis codes. for comparison, we also considered visits for non-snake (e.g. insects, spiders, scorpions) envenomation. Daily meteorology from the Daymet 1km product was linked to patient residential ZIP codes. We applied a case-crossover design to estimate associations with maximum temperature.

RESULTS: During the five-year study period, there were 2,785 visits for venomous snakebites, 825 visits for non-venomous bites and 48,248 visits for non-snake envenomation. Across the entire period, a one-degree Celsius increase in same-day maximum temperature was associated with a 6.2% (95%CI: 4.0-8.5) increase in the odds of venomous snakebite and a 7.4% (95%CI: 3.5-11.4) increase in non-venomous snakebite. Associations were most robust in the spring and fall, particularly for venomous snakebites. We also observed a positive and significant association for non-snake envenomation, albeit slightly weaker and more consistent across seasons compared to those for snakebites.

CONCLUSIONS: Our study indicates an association between outdoor temperature and snakebites in Georgia. The results suggest that climate change could alter snakebite patterns in the future; however, impacts are likely to be dependent on the local climate and snake ecology (amongst other factors).

KEYWORDS: temperature, heat, morbidity, snake, climate change, one health, planetary health

P-0624 Decrease and seasonal changes of suicides and suicide attempts in France over the last 10 years

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INTRODUCTION: The objective of this study was to examine the evolution of suicides and suicide attempts over the last 10 years in France, according to the season.

METHODS: We analyzed the number of deaths by suicide and suicide attempts in metropolitan France (2009-2018) from French national databases, on a daily, weekly or monthly basis. Seasonal variation in suicide rates was modeled using a cosinor function. Based on this model, we determined the association of suicides and suicide attempts with geographic characteristics of the departments, age, gender, and psychiatric disorders. We also collected data on the means of suicide and suicide attempt.

RESULTS: The number of suicides and suicide attempts decreased over the last ten years in France (mean decrease of 14.49% and 11.69% per year). We observed a significant and recurrent seasonal pattern of suicides and suicide attempts in France, with a peak in spring. The suicide and suicide attempt rates were higher in the northern departments of France. Suicides are more common among men (75%) and middle-age individuals (45-54 years old), while suicide attempts affected more frequently women (62%) and young adults (15-19 and 40-49 years old). Nearly two-thirds of the patients who attempted suicide suffered from comorbid psychiatric disorder, with mood disorders being the most frequent psychiatric disorder. Voluntary drug intoxication was the most common means of suicide attempt (80%), while hanging was the most common means of suicide (54%).

CONCLUSIONS: The number of suicides and suicide attempts decreased in France over the last 10 years, with large seasonal variations. Further studies are warranted to better understand the underpinning physiological and meteorological factors that may influence these seasonal variations.

P-0625 Impact of meteorological factors and psychiatric disorders : a French exploratory study.

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INTRODUCTION: The objective of our work was to study the link between meteorological factors (temperature, sunshine duration, rain, wind, humidity) and psychiatric disorders. for this purpose, we conducted two exploratory studies in France : the first one, studying the link between the weather and suicidal behaviors (suicides and suicide attempts); the other one between alcohol use disorders (AUD) and the weather.

METHODS: We analyzed the number of deaths by suicide and suicide attempts in metropolitan France (2009-2018) from French national hospitalization databases; patients who were admitted to an emergency department for an alcohol related condition were included using the Oscour database, and we used meteorological database from national weather services. Based on this model, we determined the association of suicides and suicide attempts with weather factors, and then between AUD and meteorological factors.

RESULTS: The number of suicides and suicide attempts decreased over the last ten years in France (mean decrease of 14.49% and 11.69% per year). We observed a significant and recurrent seasonal pattern of suicides and suicide attempts in France, with a peak in spring. The suicide and suicide attempt rates were higher in the northern departments of France. We found significant positive correlations between the number of alcohol-related ED visits and the mean temperature ($r = 0.55$; $p = 1.87e$) and the duration of sunlight ($r = 0.42$; $p = .0015$). Negative correlations were also found significant with rain ($r = −0.40$; $p = .0014$), humidity ($r = –0.41$; $p = .0023$) and wind speed ($r = −0.40$; $p = .0031$).

CONCLUSIONS: The number of suicides and suicide attempts decreased in France over the last 10 years, with large and recurrent seasonal variations. Emergency visits for AUD seem to increase with the temperature and duration of sunlight, and decrease with rain, humidity and wind speed.

P-0626 Long term associations of climatic factors on cognition in olderadults: Results from the Reasons for Geographic and Racial Differences in Stroke (REGARDS) Cohort

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BACKGROUND: Evidence suggests that short term exposures to extreme heat and/or cold are associated with declines in cognition among older adults. However, the effect of long term exposures are not well understood.

METHODS: The Reasons for Geographic and Racial Differences in Stroke (REGARDS) study is a nationwide cohort study exploring regional and racial differences in stroke and cognitive function over time. ~30,000 people from all areas of the US were enrolled at age 45. Word List Learning (WLL) and Word List Delayed Recall (WLD) tests were administered on a yearly basis. Continuous cognition scores were produced using factor analysis based methods and applied to each measured time point for each individual. Associations of cognition with the number of extreme hot and cold days relative to region were tested using regression models of the continuous measure of cognition within a directed non linear Distributed Lag Non-linear Modelling framework.

RESULTS: Cognition data was available for 20,091 people with a mean age of 64.6 years over miltiple time points. of these, 39.2 percent were Black. On average, respondents experienced 25.4 and 14 extremely hot and cold days the year previous to the last date of survey. Cognition was significantly and negatively impacted by same year exposure to increased numbers of extreme heat days. No association of long term heat and/or cold exposure was found for exposure days greater than one year, or for exposure to cold or precipitation for all time periods tested.

CONCLUSIONS: Evidence suggests that the greatest impacts of temperature on cognition occurs within one year of exposure. Future work should explore the potential role of climate change in increasing incidence of cognitive decline in older adults.

P-0630 Heat Exposure and Emergency Department Visits for Sepsis in Phoenix, Arizona

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BACKGROUND AND AIM: Climate change is increasing exposures to high temperatures, which can lead to death and illnesses requiring emergency care. Sepsis, the body's response to severe infection, is usually diagnosed in emergency departments (EDs). Little is known about outdoor temperatures as a risk factor for sepsis. Here, we assessed the association between temperature and sepsis-related ED visits in Phoenix, Arizona during 2016-2019.

METHODS: We acquired ED visit data for Arizona and selected visits among patients residing within the two-county Phoenix area with a diagnosis of sepsis present on arrival at the ED. We characterized the focus of infection (FOI, respiratory, urogenital, abdominal, bone and soft tissue, blood) for each sepsis visit through diagnosis codes. Using daily population-weighted average maximum temperature data from Daymet, we estimated associations with sepsis and FOI-specific sepsis ED visits via Poisson time-series regression.

RESULTS: During 2016-2019, there were 97 sepsis-related ED visits per day in Phoenix; the average daily maximum temperature was 30.5 degrees Celsius. Overall, we observed a positive association between same-day maximum temperature and sepsis-related ED visits (rate ratio: 1.014, 95% confidence interval: 1.000-1.028 for a 5 degree increase from 24 to 29 degrees Celsius). Associations were strongest in the warmer seasons of Spring, Summer, and Autumn. When stratifying by FOI, associations of same-day maximum temperature and ED visits for sepsis with infection of the urogenital area were positive; other FOIs showed null or negative (for blood) associations with temperature.

CONCLUSIONS: Results suggest that outdoor heat exposure may be an important risk factor for sepsis, in particular during the warm season and for urogenital-based infections. During times of high heat, exposure mitigation measures may reduce emergency care needs, and emergency department preparedness may be needed to ensure positive outcomes for patients.

KEYWORDS: Climate, Heat, Temperature, Sepsis, Morbidity

P-0632 Central heating in China and protection against cold temperature mortality: a longitudinal cohort study of older adults

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Central heating in northern China during the months is reliant on biomass combustion and causes air pollution. Prior studies using natural experiment design (north and south of Huai river) attribute higher pre-mature mortality due to central heating-related air pollution. However, the original intention of central heating is to protect against the cold. We used the 2000-2018 Chinese Longitudinal Healthy Longevity Survey (CLHLS), a nationwide cohort of older adults aged 65. We focused on five provinces that are between heating and non-heating areas. The heating status was measured according to the resided city. We obtained daily meteorological data from the closest national station and measured residential air pollution. Cox proportional hazards models were used to assess the effects of central heating and air pollution. We further compared the mortality risk of long-term and short-term cold temperatures for participants with and without central heating. Winter average temperature and temperature variability were used to measure the long-term cold temperature. for the acute exposure, we used a distributed lag non-linear model. We included 5,334 participants, totaling 34,608 person-years of follow-up. We recorded 6,667 deaths, and 2,051 occurred in winter. In the adjusted model, the mortality hazard ratio (HR) for central heating was 0.80 (95% CI 0.76, 0.85). In our subgroup analyses, the HR for each 1℃ increase in winter temperature variability was higher for participants without central heating than for participants with central heating (1.21 vs.1.08), but the HR for each 10 μg/m³ increase in PM2.5 was similar(1.13 vs. 1.14). Participants without central heating also had for higher mortality risk of extremely cold at the 5th percentile compared to the 60th percentile than participants with central heating (1.48 vs.1.14). Our results suggested that central heating significantly decreased winter mortality, which may partly be achieved by attenuating the mortality caused by cold temperatures.

P-0634 Allostatic load and climate change: analyzing epidemiological confounding variables, health effects and adaptative response in osteoporosis and kidney disease associated with NDVI greenness index

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BACKGROUND AND AIM: To explain individual response to stressors, research has brought attention to the common underlaying mechanisms for catecholamine- dependent adaptive response. Under this perspective, a trigger factors is the adaptation to extreme weather events linked to climate change (droughts, long warm summers, heat waves, etc) closely connected with the related concept of "allostasis" defined as “the physiological or behavioural changes required to stabilize the biological systems". As long as allostasis implies resilience (Karatsoreos, McEwen, 2011) it can be connected, conversely, with the negative effect of “allostatic load”. Nevertheless, its concurrence with confounding variables should be also evaluated: Allostasis can influence occurrence of osteoporosis-related fracture and changes on Bone mineral density (BMD) where researchers have found the apparently beneficial effect of greenness in relation to the positive impact of outdoor exercise as a stress reduction mechanism, also identified as a factor influencing BMD (Follis, Bea, Klimentidis et al. 2019)
Other example is the beneficial effect in kidney disease incidence and air pollution, where results shown that stricter air quality standards benefit kidney patients. (Lee, W, 2022)

METHODS: Systematic review on cases involving BMD and kidney disease and subsequent the catecholamine-dependent response following a two stage analysis. Residential proximity is defined as average of satellite-based Normalized Difference Vegetation Index (NDVI) in buffers of 50 m, 100 m and 250 m, 500 m

RESULTS: Evidence of beneficial effect of the greenness estimated from analysis of Normalized difference Vegetation Index- NDVI has

CONCLUSIONS: The influence of allostasis should be supported by clinical research evidence(Ramsay et al 2014). A number of studies estimating beneficial effects or greenness suggest that allostasis, as a measure of catecholamine-dependent response could be a valid approach for understanding the underlying mechanisms in environmental stressors

KEYWORDS: Allostasis, allostatic load, NDVI, greenness, behavioural changes

P-0638 Knowledge, Attitude and Practice of Health Workers and Shopping mall operators towards Decontamination during COVID -19 Pandemic in Ibadan

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BACKGROUND AND AIM: Public facilities such as hospitals and shopping malls are a potential hotspot for transmission of infectious disease like COVID-19. Decontamination practice is therefore an essential infection prevention and control strategy used in preventing disease outbreaks. Information on knowledge, attitude, and practice of facilities workers towards decontamination are poorly investigated and documented in developing countries. This study, therefore, assessed the knowledge, determined the attitude and practice of hospital and shopping mall workers towards decontamination during the Covid-19 pandemic.

METHODS: The cross-sectional study utilized a comparative approach involving the use of Adeoyo hospital and a shopping mall in Ibadan, Nigeria. An interviewer-administered questionnaire was used to assess the knowledge, attitude, and practices of decontamination among 250 respondents. Data collected were analyzed using SPSS version 25, for mean, standard deviation, and T-test at 5% significance level.

RESULTS: Most (64%) of Adeoyo respondents and majority (89%) of Shopping mall respondents had a poor practice level towards decontamination at their workplaces, however, the majority (89.8%) and (81.1%) of the respondents in Adeoyo and shopping mall respectively had a good attitude towards decontamination. Although there was a significant association between knowledge ($p = 0.001$), practice ($p < 0.001$), and study location. A little more than half (56.1%) and some (21.2%) of respondents in Adeoyo and Shopping mall respectively had poor knowledge about decontamination. Among respondents from Adeoyo, level of education ($p = 0.006$) was significantly associated with level of practice on decontamination.

CONCLUSIONS: The study revealed that both study locations had poor decontamination practice and a large percentage had poor knowledge about decontamination, therefore Hospital and mall workers should be educated on the importance of decontamination. Necessary infrastructure should be put in place to ensure decontamination practice and ensure infection control.

KEYWORDS: Decontamination, Knowledge, attitude, practice, hospital, shopping mall

P-0645 Impact of air pollution on cardiovascular mortality during the COVID-19 pandemic in South Korea

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BACKGROUND AND AIM Multiple studies have reported the impacts of the coronavirus-2019 pandemic on cardiovascular disease (CVD) and the concentration of air pollution, respectively. Although the association between air pollution and CVD outcomes has been widely identified, the changes in the association during the pandemic period have not been fully investigated. This study aimed to examine the nationwide changes in the short-term effect of fine particulate matter (PM2.5) on CVD deaths in South Korea.

METHODS: We performed an interrupted time-series analysis to estimate temporal changes in the association between PM2.5 and CVD-related deaths (total, ischemic health disease [IHD], cerebrovascular disease [CD], and hypertension) before (Jan 01, 2016 to Feb 17, 2020) and during the pandemic (Feb 18, 2020 to Dec 31, 2020), using daily data. Relative humidity, day-of-week, seasonality, and temporal trend were controlled. We conducted a two-stage analysis to estimate the risk of air pollution on CVD deaths for each of 16 regions and then generated an overall estimate.

RESULTS: The total number of CVD mortality was 53,552. The average annual concentration of PM2.5 changed before (23.8 μg/m3) and during the pandemic (17.1 μg/m3) in South Korea. for total CVD deaths, the changes in relative risks (RRs; for 10 μg/m3 increase in PM2.5) were not pronounced during the pandemic. Whereas, for ISH and CD, the RRs increased during the pandemic: (pre-pandemic to pandemic period) 1.00 (0.99, 1.01) to 1.02 (1.00, 1.04) for IHD and 1.00 (1.00, 1.01) to 1.02 (1.00, 1.04) for CD, although the changes were not statistically significant (p-values 0.08 and 0.24).

CONCLUSIONS:We found that the risks of short-term exposure to PM2.5 on mortality for IHD and CD increased in the first pandemic year in South Korea, compared to the pre-pandemic years.

KEYWORDS: COVID-19, Pandemic, PM2.5, Cardiovascular mortality.

P-0648 Higher incidence of novel coronavirus (COVID-19) cases in areas with combined sewer systems, heavy precipitation, and high percentages of impervious surfaces

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Combined sewer systems (CSS) are water management systems that collect and transport stormwater and sewer water in the same pipes. During large storm events, stormwater runoff may exceed the capacity of the system and lead to combined sewer overflows (CSOs), where untreated sewer and stormwater are released into the environment. Previous studies identified SARS-CoV-2 in sewage, urine, feces, and municipal wastewater. As such, areas contaminated by CSOs may be a reservoir of SARS-CoV-2 and may result in illness after the ingestion and/or inhalation of contaminated splashes, droplets, or aerosols. We investigated the association between COVID-19 incidence and CSSs and whether this association differed by precipitation and percent impervious surfaces as a proxy for possible CSOs. We fitted a quasi-Poisson regression model to estimate the change in percentage of incidence rate of COVID-19 cases in counties with a CSS compared to those without, adjusting for potential confounders (i.e., state, population density, date of first documented COVID-19 case, social vulnerability, and percent vaccinated) and including interaction variables between CSS, precipitation, and impervious surfaces. Our findings suggest that heavy precipitation in combination with high percentages of imperviousness is associated with a higher incidence rate of COVID-19 cases in counties with a CSS compared to in counties without a CSS. We theorize that more COVID-19 cases may be seen in counties with a CSS, heavy precipitation, and high percentages of impervious surfaces because of the possible increase in frequency and severity of CSOs. The results suggest links between climate change, urbanization, and COVID-19.

P-0650 Using Google data and weather factors to predict COVID-19 transmission in Melbourne, Australia: A time-series predictive model

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BACKGROUND AND AIM: We aimed to assess the effect of weather variability and Google data on COVID-19 transmission and develop multivariable time series AutoRegressive Integrated Moving Average (ARIMA) models for predicting COVID-19 transmission and outbreaks in Australia.

METHODS: Data including COVID-19 case notifications, meteorological factors and Google data were collected for the period of the Delta outbreak in Melbourne, Australia from the 1st of August to 15th November 2021. Time-series cross-correlation (TSCC) was used to evaluate the temporal correlation between weather factors, Google search trends, Google Mobility data and COVID-19 transmission. Time series ARIMA models with potential predictors were used to forecast COVID-19 incidence and Effective Reproductive Number (Reff) in the Greater Melbourne region. Five models were fitted to compare and validate predictive models using three-day ahead increments to test the predictive accuracy for both COVID-19 incidence and Reff. ARIMA models were fitted and validated using 70% training (75 days) and 30% validating (32 days) from 1st August 2021 to 15th November 2021 (107 days).

RESULTS: Maximum temperature (Tmax), absolute humidity, solar exposure, and transit station mobility (TSM) were significantly positively associated with COVID-19 incidence over time. Tmax and TSM were selected at a lag of 8 and 7 days respectively to develop multivariable ARIMA models. Multivariable ARIMA models including Tmax or TSM improved the predictive accuracy of COVID-19 cases slightly.

CONCLUSIONS: ARIMA modelling was useful for predicting epidemic growth, there is also a potential application for inclusion of weather and Google data in creating effective early warning systems for future outbreaks. Our results suggest that TSM and Tmax would be useful for further exploration and developing weather-informed early warning models for future potential COVID-19 outbreaks.

KEYWORDS: COVID-19, ARIMA, forecasting, weather, internet search queries, mobility

P-0652 Health impacts of a reduced aircraft noise exposure during the Covid-19-pandemic - A natural experiment in Stockholm, Sweden

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BACKGROUND AND AIM: The lock-downs during the Covid-19-pandemic induced significant changes in travel patterns. In Stockholm, Sweden, the aircraft traffic around Bromma airport reduced by 77 percent during the first wave of the pandemic, March 1 to June 15, 2020, resulting in a sharp decline in residential exposure to noise. Based on this "natural experiment", we aimed to assess the impact of the reduced aircraft noise exposure on population well-being and health.

METHODS: In September 2020, we invited 10 000 individuals residing in the vicinity of Stockholm Bromma airport (n=7 500) and in Nacka municipality (n=2 500), serving as a reference, to a web-based questionnaire survey. The questions related to a pre- and during the pandemic situation, respectively, and concerned individual and housing factors and various disturbances, e.g., noise annoyance, sleep impairment, and stress related symptoms. Residential exposure to aircraft noise was assessed for a pre-pandemic situation in 5 dB categories ranging from ≤45 to ≥55 dB Lden. Logistic general estimating equation models were used to assess Relative Risks (RR) and 95% Confidence Intervals (95% CI).

RESULTS: In total, 3 582 individuals responded to the survey (35,8%). In the pre-pandemic situation, statistically significant associations were found between aircraft noise and all investigated disturbances. During the pandemic, the associations reduced and approached unity. The RR for high noise annoyance dropped from 7.51 (95% CI 5.18-10.90) among those exposed ≥46 dB Lden compared to the reference before the pandemic, to 2.18 (95% CI 1.24-5.9) during the pandemic. Corresponding figures for high sleep disturbance were 7.64 (95% CI 3.90-15.0) and 1.57 (95% CI 1.62-1.02), respectively. Improvements were also seen for stress symptoms.

CONCLUSIONS: The reductions in aircraft noise exposure around Stockholm Bromma airport during the Covid-19-pandemic resulted in an overall improved health in the local population.

KEYWORDS: Aircraft noise, Covid-19-pandemic, annoyance, sleep, stress

P-0653 Environmental surveillance and clinical assessment of SARS-CoV-2 epidemiology and variant prevalence in an urban area in Spain

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BACKGROUND AND AIM: Wastewater-based epidemiology (WBE) provides the means to monitor pathogens prevalence in the sewage system of a community. SARS-CoV-2, the virus responsible for the COVID-19 global pandemic, can be detected in the feces of infected individuals. Therefore, viral concentrations in wastewater can be taken as an indication of SARS-CoV-2 prevalence in the entire population. This work was aimed at the detection and sequence analysis of SARS-CoV-2 RNA in wastewater and its correlation with clinical data.

METHODS: Samples collected over a nine-month period (2020-21) at a wastewater treatment plant in Elche (Spain) were concentrated by ultrafiltration and analyzed for the presence of SARS-CoV-2 RNA by reverse transcriptase quantitative polymerase chain reaction (RT-qPCR). Sequences generated from cDNA samples with a MinION Nanopore device were compared to SARS-CoV-2 sequence databases.

RESULTS: The appearance of the first qPCR positive signals correlated with the increasing number of covid-19 cases in Elche at the onset of the second wave of COVID-19 (july 2020). Measurements of viral genomes in water samples in October-November 2020 reflected the higher number of clinical cases within that period. Nanopore sequencing assay allowed the detection of spike (S) protein mutations associated with circulating SARS-CoV-2 variants both in environmental as well as in clinical samples, reflecting the emergence of the B.1.1.7 variant in Elche in late 2020.

CONCLUSIONS: This study highligted the potential of wastewater-based epidemiology (WBE) in revealing the presence of pathogenic viruses in urban populations. By the use of the nanopore sequencing technology we were able to assess the changes in circulating SARS-CoV-2 variants in a whole population.

KEYWORDS: environmental epidemiology, SARS-CoV-2 variants, wastewater, nanopore sequencing

P-0670 COVID-19 in the Eastern Caribbean: Engaging the Root of Ill-Health and Unhappiness

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BACKGROUND: The peripheral impacts of the global COVID-19 pandemic have had enduring effects on our everyday lives. Citizens of small island Caribbean states in particular faced increased frequencies and odds of morbidity beyond SARS-COV-19 infections.
AIM: Our pilot project sought to probe health-relevant outcomes among Eastern Caribbean residents.

METHODS: We surveyed residents of St. Kitts-Nevis, ages 17 to 55 and facilitated student focus groups (SFG) in 2021 and 2022. Analyses produced descriptive methods and odds ratios.

RESULTS: Among 81 respondents, 72.8% identified as female and 82.7% had been involved in academic training within a year of completing the questionnaire. Physical activity (50.6%) and mental health (69%) were at least moderately impacted due to the atmosphere of risk and restrictions. Male participants were less likely (OR: 0.32) to have friendships greatly impacted (95CI%: 0.11 - 0.86) while female participants were more likely (OR: 1.15) to report at least moderate declines in mental health (95CI%: 3.21 - 9.16). Students and teachers had a 3.92 higher odds (95CI%: 3.92 - 13.52) of experiencing mental health challenges relative to other occupations. Persons with moderate-to-severe feelings of negative mental health had increased odds (OR: 5.70; 95%CI: 2.05 - 17.83) of a moderate-to-severe comprise of diet relative to individuals feeling little to no changes in mental well-being. Informational sources such as TV as a source of COV-19 information was linked to greater mental health deficits (OR: 3.44; 95%CI; 1.31 - 9.45). SFG participants (n=8) qualified mental health challenges during the pandemic, highlighting lack of communication and clear instructions from their institutions, insufficient feedback and guidance from teachers, absenteeism due to parent(s) serving as essential worker(s) and isolation due to quarantine and/or lockdown.

CONCLUSIONS: Results reflect both unique and relatable ways in which Caribbean folks experience and reflect on health status throughout the unprecedented COV-19 pandemic.

P-0671 Long-term exposure to ambient air pollution and COVID-19 incidence in Italy

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BACKGROUND AND AIM: The SARS-CoV-2 pandemic gave rise to a large number of epidemiological studies linking ambient air pollution (AP) to COVID-19 incidence. However, to date, the role of chronic exposure to AP in explaining COVID-19 occurrence is still not clarified.

METHODS: Within a national study (EpiCovAir) promoted by National Institute of Health (ISS) and Italian Network of Environmental Protection (SNPA), we identified all COVID-19 cases in Italy from February 2020 to June 2021. Chronic exposure to particulate matter < 10 micron (PM10), < 2.5 micron (PM2.5) and nitrogen dioxide (NO2) were assigned at municipality level (n=7800) using a national satellite-based AP exposure model (1-km2 spatial resolution) for the period 2016-2019. We applied principal component analysis (PCA) and generalized propensity score (GPS) approaches to summarize information of about 50 area-level covariates to account for major determinants of the spatial distribution of COVID-19 cases (municipality characteristics, population density, mobility, population health, socio-economic status). Finally, we applied generalized negative-binomial regression models matched on GPS, age, sex, province and month to study the association between AP and COVID-19 incidence.

RESULTS: 3,995,202 COVID-19 cases occurred in Italy in the entire period (incidence rate=67x1000). Overall, incidence rates increase by 0.6% (95% CI: 0.5%, 0.7%), 0.5% (95% CI: 0.4%, 0.6%) and 0.9% (95% CI: 0.9%, 1.0%) per 1 □g/m3 increment in PM2.5, PM10 and NO2, respectively. Associations were consistent to different sensitivity analyses, particularly for NO2. Increments were higher among elderly subjects, and during the second pandemic waves (Sept. 2020-Dec. 2020). In two-pollutant models, NO2 estimates were robust to PM adjustment, while PM showed no associations after adjustment for NO2.

CONCLUSIONS: We found evidence of association between long-term exposure to ambient AP (particularly NO2) and the occurrence of 4 million COVID-19 cases in Italy, suggesting a role of AP in increasing the incidence of COVID-19 disease.

P-0674 Long-term Air Pollution Exposure on COVID-19 Risk and Severity

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Since the emergence of the COVID-19 pandemic, long-term exposure to air pollution has emerged as a possible risk factor for increased COVID-19 disease risk, severity, and mortality.
The objective of this study was to examine the association between COVID-19 and long-term exposure to air pollution.
This retrospective cohort study included patients who had a COVID-19 test at the University of Chicago Medicine Center from March 18, 2020, to March 30, 2021. Air pollution exposure was assessed using models developed for Chicago by the MESA Air Study and data from the Environmental Protection Agency's EJSCREEN. Air pollution exposure estimates were linked to the University of Chicago Medicine patients using residential addresses. Air pollution measurements included PM2.5 (MESA Air and EPA), NO2, diesel PM, the respiratory hazard index, traffic proximity, and ozone. The outcome was COVID-19 risk and severity (ICU admission). Mixed effect analyses were performed to test whether poor air quality status was associated with COVID-19 risk and severity, controlling for demographic, smoking, and comorbidity indicators collected from the medical records.
A total of 74,004 patients (mean [SD] age 44.0 [22.51] years; 42,979 [58.09%] women; and 32,870 [49.09%] African Americans) were linked to air quality exposure based on residence and other covariates using electronic medical record data in addition to COVID-19 test results. Overall, 8,463 participants (11.4%) tested positive for COVID-19. In the mixed effect analysis, long-term PM2.5 exposure was associated with increased risk of testing positive for COVID-19 (odds ratio [OR], 1.30; 95% CI, 1.23-1.38; P <0.01) and increased severity from COVID-19 (OR= 2.28; 95% CI, 2.00-2.60; P = <0.01).
The results of this retrospective cohort study provide some evidence of the effect of long-term air pollution exposure on COVID-19 risk and severity.

P-0678 Field measurements of indoor and community air quality in rural Beijing before, during, and after the COVID-19 lockdown

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BACKGROUND AND AIM: The outbreak of the coronavirus (COVID-19) initiated a global prevention response to curb the spread of the virus, including a series of actions to reduce human mobility. Previous studies report reductions in outdoor $PM_{2.5}$ associated with COVID-19 lockdown in many countries and regions. Few studies assessed the impacts of COVID-19 on local air quality in environments with diverse socioeconomic and household energy use patterns. We evaluated whether indoor and community $PM_{2.5}$ in homes with different energy use patterns in rural Beijing, China differed before, during, and after the lockdown.

METHODS: We deployed low-cost $PM_{2.5}$ sensors (Plantower), calibrated with co-located filter-based $PM_{2.5}$, to measure indoor and community air quality in 147 homes from 30 villages in Beijing in January-April, 2022. We apply mixed-effects models to assess the impact of the COVID-19 lockdown on indoor $PM_{2.5}$ and used the random component superposition model (RCSM) to estimate the contributions of indoor and outdoor sources to indoor $PM_{2.5}$.

RESULTS: Community pollution was higher during the lockdown period (61 ± 47 μg/m³) compared with before (45 ± 35 μg/m³) and after (47 ± 37 μg/m³) the lockdown. However, we did not observe higher indoor $PM_{2.5}$ during the lockdown (during vs. before: 98 ± 86 vs. 96 ± 83 μg/m³). Indoor-generated $PM_{2.5}$ was lowest in homes using clean energy exclusively for heating and without smokers, and did not change significantly during the lockdown compared with homes using solid fuels.

CONCLUSIONS: Indoor air quality did not worsen during the COVID-19 lockdown in our rural Beijing sites, though community $PM_{2.5}$ was higher during the lockdown. Indoor-generated $PM_{2.5}$ in homes using clean energy exclusively for heating was low and stable, while decreased during the lockdown in homes using solid fuel, which may be due to less solid fuel burning for heating because outdoor temperatures warmed.

P-0680 How the COVID-19 infection and deaths are shaped by socioeconomic inequities and air pollution exposure in Mumbai, India?

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BACKGROUND: The COVID-19 pandemic caused a global health crisis and exposed the low socioeconomic groups to higher exposure and death due to the existing social inequalities. India witnessed three unprecedented waves of COVID infection and deaths. However, a systematic analysis of the impact of socioeconomic inequities and other environmental factors on COVID-19 infection and mortality are not well examined in India.
AIM:
The present study aims to understand the impact of socioeconomic inequities and air pollution on COVID-19 infection and deaths in Mumbai, India.

METHODS: Ward-level data on COVID-19 cases and deaths from 24 wards is obtained from the Municipal Corporation of Greater Mumbai. Socioeconomic data is acquired from the official Govt. of India 2011 census. Bivariate and multivariate regression is applied to examine the impact of various socioeconomic factors on COVID fatalities and infections.

RESULTS: Mumbai reported 1,032,563 positive cases with an overall mortality rate of 18.9. The maximum mortality (41.9) and recovery rate (991.4) were observed in wards B and A in south Mumbai. A significant negative correlation (r=-0.55) was observed between deaths and the total population, irrespective of gender. Education (defined by literacy rate) showed a positive association with the COVID cases for both genders, suggesting no significant disparity based on gender and education ($p<0.05$). The homeless population depicted a positive correlation with mortality rates and positive cases, indicating the role of economic inequities. The higher population density in the wards may have caused higher mortalities, as suggested by a significant positive association (r= 0.46).
CONCLUSION: Our initial analysis suggests the influence of healthcare and housing affordability on the mortality rates, whereas the total positive cases seem to be driven by the non-slum population. The effect of other socioeconomic variables and air pollution, and multivariate analysis is currently underway.

KEYWORDS: COVID-19, Socioeconomic inequity, Air Pollution, Healthcare, Mortality

P-0683 Environmental, health and economic benefits of Covid-19 lockdown in Morocco

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Several measures have been taken to mitigate the effects of the Covid-19 pandemic. In this context, almost all non-essential activities in Morocco have been halted since March 20, 2020. The main objectives of this work are firstly to study the effects of lockdown measures on air quality, by analyzing dust PM2.5, NO2 and O3. Secondly, to estimate the health and the total economic benefits caused by PM2.5 during the Covid19 scenario based on Environmental Benefits Mapping and Analysis Program (BenMAP). A review of the various health and economic studies of the impact of lockdown on air quality was conducted and taken into account. The dust PM2.5 analysis was carried out from 2016 to 2020. NO2 and O3 analysis was carried out in 2019 and 2020. This study, which is based on satellite data from TROPOMI Sentinel 5P and MERRA, has shown that Morocco has experienced an improvement in air quality during the lockdown. A significant reduction in surface dust PM2.5 and tropospheric NO2 was observed (-10%, -4%, respectively on average). The total column of ozone recorded a slight increase on average of around 1%. According to the results obtained, it is inferred that the reduction of PM2.5 concentration saved lives mainly from cardiovascular and respiratory diseases, with 291 and 137 avoided deaths respectively. According to the VSL method, the economic benefits of avoiding deaths from all causes due to a decrease in PM2.5 concentration of the order of 67 % in Morocco have been estimated at about 451 million USD. This hypothetical clean air scenario has shown us the significant health and economic benefits that could be achieved through transport, climate and environmental strategies and policies that at the same time support a robust economic recovery and reduced emissions.

KEYWORDS: Air quality, Covid-19, Morocco, health impacts, economic benefits.

P-0685 Race-ethnicity disparities in COVID-19 outcomes may be worsened by shorter- and long-term aerosol pollutants exposure

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BACKGROUND AND AIM: The importance of ultrafine particles (UFP or $PM_{0.1}$) exposure to respiratory disease has been identified. However, its effect (and that of $PM_{2.5}$) on COVID-19 outcomes remain unknown. This study aims to identify and quantify shorter- and long-term aerosol impacts on COVID-19 in context of disparate outcomes observed for minority race-ethnicity groups in New York State (NYS).

METHODS: COVID-19 outcomes included infections, hospitalizations, ICU admissions, and deaths reported by the CDC COVID-19 Case Surveillance Restricted Access Detailed Data, 2020–2022. UFP and $PM_{2.5}$ data were simulated by a global three-dimensional model of chemical transport with state-of-the-science aerosol microphysical processes extensively validated with observations. for shorter-term (0–30 lag days) UFP and $PM_{2.5}$ exposure, Distributed Lag Non-linear Model (DLNM) were used to examine the association at county-level, adjusting for meteorological factors. Long-term (average level of 2013–2020) associations with COVID-19 were assessed by Negative Binomial Mixed Models adjusting for county-level confounders. County-level confounders from the Census Bureau, Behavioral Survey, and Homeland Infrastructure Data were used.

RESULTS: Compared to White, Hispanic/Black subgroups had greater excess risk of COVID-19 infection (+25%), hospitalization (+31%), ICU admission (+60%), and death (+5.5%). Excess risk per IQR increase for long-term UFP ($PM_{2.5}$) exposure was significant for COVID-19 hospitalization: +40%; 95%-CI=20.5–63.6% (+22%;18.8–25.5%), ICU admission: +44%;39.1–49.2% (+24%;18.6–30.5%), and death: +40%;38.0–42.4% (+19%;8.2–30.7%). for short-term exposures, risks for all COVID-19 outcomes were elevated (RRs range from 1.0–4.6, all $p < 0.05$) when UFP > 2000 #·cm−3 and $PM_{2.5}$ > 6.3 μg·m−3.

CONCLUSIONS: Both shorter- and long-term exposure to aerosols increased the risk of COVID-19 infection and subsequent outcomes, with ultrafine particles (UFP) exerting larger effects than $PM_{2.5}$, and with greater likelihood. The UFP and $PM_{2.5}$-associated risks were disproportionately higher for race-ethnicity minorities (particularly Hispanic and Black) and for their economically vulnerable subgroups.

KEYWORDS: COVID-19, ultrafine aerosol, particulate matter, environmental justice, socioeconomic status

P-0688 Maximum apparent temperature lowers birth weight and increase hazards of preterm birth in a constant high ambient temperature exposed population in Piura, Peru

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BACKGROUND AND AIM: Exposure to high environmental temperature during pregnancy has been associated with lower birth weight and an increased risk of preterm birth (PTB). The province of Piura is a region with a higher environmental temperature than the rest of the country; however, it is unknown how temperature would be impacting reproductive health in populations exposed to high basal temperatures. The aim of the study is to determine the association between maximum apparent temperature (HImax) during pregnancy with birth weight and preterm birth in newborns in the province of Piura, 2011-2016.

METHOD: Semi-ecological study, where maternal-perinatal data from Santa Rosa Hospital (N=17,788); and maximum apparent temperature data were evaluated. Four exposure windows were analyzed: the entire pregnancy, and each gestational trimester, which were assigned according to date of birth and gestational age, categorized into quartiles. The association with birth weight was assessed by linear regression; and Cox regression for PTB.

RESULTS: A negative association was found between birth weight and HImax in all exposure windows, except for the first trimester, the effect being greater during the third trimester. As for preterm birth, higher HImax increased the hazard of PTB, with the highest effect seen in the P95 exposed group in every exposure window; nonetheless, the first and second trimester being the most temperature-sensitive exposure windows.

CONCLUSIONS: HImax during pregnancy is related to lower birth weight and higher PTB hazards, but with different susceptibility according to the stage of pregnancy.

KEYWORDS: Apparent Temperature, Heat Index, Birth Outcomes, Peru, Latin America

P-0689 Residential exposure to Pesticides and Cleaning Detergents with increased risk of respiratory and allergic symptoms among farmworkers in Northern Tanzania

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BACKGROUND AND AIM: It has been suggested that environmental exposures to pesticides and cleaning detergents have an increased risk of respiratory and allergic symptoms in adults. However, the evidence of residential exposure to pesticides and cleaning detergents with increased risk of respiratory and allergic symptoms among farmworkers is limited. The aim was to investigate the association of environmental exposure to pesticides and cleaning detergents with increased risk of respiratory and allergic symptoms in farmworkers.

METHODS: In this cross-sectional analysis, we included farmworkers at the ages of 18 and 48 years from Kilimanjaro and Arusha region with information on residential exposure to pesticides, cleaning detergents, cough, rhinitis, wheeze, shortness of breath, cough with phlegm and itching skin collected in 2021 (N = 389) through administered questionnaires. Logistic regression analysis was used to estimate associations between exposure and outcomes, adjusting for potential confounders.

RESULTS: Cleaning detergents was associated with an increased risk of cough among farmworkers [adjusted odds ratios (95% CI) 3.90 (1.33, 11.38)]. However, there was a reduction of risk for itching when the farmworkers use cleaning agents [adjusted odds ratios (95% CI) 0.32 (0.16, 0.67)]. We found that there were risk reduction for cough, rhinitis, wheeze, shortness of breath, cough with up phlegm, difficulty in breathing and itching skin for farmworkers who had vegetable garden at their homes [adjusted odds ratios (95% CI) 0.31 (0.18, 0.54),0.48 (0.29, 0.78), 0.14 (0.05, 0.37), 0.35 (0.13, 0.96), 0.18 (0.07, 0.44), 0.20 (0.09, 0.47), 0.49 (0.25, 0.96)].

CONCLUSIONS: The findings of this study suggest that vegetable gardens at their homes had public health concerns as it reduced the risk of respiratory and allergic symptoms among our study participants. This is an important issue for future research.

KEYWORDS: Pesticides, Cleaning detergents, Respiratory, Allergic.

P-0696 Ambient air pollution and Carotid Intima-Media Thickness: a cross-sectional analysis from the Mexican Teachers' Cohort (MTC)

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BACKGROUND AND AIM. Is well known that ambient air pollution increases the risk of cardiovascular health outcomes. Carotid Intima-Media Thickness (CIMT) is a marker of subclinical atherosclerosis and a strong predictor of both prevalent and incident cardiovascular morbidity and mortality, including coronary heart disease, myocardial infarction, and stroke. CIMT has been positively associated with air pollutants such as PM2.5 and NO2, nevertheless evidence from low- and middle-income countries is scarce. We evaluated the cross-sectional association between long-term exposure to air pollutants and mean (left and right) CIMT in a population of middle-aged women from the MTC.

METHODS: We analyzed a randomized selected clinical subsample of the MTC participants living in the Mexico City Metropolitan Area, who were measured the mean CIMT once in 2017, using a standardized protocol (n=265). Self-administered questionnaires collected information on health and sociodemographic characteristics. Ambient PM2.5 and NO2 annual averages were predicted at home and work addresses using high resolution Generalized Additive Models, which were validated using ground measurements. We fitted multiple linear regression models adjusting for potential confounders: age, diabetes, body mass index, cholesterol, triglycerides, smoking and socioeconomic status.

RESULTS: Mean CIMT among participants was 618.5 µm (±86.5 SD), while mean PM2.5 and NO2 exposure was 22.5 µg/m3 (±3.5 SD) and 22.5 ppb (±6.6 SD) respectively. After confounder adjustment, each 10-unit increment of PM2.5 and NO2 exposure was positively non-significant associated with a 12.97 µm (95% CI: -16.91, 42.86) and 12.26 µm (95% CI: -1.46, 29.97) higher CIMT, respectively. Sensitivity analyses evaluating CIMT sides shown larger effects on the left CIMT.

CONCLUSIONS: Although with limited precision, these results suggest that long-term PM2.5 and NO2 exposure is associated with subclinical atherosclerosis in an upper-middle income country women population. Small sample size may have limited the statistical power to detect the effect.

KEYWORDS: Air pollution, atherosclerosis, Carotid Intima-Media Thickness

P-0712 The association between urinary concentrations of organophosphate metabolites and asthma-related outcomes at 12-month follow-up among children from informal settlements in Western Cape, South Africa

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BACKGROUND AND AIM: There is limited evidence on the relationship between pesticide exposure and child respiratory outcomes in non-agricultural settings. This study investigated the association between organophosphate pesticide (OP) exposure and child asthma-related outcomes among children from four informal settlements.

METHODS: This study was a longitudinal study of 590 schoolchildren, with a 12-month follow-up period. A standardised questionnaire adopted from the International Study of Asthma and Allergies in Childhood (ISAAC) was administered to caregivers on child's respiratory symptoms and household characteristics. Spirometry and fractional-exhaled nitric oxide (FeNO), including a phadiatop test (atopy status) and urinary concentrations of dialkyl phosphate (DAP) metabolites diethylphosphate (DEP), dimethylthiophosphate (DMTP)] were measured at baseline and follow-up. Dimethylphosphate (DMP) was measured only at baseline.

RESULTS: The mean age of schoolchildren were 9.9 ± 0.91 years and median sum DAP was 32.9 ng/ml (18.4 – 52.9 ng/ml) at baseline. Incidence proportions of new asthma outcome cases at 12-months were 2.2 % doctor diagnosed asthma, 17.8 % asthma-symptom score ≥ 2, 14.5 % forced expiratory volume 1< lower limit of normal, and 5.9 % airway inflammation across all areas. In the linear mixed and fixed effect model, no consistent patterns of increased risk of new asthma-associated outcomes at the 12-month was found. However, there was a significant increase in airway inflammation (β:2.99 (95% CI: 0.48 - 5.50) in the 3rd DEP quintile (1.9 – 3.0 ng/mL) compared to the reference quintile (1.10 ng/ml).

CONCLUSIONS: DAP concentrations were higher than those of children in other settings. However, the study did not find consistent associations between urinary concentrations of DAP metabolites and asthma related outcomes over a 12-month follow-up period among schoolchildren. Future studies with a longer follow-up period and repeated OP pesticide biomonitoring are recommended.

KEYWORDS: Pesticides, organophosphates, asthma, children, informal settlements, dialkyl phosphates, South Africa

P-0716 Epidemiological characteristics and spatio-temporal distribution patterns of human norovirus outbreaks in China, 2012-2018

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BACKGROUND AND AIM: Human norovirus are the leading cause of acute viral gastroenteritis worldwide. In China, the occurrence of norovirus outbreaks in different regions shows significant heterogeneity, while few study has focused on the spatial epidemiological characteristics of norovirus outbreaks. Thus, the aim of this study is to clarify the epidemiological characteristics and spatial distribution patterns of norovirus outbreaks.

METHODS: In China, according to the National Notifiable Disease Reporting System (NNDRS), 964 human norovirus outbreaks involving 50,548 cases in 26 provinces reported from 2012 to 2018 were analyzed in this study.

RESULTS: The outbreaks showed typical seasonality, with more outbreaks in winter and fewer in summer, and the total number of infected cases increased over time. The most common setting of norovirus outbreaks was school especially middle schools and primary schools with major transmission route of life-contact. More outbreaks occurred in southeast coastal areas of China and showed significant spatial aggregation. The highly clustered areas of norovirus outbreaks have expanded towards northeast over time.

CONCLUSIONS: By identifying the epidemiological characteristics and high-risk areas of norovirus outbreaks, this study provides important scientific support for the development of preventive and control measures of norovirus outbreaks, which is conducive to the administrative management of high risk settings and reduction of disease burden in susceptible areas.

KEYWORDS: norovirus outbreak; epidemiological characteristics; spatio-temporal heterogeneity; spatio-temporal aggregation

P-0718 The Risk of CVDs from Desalinated Seawater: A Nested Case-Control Study

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BACKGROUND AND AIM: Desalinated water has already been incorporated into municipal water supplies as the major source of water. The aim of this paper is to assess the association between desalinated seawater and cardiovascular diseases (CVDs).

METHODS: We conducted a nested case-control prospective study on a cohort of 7,806 subjects who live on an island of China that lacks fresh water. From this cohort, we identified 140 paired CVD cases and matched controls by sex and age during the same period. Questionnaires were used in order to investigate basic sociodemographic information and risk factors for CVDs, and urine samples were collected to measure calcium and magnesium levels. Using these data we developed and tested both univariate and multivariate logistic regression models.

RESULTS: We observed no significant differences in urinary calcium and magnesium levels between groups with and without directly desalinated seawater intake. From multivariate logistic regression, we found that obesity (OR= 5.38, 95% CI: 1.05 - 27.45), physical activity (OR= 0.35, 95% CI: 0.16 - 0.75), hypertension (OR= 3.61, 95% CI: 1.58 - 8.25), alcohol consumption (OR= 2.57, 95% CI: 1.02 - 6.47), and irritability (OR= 4.30, 95% CI: 1.93 - 9.60) were associated with an increased risk of CVD.

CONCLUSIONS: In this population, we found no association between desalinated seawater intake and CVDs; the incidence of CVDs was primarily related to lifestyle.

KEYWORDS: desalination, cardiovascular disease, incidence

P-0719 Socio-demographic heterogeneities govern the spatial dynamics of water and food-borne infections in the urban city of Ahmedabad, India

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BACKGROUND AND AIM: Urban areas of low and middle-income countries (LMICs) are conducive to inequality, environmental hazards, and infectious diseases due to a confluence of unique and complex risk factors such as in-migration and informal settlements. Therefore, this study aims to evaluate socio-demographic heterogeneities as determinants of water and food-borne infections in an urban city of Ahmedabad, India.
METHOD: Spatial disease dynamics of viral hepatitis, typhoid, and diarrhea in Ahmedabad from 2010 to 2017 were analyzed with socio-demographic risk factors of age/gender, slum population density, and illiteracy rates. Additionally, the administrative units' geographical distance was also considered, i.e., wards vicinity from the river. The association was delineated by spatial regression models of Ordinary Least Square (OLS) and Spatial Lag Regression (SLR).

RESULTS: A total of 97,171 cases from 2010 to 2017 were reported of viral hepatitis, typhoid, and diarrhea. Temporal trend analysis identified a rising trend of cases over the study period. Further, spatial autocorrelation analysis revealed a significant positive correlation with Moran's I statistics ranging from 0.09 for typhoid to 0.21 for diarrhea, i.e., a similar prevalence in nearby wards. The multivariate regression model revealed slum population density as a significant risk factor for all three diseases. Illiteracy rate and vicinity to the river also significantly contribute to the prevalence of viral hepatitis. Finally, excess risk mapping of diseases identified central and southern zones of the city, to the east of river Sabarmati as hotspots wards.

CONCLUSIONS: This study identified spatial disease dynamics of water and food-borne infections in Ahmedabad with hotspot wards that can be relevant from a public health perspective. The study recommends advocating rehabilitation, capacity building, and health system strengthening at sub-ward/ward levels through micro-planning to reduce the risk of diseases arising from spatial heterogeneities.

KEYWORDS: Viral Hepatitis, Typhoid, Diarrhea, Spatial heterogeneity, Socio-demographic risk factors

P-0720 Factors underlying urinary arsenic levels in a population residing close to a coastal heavy-industrial area in southern Taiwan

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The public in the southwestern Taiwan's Kaohsiung City expressed concern over risk of arsenic (As) to people living in six of that city's townships nearby a coastal area with heavy industry. To investigate, we first analyzed urinary total As levels in 539 subjects administered Taiwan's Nutrition and Health Survey, a nationwide survey of nutritional status 2005-2008 (NAHSIT 2005-8). We found the top three highest median urinary total As levels in residents from Penghu island (136.93 μg/L, n = 24), the upper northern region of Taiwan (78.54 μg/L, n = 69), and the southwestern region of Taiwan (71.87 μg/L, n = 36). We then measured total urinary As levels in 1,801 and 1,927 voluntary residents of the above-mentioned six townships in 2016 and 2018, respectively, and compared with those with people residing in the top three highest total As levels of NAHSIT 2005-8. Median urinary As levels were 84.6 μg/L in 2016 and 72.5 μg/L in 2018, similar to those in southwestern region of Taiwan, but far below those in Penghu island ($p < 0.05$). Finally, in 2020, we interviewed 116 healthy and voluntary residents from the same six townships and collected one-spot urine samples to analyze total inorganic-related As (TiAs), a summation of As3+, As5+, monomethylarsonic acid (MMA), and dimethylarsinic acid (DMA). Median urinary TiAs in participants consuming seafood two days before urine sampling (n=15) was 24.0 μg/L, significantly higher than those not consuming seafood then (median: 20.5 μg/L, n=101, $p=0.029$). The results remained significant after adjusting for other covariates ($p = 0.028$). These findings suggest that seafood consumption is probably the main source of urinary total As and TiAs in people residing close to that coastal heavy industrial area of southern Taiwan. A future intervention study (dietary control) could be conducted to re-confirm our findings.

P-0726 Determinants of carbon load in airway macrophages in pregnant women

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BACKGROUND AND AIM: The airway macrophages carbon loading (AMCL) has been suggested to be a biomarker of the long-term exposure to air pollution; however, to date no study has characterized AMCL for the pregnancy period. Therefore, this study aimed to assess the determinants of AMCL during pregnancy in Iran, a middle-income country.

METHODS: This study was based on a sample of 234 pregnant women with term and normal vaginal delivery who were residing in Sabzevar, Iran (2019). Image analysis was applied to calculate the carbon area (µm2) in airway macrophages as an indicator of AMCL. Measuring the AMCL was performed by two independent investigators and checked by third investigator to reduce the AMCL measurement bias. We characterized 35 potential determinants of personal exposure to air pollution for each participant, including six personal, nine indoor, and 20 home-outdoor factors. We applied Deletion/Substitution/Addition algorithm to identify the most relevant determinants that could predict AMCL levels.

RESULTS: The median (IQR) of AMCL level was 0.12 (0.30) µm2 with a successful sputum induction in 82.9% (194) of participants. Ambient residential PM2.5 levels were positively associated with higher AMCL levels. On the other hand, increased residential distance to the traffic lights, squares and ring-roads, the duration of opening window per day, and opening window during cooking were inversely associated with AMCL levels.

CONCLUSIONS: This study is the first to characterize AMCL during pregnancy. Moreover, this is one of the largest reported studies on characterization of AMCL levels. Furthermore, this is the first study to explore the personal, indoor and outdoor determinates of personal exposure to air pollution in pregnant women in an LMIC. Our findings provide novel insights on the different personal, indoor, and outdoor determinants of personal exposure to air pollution during pregnancy in a middle-income country.

KEYWORDS: Air pollution, Pregnancy, Biomarker, Lung

P-0727 Association of Traffic-Related Air Pollution with Newborn's Anthropometric Indexes at Birth

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BACKGROUND AND AIM: The evidence suggested many adverse health effects due to exposure to traffic-related air pollution (TRAP). However, the evidence on neonatal anthropometric measurements (NAPM) in low and middle-income countries is very scarce yet. Therefore, we investigate the association of prenatal exposure to indicators of traffic and ambient particulate matter (PM) with NAPM.

METHODS: This cross-sectional study was based on hospital medical records of 4053 mother-neonate pairs (2016-2018). Pwere estimated at residential addresses based on validated spatiotemporal models. Moreover, total street length in 100, 300 and 500m buffers around the home, residential distance to the ring road, major roads, heavy-traffic lights, gas station, motorway junction, bank, square, bus terminal, public parking and industrial land-use were calculated as indicators of traffic. The head circumference (HC), birth weight (BW) and birth length (BL) of neonates were collected as NAPM. Multivariate regression models were applied to evaluate the relationship between PMs and indicators of traffic with NAPM, controlled for relevant covariates.

RESULTS: The adjusted models revealed that higher exposure to PM2.5 and PM10 was significantly related with lower BW and BL. Similarity results were observed for total street length in a 100 m buffer around maternal home with BW and BL. Moreover, higher distance to heavy traffic lights was significantly associated with higher BW and BL. An IQR increase in PM10 was significantly related to lower HC (95% CI: -0.11, -0.01, P-value = 0.03). An increase in distance from residential address to heavy traffic lights, ring roads, bus terminal, and transportation land-use was associated with higher HC.

CONCLUSIONS: This is the first study on the association of prenatal exposure to ambient PMs and different indicators of traffic with NAPM. Overall, our findings suggested that higher prenatal exposure to TRAP was related with lower BW, BL and HC.

KEYWORDS: Infant, Maternal, Neonates

P-0731 Physical Activity Profiles and Uptake of Fitness Tracking Technology among Caribbean Residents

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BACKGROUND: Health is inextricably linked to, among various lifestyle factors, physical activity. However, countries in the Caribbean are understudied relative to other nations in North America, Europe and Asia regarding probes of potential associations between well-being and physical activity.
AIM: Our pilot study aimed to investigate physical activity in the Caribbean.

METHODS: We survey Caribbean ages 18 to 75 from 2016 to 2022. Analyses included descriptive statistics and logistic regression.

RESULTS: Among 272 survey respondents including a 10-member fitness tracker focus (FTF) group, approximately 53.0% reported not having diagnoses or symptoms of any illnesses. The most popular activities that persons engaged in were dancing (34.9%), football (27.6%), track and field (26.1%) and walking (38.2%). at least one hour was spent per week exercising (70.2%) and socializing (83%). The most popular recreational event types were related to carnival festivities (46.2%) and concerts (26.7%). Persons who participated in carnival were less likely to report recent maladies relative to non-participants (OR: 0.57; 95%CI: 0.35, 0.92). FTF group members report greater activity when supported by peers. FTF "revelers" (carnival participants) logged up to ten times more steps on carnival event days than non-event days. The top three barriers to being consistent in physical activity were lack of time (72.1%), lack of motivation (58.1%) and access to workout facilities (27.2%). While persons 30 and over were less likely than persons under 30 to be perceive facility access as an obstacle (OR: 0.45, 95%CI: 0.26, 0.78), persons under 30 were more likely to report insufficient time as a challenge to being more active relative to their older counterparts (OR: 1.84; 95%CI: 1.08, 3.17).

RESULTS: Findings proffer insight into the unique ways in which Caribbean peoples pursue and participate in various forms of physical activity with potential health benefits, partially mediated by peer support and fitness technology.

P-0732 NutriBodEC: A Cross-sectional Survey on Nutrition and Body Image in the Eastern Caribbean

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BACKGROUND: Body image dissatisfaction often driven by experiences as well as exposure to “unrealistic” body images through various visual media, has been linked to individual health.
AIM: Our pilot study intended to assess perceptions of body image and links to various lifestyle factors including diet.

METHODS: We surveyed 115 persons, ages 17 to 65, between 2018 and 2022 in the Eastern Caribbean country of St. Kitts and Nevis. Logistic analyses were applied.

RESULTS: Less than 20% of participants regarded their diet as "healthy". Neither food type nor portion sizes were significantly associated with weight, body types or perceptions of self. However, respondents with higher BMI (>25 kg/m2) were more likely (OR: 3.64; 95%CI: 1.63, 8.60) to eat larger portions of fish than those with lower BMI. The most desirable body types were (i) for women: hourglass (wide bust, narrow waist, with wide hips) and triangle (wide hips) and (ii) for men: inverted triangle (broad shoulders with small waist) and trapezium (broad shoulders with medium waist). Median complexions were higher ranked than extremes. While most respondents did not rate body types similar to their own as highly desirable, persons tended to rank complexion at least somewhat similar to their own more favorably. Male respondents were less likely to have negative thoughts about their appearance (OR: 0.41; 95%CI: 0.17, 0.94). Persons with BMI>25 kg/m2 were marginally more likely to be dissatisfied with taking selfies (OR: 2.84; 95%CI: 0.90, 10.91) than participants with lower BMI. Students, many of whom had to wear tailored uniforms to school, had a higher likelihood of anxiety (OR: 3.19; 95%CI: 1.10, 11.62) around their appearance relative to their non-academic counterparts.

CONCLUSIONS: Findings contribute to existing literature on perceptions of body image, while providing profiles of diet, body image satisfaction and health in an overlooked population

P-0744 Household fuel choices and the risks of cooking-related burns in Ghana

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BACKGROUND AND AIM: Cooking-related burns are a major public health concern in developing countries. Women and children are extremely vulnerable to burns at home. This study aimed to assess the determinants of household fuel choices and the risk of cooking-related burns among two riparian peri-urban communities along the Lower River Volta of Ghana.

METHODS: This cross-sectional study was conducted as part of a baseline assessment of an ongoing Invasive Aquatic Weeds Biomass Briquette Production for use as a Cooking Fuel project (AQUAWEB). The AQUAWEB is a cluster randomized control trial involving 400 households in intervention and control riparian communities (1:1) along the Lower Volta Lake in Ghana. In-person interviews guided by structured questionnaires hosted on the REDCap application served as the primary data source for the study. Chi-square tests and Logistic Regression tests were employed to analyze the data.

RESULTS: The majority of the households depended largely on charcoal (64.99%) and less on wood fuel (15.12%) and LPG (19.89%) as their primary cooking fuel. of the LPG users, 53.7% used LPG exclusively, whereas 3.3% and 43.3% used wood fuel and charcoal as secondary fuels respectively. Among charcoal users, 57% used it exclusively but 11% and 31.8% used wood fuel and LPG as their secondary fuel respectively. Among the primary users of wood fuel, 75% used it exclusively. But 23.6% and 1.3% used charcoal and LPG as their secondary fuel respectively. 68.5% of the adult population in households suffered any household air pollution cooking-related burns. Charcoal (OR=2.15, p-value = 0.004) and wood fuel (OR=1.98, p-value = 0.038) were associated with cooking-related burns.

CONCLUSIONS: Charcoal is predominantly used in riparian communities as a primary fuel. Wood fuel and LPG were also used to support the primary fuel. Charcoal and wood fuel is associated with cooking-related burns.

P-0745 Urinary pesticide residual levels and acute respiratory infections in children under five years of age: Findings from the Offinso North Farm Health Study

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BACKGROUND: Several environmental factors are associated with the risk of acute lower respiratory infections (ALRIs) and upper respiratory infections (URIs) in children under five years of age (YOA). Evidence implicating chemical pesticides remains equivocal. There are also no data on this subject in these children in Ghana. This study investigated the association between urinary pesticide residual levels and the risk of ALRIs/URIs in children under five YOA .

METHODS: The participants for this study were from the Offinso North Farm Health Study, a population-based cross-sectional study. 254 parents/guardians who had answered affirmatively to the question "Has your child ever accompanied you to the farm?" were interviewed on household socio-demographic and environmental factors, being breastfed, child education, age, gender, and respiratory infection. 150 children were randomly selected to provide the first void urine.

RESULTS: The proportion of children with ALRI was 22.1% and those with Upper Respiratory Infection (URI) were 35.8%. We observed a statistically significant exposure-response relation of p,p'-DDE (tertile) with ALRI [1.7-3.2 µg/L urine: prevalence ratio (PR)=1.22 (1.05-1.70), ≥ 3.2 µg/L urine: 1.50 (1.07-3.53) (p-for trend=0.0297)]. This observation was observed in children older than 2 YOA (p-for trend=0.0404). Delta-HCH and beta-HCH (2-levels) were significantly associated with ALRI but not URI. The risk of ALRI increased with deltamethrin levels in an exposure-response manner [2.5-9.5 µg/L urine: 2.10 (1.37-3.24), ≥ 9.5 µg/L urine: 4.38 (1.87-10.32) (p-for trend=0.0011) and this was also observed in older than 2 YOA. Similar observation was noted for URI. Bifenthrin (>0.5µg/L urine) was associated with ALRI and URI. But permethrin (≥1.2 µg/L urine) was associated with URI.

CONCLUSIONS: The present study reinforces the hypothesis that exposure to chemical pesticides is associated with respiratory infections in children under five YOA.

P-0746 Differential impact of environment on malaria due to control interventions in Uganda, 2010-2018

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BACKGROUND AND AIM: Studies have estimated the impact of environment on malaria incidence although few have explored the differential impact due to vector control interventions. We aimed to evaluate the influence of temperature, rainfall, humidity, and vegetation, in presence or absence of long-lasting insecticide treated bednets (LLIN) and indoor residual spraying (IRS).

METHODS: This study used weekly malaria cases from 2010 to 2018 from six health facility-based malaria surveillance in Uganda. Environmental variables were extracted from remote sensing sources and include enhanced vegetation index (MODIS), cumulative rainfall (ARC2), minimum and maximum temperature (ERA5), specific humidity (ERA5), averaged over different time periods (one to four months). Non-linearity of environmental variables was investigated, and general linear models based on a negative binomial distribution was used to explore the influence of ITN and LLIN on the malaria-environment relationship.

RESULTS: A total of 204,252 malaria cases were laboratory confirmed and the median (range) weekly cases was 58.0 (0-597), rainfall 18.6 mm (0-129), minimum temperature 17.6˚C (12.3-24.2), maximum temperature 26.7˚C (20.1-34.8), and humidity 0.014 kg.kg (0.006-0.018). The best fit model was with the meteorological measures averaged over 3 months. All environmental variables showed a relatively linear pattern. Both IRS and LLIN were significantly associated with risk reduction (IRR: 0.39, 95% CI: 0.36–0.42 ; IRR: 0.71, 95% CI: 0.67–0.75, respectively). Marginal effects of environmental variables showed that joint effect of IRS and LLIN reduced the weekly predicted counts of malaria by 72.5% compared to no intervention.
CONCLUSION: LLIN and IRS both reduced the influence of environmental drivers of malaria and therefore morbidity in various transmission setting in Uganda. The benefits appeared to be greatest when the two interventions are used in combination.

P-0751 Personal exposure to heat amongst older adult women in Tamil Nadu, India

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BACKGROUND AND AIM: In 2019, 127,000 deaths were attributed to heat exposure globally, with over 40% in India, where a substantial portion of the population has limited access to cooling technologies. This substantial burden is expected to worsen with climate change, but little is known about personal exposure to outdoor temperatures in India We leverage data collected as part of the Household Air Pollution Intervention Network (HAPIN) randomized controlled trial to describe personal temperature exposure of older adult women in Tamil Nadu. We compare personal exposure to ambient monitoring stations and modelled temperature products.

METHODS: As part of HAPIN, older adult women in Tamil Nadu periodically wore instrumentation for a 24-hr period to measure air pollution; these instruments also measure temperature. We analyzed temperature measurements taken between 2018 and 2021 and compared them to the nearest identified ambient monitoring stations, and to the ERA5 and GLDAS meteorological products.

RESULTS: Personal measurements were recorded from 105 different participants for a total of 1.7 million datapoints. The mean temperature recorded was 28.6 °C with a standard deviation of 3.5 °C. Differences of ≥5 °C across individuals on the same day were not uncommon, nor were intra-individual exposures that varied by several degrees within an hour -- potentially a result of elevated heat while cooking. ERA5 estimates were more positively correlated with personal exposure than with GLDAS or ambient monitors. Correlations varied by season, with best performance across all products during the monsoon season.

CONCLUSIONS: Accurate exposure assessment is important for assessing health effects of heat – a growing problem. There is substantial variability in how well public datasets correlate with personal experience, not only by product type but also location and season. It is important to quantify these differences to appropriately estimate health effects.

KEYWORDS: Heat, India, Remote Sensing, Exposure Assessment

P-0762 Health outcomes in redlined versus non-redlined neighborhoods: A systematic review and meta-analysis

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BACKGROUND AND AIM: Redlining was a racialized zoning practice in the U.S. that blocked fair access to home loans during the 1930s, and recent research is illuminating health problems in the current residents of these historically redlined areas. However, this work has not yet been holistically summarized. Here, we present the first systematic review and meta-analysis comparing health outcomes in redlined versus non-redlined neighborhoods in U.S. cities.

METHODS: We extracted relevant articles in PubMed, Web of Science, Cochrane and Science Direct databases published from January 2010 to September 2021.

RESULTS: The search revealed 12 studies on preterm births (n=3), gunshot-related injuries (n=2), cancer (n=1), asthma (n=1), self-rated health (n=1), multiple health outcomes (n = 2), heat-related outcomes (n=1) and COVID-19 incidence and mortality (n=1). A meta-analysis of three studies found the odds of having preterm birth was significantly higher (OR=1.41, 95% CI: 1.05-1.88; p=0.02) among women living in redlined areas compared to those in non-redlined areas. Review of other outcomes revealed that gunshot-related injuries, asthma, heat-related outcomes, and multiple chronic conditions were worse in redlined areas, while associations with cancer varied by cancer type. In terms of cause-specific mortality, one study revealed no link between residential redlining and infant mortality rate, while one study on COVID-19 outcomes was inconclusive.

CONCLUSIONS: Overall, this review presents evidence that living in historically redlined areas is associated with increased risk of multiple serious adverse health outcomes. Further research on mechanisms, remediation, and neighborhood-level interventions is needed to strengthen the understanding of the impacts of redlining on health.

KEYWORDS: Redlining; health inequities; structural racism; environmental justice; racial disparities; place-based disparities

P-0764 Identifying susceptibility factors for methylmercury-induced developmental neurotoxicity

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BACKGROUND AND AIM: Methylmercury (MeHg) exposures during pregnancy or childhood can cause developmental neurotoxicity (DNT), including cognitive, behavioral, and other effects. While many studies have reported on these effects, fewer have examined other factors that contribute to susceptibility to MeHg-induced DNT. The first objective of this project is to determine whether there are demographic, biological, psychosocial, societal, environmental, or other factors that may make developmentally exposed individuals more susceptible to these effects. A second objective is to develop a replicable approach for identifying susceptibility data in assessments of the health effects of chemicals.

METHODS: A systematic literature search for 2019-2021 aimed to identify all epidemiology studies that examined methylmercury exposure and DNT. Identified studies were then screened for susceptibility information at the title/abstract and full text levels by two reviewers. A search string was also developed and applied to title/abstracts to determine whether these studies could be identified without extensive screening. Susceptibility information was then summarized.

RESULTS: Data examining several potential susceptibility factors for MeHg were identified, including genetic polymorphisms, sex, maternal factors, nutritional status, and multi-chemical exposures.

CONCLUSIONS: This project identifies potential susceptibility factors associated with MeHg and DNT. The methods applied to MeHg may be adapted and utilized for identifying and interpreting the literature on susceptibility factors for adverse health effects from other chemical exposures.

KEYWORDS: methylmercury, developmental neurotoxicity, susceptibility, systematic review, environmental justice

Disclaimer: The views expressed in this abstract are those of the author and do not necessarily represent the views or the policies of the U.S. Environmental Protection Agency.

P-0769 Association between historical redlining and preterm birth in North Carolina, 2003-2015

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BACKGROUND AND AIM: Starting mid-1930s, the Home Owners' Loan Corporation (HOLC) ranked urban neighborhoods as least to most desirable in terms of perceived mortgage stability. This racist practice, redlining, likely led to disparities in proximity to environmental pollutants in these areas. Recent research suggests associations between historical redlining and adverse birth outcomes today. We investigated the association between historical redlining and preterm birth (PTB, <37 weeks gestation) in North Carolina (NC) and evaluated modification of that association by gestational parent (GP) race/ethnicity.

METHODS: We assembled a retrospective, administrative cohort of singleton births in NC from 2003-2015, linking geocoded residences at time of delivery to Mapping Inequality's HOLC polygons. Eligible births were assigned HOLC grade A (Best), B (Still desirable), C (Declining), or D (Hazardous). We estimated odds ratios (OR (95%CI)) using logistic regression adjusting for GP age at delivery and smoking during gestation, and applying generalized estimating equations to account for clustering by city.

RESULTS: Our analysis included 36,571 births within historically redlined cities in NC (Asheville, Charlotte, Durham, Greensboro, Winston-Salem). for births within the historically defined HOLC grades B, C, and D, respectively, the odds of PTB were 1.43 (95%CI: 1.10, 1.86), 1.77 (1.50, 2.09), and 2.10 (1.79, 2.48) compared to HOLC grade A. In stratified analyses, ORs were null and imprecise for all HOLC grades compared to HOLC grade A among non-Hispanic Black individuals (e.g. D vs A: 1.01 (0.60, 1.72)). ORs were positive but similarly imprecise among Hispanic and non-Hispanic white individuals with ORs that ranged from 1.61 (0.57, 4.54) to 1.70 (0.74, 3.93) and 1.20 (0.96, 1.50) to 1.27 (0.97, 1.67), respectively.

CONCLUSIONS: These preliminary results suggest that historical redlining is associated with poorer PTB outcomes decades later, providing additional evidence that historically racist practices continue to have lasting negative environmental burdens and health impacts on communities today.

P-0772 Quantifying sociodemographic inequities in exposure to point source carcinogenic industrial pollution emissions across the USA

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BACKGROUND AND AIM: Few studies have investigated how carcinogenic environmental exposures are distributed among the general population. We described recent cross-sectional relationships between carcinogenic industrial emissions and sociodemographic characteristics across the USA (US).

METHODS: We linked US Environmental Protection Agency's 2018 Toxics Release Inventory to sociodemographic characteristics in 2010 Census tracts. Using chemical abstract service registry numbers, we identified onsite emissions (e.g., air, landfill, surface) of known and probable carcinogens as classified by the International Agency for Research on Cancer. Tract characteristics included total population, median household income, Yost neighborhood deprivation index, poverty, and percentages of Black, Hispanic, and white populations. We used linear regression to investigate the relation between quintiles of emissions in each census tract and distributions of these characteristics.

RESULTS: 5,209 (7%) tracts with an estimated 23.2 million population contained 7,028 facilities emitting known (n=22) or probable (n=33) carcinogens, including 1 billion pounds of these emissions in total (median: 226; IQR 7-5970 pounds/tract). Compared to tracts without emissions (all p-values <0.01), those with the highest quintile of emissions had higher proportions of rural (44% vs. 19%) and white (71% vs. 62%) populations, lower median household income ($45,000 vs. $55,000), and a higher deprivation score (62 vs. 49). Tracts with the highest emissions had a higher proportion of population with a high school education or less (53% vs. 44%). Overall, the proportions of families below the poverty level did not differ; however, greater numbers of black and white families below poverty lived in the tracts with the highest emissions. We observed similar demographic patterns in analyses restricted to air emissions.

CONCLUSIONS: Our novel assessment demonstrates that carcinogenic emissions are not homogeneously distributed among the US population. It may be important to consider joint distributions of sociodemographic characteristics when describing environmental exposures and associated health disparities.

KEYWORDS: carcinogens, health disparities

P-0786 Quantification of green and walkable neighbourhoods across the distribution of social and material deprivation in Metro Vancouver, Canada

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BACKGROUND AND AIM: Along with other environmental exposures, both neighbourhood walkability, and greenspace exposure and access have been linked to many diverse health benefits. Previous work has examined the spatial relationship of built and natural environments according to levels of neighbourhood deprivation; however, less is known about how these relationships may vary when different greenspace metrics are used. This work examines how normalized differences vegetation index (NDVI), tree canopy cover, green land cover, and park count metrics relate to walkability, and how these neighbourhood characteristics associate with both social and material deprivation.

METHODS: Greenspace exposure was measured using NDVI, tree canopy cover, and green land cover, while park access was quantified by the number of designated public parks within 1000m and 400m network buffers for each six-digit postal-code centroid in Metro Vancouver, Canada. Local area deprivation was measured using the 2016 Material and Social Deprivation Index (MSDI). Pearson's correlation coefficients were calculated to compare these neighbourhood characteristics.

RESULTS: Walkability was positively associated with social deprivation (1000m $r = 0.48$; 400m $r = 0.48$, $p < .01$), while walkability has a weak inverse relationship with material deprivation (1000m $r = -0.21$, $p < .01$). Tree canopy was negatively related to both social (1000m $r = -0.23$, 400m $r = -0.23$, $p < .01$) and material deprivation (1000m $r = -0.24$, 400m $r = -0.23$, $p < .01$). In contrast, the relationship between park count and both deprivation measures was weak.

CONCLUSIONS: In this study, areas with greater social and material deprivation tend to have less greenspace, but not necessarily less park access. The identification of neighbourhoods with higher material deprivation, low walkability, and low greenspace, may be prioritized by urban planners and decision makers as possible locations for additional greenspace allocation.

KEYWORDS: greenspace, walkability, social deprivation, material deprivation

P-0794 Disparities in adverse birth outcomes attributable to elevated ambient air pollution in the U.S.

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BACKGROUND AND AIM: Preterm birth and low birth weight are global health challenges that increase a child's lifelong risk for chronic disease. These adverse birth outcomes (ABO) are associated with ambient air pollution with differential risks across socioeconomic groups, yet are not presently accounted for in environmental policy assessments. This study estimates annual counts of ABO associated with $PM_{2.5}$ exceeding American Thoracic Society (ATS) recommended standards and investigates relevant disparities by race and income.

METHODS: Pollution increments of annual $PM_{2.5}$ were calculated for all monitored U.S. counties by comparing 2018-2020 EPA design values to counterfactuals meeting ATS recommended levels (8 μg/m³ for annual and 25 μg/m³ for 24-hour $PM_{2.5}$). Increments were coupled with current concentration-response functions and CDC baseline incidence data to determine county-level annual numbers of ABO associated with $PM_{2.5}$ above counterfactual levels. Sub-group analyses by mother's race and source of delivery payment were conducted to determine exposure differentials.

RESULTS: Across monitored U.S. counties, approximately 7,300 (95% CI: 3,700–11,500) preterm and 5,200 (95% CI: 3,300–7,500) low weight births are associated with $PM_{2.5}$ levels above ATS recommendations. $PM_{2.5}$-related ABO rates were higher among Black vs. White mothers, driven by higher baseline incidence rates experienced by Black mothers. $PM_{2.5}$-related ABO rates were higher among Medicaid vs. non-Medicaid payees, a result of both higher $PM_{2.5}$ increments and higher baseline incidence among Medicaid payees.

CONCLUSIONS: Approximately 12,500 annual U.S. ABO can be linked to $PM_{2.5}$ above ATS recommended levels, with trends towards greater air pollution-related ABO for both Black mothers and Medicaid recipients. The magnitude of this effect, combined with lifelong health impacts attributable to these birth outcomes, provides a compelling argument that ABO should be factored into future environmental policy assessments.

KEYWORDS: birth outcomes; environmental justice; health impact assessment; particulate matter.

P-0806 Use of gradient boosting machine for exposome-wide analyses: application for pharmaceutical risk factors for amyotrophic lateral sclerosis

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BACKGROUND
Accumulating evidence suggests that human health is affected by a complex set of exposures, including to environmental toxicants, dietary constituents, psychosocial stressors, and physical factors. Capturing the complexity of the whole exposome is pivotal for advancing etiological knowledge, yet standard statistical methods, as well as recent developments for mixtures analysis, are limited to considering only a modest number of exposures and interactions while often also making the implicit assumption that the exposures are continuous. Machine learning approaches could offer benefits in these very high-dimensional settings.
METHOD
Using gradient boosted decision trees coupled with Bayesian model optimization and a nested cross-validation design, we describe an approach for outcome prediction based on a mixture of exposures, and for identification of specific culprit factors within the mixture that consistently drive the association while allowing for synergistic or antagonistic interactions between the predictors. While this flexible approach is applicable to many settings, we used it to evaluate the association between patients' history of medication use and risk of amyotrophic lateral sclerosis (ALS), as a steppingstone for integrating additional exposures and in a setting that largely avoids exposure measurement errors that further complicate many toxicant mixtures.

RESULTS: of nearly 800 binary predictors, we identified 7 medication classes that were consistently associated with ALS risk across independently trained models. Interactions between medication groups did not substantially affect the risk. Prediction accuracy was consistent, but low due to the lack of information on other etiological risk factors for ALS.
SUMMARY
The described methodology allows to predict the overall effect of a mixture and to identify specific culprit factors in very high dimensional settings and when both continuous and categorical exposures are of interest. While causal interpretation of purely predictive models should generally be avoided, the repeated sampling of the dataset has interesting causal inference implications.

P-0808 World Trade Center Exposome: A novel, data-driven approach to modeling risk and protective factors for adverse mental and physical health outcomes among WTC Responders

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BACKGROUND AND AIM: Responders involved in rescue and recovery efforts following the 9/11 World Trade Center (WTC) attacks were exposed to hazardous working conditions and toxic agents. Previous studies associating WTC exposure with adverse health outcomes focus on a small number of risk factors selected a priori. We proposed a data-driven, exposomic approach to investigate the mixture of risk and protective factors experienced by WTC responders (i.e., a 'WTC exposome') and its relation to responder health.

METHODS: We included 34,096 responders from the WTC Health Program (WTC-HP) with a physical and mental health evaluation and exposure assessment at first (post 9/11/01) visit. We used generalized weighted quantile sum (gWQS) regression to examine positive (i.e., risk) and negative (i.e., protective) associations between the "WTC Exposome" index containing 84 factors (i.e., dust and traumatic exposures, baseline health information, social support) and five WTC-related health outcomes as dichotomous (ever/never): post-traumatic stress disorder (PTSD), gastroesophageal reflux disease (GERD), respiratory problems, diabetes, and headaches. All models were adjusted for age, race, ethnicity, and gender.

RESULTS: The WTC exposome was associated with all five health outcomes (PTSD β_{risk} = 6.4, $\beta_{protective}$ = 0.1; GERD β_{risk} = 4.4, $\beta_{protective}$= 0.5; respiratory problems β_{risk} = 3.9, $\beta_{protective}$ = 0.6; diabetes β_{risk} = 1.6, $\beta_{protective}$ = 0.7; headaches β_{risk} = 5.6, $\beta_{protective}$ = 0.3; $p<0.0001$ for all models). The WTC exposomic profile (i.e., the mix of risk and protective factors) differed by health outcome. for example, working in an enclosed area contaminated with dust contributed most to PTSD risk while full-time employment post 9/11 appeared protective against PTSD.

CONCLUSIONS: Understanding WTC-related risk and protective factors enable us to better identify responders vulnerable to adverse outcomes and identify factors that may protect against the development or progression of disease. This approach has potential for future disaster response studies.

P-0815 Sex-specific associations between prenatal exposure to phthalates and neurocognitive development in Taiwanese children: Application of environmental mixture methods to small study sample

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BACKGROUND AND AIM: Few studies have examined the sex-specific effect of phthalates as a mixture by applying multiple mixture methods to a small study sample. This study, therefore, examined sex-specific associations of prenatal exposure to urinary phthalates with neurocognitive development in Taiwanese children aged two to three years old.

METHODS: The study included 127 children who were followed up at the ages two-three years in the Taiwanese Maternal and Infant Cohort Study. The Mental Development Index (MDI) and Psychomotor Development Index (MDI) were measured in children using the Bayley Scales of Infant Development-II (BSID-II). The monomethyl phthalate, monoethyl phthalate, mono-butyl phthalate (MBP), mono-benzyl phthalate, mono-2-ethylhexyl phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate, mono (2-ethyl-5-oxohexyl) phthalate (MEOHP) were measured in urine samples collected from mothers during pregnancy. Multivariable linear regression (MLR), Weighted Quantile Sum (WQS) regression, quantile g-computation (qgcom), Bayesian Kernel Machine Regression (BKMR), the Super Learner with g-computation were applied and compared to examine the sex-specific effects of the phthalate mixture on MDI and PDI.

RESULTS: The mediation MDI and PDI were 94.0 and 99.0, respectively. The spearman correlation ranged between -0.01 and 0.74. None of these methods could detect any sex-specific associations between phthalates and MDI. Results suggest that WQS and qgcomp were able to detect inverse associations between phthalates and PDI with a stronger effect in boys. BKMR and Super Learner with g-computation were unable to detect any precise associations of phthalates with PDI. However, mixture methods detected mixtures' negative directionality and linear dose-response effects on neurocognitive development. MBP, MEHP, and MEOHP dominated these associations with PDI.

CONCLUSIONS: Mixture methods outperformed MLR. However, flexible approaches like BKMR and Super Learner with g-computation may perform better with larger samples. Therefore, the study recommends using multiple mixtures methods for getting comprehensive results from mixture studies.

KEYWORDS: Mixture; Neurodevelopment; WQS; BKMR; G-computation

P-0820 Residential greenness, air pollution, and incident ischemic heart disease: A prospective cohort study in China

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BACKGROUND AND AIM: Green living environments are associated with beneficial health outcomes, whereas higher air pollution exposure might increase the risk of chronic diseases. Moreover, few studies have explored the interaction between residential greenness and air pollution on the risk of ischemic heart disease (IHD). Therefore we aimed to estimate the associations of residential greenness and air pollution with IHD and their interaction.

METHODS: We performed a prospective cohort study that included 29,141 adult participants recruited from Yinzhou District, Ningbo, China. Normalized Difference Vegetation Index (NDVI) around each participant's residence was calculated to measure residential greenness exposure. Land-use regression models were conducted to estimate long-term individual exposure to air pollutants, including nitrogen dioxide (NO2) and particulate matter with aerodynamic diameters ≤ 2.5 μm (PM2.5) and ≤10 μm (PM10). Cox proportional hazard models were used to calculate the hazard ratios (HRs) and 95% confidence intervals (95% CIs) for the association of residential greenness and air pollutants with the risk of incident IHD.

RESULTS: During 101,172.5 person-years of follow-up, 1,392 incident IHD cases were reported in the study population. Residential greenness, expressed as an interquartile range (IQR) increase in NDVI within 300m, was inversely associated with incident IHD. However, long-term air pollution exposures were associated with higher IHD incidence. Mediation analyses suggested that the beneficial effect of residential greenness on incident IHD could be partly mediated by reducing the exposure to PM2.5.

CONCLUSIONS: Higher greenness was associated with decreased risk of IHD, while air pollutants were positively associated with incident IHD. Meanwhile, residential greenness may decrease the risk of IHD by reducing PM2.5 exposure.

KEYWORDS: Residential greenness; Air pollution; Ischemic heart disease; Cohort study; Effect mediation

P-0827 Solar and Geomagnetic Activity Reduces Pulmonary Function and Enhances Particulate Pollution Effects

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BACKGROUND: Increased solar and geomagnetic activity (SGA) may alter sympathetic nervous system activity, reduce antioxidant activity, and modulate physiochemical processes that contribute to atmospheric aerosols, all which may reduce pulmonary function.
Aim: Investigate associations between forced expiratory volume at 1 second (FEV1) and forced vital capacity (FVC) with SGA, and assess whether SGA enhances adverse effects of black carbon (BC) and particulate matter ≤2.5 μm in diameter (PM2.5).

METHODS: We conducted a repeated measures analysis in 726 Normative Aging Study participants (Boston, USA) between 2000 and 2017, using interplanetary magnetic field (IMF), planetary K index (Kp), and sunspot number (SSN) as SGA measures. Linear mixed effects models were used to assess exposure moving averages up to 28 days for both SGA and pollution.

RESULTS: Increases in IMF, Kp Index and SSN from the day of the pulmonary function test averaged through day 28 of were associated with a significant decrement in FEV1 and FVC, after adjusting for potential confounders. There were greater effects for longer moving averages and enhanced effects of PM2·5 and BC on FEV1 and FVC with increased SGA. for example, for each inter-quartile increase (4.55 μg/m3) in average PM2·5 28 days before testing, low IMF (10th percentile: 3.2 nT) was associated with a -21.4 ml (95% CI:-60.8, 18.1) and -7.1 ml (95% CI:-37.7, 23·4) decrease in FVC and FEV1, respectively; high IMF (90th percentile: 9.0 nT) was associated with a -120.7 ml (95% CI:-166.5, -74.9) and -78.6 ml (95% CI: -114.3, -42·8) decrease in FVC and FEV1, respectively.

CONCLUSIONS: Increased periods of SGA may directly contribute to impaired lung function and enhance effects of PM2.5 and BC. Since exposure to solar activity is ubiquitous, stricter measures in reducing air pollution exposures are warranted, particularly in elderly populations.

KEYWORDS: Pulmonary Function, Air pollution, Solar and Geomagnetic Activity

P-0841 The urban vegetation and allergic rhinitis in Montreal, Canada

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BACKGROUND: Urban vegetation offers many benefits to population health and wellbeing. In addition to these benefits, trees also emit pollen that can cause allergies.
Objective: This study aimed to assess the association between urban vegetation and allergic rhinitis in the Montreal area.

METHODS: Data on spring symptoms (April, May, June) of allergic rhinitis were retrieved from the 2008 and 2014-2015 Quebec Population Health Surveys (EQSP) and population-weighted. 2015 Landsat-8 satellite images and LiDAR (Light Detection and ranging) point cloud were used to calculate, respectively, the Normalized Difference Vegetation Index (NDVI) and the average crown volume of trees. The values of these indices were classified into population quintiles. Associations between vegetation parameters and the prevalence of symptoms of allergic rhinitis were assessed with logistic regression models within buffer zones of 100, 250, 500, and 1000 meters around the respondent's six-digit residential postal codes, adjusting for sex, age and categories of income.

RESULTS: The combined sample of the two surveys totaled 6,901 respondents. The estimated prevalence of spring symptoms of allergic rhinitis in the population was 11.3% (CI95%: 10.4 – 12.2). The NDVI and average crown volume were not associated with symptoms of allergic rhinitis for any of the buffer zones. for a buffer zone of 250 meters, the adjusted odds ratio for an increase from the lowest to the highest NDVI value (Q1 and Q5) was 1.029 (CI95%: 0.764 – 1.385). The adjusted odds ratio for an increase from the lowest to the highest average crown volume value was 1.167 (CI95%: 0.878 - 1.552).

CONCLUSIONS: The results suggest that vegetation density does not have an impact on the prevalence of spring symptoms of allergic rhinitis in residents of the Montreal urban area. More detailed assessments on the associations with vegetation types are needed.

KEYWORDS: Urban vegetation, allergic rhinitis, Remote Sensing, NDVI

P-0843 Spatiotemporal exposure modeling of environmental circadian misalignment

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BACKGROUND AND AIM: Light exposure is the most powerful resetting signal for circadian rhythms. Environmental circadian misalignment (ECM) occurs from geographic variation in light exposure due to location within a time zone (delayed circadian phase from less morning and greater evening light exposure moving west in a time zone). The aim of this study was to develop and validate the first-ever nationwide spatiotemporal exposure model of ECM in the US.

METHODS: for all US census tracts, the ECM exposure model incorporated elevation (in meters) and the average difference (in minutes) in sunrise time and sunset time between the census tract center of population and the eastern-most time zone boundary. Higher ECM exposure values indicate higher circadian misalignment due to higher elevation (fewer obstructions/extended field of view) and larger differences in sunrise and sunset times. Spearman correlation coefficients and multivariable linear regression adjusting for age, sex, race, ethnicity, median household income, and population density were used to validate the ECM exposure model with census tract-level prevalence of obesity (2016-2019) (known outcome associated with circadian misalignment).

RESULTS: Among the 60,943 census tracts included in this study, obesity prevalence was 32.62%. ECM exposure was positively correlated with obesity prevalence, with the strongest correlation in the Eastern time zone (r_s=0.44, $p<0.01$). The highest vs. lowest ECM quintile was associated with higher obesity prevalence in the Eastern (adjusted β=6.00, 95% CI 6.68, 7.11) and Central time zones (adjusted β=2.85, 95% CI 2.62, 3.09), which are the US time zones characterized by the largest east-to-west distance (i.e., opportunity for ECM).

CONCLUSIONS: We developed and validated a US nationwide spatiotemporal ECM exposure model, which can be used for exposure assessment in epidemiologic studies to enable comprehensive characterization of geographic variation in light exposure potentially impacting circadian phase.

KEYWORDS: light exposure; circadian misalignment; exposure model

P-0846 Phenols, parabens and triclosan in maternal urine, Medellín-Colombia

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INTRODUCTION: Phenols, phthalates, parabens and triclosan are endocrine disruptors and are suspected of generating epigenetic damage during prenatal life (1). The biological matrix most used to measure them is urine (2). Objective: to quantify the concentrations of phenols, parabens and triclosan) in pregnant women in two health institutions in Medellín.

METHODS: 400 pregnant women were recruited and of these it was possible to analyze 38 pools of urine (20 punctual samples) to quantify the metabolites of phenols, parabens and triclosan, the analysis was carried out at the Norwegian Institute of Public Health (NIPH), by ultra-high resolution liquid chromatography coupled to tandem mass spectrometry (UPLC-MS-MS) (2), the analyzes were corrected by specific gravity.

RESULTS: the geometric means according to the metabolites were Bisphenol A (BPA: 1.78 ng/mL), Methyl paraben (MEPA: 88.91 ng/mL), Ethyl paraben (ETPA: 2.95 ng/mL), Propyl paraben (PRPA: 10.32 ng/mL), Oxybenzone (OXBE: 27.94 ng/mL) and Triclosan (TRCS: 36.74 ng/mL).

CONCLUSIONS: This is the first study in Colombia that quantifies concentrations of phenols, phthalates, parabens and triclosan in pregnant women from Medellin. The geometric means of the metabolites BPA and parabens are in the middle when comparing with studies, but TRCS is above other studies in the world.

KEYWORDS: phenols, parabens, triclosan, endocrine disruptors; urine

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P-0849 Personal exposure to radiofrequency electromagnetic fields in various occupations in Spain

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BACKGROUND: A Job-Exposure Matrix (JEM) for radiofrequency electromagnetic fields (RF-EMF) was previously created based on measurements collected from the literature and individualized EMF source-based information. In the context of an international study aimed at enhancing this preliminary JEM, personal measurements of occupational exposure to RF-EMF were conducted among various occupations in Spain.

METHODS: Identification and prioritization of occupations to be measured were based on the levels and prevalence of exposure to RF fields in the preliminary RF-JEM and expert judgements. A screening questionnaire developed within our project was used to identify potential participants, based on job titles, tasks, and reported sources of RF exposure. Personal full-shift measurements were conducted using 10 Narda RadMan 2XT personal measurement devices.

RESULTS: Personal full-shift measurements were collected for 285 workers of various occupations in Spain. Exposures to electric (E) and magnetic (H) fields were low (99.74% of (E-fields) measurements <1% ICNIRP standards). Results exceeded the ICNIRP limits for only 3% of the workers, though these exceedances lasted a few seconds. Overall, almost 50% of workers had values above 1% of the ICNIRP standards (exposure duration between 1 second and 27.13 minutes). Electric and magnetic fields peaks exceeding 100% of the standards were observed among 8% of the physiotherapists (N=59) and 7% of the nursing auxiliaries (N=28), with exposure durations ranging from 1 to 13 seconds (E-fields) and 2 to 36 seconds (H-fields) of exposure above the limits, respectively.

CONCLUSIONS: We performed the first phase of data collection of personal RF-EMF measurements among various occupations in Spain in the framework of an international study. The initial results in Spain showed low prevalence and low overall levels of exposure to RF fields, despite some short-term peaks. Additional measurements will be conducted in France and the Netherlands.

KEYWORDS: Radiofrequency electromagnetic fields, occupational exposure assessment, job-exposure-matrix

P-0857 Assessing environmental exposure and socioeconomic history prior to cancer diagnosis

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BACKGROUND AND AIM Exposure assessment solely based on the address at cancer diagnosis assumes fixed exposure over time, while ignoring exposures from other addresses prior to cancer diagnosis. We aim to examine excess exposure risks of non-asbestos air toxics and socioeconomic status (SES) estimated over available residential history for mesothelioma patients.

METHODS: Patients' residential histories were obtained by linking mesothelioma cases (n=1,015) diagnosed during 2011-2015 from the New York State Cancer Registry to LexisNexis administrative data and inpatient claims data. Percentile ranking of lifetime cancer risk from inhalation of non-asbestos air toxics was based on the National Air Toxic Assessment. SES was measured by Yost index, which is a percentile ranking derived from U.S. Census data. Excess exposure risk was calculated by dividing exposures at individual census tracts by the state-level average and subtracting one. We used a generalized linear regression model with the generalized estimating equation to compare the excess exposure risk in years prior to and at cancer diagnosis.

RESULTS: Approximately 43% of the study sample had a residential history prior to the cancer diagnosis for up to 30 years, and 94% up to 5 years. The excess exposure risks at the cancer-diagnosis tracts were below the state average, with means ranging from -0.22 to -0.11 for air toxics, and from -0.23 to -0.18 for SES. Excess exposure risks for both air toxics and SES tended to be higher in earlier addresses than addresses at cancer diagnosis, though the effect size was relatively small (1%-6.2%).

CONCLUSIONS:We demonstrated the feasibility of including residential history in cancer research and revealed differences between multiple approaches of estimating residence-related exposure risks over time. As the findings may be unique to the mesothelioma patients studied, future examinations using different exposure indicators and among different patient populations and other cancer types are needed.

P-0864 Influence of Environmental and Dietary Exposures on Trace Metals and Organochlorine Pollutants Accumulation Among the Residents of a Major Industrial Harbour (Fos-sur-Mer, France)

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BACKGROUND AND AIM. – We investigated whether residents who lived closer to the core of one of the largest industrial zone in Europe (Fos-sur-Mer, France) had higher serum or urine levels of trace metals (Antimony, Arsenic, Cadmium, Chromium, Cobalt, Mercury, Nickel, Lead and Vanadium) and organochlorine indicators (NDL-PCBs, DL-PCBs and PCDD/Fs) than people who lived out of the industrial core zone (Saint-Martin-de-Crau, France).

METHODS: –The INDEX cross-sectional study was conducted from September to November 2016. We collected blood samples from 138 people (80 in the exposed area and 58 in the control area), which were included using a stratified random sampling method and selected with strict criteria (e.g., 30–65 years old, living in the area for at least 3 years, not working in the industrial sector, non-smoker). Biomonitoring indicators were calculated using single-pollutant multivariate linear regression models (using substitution when censored data were under 15% and Tobit models alternatively), adjusting for personal physiological, social, dietary, housing characteristics and leisure activities. We also measured these pollutants in samples of lichens (Xanthoria parietina) and atmospheric particles (PM2.5).

RESULTS: – Living close to the core industrial zone was significantly associated with an increase in blood levels of lead (adjusted geometric mean = 17.2 [15.8-18.7] vs 15.1 [13.7–16.7] µg.g-1 creatinine, $p<0.05$). We reported that behaviours that involved environmental exposures (i.e., gardening, dietary history of consumption of vegetables, eggs, poultry, and local seafood) were significantly associated with an increase in some organochlorine and trace metals urine/serum levels amongst residents of the industrial port zone compared to the residents of the control area.

CONCLUSIONS: - These results brought interesting clues, in complement to national programs, regarding the exposure to trace metals of residents living in a major industrial european harbor.

KEYWORDS: - Industrial pollution - Biomonitoring - Heavy metals - PCBs – Dioxines - Dietary habits

P-0867 Urinary Creatinine Concentrations and Its Explanatory Variables in General Chinese Population: Implications for Creatinine Limits and Creatinine Adjustment

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BACKGROUND AND AIM Urinary creatinine (Ucr) is commonly used to determine the acceptability of spot urines and to adjust for dilution variation of spot urine specimens. However, some controversy exists over the creatinine limits (0.3–3.0 g/L) recommend by WHO. Ucr concentrations variy across individuals and are affected by numerous factors, which may complicate epidemiologic associations related to chemical-to-creatinine ratios. An improved understanding of the variation and predictors of Ucr concentrations is necessary. The study aimed to analyze the applicability of the WHO's exclusionary guidelines in the general Chinese population, and to identify Ucr related factors.

METHODS: The cross-sectional study included 21,167 participants aged 3 to 79 years from the initial cycle of the China National Human Biomonitoring Program. We used mixed linear models and restricted cubic splines (RCS) to analyze associations between explanatory variables with Ucr.

RESULTS: In general Chinese population, the geometric mean and median concentrations of Ucr were 0.90 g/L and 1.01 g/L, respectively. 9.36% samples were outside 0.3-3.0 g/L, including 7.83% below the lower limit and 1.53% above the upper limit. Middle age, male, obesity, smoking, higher frequency of red meat consumption and chronic kidney disease were significantly associated with higher concentrations of Ucr. Results of RCS showed Ucr was inversely and linearly associated with BMI, systolic blood pressure, diastolic blood pressure, triglycerides and glomerular filtration rate, and were non-linearly associated with triiodothyronine.

CONCLUSIONS:The age- and sex-specific cut off values of Ucr determining the validity of urine samples in general Chinese population were recommended. To avoid introducing bias into epidemiologic associations, potential predictors of Ucr observed in the present study should be considered when choosing correction methods.

KEYWORDS: Biomonitoring; Urine; Hydration correction; Creatinine

P-0872 Metal contaminants in river water and human urine after an episode of major pollution by mining wastes in the Kasai province of DR Congo

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BACKGROUND: In July2021, the Tshikapa river became heavily polluted by mining wastes from a diamond mine in neighboring Angola, leading to massive killing of fish, disease and even deaths among residents living along the Tshikapa and Kasai rivers. The exact nature of the pollutants was unknown.

METHODS: In a cross-sectional study, conducted in the city of Tshikapa in August 2021, we enrolled by opportunistic sampling 65 residents (11 children <16y) living alongside the polluted rivers, and 65 control residents (5 children) living alongside the Kasai river upstream from the Tshikapa-Kasai confluence. We administered a questionnaire and obtained river water and spot urine samples for measuring thiocyanate (a metabolite of cyanide) and 26 trace metals (by ICP-MS).

RESULTS: Participants from both groups consumed river water. In the area affected by the pollution, most participants had eaten dead fish. Prevalences of reported health symptoms were higher in the exposed group than among controls: skin rashes (52% vs 0%), diarrhea (40% vs 8%), abdominal pain (8% vs 3%), nausea (3% vs 0%). In polluted water, concentrations [median (range)] were only higher for nickel [(2.2(1.4–3.5)µg/L] and uranium [78(71–91)ng/L] than in non-polluted water [0.8(0.6–1.9)µg/L; 9(7–19)ng/L]. In urine, concentrations [µg/g creatinine, median(IQR)] were significantly higher in the exposed group than in controls for lithium [19.5(12.4–27.3) vs 6.9(5.9–12.1)], thallium [0.41(0.31–0.57) vs 0.19(0.16–0.39)], and uranium [0.026(0.013–0.037)] vs 0.012(0.006–0.024)]. Urinary thiocyanate concentrations did not differ.

CONCLUSION. This study after an ecological disaster in DR Congo has documented contamination of river water by nickel and uranium, and high urinary levels of some trace metals among affected riverine populations. However, the exact cause of the massive fish kill and disease among residents remains elusive. The capacity to rapidly investigate toxic pollution events must be increased in the area.

KEYWORDS: Trace Metals,mining,Water pollution,Kasai province.

P-0874 An ecological analysis of the association between industrial air pollution and asthma onset in children of Quebec, Canada

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BACKGROUND AND AIM: Asthma is the most prevalent respiratory disease in children worldwide. During the past decades, industrial emissions decreased dramatically in Canada. However, whether these decreases contributed to the decrease in asthma cases is still unclear. The aim of this study was to assess the associations between the changes in concentrations of industrial PM2.5, NO2, and SO2 emissions and the changes in asthma onset in children (<12 years) in Quebec, Canada with an ecological longitudinal design.

METHODS: Within 1310 small geographic sectors of Québec, yearly new cases of asthma in children were compiled from linked medico-administrative databases. The annual ambient concentrations of PM2.5, NO2, and SO2 related to industrial emissions from overall sectors for 2002 to 2015 were estimated by the POLAIR3D chemical transport model. Fixed-effects regression models were used to assess the associations between the time trend of industrial air pollution levels and the time trend of rates of asthma onset within the small areas, adjusting for median annual household income. Environmental tobacco smoke was additionally adjusted in sensitivity analyses.

RESULTS: The pollutant levels from industrial emissions per small area ranged from 0 to 12.91 µg/m3 for PM2.5, 0 to 28.63 ppb for NO2, and 0 to 494.34 ppb for SO2, respectively. The adjusted incidence rate ratios per 1 µg/m3 increase in PM2.5 and per 1 ppb increase in NO2 and SO2, were 1.045 (95% CI: 1.016 - 1.075), 1.045 (1.032 - 1.060), and 1.006 (1.004 - 1.07), respectively.

CONCLUSIONS: Industrial emission-related air pollutions were significantly associated with childhood asthma onset in Quebec. Since significant reductions in industrial emissions of air pollutants and asthma incidence have been observed in Quebec over the past two decades, our results suggest that the reduced industrial emissions may have contributed to the decreased asthma onset rate.

KEYWORDS: asthma, industrial emission, pollution, fixed-effects model

P-0877 Predicting Monthly Community-level Radon Concentrations with Spatiotemporal Random Forest METHOD: a Study in Northeastern and Midwestern USA

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BACKGROUND AND AIM: Exposure to radon gas is the lead cause of lung cancers in never-smokers in the USA. Studies associating radon to other health outcomes have reported conflicted results, likely due to the inaccurate exposure assessments. Most previous radon-related epidemiological studies relied on an out-of-date county-level exposure model without temporal variation, which introduced misclassifications. Tens of millions of radon measurements have been conducted in the U.S, therefore enabling us to estimate radon concentrations at higher resolutions with better accuracy.

METHODS: We obtained over four million radon measurements from Spruce Environmental Technologies, Inc, a leading radon detector manufacturer. Community-level monthly radon concentrations were predicted based on geological, architectural, meteorological, and socioeconomic factors. Our innovative spatiotemporal random forest method extended the original one by allowing the relation between radon and its predictors to vary across space and time. Specifically, we fitted an independent model for each ZCTA and month based on the nearby radon measurements that are defined by the spatiotemporal proximity. The abundance of measurements enabled us to predict concentrations in the basement and upstairs respectively.

RESULTS: In Northeastern and Midwestern U.S, the average radon concentrations are 81.8 Bq/m3 in the basement and 50.7 Bq/m3 in the upstairs. The correlation (R2) between the predicted and observed geometric mean of radon concentrations is 0.77 in the basement and 0.57 in the upstairs if there are over 10 radon measurements in the same ZCTA and month. The mean absolute error (MAE) and mean relative error (MRE) are 19.7 Bq/m3 and 14.3% without obvious spatial trends.

CONCLUSIONS: Our predicted radon concentrations are highly correlated with the observed levels, therefore can be used in epidemiological studies to reduce misclassifications. The temporal variation characterized in our model will facilitate studies regarding the acute effects of radon.

KEYWORDS:
Radon, Machine Learning, Exposure Assessment.

P-0879 A National Comparison Between Short- and Long-term Radon Measurements in the USA

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BACKGROUND AND AIM: Understanding the spatiotemporal distribution of radon is essential to assess residential radon exposure. Long-term radon measurements that last over 90 days are considered gold standard to assess residential exposure but were conducted in a limited quantity due to the long duration. Tens of millions of short-term radon measurements, which normally last 2 to 4 days, have been conducted in the past decades because radon disclosures are required during property transaction in 35 out of 48 contiguous states. However, the application of these massive short-term measurements is limited likely because of the unknown real-life uncertainty.

METHODS: We therefore collected 2,450 pairs of collocated short- and long-term measurements, evaluated the pairwise correlation between them, and investigated the factors that determine the correlation between them via stratified linear regression and bootstrapping resampling.

RESULTS: We found that the pairwise correlation between the short- and long-term radon measurements is a joint function of two factors: the temporal difference between two measurements and the measuring length of the following long-term measurements. The correlation was as high as 0.76 (0.95 Confidence Interval [CI]: 0.70 to 0.84) when the temporal difference was shorter than two weeks and the length of long-term measurement was shorter than 100 days. Meanwhile, the correlation can be as low as 0.13 (0.95 CI: 0.09 to 0.32) when the temporal difference was over two months, and the length was close to a calendar year.

CONCLUSIONS: The high correlations indicates that short-term measurements can be used as a reliable proxy to a long-term measurement under specific conditions after adjusting for inherent differences. Our conclusion will facilitate the usage of this abundant data source, which has been obtained but was underutilized, thus likely enhancing our knowledge regarding other health effects associated with radon.
KEY WORDS
Radon, Exposure Assessment, Statistics

P-0883 Case-crossover study between PM2.5 and hospital admissions for respiratory diseases in Pretoria

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BACKGROUND: Particulate matter air pollution has been associated with adverse health effects. Air pollution epidemiology traditionally focuses on the relationship between individual air pollutants and health outcomes (e.g., mortality). To account for potential co-pollutant confounding, individual pollutant associations are often estimated by adjusting or controlling for other pollutants in the mixture. The objective of the study is control for components within the mixture which are highly correlated.
METHOD: An overall study is performed where PM2.5, BC, UV-PM and trace elements were controlled for Tapp and public holidays, stratified for age and sex. A second model, where PM2.5 is also controlled, was performed.

RESULTS: In total, there were 15 155 reported hospitalisations for respiratory diseases (J00-J99) over the 34-month period. The increase in respiratory hospital admissions was significantly increased by an increase in total PM2.5 of 2.7% (95% CI: 0.6, 4.9) per 10 µg/m3 increase. respiratory hospital admissions significantly increased for Ca by 4.0 % (95% CI: 1.4% - 6.8%), Cl by 0.7 % (95% CI: 0.0% - 1.4%), Fe by 3.3 % (95% CI: 0.5% - 6.1%), K by 1.8% (95% CI: 0.2 – 3.5) and Si by 1.3 % (95% CI: 0.1% - 2.5%). When controlling for PM2.5, respiratory hospital admissions increased significantly for total Ca by 3.2 % (95% CI: 0.3, 6.1) and for the 0 – 14 age group by 5.2 % (95% CI: 1.5, 9.1). Hospital admissions was positive and significantly increased with an increase in resuspended dust matrix by 2.9 % (95% CI: 0.1% - 5.7%) and for biofuel burning by 1.6 % (95% CI: 0.1% - 3.2%) sources.

CONCLUSIONS: Controlling for a co-pollutant which is highly correlated with PM2.5 does reduce overestimation, but further studies should include deposition rates and parallel sampling analysis.

KEYWORDS: Tapp, PM2.5, sources, respiratory

P-0896 Intrauterine exposure to phthalates in pregnant women, Colombia

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INTRODUCTION: Phthalates are endocrine disruptors used in the manufacture of multiple industrial products, mainly plastics. Intrauterine life represents the main window of vulnerability and exposure to phthalates in this stage of life generates adverse fetal and postnatal effects (1). The most reliable biomarker for phthalate measurement is urine.
OBJECTIVE: To characterize the different sources of exposure to endocrine disruptors and to quantify the urinary concentration of phthalates in pregnant women.

METHODS: 400 women ≤12 weeks pregnant were included at baseline, and of these 38 pools of urine (20 spot samples) were analyzed for phthalate metabolites, analysis was performed at the Norwegian Institute of Public Health (NIPH) (2), analyzes were corrected for specific gravity and descriptive statistics are presented.

RESULTS: The geometric means of phthalate Di(2-ethylhexyl)phthalate(DEHP), Mono-n-butyl phthalate(MnBP), Mono-2-ethyl-5-hydroxyhexyl phthalate(MEHHP), and Mono-2-ethyl-5- oxohexyl phthalate(MEOHP) were 162.72 µg/L, 58.50 µg/L, 33.93 µg/L and 31.63 µg/L, respectively.

CONCLUSIONS: it is the first study that quantifies phthalate metabolites in Colombia. Concentrations of MnBP, MEHHP, and MEOHP in urine are higher than those found in pregnant women around the world.

KEYWORDS: phthalates; endocrine disruptors; urine; pregnancy
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P-0898 Occupational Exposure to Diesel Exhaust in Bus Drivers in the New York Metropolitan Area

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BACKGROUND AND AIM: Exposure to diesel exhaust (DE) has been associated with adverse respiratory health outcomes and bus drivers could be at significant risk. We leveraged exposure data collected from real-time personal monitoring and geospatial location information to identify the factors influencing DE exposure in New York bus drivers.

METHODS: DE exposure was estimated via black carbon (BC; a component of DE) measurements recorded using a micro-Aethalometer (microAeth®Model-AE51) every minute over six 24-hour periods in four bus drivers during September-October 2014. Driving routes originated from two Westchester bus depots and traversed lower Westchester. Each driver's location was continuously recorded every minute using a global positioning system (GPS) device. Information on fuel type, smoking status, worker activities, and meteorological variables were collected. Road density indices were calculated based on an 100-meter buffer. We performed multivariable-adjusted regression models to assess the factors associated with BC levels.

RESULTS: BC data were collected for a total of 2682 working minutes and 4328 non-working minutes. Overall median BC level was 578 ng/m3 (IQR: 189-1487 ng/m3) [working hours: 1166 (612-2168) ng/m3; non-working hours: 351 (132-860) ng/m3]. Multivariable-adjusted models predicted that compared to times working in office, workers were on average exposed to an additional 1403.5 ng/m3 and 2150.4 ng/m3 of BC when they were in the depot yard and driving the bus, respectively. Driving a diesel-powered vehicle was associated with 2.7-fold increase in BC levels compared to gasoline-powered. for every 10% increase in the sum of road length index, BC level increased by 19% (95%CI=15-24%). Further, for every 10% increase in average speed, BC level increased by 20% (95%CI=17-23%).

CONCLUSIONS: Driving a diesel-powered vehicle presented significantly more BC exposure comparing to gasoline-powered vehicle. Roadway density and driving speed contributed to elevated BC levels.

KEYWORDS: diesel, transportation, bus driver, occupational exposure

P-0912 Health Benefit of PM2.5 Control Legislations in Korea

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BACKGROUND AND AIM: Exposure to PM2.5 has been associated with increased mortality. The aim of the present study was to evaluate the health benefit of policies to reduce air pollution.

METHODS: We selected three air pollution control policies that were implemented between 2006 and 2018 in Seoul and Incheon, Korea. We estimated three types of impacts to evaluate the benefit of each policy. These impacts are benefit from reduced PM2.5 concentration (Impact 1), benefit from reduced magnitude of association (Impact 2) and reduced both concentration and magnitude of association (Impact 3). We conducted interrupted time series analyses to examine changes in PM2.5 concentration and magnitude of association with mortality after the implementation of the policies. We calculated the health benefit accounting for reduced daily PM2.5 concentration and its association with mortality.

RESULTS: We observed a decrease of PM2.5 concentrations after interventions in Seoul and Incheon. The effect of policy on associations between PM2.5 and mortality were different from intervention to intervention, but the magnitude of association in Seoul continued to decline. The numbers of prevented deaths in Seoul in one year after the implementation of each policy were 252 (95% CI: 221, 293), 365 (95% CI: 24, 432) and 120 (95% CI: 0, 262), respectively. In Incheon, the numbers of prevented deaths were 68 (95% CI: 0, 197), 167 (95% CI: 0, 184) and 149 (95% CI: 0, 298), respectively.

CONCLUSIONS: The present results suggests that air pollution control policies in Seoul and Incheon were effective in terms of preventing mortality.

KEYWORDS: mortality, health impact assessment, policy, particulate matter, attributable deaths

P-0913 Association of sound pressure levels and frequency components of road traffic noise with prevalent depression in Taichung, Taiwan

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The World Health Organization has reported that the prevalence of mental illness is 4% in the global population. Epidemiological studies have reported a relationship between road traffic noise exposure and depression, but the association between noise frequency components and depression remains unclear. This cross-sectional study investigated the associations between road traffic noise exposure and its frequency components with prevalent depression. A total of 3,200 residents living in Taichung who participated in the Taiwan Biobank between 2010 and 2017, were included as study participants. We used land-use regression models to evaluate individual annual average values of A-weighted equivalent sound level over 24 h (Leq,24h) and particulate matter with an aerodynamic diameter less than 2.5 μm (PM2.5) using the geographic information system. Multiple logistic regression was applied to estimate the odds ratios (ORs) for depression after adjusting for potential risk factors and PM2.5. An interquartile range increase in Leq,24h at full frequency (4.7 dBA), 1000 Hz (5.2 dB), and 2000 Hz (4.8 dB) was significantly associated with an elevated risk for depression with ORs of 1.62 (95% confidence interval [CI]: 1.03, 2.55), 1.58 (95% CI: 1.05, 2.37), and 1.58 (95% CI:1.03, 2.43), respectively, by controlling for PM2.5. The high-exposure group (≥ the median of noise levels) at full frequency, 500 Hz, and 2000 Hz had an increased risk for depression with ORs of 1.87 (95% CI: 1.03, 3.39), 1.94 (95% CI: 1.03, 3.65), and 1.86 (95% CI: 1.03, 3.37), respectively, compared with the low-exposure group (< the median of noise levels) after adjustment for PM2.5. Road traffic noise exposure may be associated with an increased prevalence of depression, particularly at 500 to 2000 Hz.

P-0917 Multiple xenoestrogen air pollutants and breast cancer risk: statistical approaches to investigate the combined exposures effect

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BACKGROUND AND AIM: Despite that the population is exposed to a mixture of multiple air pollutants, the joint effect of these pollutants on breast cancer (BC) has never been investigated. We applied two new statistical approaches to assess the complex effect of exposure to a mixture of four xenoestrogen air pollutants (Benzo-[a]-pyrene (BaP), cadmium, dioxins, Polychlorinated Biphenyl 153(PCB153)) on the risk of BC.

METHODS: The study was conducted on 5,222 cases and 5,222 matched controls nested within the French national E3N cohort. Annual estimates of exposures to pollutants at participants' addresses for each year from recruitment 1990 through 2011, were assessed using a chemistry transport model. Mean annual concentrations for each pollutant was then estimated from inclusion in the study to the index date. We fitted the bayesian kernel machine regression (BKMR) and the weighted quantile sum (WQS) regression models to estimate the risk of BC associated with the joint effect of co-exposure of four xenoestrogens air pollutants.

RESULTS: In BKMR, despite the no statistically significant association, there was an increasing trend between the joint effect and the risk of BC, when fixing other chemicals at their median concentrations. BaP, cadmium and PCB153 showed positive trends in the multi-pollutant mixture, while dioxin showed a modest inverse trend. In WQS, there was a borderline positive association between the WQS index of the joint effect and the risk of BC (odds ratio (OR)=1.06, 95% confidence intervals (CI):0.99-1.10). By menopausal status, there was a differential joint effect, with a significant positive association observed only in women who underwent menopausal transition (OR=1.09, 95% CI:1.02-1.14)

CONCLUSIONS: Overall, although no clear association was observed with BKMR model, there was a tendency of an increased risk of BC associated with co-exposure to long-term xenoestrogens air pollutants using both approaches. Further studies are needed to confirm these findings.

P-0921 Estimating attributable deaths from short-term pollution effects: Differential air pollution impact on cause-specific mortality

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BACKGROUND AND AIM: Health impact assessment (HIA) is a common policy tool that quantifies health burden from air pollution under different policy scenarios. Most HIAs consider all-natural-cause deaths from single-pollutant models, leaving uncertainty about varying impacts on cause-specific mortality from multiple air pollutants.

METHODS: Daily city-wide average air pollution concentrations were collected from the Environmental Protection Agency's Air Quality System and mortality records (2005-2019) from New York City (NYC) Vital Statistics. Total cumulative pollution attributable fractions (AFs) and annual average attributable counts (ACs) of mortality were estimated from single- and co-pollutant quasi-Poisson distributed lag time-series models at one lag day. Three mortality outcomes were evaluated: all-natural-cause, cardiovascular (CVD), and respiratory. Full year and seasonal models, adjusting for temperature and seasonal trends, were fit for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone, fine particulate matter ($PM_{2.5}$), and carbon monoxide (CO).

RESULTS: Across all pollutants, outcomes, and seasons, single-pollutant models showed positive associations, although cold-season models generally had lower AFs and larger confidence bands. for all-natural-cause mortality, NO_2 AF from the full-year, single-pollutant model was 1.4% (95% CI: 0.6%, 2.3%) representing the largest pollution AC, about 660 deaths annually, which did not change when additional pollutants were added to the model. CVD full-year model of $PM_{2.5}$ was robust to addition of NO_2, contributing about 250 deaths annually: 1.2% AF (0.5%, 1.9%). for respiratory mortality, warm-season NO_2 AF was 4% (-0.4%, 7.9%) and robust in co-pollutant models with $PM_{2.5}$ and NO_2, but not ozone. Warm-season ozone AF was 8.1% (2.9%, 13%), representing about 125 respiratory deaths annually.

CONCLUSIONS: Concentration-response functions used to quantify health burden based on air pollution attributable all-natural-cause deaths must consider short-term NO_2 associations in NYC. Cause-specific associations differ from those for all-natural-cause deaths, with $PM_{2.5}$ more important for CVD deaths and ozone for respiratory deaths.

KEYWORDS: Air pollution, Mortality

P-0922 Chronic exposure to ambient air pollution and the risk of non-alcoholic fatty liver disease: A cross-sectional study in Asia

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BACKGROUND AND AIM: Information on the relation between air pollution and non-alcoholic fatty liver disease (NAFLD) is scarce. We conducted a population-based cross-sectional study to evaluate the relationship between air pollution and NAFLD.

METHODS: We recruited 329,048 adults (mean age: 41.0 years) without other liver disease (hepatitis and cirrhosis) or excessive alcohol consumption in Taiwan and Hong Kong from 2001 to 2018. The levels of PM2.5 were estimated using a satellite-based spatio-temporal model, and the concentrations of NO2 and O3 were measured using a space–time regression model. NAFLD was determined using the hepatic steatosis index (HSI) or the fatty liver index (FLI). NAFLD-related advanced fibrosis was determined using fibrosis-4 (FIB-4) or the BARD score. A logistic regression model was used for data analysis.

RESULTS: We found positive relationships between PM2.5 and the odds of NAFLD and NAFLD-related advanced fibrosis, with a 10% (95% confidence interval [CI]: 9%–11%) increase in the prevalence of NAFLD and an 8% (95% CI: 7%–9%) increase in the prevalence of advanced fibrosis for every standard deviation (SD, 7.5 μg/m3) increase in PM2.5 exposure. Similarly, every SD (18.9 μg/m3) increase in NO2 concentration was associated with 8% (95% CI: 7%–9%) and 7% (95% CI: 6%–8%) increases in the prevalence of NAFLD and NAFLD-related advanced fibrosis, respectively. In addition, every SD (9.9 μg/m3) increase in O3 concentration was associated with 12% (95% CI: 11%–13%) and 11% (95% CI: 9%–12%) decreases in the prevalence of NAFLD and advanced fibrosis, respectively.

CONCLUSIONS: Long-term exposure to PM2.5 and NO2 is associated with higher odds of NAFLD and NAFLD-related fibrosis. Our findings indicate that reducing PM2.5 and NO2 concentrations may be an important strategy for preventing NAFLD. Further investigations on O3 are warranted.

KEYWORDS: PM2.5; NO2; ozone; non-alcoholic fatty liver disease; advanced fibrosis

P-0933 Interdisciplinary Community-based Participatory Health Research across a Major Industrial Harbour (Fos-sur-Mer, France)

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BACKGROUND AND AIM. – We conducted a community-based participatory environmental health study in three towns: two in the heart of Marseille's (France) industrial zone (Fos-sur-Mer and Port-Saint-Louis-du-Rhône) and one on the periphery located about 30 km away (Saint-Martin-de-Crau).

METHODS: – We first conducted a cross-sectional survey of a random sample of residents in each of the three towns. We asked study participants to self-report a wide variety of health issues (Port-Saint-Louis: n = 272, Fos-sur-Mer: n = 543, Saint-Martin-de-Crau: n = 439). We then conducted focus groups with residents and other stakeholders to share preliminary data in order to propose areas of reflection and collaboratively produce contextually-situated knowledge of their health and environment. We directly standardized the prevalences (by age and gender) to the French metropolitan population to make our results more comparable.

RESULTS: – Study participants who lived closer to the core industrial zone (residents of Fos-sur-Mer and Port-Saint-Louis-du-Rhone) had significant higher prevalences of eye irritation, nose and throat problems, chronic skin problems and headaches than people who lived further away (residents of Saint-Martin-de-Crau). Residents also offered diverse qualitative insights about their environment and health experiences, strengthening an understanding of their own empirical observations which helps to produce knowledge about health in an industrial context. The results of the workshops show an important benefit from the co-production of local knowledge.

CONCLUSIONS: – We encourage future researchers to do in-depth, community-based research to comprehensively describe the health of residents in other heavily polluted zones, product local knowledge and to help identify policy solutions, engender trust among the local people, and identify opportunities for intervention.

KEYWORDS: - Community-based participatory research
Environmental health - Health disparities - Industrial pollution

P-0934 Association between polycyclic aromatic hydrocarbon exposure and esophageal cancer risk in typical areas of China

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BACKGROUND: Studies of people show that individuals exposed by breathing, skin contact, or diet for long periods to polycyclic aromatic hydrocarbon (PAHs) can develop cancer, such as lung, skin, and bladder cancer. However, their effects on esophageal cancer have not been well examined.
AIM: This study is to compare the concentration of PAHs metabolite(OH-PAHs) in the urine of patients in the early stages of esophageal cancer and healthy people, and to evaluate the association between PAHs exposure and esophageal cancer risk.

METHODS: The 211 urine samples were collected from 105 esophageal cancer patients in the early stages and 106 healthy people in three high Incidence districts of esophageal cancer from November 2019 to June 2020. The 10 OH-PAHs (including 1-NAP, 2-NAP, 2-FLU,3-FLU,9-FLU,1-PHE,2-PHE, 3-PHE, 4-PHE,1-PYR) were analyzed with isotope dilution gas chromatography/tandem mass spectrometry (GC-MS/MS) based on CDC method.

RESULTS: The 10 OH-PAHs detection rate were relatively high more than 90%. 1-NAP and 2-NAP were the most abundant contributor to the total concentration of OH-PAHs.The mass concentration of OH-PAHs in the urine of healthy people was in the range of 1.5-44.6 μg/g, the median concentration of ∑OH-PAHs was 6.1 μg/g and the geometric mean concentration was 6.8 μg/g. ∑OH-PAHs concentration in the urine of esophageal cancer patients in the early stages was in the range of 3.6-104.2 μg/g, the median concentration of ∑OH-PAHs was 9.8 μg/g and the geometric mean concentration was 10.2 μg/g.

CONCLUSIONS: The results showed ∑OH-PAHs concentrations in urine from esophageal cancer patients in the early stages were higher than healthy people. The different habits and way of life, such as smoking and fried food, were increasing the PAHs exposure causing esophageal cancer risk.

KEYWORDS: polycyclic aromatic hydrocarbon, urine, esophageal cancer risk, typical areas

P-0938 Cluster analysis of premature deaths attributable to PM2.5 in aging population, South Korea

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BACKGROUND AND AIM: Health impact analysis for PM2.5 can display spatial heterogeneity of premature deaths attributable to PM2.5 and stands out as one of the best effective tools to present scientific evidence to guide policy actions. Subsequent spatial cluster analysis allows us to detect the areas with large burden and guide intervention programs to target such areas. We aimed to estimate the number of attributable deaths associated with PM2.5 exposure and identify the clustered areas with large attributable deaths compared to other areas in Korean aging population.

METHODS: We computed district-specific attributable deaths for lung cancer, chronic obstructive pneumonia disease, ischemic heart disease, and stroke each year for 2016 – 2019 using district averages of PM2.5 obtained from a previously-validated prediction model, district-level population aged 65 years and over, provincial-level mortality rate, and relative risks of cause-specific deaths for PM2.5. Then, we aggregated to total attributable deaths including all four causes in each of the 250 districts over four years. Finally, we applied spatial scan statistic with optimal size of elliptic shape window and identified the most significant cluster of high premature deaths.

RESULTS: Over four years, the total number of deaths attributable to PM2.5 was 49,449 out of 35,368,100 old adults in South Korea. The premature deaths attributable to PM2.5 were higher in the Northwest and Southeastern districts where population is relatively old. The cluster analysis showed the Southeastern districts as the significantly high mortality burden cluster attributed to PM2.5.

CONCLUSIONS: This study suggests that the cluster analysis can increase the benefit of the health impact analysis.

KEYWORDS: health impact assessments, cluster analysis, ambient air pollution, premature death

P-0939 NATURGREEN: Health impact assessment of greening Denver through native plants

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BACKGROUND: Cities often use exotic plants (e.g., turf grass and non-native trees) to expand green space to reduce micro-heat islands or promote physical activity. Native plants, however, may require less water, be more drought-tolerant, and have co-benefits for local biodiversity (e.g., pollinators). Epidemiologic studies suggest urban green space can improve human health and prevent premature mortality, but the benefits associated with this specific type of vegetation has received little attention.
AIM: We aim to estimate premature deaths that would be prevented by the implementation of native-plants policy scenarios in the City of Denver, Colorado, USA.

METHODS: To develop realistic native-plants policy scenarios, we conducted interviews with local stakeholders engaged in green-space advocacy, research, and policy in Denver. We build four scenarios: 1) greening a 20% of all city census-block groups to the greenness level of native plants, 2) adding 200-foot native-plants buffers around riparian areas, 3) constructing additional large water retention ponds landscaped with native plants, and 4) greening parking lots. We measured existing green space with satellite imagery and linked with census and land-use data. Using a health-impact assessment approach, we estimated premature mortality averted under each scenario.

RESULTS: In the most ambitious scenario, we estimated that 45 (95% confidence interval (CI): 42, 49) annual premature deaths would be prevented by greening 20% of all city census block groups with native plants. We estimated that greening 20% of parking-lot surface with native plants would prevent 8 annual deaths (95% CI: 7, 9), adding the native buffers around riparian areas would prevent 8 annual deaths (95% CI: 6, 9), and adding the planned native-landscaped stormwater retention ponds would prevent 1 annual death (95% CI: 1, 1).

CONCLUSIONS: Using native plants to increase green spaces has the potential to prevent substantial premature deaths in the City of Denver.

P-0941 Health risk assessment of PM2.5 and PM2.5-bound trace elements in Pretoria, South Africa

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BACKGROUND: The objective of the present study was to assess the human health risks associated with fine particulate matter (<PM2.5) and trace elemental constituents in Pretoria, South Africa.
METHOD: Outdoor ambient PM2.5 was sampled at the School of Health Systems and Public Health from 18 April 2017 to 28 February 2020. The health risk assessment method followed the USA Environmental Protection Agency's (US EPA) health risk assessment method. Reference doses for PM2.5 were taken from the World Health Organization (WHO) guidelines and the South African National Ambient Air Quality Standards (NAAQS).

RESULTS: The average yearly concentration for PM2.5 was 23.2 µg/m3 (N = 350) for the 34-month sampling campaign. This is above the yearly WHO guidelines (5 µg/m3) and the South African NAAQS (20 µg/m3). The monthly PM2.5 concentration is seasonal as is the concomitant Health Quotient (HQ). The calculated HQ for Adults, Children and Infants was above 1 when utilising both the WHO guidelines and the SA standard for ambient PM2.5. Children and Infants were three times higher at risk than adults throughout the year for summer and in winter for K and Si. Particle-bound Ni presented a cancer risk (CR) throughout the year.

CONCLUSIONS: It can be concluded that PM2.5 poses health risks in central Pretoria.

KEYWORDS: Air pollution, PM2.5, Seasons, Health Risk Assessment, South Africa, Trace elements

P-0943 Effects of hourly levels of ambient air pollution and the emergency department visits for asthma in Taiwan

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BACKGROUND AND AIM: Daily exposure to O_3, NO_2, and $PM_{2.5}$ is associated with asthma attacks. However, peak exposure (hourly) of such air pollution exacerbating asthma symptoms remains unknown.

METHODS: Daily emergency department visits (EDVs) of asthma from the National Health Insurance Research Database and hourly concentrations of O_3, $PM_{2.5}$, and NO_2 recorded at fixed-site monitoring stations in Taiwan from 2006 to 2016 were used. Excess risks (ERs) of asthma EDVs (ICD-10-CM: J45) at 0–2 lag days associated with daily maximum rolling 1-, 3-, 8-, and 24-hour concentrations of air pollutants were evaluated using the quasi-Poisson generalized additive models (GAMs). Models were stratified by warm and cold season and adjusted for townships, days of the week, and the smoothing splines as the year, temperature, and relative humidity at the same hours.

RESULTS: A total of 369,256 asthma EDVs in 50 townships of Taiwan from 2006 to 2016 were observed. The cold period (110 ± 125) had a higher average count of daily asthma EDV than the warm period (70 ± 90). Among air pollutants, there were positive associations between concentrations of all hourly pollutants and asthma EDVs, even in 1-hour exposure. Every a 10-unit increase in 1-hour exposure to $PM_{2.5}$ in warm (lag2) and O_3 in cold (lag2) increases the risks of daily asthma EDVs by 1.74% (95% CI, 1.43–2.04%) and 1.13% (95% CI, 0.83–1.44%), respectively. Exposure to 1-hour NO_2- in warm had the most significant effect (ER = 2.91%, 95% CI: 2.36–3.46%) on daily asthma EDVs. Then, all pollutants indicated that the 24-hour exposure was much more severe than 1-hour.

CONCLUSIONS: Short-term (1-hour) exposure to air pollutants is significantly associated with daily asthma EDVs. Hourly standard of air quality is suggested.

KEYWORDS: Asthma; emergency department visits; hourly air pollution; stratified analysis; sensitivity analysis

P-0946 The effectiveness of a text messaging intervention trial to reduce mercury contaminants and conserve healthy fish consumption in reproductive age Chicago Asian women

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BACKGROUND AND AIM: Hg exposure during pregnancy can impact cognition, memory, attention, language, fine motor skills, and visual spatial skills in offspring. There is a high prevalence of elevated mercury (Hg) levels among Asian communities, attributable to frequent fish consumption. A controlled, cluster-randomized, 6-month intervention trial was conducted to decrease consumption of fish with moderate to high mercury levels and/or very frequent fish consumption and to reduce hair Hg levels.

METHODS: Reproductive age Asian women were recruited with the help of community organizations serving the Chinese, Vietnamese, and Korean communities in Chicago. The control group (n = 131) received general nutrition text messages, while the intervention group (n = 154) received text messages on risks and benefits of fish consumption, with advice tailored to the Chicago Asian communities based on a prior community assessment. Outcomes were hair Hg measurements and rates of fish consumption. Non-parametric tests compared treatment groups at baseline and six months and the effect of the intervention on outcomes was tested using longitudinal linear models with random effects for cluster.

RESULTS: Geometric mean hair mercury decreased 16% in the intervention group and increased 2% in the control group (p=0.04, Figure). In Chinese women, hair Hg decreased 9% in intervention and control groups, while in Korean women hair Hg decreased 27% in the intervention and increased 10% in the control group (p=0.04). The rate of ingestion of moderate and high mercury fish (g/day) decreased 50% in the intervention and 35% in the control group (p = 0.15).

CONCLUSIONS: Our findings suggest that in reproductive age Asian American women, a text messaging intervention providing information on healthy fish consumption and health risks of contaminated fish consumption decreased hair mercury levels, but efficacy differed by Asian ethnicity.

P-0952 The Association of Air Pollution and Serum Biomarker Abnormalities in Individuals with Hemodialysis-Dependent Kidney Failure

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BACKGROUND AND AIM: Ambient PM2.5 is a ubiquitous air pollutant with established adverse health consequences. While postulated to promote a systemic inflammatory response, few studies have demonstrated changes in serum biomarkers related to PM2.5 exposure. To examine associations between short-term PM2.5 exposure and commonly measured biomarkers known to be affected by inflammation among patients receiving maintenance in-center hemodialysis.

METHODS: We conducted a retrospective open cohort study from 1/1/2008 to 12/31/2014 among 173,697 cohort patients identified from the USA Renal Data System and linked at the patient level to laboratory data from a large dialysis organization. Daily ambient PM2.5 was estimated on a 1 km grid for the entire contiguous US and assigned to cohort patients based on the ZIP code of their dialysis clinics. Serum albumin, serum ferritin, transferrin saturation (TSAT), and serum hemoglobin were ascertained from the dialysis provider organization database. Mixed-effect models were used to assess the changes in biomarker concentrations associated with PM2.5 exposure.

RESULTS: Among study cohort, 50.3% patients were older than 65 years at the initiation of hemodialysis, 44% were female, and 62.8% were of white race. Overall, the daily ZIP-level ambient PM2.5 averages were 8.4 to 8.5 µg/m3, and the inter-quartile ranges (IQRs) were 5.9 to 6.0 µg/m3 for dates when biomarkers were measured. A 10 µg/m3 increase in same-day ambient PM2.5 exposure was associated with higher relative risks of low albumin (RR: 1.01, 95% CI: 1.01, 1.02) and low hemoglobin (RR: 1.02, 95%CI: 1.01, 1.03). Associations of same-day ambient PM2.5 exposure and high ferritin and low TSAT did not reach statistical significance.

CONCLUSIONS: Short-term PM2.5 exposure was associated with low serum hemoglobin and albumin. The findings among patients receiving in-center hemodialysis lend support for the potential of inflammation-driven changes after PM2.5 exposure.

KEYWORDS: Biomarker, air pollution, vulnerable population, dialysis patients

P-0953 Diesel exhaust particles affected heart rate variability but not endothelial function – results from a controlled chamber study

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BACKGROUND: Adverse cardiovascular effects have been associated with exposure to both diesel exhaust and road traffic noise. Effects of these highly correlated exposures are hard to disentangle in epidemiological studies, but effects on intermediary outcomes and mechanisms can be studied experimentally. Heart rate variability (HRV) and peripheral arterial tonometry (PAT), a measure of endothelial function, are noninvasive methods to study mechanisms related to the autonomic nervous system associated with cardiovascular risk. The aim of this study was to evaluate the impact of diesel exhaust particles and traffic noise on HRV and PAT, and possible synergistic effect of combined exposure.

METHODS: Eighteen healthy adults were in a controlled chamber exposed to four exposure scenarios in a randomized cross-over fashion. Each scenario consisted of either filtered (clean) air or diesel engine exhaust (PM concentrations around 300 µg/m3), and low (46 dB(A)) or high (75 dB(A)) traffic noise for three hours at rest. ECG was recorded for 10-minute periods before and during each scenario, and frequency-domain heart rate variability (HRV) computed. Endothelial function and arterial stiffness were assessed after each exposure using EndoPAT 2000.

RESULTS: Compared to the control scenario, HRV in the high frequency band decreased during exposure to diesel exhaust, both alone and combined with noise, but not during exposure to noise only. The differences were stronger in women. There were no synergistic effects of combined exposure, no significant differences between exposure scenarios for other HRV indices, and no effect on endothelial function or arterial stiffness after exposure.

CONCLUSION: Three-hour exposure to diesel exhaust, but not noise, was associated with decreased HRV in the high frequency band. This indicates activation of irritant receptor-mediated autonomic reflexes, and increased cardiovascular risk during chronic diesel exposure.

KEYWORDS: Diesel, PM1, noise, heart rate variability, endothelial function, cardiovascular

P-0954 Placental Cellular Composition and Umbilical Cord Metal Concentrations: A Descriptive Molecular Epidemiology Study Leveraging DNA Methylation

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BACKGROUND AND AIM: During pregnancy, potentially toxic metals and metalloids can cross the placenta with varying degrees of efficiency. We hypothesized metal toxicokinetics may be regulated by placental cellular composition. Until recently, disentangling complex placental tissue at the population level has been challenging. Here, we leveraged DNA methylation profiles to characterize major placental cell types and described relationships with umbilical cord metal concentrations in an extremely preterm birth cohort.

METHODS: Among 145 infants born before 28 weeks' gestation enrolled in the US-based ELGAN cohort (2002-2004), we quantified concentrations of 7 non-essential metals/metalloids in cord tissue, representing passage through the placental barrier. Placental DNA methylation profiles were measured by the Illumina EPIC BeadChip and deconvoluted using a novel reference-based approach (planet) to estimate proportions of six constituent cell types. To satisfy the sum-to-one constraint of proportions, we transformed the data into pivot coordinates (a special case of isometric log-ratios) before fitting linear regression models with cord tissue metal concentrations.

RESULTS: Arsenic, lead, strontium, and barium were detected in all umbilical cord tissue samples; cadmium and mercury were detected in 97.9% and antimony in 93.7%. The most relatively abundant cell type in placental tissue was syncytiotrophoblast (31.7%), followed by nucleated red blood (27.3%), endothelial (19.4%), Hofbauer (9.6%), stromal (8.8%), and trophoblast cells (3.2%). As syncytiotrophoblasts increase, arsenic levels in cord tissue decrease (Coefficient = -0.6 ng per 1-percentage point, p-value = 0.03) whereas as Hofbauer cells increase, cadmium levels increase (Coefficient = 0.3 ng per 1-percentage point, p-value = 0.03). Null associations were observed for the other metals/metalloids.

CONCLUSIONS: The findings suggest the cellular composition of the placenta may influence the transport of environmental metals to the fetus. Future studies examining prenatal environmental exposures should consider methylation-based deconvolution as a powerful tool for investigating placental biology.

P-0965 Impact of urban exposures during pregnancy on placental small non-coding RNAs

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BACKGROUND AND AIM: Epidemiological studies show that urban exposures (e.g., air pollution, built and natural environment, and noise) during pregnancy could adversely influence the developing foetus. Although the underlying mechanisms are unclear, recent findings suggest that placental transcriptome can be a proxy of placental function during pregnancy and a plausible mediator of the association between intrauterine environmental exposures and foetal growth and development, and childhood and adult health trajectories. In particular, there is an increasing interest in small non-coding(nc)RNAs, including microRNAs (miRNAs), which are regulatory RNAs critical for placenta function and foetal development. Our main aim is to assess the association of several urban exposures during pregnancy with placental small ncRNA profiles in the Barcelona Life Study cohort (BiSC).

METHODS: BiSC is a population-based birth cohort of 1,086 mother-child pairs from the Barcelona metropolitan area (2018 onwards). We will characterize exposure to air pollution, noise, green space, and built environment as indicators of the urban exposome. Placental RNA was obtained from 450 placental foetal villi biopsies. Small ncRNA profiles were measured by RNA-sequencing (library insert of 17-52 nucleotides length, 50 nucleotides sequencing length, and 5M reads/sample). Quality control, processing of RNA-sequencing data, and small ncRNAs annotation and quantification will be done with the SeqCluster/SeqBuster bioinformatic tool.

RESULTS: A pilot study of 8 samples identified a total of 550 small ncRNAs, 44% being miRNAs. MiRNAs of the placental specific C19MC cluster were found among the most abundant. In the ISEE Conference we will present the placental small ncRNA profiles and their association with urban-related exposures.

CONCLUSIONS: Studying the impact of pregnancy exposures on the foetus and its biological intermediates is crucial to prevent their harmful effects and to develop biomarkers that allow early monitoring and treatment.

KEYWORDS: transcriptomics, microRNAs, small non-coding RNAs, placenta, urban exposures, air pollution, built environment, noise

P-0968 Epigenome-Wide Association of Neonatal Methylation and Prenatal PM2.5 Exposure Suggests Timing-Specific Effects

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BACKGROUND AND AIM: Exposure to particulate matter with an aerodynamic diameter smaller than 2.5 microns (PM2.5) can affect birth outcomes through physiological pathways such as inflammation. One potential way PM2.5 affects physiology could be through altering DNA methylation (DNAm). Considering that exposures during specific windows of gestation may have unique effects on DNAm, we hypothesized a timing-specific association between PM2.5 exposure during pregnancy and DNAm in the neonatal epithelial-cell epigenome.

METHODS: After collecting salivary samples from a cohort of 91 neonates, DNAm was assessed using the MethylationEPIC array (EPIC) which covers over 850,000 CpG methylation sites (850K) on the epigenome. Daily ambient PM2.5 concentrations were estimated based on the mother's address of primary residence during pregnancy. PM2.5 was then averaged over the first two trimesters, separately and combined, and tested for association with DNAm through an epigenome-wide association (EWA) analysis. for each EWA, FDR-corrected $p < 0.05$ constituted a significant finding, and every CpG site with uncorrected $p < 0.0001$ was selected to undergo pathway and network analysis to identify molecular functions enriched by them.

RESULTS: Our analysis showed that cg18705808 was associated with the combined average of PM2.5. Pathway and network analysis revealed little similarity between the first two trimesters. Previous studies reported that TMEM184A, the gene regulated by cg18705808, has a putative role in inflammatory pathways.

CONCLUSIONS: The differences in pathway and network analyses could potentially indicate trimester-specific effects of PM2.5 on DNAm. Further analysis with greater temporal resolution would be valuable to fully characterize the effect of PM2.5 on DNAm and child development.

P-0972 Exposure to Metals and the microRNA Profile of Participants in the Normative Aging Study

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BACKGROUND AND AIM: Metals have previously been associated with adverse effects in multiple organ systems. However, the molecular mechanisms by which they cause these effects are not fully elucidated. MicroRNAs are short non-coding RNA sequences that play an important role in the regulation of gene expression and may be a mechanism by which metals influence health.

METHODS: The study population consisted of496 persons (with 694 samples) enrolled in the Normative Aging Study (NAS). This cohort began recruiting male veteran who lived in the New England area in 1963 and has followed up with them every three to five years ever since. Our study period includes visits from 1999 to 2014. Extracellular microRNAs were sequenced from participants' plasma, and toenail samples were used to measure levels of metals, namely: arsenic (As), cadmium (Cd), lead (Pb), manganese (Mn), and mercury (Hg). We used canonical correlation analysis (CCA) to find whether metal levels correspond with microRNA levels. We further assessed the relationship between metals and microRNA using Bayesian kernel machine regression (BKMR).

RESULTS: Our preliminary CCA results showed very strong correlations between the first five canonical variables of the metals and those of the microRNA, with correlation values of 0.937, 0.923, 0.903, 0.894, 0.886, respectively. However, only the correlation between the first canonical variables was statistically significant. Pb and Cd showed the strongest association with the first canonical variable of the metals dataset. The strongest associations between the first canonical variable in the microRNA set were with the following microRNAs: miR-182-5p, miR-183-5p, miR-516b-5p, and miR-26a-5p.

CONCLUSIONS: There was a strong correlation between the first canonical variables of the metals and the microRNA, indicating a potential association between them. Future analyses will use BKMR to assess the joint effect of metals on the microRNA profile.

KEYWORDS: Metals, microRNA, Epigenetics, Mixtures Analysis

P-0975 Exposure to persistent organic pollutants and biomarkers of oxidative stress - A scoping review

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BACKGROUND AND AIM: Oxidative stress is a known mediator in pathways related to environmental exposures and numerous diseases. However, epidemiological studies investigating the association of persistent organic pollutants (POPs) and oxidative stress are limited and revealed inconsistent results. This scoping review evaluates the effect of POPs, including per- and polyfluoroalkyl substances (PFAS), polychlorinated biphenyls (PCBs), organochlorine pesticides, and polybrominated diphenyl ethers (PBDEs), on oxidative stress biomarkers in epidemiological studies.

METHODS: A search was conducted in PubMed and Embase through September 7, 2021, to identify all published studies related to POPs and oxidative stress. Search results were uploaded into Covidence systematic review management tool for de-duplication and for double independent abstract and full-text screening. We included human observational studies reporting at least one exposure and oxidative stress biomarker of interest for data extraction. The Office of Health Assessment and Translation risk of bias assessment tool was implemented for quality assessment.

RESULTS: Thirteen epidemiological studies met inclusion criteria – 7 for organochlorine pesticides, 5 for PFAS, 3 for PCBs, and 1 for PBDEs. Ten studies have overall low risk of bias. We found consistent positive associations of organochlorine pesticides and PFAS with several oxidative stress biomarkers, eg, of organochlorine pesticides with protein carbonyls, nitric oxide, and malondialdehyde, and of PFAS with 8-hydroxyguanosine and malondialdehyde. Additionally, we found consistent negative associations of organochlorine pesticides with several antioxidants, such as with acetylcholine esterase and paraoxonase-1, but associations of organochlorine pesticides, PCBs, and superoxide dismutase were inconsistent.

CONCLUSIONS: This is the first review of association of POPs and oxidative stress biomarkers in humans. Lack of prospective studies and some inconsistent results pose challenges to draw causal inference. Further evidence is needed to better elucidate the relationship of POPs and oxidative stress.

KEYWORDS: persistent organic pollutants, oxidative stress, biomarkers, review

P-0979 Use of high-resolution metabolomics to assess the biological perturbations associated with maternal exposure to Bisphenol A and Bisphenol F among pregnant African American women

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BACKGROUND: Human and animal exposure to bisphenol A (BPA) is strongly associated with adverse developmental and reproductive effects. The molecular mechanisms by which BPA exposure exerts its effects are not well-understood, even less known about its analogues bisphenol F (BPF). To address these knowledge gaps, we conducted an untargeted metabolome-wide association study (MWAS) to identify metabolic perturbations associated with BPA/BPF exposures in a pregnant African American cohort.

METHODS: From a subset (N=230) of study participants enrolled in the Atlanta African American Maternal-Child cohort, we collected both urine samples, for targeted exposure assessment of BPA and BPF, and serum samples, for high-resolution metabolomics (HRM) profiling, during early pregnancy (8-14 weeks' gestation). Using an established untargeted HRM workflow consisting of MWAS modeling, pathway enrichment analysis, and chemical annotation and confirmation, we investigated the potential metabolic pathways and features associated with BPA/BPF exposures.

RESULTS: The geometric mean creatinine-adjusted concentrations of urinary BPA and BPF were 0.85±2.58 and 0.70±4.71 μg/g creatinine, respectively. After false positive discovery rate correction at 20 % level, 264 and 733 unique metabolic features were significantly associated with urinary BPA and BPF concentrations, representing 10 and 12 metabolic pathways, respectively. Three metabolic pathways, including steroid hormones biosynthesis, lysine and lipoate metabolism, were significantly associated with both BPA and BPF exposure. We confirmed the chemical identity of 16 of the metabolites significantly associated with BPA or BPF exposure with Level One evidence using reference standard.

CONCLUSIONS: Our findings support that exposure to BPA and BPF in pregnant women is associated with the perturbation of aromatic amino acid metabolism, xenobiotics metabolism, steroid biosynthesis, and other amino acid metabolism closely linked to stress responses, inflammation, neural development, reproduction, and weight regulation.

KEYWORDS: Bisphenol A, Bisphenol F, Urinary bisphenol metabolites, High-resolution metabolomics, Metabolic perturbations

P-0982 Short-term PM2.5 exposure and executive function: association and neurophysiological mechanisms

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INTRODUCTION: Although converging evidence has shown that exposure to PM2.5 caused adverse effects on brain structure and cognitive function, the association between the short-term exposure to PM2.5 and cognition dysfunction remain underexplored, especially possible neurophysiological mechanisms.

METHODS: We conducted a longitudinal observational study with four repeated measurement sessions among 90 young adults from September 2020 to June 2021. During each measurement session, we measured participants' personal level air pollution exposure for one week with portable monitors, followed by executive function assessment and electrophysiological signals recordings at the assessment center. Standard Stroop color-word test was used accompanied with electrophysiological recordings to assess performance on executive function.

RESULTS: Adjusted mixed-effect models demonstrated that elevated PM2.5 exposure three days prior to cognitive assessment (lag 3) was associated with (1) declined performance in both congruent and incongruent tasks in Stroop tests, (2) reduced lower alpha event-related desynchronization (ERD) during 500-1000 ms after stimuli, both indicating impaired executive control. No associations were found between short-term PM2.5 exposure and aperiodic exponents both in tonic and phasic state, residual periodic alpha oscillation in tonic state.

CONCLUSIONS: Our results provided evidence that short-term PM2.5 exposure was associated with brain executive dysfunction. Reduced alpha ERD was likely to be the underlying pathway through which PM2.5 induced adverse effects on neuron activities during cognitive tasks. This study implies that transcranial electric stimulation and transcranial magnetic stimulation could be applied to access cortical neuron excitability to compensate for the cognitive impairment caused by PM2.5 exposure.

P-0983 Persistent organic pollutant exposure contributes to Black/White differences in leukocyte telomere length: Evidence from NHANES 1999-2002

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BACKGROUND AND AIM: Despite racial disparities in diseases of aging and premature mortality, non-Hispanic Black Americans tend to have longer leukocyte telomere length (LTL), a biomarker of cellular aging, than non-Hispanic White Americans. Previous findings suggest that exposures to certain persistent organic pollutants (POPs) are both racially-patterned and associated with longer LTL. We examine whether Black/White differences in LTL are explained by differences in exposure to 15 POPs by estimating the indirect effect (IE) of race on LTL that is mediated through polychlorinated biphenyls (PCBs), furans, and dioxins, as well as their mixtures.

METHODS: Our study includes 1,251 adults from the 1999-2000 and 2001–2002 cycles of the National Health and Nutrition Examination Survey (NHANES). We characterized single-pollutant mediation effects by constructing survey-weighted linear regression models and implemented various approaches to quantify a global mediation effect of POPs, including unpenalized linear regression, ridge regression, and three summary exposure scores (derived from principal components analysis [PCA], principal direction of mediation, and the Toxic Equivalency Quotient [TEQ] score) using survey weights when possible.

RESULTS: We found support for the hypothesis that exposure to PCBs partially mediates Black/While differences in LTL. In single-pollutant models, there were significant IEs of race on LTL through PCBs 118, 138, 153, 170, 180, and 187 (percent mediated ranging 18.4-43.4%) after correction for multiple testing. Ridge regression and models examining summative exposure scores with linear combinations derived from PCA and TEQ scores showed significant IE when incorporating survey weights (percent mediated 26.0-34.8%), which also supports our hypothesis based on the IE attributable to exposure mixtures.

CONCLUSIONS: Exposures to individual POPs and their mixtures, which may arise from residential and occupational segregation, may help explain why Black Americans have longer LTL than their White counterparts, challenging genetic explanations for counterintuitive race differences in cellular aging.

KEYWORDS: telomeres, mediation, disparities, persistent organic pollutants

P-0984 Effects of prenatal exposure to air pollution on placental molecular hallmarks and black carbon load

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BACKGROUND AND AIM: There is a rising social concern regarding the effects of air pollution on fetal development, as increasing epidemiological evidence shows an association with several adverse birth outcomes. However, the specific mechanisms that drive these outcomes are still not comprehensively elucidated. To better understand the pathophysiology of prenatal exposure to air pollution through the placenta is precisely one of the aims of the Barcelona Life Study Cohort (BiSC).

METHODS: BiSC is a birth cohort of 1086 mother-child pairs residing in the Barcelona metropolitan area (Spain) that includes a comprehensive follow-up, both environmental (personal exposure to noise and air pollution) and clinical (3rd trimester comprehensive sonography and reproductive outcomes). Further post-natal follow-up is focused on neurocognitive development and includes a Bayley's test (BSID-III) at 6 months.
A specific work package in BiSC is focused on how the placenta responds to prenatal exposure to air pollution, as an intermediate organ between the environment and its effects on early-life development. Specific sections include:
1. To precisely evaluate the personal exposure to air pollution during pregnancy and quantify the translocation of air pollution particles (black carbon) to placental tissue through advanced microscopy.
2. To evaluate placental function measuring maternal-fetal circulation through Doppler sonography, as well as molecular biomarkers (telomere length and mitochondrial DNA content through qPCR) to define both the degree of tissue aging and metabolic capacity.

RESULTS: Black carbon particle detection, telomere length and mitochondrial DNA content measures are currently being performed in placental samples from the BiSC cohort. Dose response associations between air pollution exposure, placental carbon load and markers of placental function (maternal-fetal circulation, placental telomere length and mitochondrial DNA content) will be investigated.

CONCLUSIONS: This study will help to understand underlying mechanisms of air pollution effects on early life.

KEYWORDS: Air pollution, DOHaD, placental function, fetal development

P-0990 Phthalates and Adipokines in Midlife Women: A Cross-sectional Study in the Study of Women's Health Across the Nation (SWAN)

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BACKGROUND AND AIM: Phthalates are associated with obesity and its metabolic complications, but the mechanisms are not well-understood. We examined if phthalate exposure was associated with adverse adipokine profiles, a potential mechanism of metabolic disturbance.

METHODS: In 1250 midlife women in the Study of Women's Health Across the Nation (SWAN), we measured 11 phthalate metabolites in spot urine samples and leptin and high-molecular-weight (HMW) adiponectin in fasting blood samples from 2002/2003. We used linear regression to examine the association between each hydration-adjusted metabolite and log-transformed leptin, HMW adiponectin, and the leptin:HMW adiponectin ratio, adjusting for demographic, lifestyle, and menopause-related factors. Additionally, we used Bayesian kernel machine regression (BKMR) to examine the joint associations between the phthalate metabolite mixture and adipokines.

RESULTS: In single-pollutant models adjusted for all covariates except body mass index (BMI), most phthalate metabolites were positively associated with leptin. Mono(2-ethylhexyl) phthalate (MEHP) was positively associated with HMW adiponectin and inversely associated with the leptin:HMW adiponectin ratio. Adjustment for BMI attenuated all associations with leptin, but MEHP remained robustly associated with higher HMW adiponectin and a lower leptin:HMW adiponectin ratio. Compared to the 1st quartile, the 2nd to 4th quartiles of MEHP were associated with -16.9% (95% confidence interval (CI): -29.1, -2.6), -24.0% (-35.2, -10.8), and -17.7% (-30.2, -3.1) lower leptin:HMW adiponectin ratio. BKMR revealed a statistically significant, positive association between the phthalate metabolite mixture and HMW adiponectin and identified MEHP as the most important metabolite.

CONCLUSIONS: Phthalates were not associated with leptin concentrations independent of BMI. MEHP was associated with higher HMW adiponectin and a lower leptin:HMW adiponectin ratio, suggesting a more beneficial adipokine profile. The apparent difference between these findings and phthalates' associations with metabolic diseases calls for further investigations on phthalates' potential metabolism-disrupting mechanisms.

KEYWORDS: phthalates, obesity, adipokines

P-0992 Periconceptional and Prenatal Metals Exposure and Extracellular Vesicle miRNA in Breast Milk: A Pilot Study

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BACKGROUND AND AIM: Breast milk is a rich source of extracellular vesicle (EV) miRNA, which are hypothesized to contribute to maternal-offspring communication during the postnatal period and child development. Impacts of environmental contaminants on EV miRNA in breast milk are largely unknown. Our pilot study examined the relationships of metal exposures during the periconceptional and prenatal periods with breast milk-derived EV miRNA.

METHODS: EV miRNA were extracted from breast milk samples collected approximately 6 weeks postpartum from participants (N=54) in the New Hampshire Birth Cohort Study. 799 miRNA were profiled using the NanoString nCounter platform; 200 miRNA were widely detectable and retained for downstream analyses. Exposure to five metals (arsenic, manganese, mercury, lead, and selenium) during the periconceptional and prenatal periods was measured in maternal toenail clippings collected at two time points. Metal-miRNA associations were evaluated using covariate-adjusted robust linear regression models.

RESULTS: In this preliminary analysis, we found 12 miRNA to be inversely associated with As exposure in the periconceptional period and 42 miRNA to be inversely associated with As exposure in the prenatal period. Four miRNA were inversely associated with As exposure at both time points (miR-106b-5p, miR-152-3p, miR-429, miR-1234-3p). Associations for other metals showed potential trends which motivate further investigation in a larger study.

CONCLUSIONS: In a pilot study of participants in northern New England, we identified four miRNA that were inversely associated with both periconceptional and prenatal As exposure and an additional set of miRNA that were inversely associated with As exposure in a time-dependent manner. In future studies, we plan to expand the number of participants with these measures to investigate multiple metal exposures simultaneously using environmental mixture modeling approaches, examine possible downstream consequences for children's health, and conduct validation studies in other cohorts.

KEYWORDS: Metals, EV miRNA, Breast Milk, Periconceptional, Prenatal

P-1004 Hair cortisol as a biomarker of chronic stress: influence of school context and bullying

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BACKGROUND: Bullying has been identified as the most common form of aggression and the main source of stress during childhood and adolescence. The study aimed to analyze the effects of school context and bullying (victim, bully and bully/victim roles) as chronic stressors, using hair cortisol as a biomarker. Moreover, executive function was examined for its relationship with cortisol as well as its influence on bullying and academic skills.
METHOD: The study included 659 eleven-year-old preadolescents from the INMA cohorts of Gipuzkoa and Sabadell. Bullying (Olweus Bully Victim Questionnaire) and variables related to the school context were used as stressors: perception of the school environment (Kidscreen-27 questionnaire), problems with peers (SDQ: strength and difficulties questionnaire) and academic skills (ad hoc questionnaire). Hair samples were used to measure cortisol levels. Additionally, executive function was evaluated using the Cups Task neuropsychological test. To test our hypothesis, structural equation modeling was conducted.

RESULTS: In this study, it was found that being a bully/victim in bullying situations is associated with higher hair cortisol concentrations (b=0.075; p=0.056). Additionally, higher hair cortisol concentrations were associated with worse executive functions across all models (victims: b=0.113; p=0.004; bullies: b=0.112; p=0.004; bullies/victims: b=0.112; p=0.004). Finally, having a poorer relationship with peers, a poorer perception of a school environment or lower academic skills did not affect hair cortisol levels (p>0.05).

CONCLUSIONS: The present study examines the relationship between school context in general and bullying in particular with hair cortisol concentrations as an indicator of chronic stress for the first time. Despite concluding that the role of bully/victim appears to be related to hair cortisol concentrations, more research is needed to study this relationship.

P-1006 The Association between Exposure to Metals and Phthalates during Pregnancy and Children's DSM-oriented Problems at Age Four Years

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BACKGROUND AND AIM: About 10%–20% of children and adolescents suffer from mental problems worldwide, and it may increase the global burden of disease. Neurotoxic metals are associated with inflammation or cytotoxicity in the brain. Prenatal phthalates (PAEs) exposure is associated with cognitive function deficits. However, the effect of co-exposure to metals, PAEs, and the association with child behaviors are less well studied. We aimed to investigate prenatal co-exposure to metals and PAEs and the consequent behavioral outcomes in early childhood.

METHODS: Participants from the central, southern, and eastern areas of the Taiwan Maternal and Infant Cohort Study were followed up during 2015–2017. We quantified the maternal urinary concentration of metals and metabolites of PAEs as prenatal exposure. Child mental disorders at age four years were according to caregiver-reported scales of the Child Behavior Checklist to define DSM (The Diagnostic and Statistical Manual of Mental Disorders)-oriented problems. Finally, there were 408 children included in further statistical analysis.

RESULTS: Maternal urinary copper was significantly associated with depressive (OR=2.30), attention-deficit/hyperactive (OR=2.31), and oppositional defiant (OR=1.98) in children. Increased concentration of cadmium and lead was significantly associated with attention-deficit/hyperactive (OR=2.55), and oppositional defiant (OR=1.70) problems, respectively. Maternal urinary concentration of mono-isobutyl phthalate was also significantly associated with depressive problems (OR=1.72) in children. In the further analysis that considering prenatal co-exposure to metals and PAEs, co-exposure to these materials was significantly associated with autism spectrum problems in children (OR=5.15).

CONCLUSIONS: We observed that prenatal exposure to copper, cadmium, lead, and dibutyl phthalate was associated with some DSM-oriented problems in children at age four. Also, prenatal co-exposure to metals and PAEs may play a certain role in children's mental health. Reduction of exposure to metals and PAEs in pregnancy is suggested to prevent increased mental problems in childhood.

KEYWORDS: birth cohort, metal, phthalate, mental disorder

P-1007 Pesticide exposure and development in children living in low- and middle-income countries: a systematic review

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BACKGROUND AND AIM
Pesticides are widely used in residential and agricultural settings in low- and middle-income countries (LMICs). Evidence from high-income settings shows that pesticide exposure in pregnancy and childhood is associated with poor child development. Our aim was to systematically review evidence on the associations between pesticides and development in children <18 years in LMICs.

METHODS: We searched 10 electronic databases through November 2021 with no language restriction. We included prospective cohort and cross-sectional studies investigating associations between self-reported or measured pesticide exposure in children and development. Two independent researchers screened studies and extracted data. Results were summarised narratively.

RESULTS: of 3372 records retrieved, 31 articles from 12 countries met the inclusion criteria. All articles assessed associations cross-sectionally; sample sizes ranged from 35 to 1762 (n=9083 total participants). Twenty-one articles assessed urine or blood biomarkers, five assessed self-reported exposure, and five used community of residence as a proxy for exposure. Two articles assessed organochlorines, 26 organophosphates, 11 carbamates, and eight pyrethroids.
In the three articles assessing children <2 years, pesticides were negatively associated with motor and social development (n=2), but not with language or adaptive development (n=2). In the 12 articles assessing pre-schoolers (2-5 years), pesticides were negatively associated with motor (n=4), language (n=3), and social (n=3) development, and with attention, memory, and processing speed (n=2). Two studies found no associations between organophosphates and these outcomes. In the 21 articles assessing school-aged children (6-18 years), pesticides were negatively associated with motor development (n=4), memory (n=6), attention (n=4), processing speed (n=4), and IQ (n=2). Five studies found no associations between pesticides and these outcomes.

CONCLUSIONS: Pesticides may be associated with deficits in multiple child development domains. However, evidence in LMICs remains inconclusive due to the small number of studies and variable methodologies used.

KEYWORDS: pesticides, child development, developing countries

P-1009 Associations of gestational phenol exposure with cognition in 7.5-month-old infants

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BACKGROUND AND AIM: Triclosan and benzophenone-3 are ubiquitous phenolic endocrine disrupting chemicals. Similar chemicals are associated with adverse neurodevelopmental outcomes, but little is known about the effects of triclosan and benzophenone-3 on neurodevelopment. We investigated associations of gestational triclosan or benzophenone-3 exposure with infant cognitive outcomes.

METHODS: A visual recognition memory task assessed 312 7.5-month-old infants (151 males; 161 females) from a prospective birth cohort study. Triclosan and benzophenone-3 concentrations were quantified in maternal urines pooled from five timepoints across pregnancy. Infrared eye-tracking recorded infants' looking as they observed identical black-and-white photographs of human faces side-by-side (familiarization) and then the familiar next to a novel face (test trials). All infants saw the same face pairs. However, half the infants saw one set of faces as familiar (stimulus set 1), and half saw the other set as familiar (stimulus set 2). Multivariable generalized linear models (adjusted for income, parity, gestational age, testing age, child sex, stimulus set) assessed associations of triclosan or benzophenone-3 with time to familiarization (time to accrue 20s of looking during familiarization; attention measure), average run duration (time looking at stimuli before looking away; information-processing speed measure), and novelty preference (proportion of time looking at novel faces; recognition-memory measure).

RESULTS: Mothers were mostly white and college-educated with household income >$50,000/yr. Urinary concentrations (mean ± SD μg/L) of triclosan (68.8 ± 43.5) and benzophenone-3 (339.2 ± 638.5) were higher than those in reproductive-age females in the general U.S. population. Sex- and set-specific estimates demonstrated associations only in males who saw set 2: triclosan with longer time to familiarization (β=0.076; 95%CI: 0.04,0.112; p<0.0001) and benzophenone-3 with longer run duration (β=0.001; 95%CI: -0.0001,0.002; p=0.067).

CONCLUSIONS: In male infants, gestational exposure to triclosan and benzophenone-3 may be associated with poorer attention and slower information processing, respectively. (ES007326;ES022848;RD83543401;OD023272)

KEYWORDS: phenols, infant cognition, neurodevelopment

P-1011 The effect of Bisphenol A exposure on Attention Deficit Hyperactivity Disorder

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BACKGROUND The effect of Bisphenol A (BPA) on attention deficit/hyperactivity disorder (ADHD) is not fully understood. This study investigated the associations (i) between postnatal BPA exposure and ADHD in children; and (ii) between BPA and IgE levels for the possible disease pathogenesis.

METHOD A total of 453 children from Childhood Environment and Allergic Diseases Study cohort with urine samples were recruited in Taiwan. Urinary BPA glucoronide (BPAG) levels were measured by UPLC-MS/MS. The associations between BPAG levels and IgE levels and the risk of ADHD were evaluated by multivariate linear regression and logistic regression.

RESULT The geometric mean (SD) of BPAG concentrations was 8.84(±2.57) ng/ml at age 6. Urinary BPAG levels were positively associated with the risk of ADHD at age 6 (β=3.21 KU/l per ln-unit increase BPAG level; 95% CI, 0.99- 10.51 KU/l), after adjusting for potential confounders . There was no significant gender difference. The BPAG levels were positively associated with IgE levels at age 6 (β=64.85 KU/l per ln-unit increase BPAG level; 95% CI, 14.59- 115.11 KU/l).

CONCLUSION BPA exposures were positively associated with the risk of ADHD in children. The BPAG levels were positively associated with IgE levels.

KEYWORDS:： Behaviour, Children, BPA.

P-1019 Early-life critical windows of metal exposure associated with internalizing symptoms in young adolescents

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Introduction and Aim: Internalizing disorders, such as anxiety and depression, affect 10 – 20% of children and increase the risk for later-life psychopathology. The neural circuitry subserving internalizing phenotypes begins developing in utero and is vulnerable to early-life environmental exposures. Although early-life exposure to metals can adversely impact children's neurodevelopment and have lifelong impacts on mental health, little is known about critical windows to metal exposures and adolescent internalizing disorders. In this study, we hypothesized that early-life exposure to a mixture of metals is associated with increased internalizing problems in early adolescence.

METHODS: Among 431 (8-12 years; 216 females) pre-adolescents enrolled in the Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) longitudinal birth cohort study in Mexico City, we estimated weekly concentrations of 15 metals in naturally shed deciduous teeth using laser ablation-inductively coupled plasma-mass spectrometry (i.e., Ba, Bi, Cd, Co, Cr, Cu, Li, Mg, Mn, Mo, Ni, Pb, Sn, Sr, and Zn) from the 14th gestation week through one year of age). Internalizing problems were assessed using the Behavior Assessment System for Children, 2nd edition (BASC-2). We used lagged weighted quantile sum (lWQS) regression to estimate a time-varying mixture effect of multiple metals on internalizing problems. Models were adjusted for age and sex.

RESULTS: A higher metal mixture index in the 22nd-43rd postnatal weeks was associated with increased internalizing problems (maximum $\beta = 0.37$ [95% CI 0.06, 0.69]), driven mainly by Mg, As, Sn, and Bi.

CONCLUSIONS: This study supports the hypothesis that mixed metal exposure during specific critical windows in early life may associate with mental health disorders in childhood and adolescence. Our lWQS modeling approach and results may inform the role of exposure timing in driving neurodevelopmental outcomes, thereby pointing to future optimal, efficient, and properly timed public health interventions.

P-1022 Associations of Prenatal Metal Exposure and Non-nutritive Suck Among Infants from the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) Birth Cohort Study

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BACKGROUND AND AIM: Infant non-nutritive sucking (NNS) has been used as an early marker of neonatal brain function. Although there is an established relationship between metal exposure and brain development, the association between prenatal metal exposure and NNS has yet to be explored. To have a better understanding of the relationship, in this study, we explored associations between maternal urinary metal concentrations and NNS measurements among 116 infants from the Puerto Rico PROTECT birth cohort.

METHODS: We measured urinary concentrations for seven metals collected between 16-20 weeks and 24-28 weeks gestation. Linear mixed effects models (LMEs) were used to regress NNS on metals, adjusting for specific gravity, maternal age, birth weight, and fetal sex. Fetal sex effects were estimated using interaction terms between metal exposure variables and fetal sex indicators.

RESULTS: We observed significant positive associations between mercury and manganese with NNS duration (mercury: Δ= 1.08, 95% CI: 0.42, 1.74; manganese: Δ= 0.67, 95% CI: 0.15, 1.20) and NNS cycles/min (mercury: Δ= 1.85, 95% CI: 0.58, 3.11; manganese: (Δ= 1.37, 95% CI: 0.40, 2.34). Furthermore, the association between NNS cycles/burst and manganese (Δ= 4.44, 95% CI: 1.40, 7.47) were in the opposite direction from its association with zinc (Δ= -9.30, 95% CI: -14.71, -3.89), as well as with copper (Δ= -6.58, 95% CI: -12.06, -1.10). We also observed differences in metal-NNS associations by fetal sex.

CONCLUSIONS: We observed significant associations between prenatal metal exposure and child neurodevelopment, using NNS measurements, among infants from the ongoing Puerto Rico PROTECT cohort. We believe this study will inform future efforts aimed at reducing health risks related to early life metal exposures, such as developing early identification of metal-induced adverse outcomes in child neurodevelopment.

KEYWORDS: Exposure, Child Neurodevelopment, Pregnancy, Metals, Puerto Rico

P-1029 Early-life exposure to a mixture of phthalates and phenols and child social behavior in a new type of mother-child cohort relying on within-subject pools of repeated urine biospecimens

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BACKGROUND AND AIM: Previous cohorts characterized exposure to phenols and phthalates using few spot urine samples, incurring in exposure misclassification. Early infancy exposure remains understudied. We relied on a cohort with improved exposure assessment to examine associations of phthalates and phenols with child autistic traits.

METHODS: This analysis included 406 mother-child pairs from the French SEPAGES cohort. 25 phenols/phthalate metabolites were measured in within-subject pools of repeated urine samples collected at second and third pregnancy trimesters (median= 21 samples/trimester), and at 2 and 12 months of age (median= 7 samples/period). Autistic traits were parent-reported at 3 years using the Social Responsiveness Scale (SRS). Adjusted differences in SRS raw scores were estimated per doubling in each biomarker concentration using linear regression. A literature review was performed to prioritize the measured phthalates/phenols based on their likelihood to affect social behavior. The mixture effect was estimated for the prioritized compounds (bisphenol A, triclosan, DEHP, MEP, MnBP and MBzP) using Bayesian Weighted Quantile Sum (BWQS) regression.

RESULTS: Most associations were observed in the 12-months exposure window. Among the prioritized compounds, triclosan (β= 0.79; 95%CI: 0.01, 1.56) and MEP (β= 0.92; 95%CI: -0.11, 1.95) were associated with worse total SRS scores, while MnBP and ∑DEHP were associated with worse social awareness (β= 0.25; 95%CI: 0.01, 0.50), and social communication (β= 0.43; 95%CI: -0.02, 0.88) scores, respectively. The mixture of prioritized compounds was associated with worse total SRS scores (Beta1= 1.40; 95%CrI: -0.22, 2.99), driven by the social awareness (Beta1= 0.36; 95%CrI: 0.03, 0.70) and social communication (Beta1= 0.87; 95%CrI: 0.31, 1.51) subscales.

CONCLUSIONS: The literature search allowed to prioritize the compounds with a higher weight of evidence. Our results suggest that early infancy is a critical window for the effects of phenols and phthalates on child social development.

KEYWORDS: phthalates, bisphenol, neurodevelopment, social behavior, autism

P-1034 Associations between phthalates and sleep quality in pregnant women with repeated assessment of exposure

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BACKGROUND AND AIM: Phthalates are associated with sleep disorders in midlife women. However, this relationship among pregnant women remains unknown. This study investigated associations of repeated measures of urinary phthalates in early and late pregnancy with sleep quality in pregnant women.

METHODS: This study analyzed eight urinary phthalates in pregnant women from the Korean Children's Environmental Health Study (n = 2,324). Multiple informant models were fit using generalized estimating equations to examine the association between phthalate metabolites measured in early and late pregnancy and sleep quality. Summary measures of phthalate mixtures, including the phthalates from plastic sources (∑Plastic), anti-androgenic phthalates (∑AA), di-(2-ethyhexyl) phthalate (∑DEHP), and all phthalate metabolites measured (∑All), were calculated from urinary phthalate metabolites. The sleep quality was assessed by the Pittsburgh Sleep Quality Index (PSQI) global and subscale scores.

RESULTS: Compared to the lowest quartile, ∑Plastic (adjusted odds ratio [OR] = 1.36; 95% confidence interval [CI]: 1.02, 1.81), ∑AA (OR = 1.60; 95% CI: 1.20, 2.12), ∑DEHP (OR = 1.37; 95% CI: 1.03, 1.82), and ∑All (OR = 1.66; 95% CI: 1.25, 2.20) in the highest quartile were significantly associated with increased odds of low sleep efficiency (85% or less). The highest quartile of ∑All had 1.40 times (95% CI: 1.02, 1.94) the odds of short sleep duration (7 hour or less). In linear models, there was a trend with any of the summary phthalate measures and sleep efficiency: each log-unit increase in concentration was associated with 1.20 to 1.24 times the odds of low sleep efficiency. Summary phthalate measures showed a nonlinear association with sleep efficiency and sleep duration (p for nonlinearity < 0.05) in the restricted cubic spline regression.

CONCLUSIONS: Our findings suggest that phthalate exposure is associated with poor sleep quality in pregnant women.

KEYWORDS: Phthalates, Pittsburgh Sleep Quality Index, sleep efficiency, pregnant women

P-1038 Wildfire Smoke and Symptoms Affecting Mental Health among Adults in Oregon

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BACKGROUND AND AIM: The impact on mental health status of experiencing a wildfire is believed to be substantial; however, few data are available to describe symptoms affecting mental health among people affected by wildfires. We assessed associations between exposure to wildfire smoke and self-reported symptoms affecting mental health among adults living in Oregon, a geographic area of the USA regularly affected by wildfires.

METHODS: We analyzed data from 5,807 adults in Oregon who responded to the 2018 Behavioral Risk Factor Surveillance System's depression and anxiety module. We linked by interview date and county of residence each adult's responses about the symptoms affecting their mental health status with smoke plume density, a proxy for wildfires and wildfire smoke exposure. Associations between days in the past year with light, medium, and heavy smoke plume densities and symptoms affecting mental health during the two weeks before the interview date were estimated using predicted marginal probabilities from logistic regression models.

RESULTS: In the year before completing the interview, 100% of respondents experienced ≥14 days of medium or heavy smoke plumes, with an average exposure duration of 32 days. Nearly 10% reported being unable to stop or control their worrying more than half the time over the past two weeks. Medium or heavy smoke for 42–74 days in the past year, compared to ≤27 days in the past year, was associated with a 30% higher prevalence of being unable to stop or control worrying more than half the time during the past two weeks (prevalence ratio: 1.30, 95% confidence interval: 1.03, 1.65).

CONCLUSIONS: Among adults in Oregon, selected symptoms affecting mental health were associated with extended durations of medium and heavy smoke. These findings highlight the burden of symptoms affecting mental health among adults living in communities affected by wildfires and wildfire smoke.

P-1050 Effect of Cadmium on the Association between Blood Pressures and Telomere Length: A Population-based Cross-sectional Study in Japan

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BACKGROUND AND AIM: Telomeres (TL) are repeated oligomers in the end of chromosome. TL shortening is associated with many pathophysiological outcomes, later in life such as cardiometabolic diseases and malignancy. However, not much is known regarding the role of heavy metals in TL shortening in association with increased blood pressure (BP). The objective of this study is to determine whether the association between high BP and TL shortening could be modified by the environmental cadmium (Cd) exposure.

METHODS: This study was a community-based cross-sectional study with 1047 individuals of age more than 19 years of 2019 Iwaki Health Promotion Project, Japan. A questionnaire survey, blood pressure measurement and blood sampling were performed by the trained research teams. Spot urine sample was also collected, and urinary Cd concentrations was measured, while Leucocyte TL was assessed by G-tail telomere hybridization protection assay. Regarding the statistical analysis, first, descriptive analysis was done using means, frequency, and percentage. Later, multivariate linear regression analysis was performed to evaluate the associations between urinary Cd concentration, BP/hypertension, and TL in relevance.

RESULTS: In high Cd concentration group, systolic blood pressure (SBP), diastolic blood pressure (DBP) and pulse pressure were significantly higher while TL was significantly shorter. By stratified multivariate regression models, telomere G-tail shortening was significantly associated with higher SBP (beta= -27.31; 95% CI: -50.71, -3.91, p=0.022) and DBP (beta= -49.33; 95% CI: -87.25, -11.42, p=0.011), only in high Cd concentration group. Similarly, TL was shorter among the hypertensive individuals (beta= -978.79; 95% CI: -1920.09, -37.51, p=0.042).

CONCLUSIONS: This study firstly identified that the negative associations of BP and TL were observed only in high Cd concentration group. These findings indicate that the associations of BP and TL could be mediated by environment Cd exposure.

KEYWORDS: Blood Pressure; Hypertension; Telomere; Cadmium; Japan

P-1054 The Effects of Minimally Processed and Ultra-Processed Food Intake on Cardiovascular Health based on the Korea National Health and Nutrition Examination Survey (KNHANES), 2013-2015

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Cardiovascular disease (CVD) is the leading cause of death worldwide. CVD risk factors are usually chronic, and a diet and lifestyle can be important determinants of cardiovascular health (CVH). Recently, the importance of dietary patterns rather than single nutrients has been emphasized for CVH. Consumption of processed food is increasing due to socio-economic changes in Korea. Although harmful substances may be added or created during the processing and packaging of foods, few studies evaluated the CVH effects of processed foods in Koreans. This study investigated the effect of minimally processed food (MPF) and ultra-processed food (UPF) intake on CVH. We used the data of 6,945 adults from the Korea National Health and Nutrition Examination Survey 2013–2015. Based on the CVH metrics (Life's simple 7), the CVH indicator was estimated as the sum (0–12) of the six (blood pressure, fasting plasma glucose, total cholesterol, body mass index, smoking status, physical activity) scores, and categorized as Inadequate (0–4), Average (5–8), and Optimum (9–12). MPF and UPF intake were estimated as the distribution of total energy intake using NOVA food classification. The mean (standard deviation) of MPF and UPF intake was 61.28(0.28) and 20.27(0.24) %kcal/day, respectively. After adjusting for all covariates, we found significant positive associations between MPF intake and CVH ($p<0.001$), while associations between UPF intake and CVH were significantly negative ($p<0.001$). Comparing the highest quartiles with the lowest of MPF intake, the adjusted odds ratio (OR) (95% Confidence interval) for Inadequate (compared with Optimum) was 0.36 (0.22–0.58), while UPF intake, adjusted OR was 2.63 (1.52–4.55). This study suggests that processed food intake was significantly associated with CVH in Korean adults. Public health policies are needed to promote choosing less processed foods to prevent CVD.

KEYWORDS: Cardiovascular Health, Minimally Processed Food, Ultra-Processed Food, Dietary, NOVA food classification

P-1055 Association of perfluoroalkyl substances (PFAS) with lipid trajectories in midlife women: the Study of Women's Health Across the Nation

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BACKGROUND AND AIM: Despite lipid-lowering effects of perfluoroalkyl substances (PFAS) observed in rodent models, PFAS have been associated with unfavorable blood lipid profiles in human populations. However, evidence from longitudinal studies in the general population is limited. We examined the association of serum concentrations of PFAS with longitudinal trajectories of blood lipids in the Study of Women's Health Across the Nation.

METHODS: We included 1143 women aged 45-56 years in 1999-2000. Concentrations of PFAS including linear and branched perfluorooctane sulfonic acid (n-PFOS and Sm-PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorohexane sulfonic acid (PFHxS) were measured in serum collected at baseline. Total, low-density lipoprotein (LDL), and high-density lipoprotein (HDL) cholesterol, and triglycerides were measured in blood annually or biannually during follow-up through 2016. Using latent class growth models (LCGMs), trajectories of each lipid were estimated based on the population data. The associations between PFAS and lipid trajectory classes were evaluated by multinomial log-linear models with latent class membership as outcomes and log-transformed PFAS as exposure.

RESULTS: Three distinct lipid trajectories (low, medium, and high trajectories) were identified. After adjustment for covariates, n-PFOS and Sm-PFOS were positively associated with higher LDL cholesterol [ORs (95% CI) for high vs. low trajectory per doubling of each PFAS: 1.28 (1.04, 1.56) and 1.24 (1.04, 1.48), respectively]. N-PFOS, n-PFOA, PFNA, and PFHxS were inversely associated with higher triglycerides [ORs (95% CIs) for high vs. low trajectory per doubling of each PFAS: 0.72 (0.55, 0.94), 0.65 (0.50, 0.84), 0.78 (0.62, 1.00), and 0.76 (0.62, 0.93), respectively]. The associations of PFAS with total or HDL cholesterol were insignificant.

CONCLUSIONS: Higher serum concentrations of selected PFAS were associated with a higher trajectory of LDL cholesterol and a lower trajectory of triglycerides. Further studies on the underlying mechanisms of the findings are warranted.

KEYWORDS: PFAS, dyslipidemia, midlife women

P-1056 Frequent Cannabis Smoking and Association with Prediabetes and Diabetes in Early Adulthood

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BACKGROUND: Cannabis use in young adulthood has been linked with increased risk of prediabetes later in life. However, many previous studies have only used fasting blood samples to determine risk for type 2 diabetes (T2D), which may not detect early changes in glucose homeostasis. The objective of this study was to determine the association between cannabis use and risk for prediabetes and T2D in young adults using several measures of glucose homeostasis, including an oral glucose tolerance test (OGTT).

METHODS: The Meta-CHEM study is a subset (N=84) of overweight and obese young adults aged 22–25 years from the Children's Health Study (CHS). Participants underwent a single clinical visit which included a 2-hour OGTT and questionnaire about cannabis smoking habits in the past year. Participants were classified as non-smokers, light cannabis smokers (smoke <once a week), and heavy cannabis smokers (smoke >once a week). Those smoking more than one cigarette in the past week were excluded from the study. Participants were classified as having prediabetes or T2D if they had a HbA1c >5.6%, fasting glucose >99 mg/dL, and/or 2-hour OGTT glucose >139 mg/dL. Logistic regression was used to assess the associations between cannabis smoking habits and metabolic outcomes after adjusting for age, sex, education, body mass index, Hispanic ethnicity, physical activity, and alcohol consumption.

RESULTS: 52 (62%) participants were non-diabetic, 28 (33%) had pre-diabetes, and 4 (0.05%) had T2D. 25 (30%) participants were nonsmokers, 47 (56%) were light cannabis smokers, and 12 (14%) were heavy cannabis smokers. The odds of having prediabetes or T2D was 7.3 times higher among heavy smokers (95% CI: 0.94, 7.7), and 1.5 times higher among light smokers (CI: 0.43, 6.0) than nonsmokers (P-value for trend = 0.03).

CONCLUSIONS: Cannabis use in overweight and obese young adults was significantly associated with risk of having prediabetes or T2D.

P-1062 Seasonal variations of hospitalizations for chronic rhinosinusitis by different endotypes

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BACKGROUND AND AIM: chronic rhinosinusitis (CRS) affects ~12% of the population and costs ~$30 billion each year in the US. A recent study reported winter and spring exacerbations of sinonasal symptoms among CRS patients; however, little is known about seasonal exacerbations by endotypes. This study aims to investigate seasonal variations of CRS hospitalizations among different inflammatory endotypes.

METHODS: CRS patients with different endotypes were identified in Mount Sinai electronic health records using a multi-layer CRS phenotyping algorithm integrating features such as encounter frequencies, surgeries, provider specialties and biomarkers, which was previously evaluated with high prediction performance (PPV=0.91). The patients with hospitalizations from 2003-2019 were included while patients with comorbidities of asthma or allergic rhinitis were excluded. Quasi-Poisson regression models were used to evaluate the associations between seasons and daily counts of CRS hospitalizations, adjusting for long-term temporal trend, day-of-the-week, daily temperature and PM2.5.

RESULTS: The counts of CRS hospitalizations were 32,194 in spring, 31,993 in summer, 32,077 in fall, and 30,584 in winter. for all CRS patients, no significant differences by season were detected. Among patients with nasal polyps (1615/7604), the highest risk of hospitalization was seen in spring (RR: 1.11; 95% CI: 1.06-1.17), followed by fall (RR: 1.06; 95% CI: 1.01-1.12), compared to winter. Similar patterns were observed in patients with blood eosinophil count > 300 cells/mcL (596/7604): increased risks of hospitalization were observed in spring (RR: 1.10; 95% CI: 1.04-1.16) and fall (RR: 1.08; 95% CI: 1.01, 1.14). In contrast, no differences by season were found for CRS patients without nasal polyps or with low eosinophil count.

CONCLUSIONS: Elevated risks of hospitalizations in spring and fall were only observed in CRS patients with endotypes related to eosinophilic type 2 inflammation. The high recurrence and refractory nature of these endotypes might be attributable to seasonal environmental factors.

KEYWORDS: rhinosinusitis, seasonal exacerbations

P-1066 Long-term air pollution, cardiometabolic multimorbidity, and genetic susceptibility: a prospective study in UK biobank cohort

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BACKGROUND AND AIM: Air pollution has been associated with individual cardiometabolic diseases (CMDs) including type II diabetes (T2D), ischemic heart disease (IHD), and stroke. However, little is known about their relationship with the risk of cardiometabolic multimorbidity (CMM) with at least two of the CMDs. Therefore, we aimed to explore whether the long-term exposure to PM2.5, PM10, PM2.5–10, NO2, and NOx were associated with the progression of CMM.

METHODS: We used data from 415,855 adults of UK Biobank that were free of any of the three CMDs at baseline enrollment with a median follow-up of 8.93 years. The Land Use Regression model was used to estimate the annual average ambient concentrations of PM2.5, PM10, PM2.5–10, NO2, and NOx. We employed a multi-state model to assess associations of five pollutants with different transitions of the CMM trajectory.

RESULTS: A total of 33,375 participants developed one CMD, 3,257 of which subsequently developed another one or two. We found that PM2.5, PM10, NO2, and NOx levels were associated with the transition from healthy to having the first cardiometabolic disease (FCMD), and then to CMM with relatively higher risks. for instance, per 5-μg/m¬3 increasing in PM2.5 levels, the FCMD risk increased 27% (95% CI: 1.20-1.34) and the subsequent CMM risk raised to 41% (95% CI: 1.18-1.68). Robust associations of a weighted air pollution index with the CMM trajectory were also observed. Participants with IHD first were more likely to develop CMM than those with T2D or stroke. Additionally, the observed relationship between air pollution and CMM could be enhanced by the genetic susceptibility of CMDs.

CONCLUSIONS: Air pollution is not only associated with the individual CMDs but also could expedite the progression of CMM, which could be modified by genetic predisposition.

KEYWORDS: air pollution, PM2.5, cardiometabolic multimorbidity, multi-state model, genetic susceptibility

P-1069 Lung Cancer Mortality Risks of Long-term Exposure to Particulate Matter in South Korean Adults Including and Excluding Lung Cancer Patients

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BACKGROUND AND AIM: Lung cancer is a major burden of disease worldwide. Many epidemiological studies suggested particulate matter(PM) as a prominent risk factor of lung cancer mortality. The risk also could differ depending on the cancer status related to susceptibility, but few studies focused on this difference. This study aims to compare the associations of PM2.5 and lung cancer mortality by including and excluding lung cancer patients in the Seoul Metropolitan Areas using a population-based nationwide cohort.

METHODS: From the National Health Insurance Services-National Sample cohort for 2002-2015, we selected the study population who carried out national screening during 2005-2007, aged over 30, were non-severely disabled, and had full address information every year. for our comparison, we created two sub-populations excluding and including those who had been diagnosed with lung cancer until the baseline in 2007. Lung cancer deaths were identified for 2007-2015, while individual-level long-term exposures to PM2.5 were assessed as 5-year average concentrations estimated from a previously-validated prediction model. We performed time-dependent Cox proportional hazards model to estimate hazard ratios (HRs) and 95% confidence intervals (95% CIs) per 10ug/m3 increase in PM2.5 adjusting for individual characteristics.

RESULTS: of 87,608 and 86,739 people including and excluding 867 lung cancer patients, 367 (0.42%) and 53 (0.06%) people died with lung cancer, respectively. Although all effect estimates were statistically non-significant, both groups showed positive effect estimates with similar magnitudes. (HR=1.60 [95% CI=0.24-10.76] and 1.55 [0.73-3.26] for the populations excluding and including lung cancer patients, respectively).

CONCLUSIONS: Our finding of positive risk estimates, although non-significant, between two populations including and excluding lung cancer patients suggest a possibility of consistent risks of dying with lung cancer attributed to PM2.5 regardless of susceptibility derived by cancer status. Further studies need to confirm our findings using extended populations.

KEYWORD
Particulate matter; Lung cancer; Mortality; Cohort

P-1073 Prenatal Maternal and Paternal Household Pesticide Exposure and Childhood Acute Lymphoblastic Leukemia (ALL): Does Exposure Comparison Modeling Influence Risk Estimates?

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BACKGROUND AND AIM: Household pesticide exposure is associated with increased risk of childhood acute lymphoblastic leukemia (ALL). We sought to investigate whether ALL risk estimates for pest-specific use categories (PSUC) change when using an analysis method (AM) versus a design method (DM) of multiple-PSUC confounding adjustment.

METHODS: Cases (N=1810) ages ≤15 were identified through Children's Cancer Group institutions between 1989-1993 and age-/sex-matched to community controls (N=1951). Household pesticide use during pregnancy (including the month prior) was collected via telephone interview. We used unconditional logistic regression to estimate ALL odds ratios (OR) for parental (mother/father/both) exposure to ten household PSUC (ant-cockroach-fly-bees, moths, spiders-mites, rodents, fleas-ticks, termites, slugs-snails, weeds, plants, or commercial exterminator). for AM, we assessed risk by including all PSUC covariates. for DM, each PSUC was assessed as a contrast with a zero-use comparison group (all ten-categories=zero) in adjusted models. All models were adjusted for known ALL risk factors which remained significant in final models (income, maternal age, and prenatal-vitamin use).

RESULTS: Pesticide use during pregnancy was prevalent (54% reported exposure to 2+ PSUC). PSUC bivariate correlations were all less than 0.25. Using AM, elevated ORAM (range: 1.41-1.55) were observed in three maternal and one paternal PSUC ($p<0.05$). All ORs increased when using DM (mother's range: 22.84%-62.50%; father's range: 22.34-60.50%). Risks were highest for termite (ORDM=3.98, 95% CI: 1.24-12.75, mothers) and spider-mite pesticides (ORDM=2.72, 95% CI: 1.29-5.75, fathers).

CONCLUSIONS: ALL risk estimates for exposure to ten pesticide use categories increased among both mothers and fathers when restricting exposure contrasts to a zero-use comparison group. These results are consistent with other studies reporting highest risks for termite pesticide exposure. This may reflect either a true risk difference or other characteristics among zero-use households which reduce risk. Investigation of potential mediation among pesticide classes appears warranted.

KEYWORDS: Acute Lymphoblastic Leukemia; childhood; pesticides; prenatal; case-control

P-1076 Dietary intakes of dioxins and polychlorinated biphenyls (PCBs) and breast cancer risk in 9 European countries

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BACKGROUND AND AIM: Dioxins and polychlorinated biphenyls (PCBs) are known to be mobile and highly persistent in the environment leading to a ubiquitous pollution. These chemicals are carcinogenic. Due to bioaccumulation along the food chain, the main route of exposure in general population is through diet. However, evidence in general population is lacking. The aim of the present study was 1) to estimate dietary intakes for 17 dioxins and 35 PCBs in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort 2) to investigate the association with breast cancer risk

METHODS: EPIC is a prospective cohort that has enrolled 520,000 adults recruited across 10 European countries. Dietary and lifestyle data have been collected at baseline through validated questionnaires. Dietary intake for 17 dioxins and 35 polychlorobiphenyls were assessed through a combination of EPIC food consumption data and food contaminant levels from the European Food Safety Authority monitoring programs. Association between intakes of dioxins and PCBs and breast cancer risk were estimated using multivariate Cox regression. Analyses included 318,607 women with 13,241 incident breast cancers (median follow-up: 14.9 years).
RESULTS
Exposure to dioxins, Dioxin-Like-PCBs (DL-PCBs), and Non-Dioxin-Like-PCBs (NDL-PCBs) estimated from reported dietary intakes were not associated with breast cancer incidence, with the following hazard ratios (HRs) and 95% confidence intervals for an increment of 1 SD: HRdioxins = 1.00 (0.98 to 1.02), HRDL-PCB = 1.01 (0.98 to 1.03), and HRNDL-PCB = 1.01 (0.99 to 1.03), respectively. Results remained unchanged when analyzing intakes as quintile groups, as well as when analyses were run separately per country, or separating breast cancer cases based on estrogen receptor status

CONCLUSIONS: This large European prospective study does not support the hypothesis of an association between dietary intake of dioxins and PCBs and breast cancer risk.

KEYWORDS: Breast cancer, dioxins, PCBs

P-1077 Dietary intakes of Dioxins and polychlorobiphenyls (PCBs) and mortality: EPIC cohort study in 9 European countries

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BACKGROUND AND AIM: Dioxins and polychlorinated biphenyls (PCBs) are persistent organic pollutants which are carcinogenic. The main route of exposure in general population is through diet. Cohort studies have reported inconsistent associations between these chemicals and mortality. The aim of the present study was 1) to estimate dietary intakes for 17 dioxins and 35 PCBs in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort 2) to investigate the impact on mortality.

METHODS: EPIC is a prospective cohort that has enrolled 520,000 adults recruited across 10 European countries. Dietary intake of dioxins and PCBs was assessed combining EPIC food consumption data with European food contamination data provided by the European Food Safety Authority. Association between intakes of dioxins and PCBs and breast cancer risk and mortality were estimated using multivariate Cox regression. Analyses included 451,390 adults with 46,627 deaths (median follow-up: 17.4 years).
RESULTS
A U-shaped non-linear association with all-cause mortality for dietary intake of dioxins (Pnon-linearity<0.0001), DL-PCB (Pnon-linearity=0.0001), and NDL-PCBs (Pnon-linearity<0.01) was observed. for example, the hazard ratios (95%Confidance interval) for all-cause mortality obtained with the spline model was equal to 1.03 (1.02-1.05) for low intake of dioxins (7 pg TEQ/day), 0.93 (0.90-0.96) for moderate intake (25pg TEQ/day), while for high intake of dioxins (55pg TEQ /day) it was 1.03 (0.97-1.09). There was no association between intakes of dioxins and cancer mortality, but a U-shaped association was observed for intake of DL-PCBs and intake of NDL-PCBs and cancer mortality. Intakes of dioxins, DL-PCBs and NDL-PCBs was not associated with cardiovascular mortality.

CONCLUSIONS: This large European prospective study does support the hypothesis of a non-linear association between dietary intake of dioxins and PCBs and mortality which might be explained by endocrine disrupting properties

KEYWORDS: mortality, dioxins, PCBs

P-1079 Long-term atmospheric exposure to PM2.5 and PM10 and breast cancer risk in a case-control study nested in the French E3N cohort from 1990 to 2011

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BACKGROUND AND AIM: Breast cancer is one of the most prevalent cancers in women and its incidence increased in France during the past thirty years. Known risk factors include ageing, genetic, reproductive, anthropometric, and lifestyle factors. Since they fail to totally explain the observed risk increase, it has been hypothesized that some of this increase could be related to environmental exposure to endocrine disrupting chemicals. Among those, particulate matters (PM) have been pointed out by epidemiological studies due to their potential endocrine disrupting and carcinogen properties We aimed to estimate the association between PM2.5 and PM10 exposure and the risk of breast cancer among women in a case-control study nested in the French E3N cohort.

METHODS: Our study focused on 5222 invasive breast cancer cases diagnosed between 1990 and 2010 and 5222 randomly selected controls matched to cases. Assessment of PM2.5 and PM10 exposures were estimated by land use regression (LUR) models and assigned to the geocoded residential postal codes of participants for each year from recruitment 1990 through 2011. We estimated odds ratios (OR) and 95% confidence intervals (CI) for breast cancer using conditional adjusted logistic regression models.

RESULTS: We found a positive association between breast cancer risk and PM2.5 (OR=1.15, 95%CI: 1.00-1.31, per 10µg/m3) and PM10 (OR=1.07, 95% CI: 0.99-1.15). These results were confirmed estimating PM2.5 and PM10 exposure with a chemistry transport model (CHIMERE).

CONCLUSIONS: We found suggestive evidence of an association between air pollution exposure and incidence of breast cancer risk in French woman

KEYWORDS: Particulate matters, breast cancer, air pollution, risk factor, land use regression models

P-1081 Is Cadmium Exposure associated with Thyroid Cancer? A National Health and Nutrition Examination Survey Analysis

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INTRODUCTION
The increasing thyroid cancer incidence in the past few decades might be partially explained by the changing prevalence of environmental exposures, including to the heavy metal cadmium. Although cadmium is known to accumulate in the thyroid gland and has been labeled a carcinogen, an association between cadmium exposure and thyroid cancer has not been demonstrated to date. To assess this potential effect of cadmium exposure, this study investigated the association between blood cadmium levels and thyroglobulin antibodies (TgAb) as previous studies showed that positive TgAb predicts the presence of thyroid cancer in patients with thyroid nodules.

METHODS: Using the 2007-2012 National Health and Nutrition Examination Survey (NHANES), participants of 20 years and older without thyroid disease/ cancer with reported blood cadmium and thyroid function levels were included (n=7,383). TgAb and cadmium were log-adjusted. Models with cadmium as a log-adjusted continuous variable and divided into quartiles of exposure, adjusted for age groups, sex, race, BMI groups, alcohol, smoking, and iodine status were assessed using complex survey design.

RESULTS: The geometric mean of cadmium across all participants was 0.348 ng/mL (standard error (SE): 0.005). After adjustment, there was no significant association between continuous cadmium levels and TgAb (β=0.057, 95% confidence interval (CI): -0.004; 0.119. Models with cadmium divided into quartiles showed that though quartile 2 and 3 were associated with increased TgAb, this association was only significant for quartile 4 (β=0.193, 95% CI: 0.069; 0.317), versus quartile 1.

DISCUSSION
High levels of cadmium were positively associated with TgAb levels indicating that cadmium exposure needs to be further explored as a potential risk factor for thyroid cancer, especially given the widespread use and exposure of the general population to cadmium. This includes in-depth studies into the potential carcinogenic mechanism of cadmium on the thyroid gland.

P-1085 Household Cooking Fuel and Gallbladder Cancer Risk: A Multi-Centre Case Control Study in India

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BACKGROUND-AIM: Evidence from India, a country with certain unique cancer patterns (e.g., high incidence of gallbladder cancers (GBC)) and distinct risk exposures such as 'biomass burning' for cooking, may offer insights into the role of indoor air pollution in cancer etiology. We evaluated the association between household cooking fuel and GBC risk in a case-control study conducted among long-term residents (i.e., at least 10-years) of North-East and East Indian regions of Assam and Bihar, with high-risk for GBC and intense 'biomass burning'. We explored if these associations were accounted-for by healthy diet, fire-vents and 'daily exposure duration'.

METHODS: We recruited men and women aged 30-69 years from hospitals between 2019 and 2021, with newly diagnosed, biopsy-confirmed GBC (N=214) and unrelated controls frequency-matched by age, sex and region (N=166). Information about cooking fuel, lifestyle, personal and family history, socio-demographics and physical measurements was collected. We tested associations using multivariable logistic regression analyses adjusted-for confounders.

RESULTS: All participants (73.4% women) were categorised based on lifetime use and duration of predominant cooking fuel. Group-1: LPG for ≥20 years (13.5%); Group-2: LPG for 1-19 years with no concurrent biomass (15.6%); Group-3: LPG 1-19 years with concurrent biomass (12.9%); and Group-4: Biomass for ≥20 years (57.9%). Compared to group-1, GBC risk was higher in group-3 [OR=2.69, 95%CI (1.07-6.72)] and group-4 [OR=2.44, 95%CI (1.07-5.56)] but not in group-2 (p-trend=0.020). The associations strengthened in women-only analysis; and attenuated with high daily consumption of fruits-vegetables, but did not alter with fire-vents or 'daily exposure duration'.

CONCLUSIONS: With cautious interpretation for residual confounding, sample-size limitations and possible errors in exposure, the findings identify 'biomass burning' as a modifiable risk factor for GBC in high-risk regions. It further highlights 'clean fuel replacement' can mitigate the risk; and a healthy diet can partially reduce the risk.

KEYWORDS: Gallbladder cancer, biomass, India

P-1086 Lifetime Chronic Arsenic Exposure and Gallbladder Cancer Risk: Evidence from Endemic Regions of India

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BACKGROUND-AIM: Evidence for the associations of varying levels of arsenic in drinking water and digestive tract cancers is limited. Data from endemic regions of India, with high incidence of a rare digestive tract cancer-gallbladder cancer (GBC)- may explain the role of chronic arsenic exposure in cancer etiology. We evaluated the associations between arsenic levels in groundwater and GBC risk in a case-control study conducted among residents of Assam and Bihar (2019-2021), the two most arsenic-impacted states of India next to West Bengal.

METHODS: We recruited men and women aged 30-69 years from hospitals (73.4% women), with newly diagnosed, biopsy-confirmed GBC (N=214) and unrelated controls frequency-matched by age, sex and region (N=166). Information about lifetime residential history, lifestyle, personal and family history, socio-demographics and physical measurements was collected. Average-weighted lifetime arsenic concentration (AwLAC) was estimated extrapolating district-level groundwater monitoring data (2017-2018) and lifetime residential history. Accounting for confounders, tertiles of AwLAC (ug/L) was modelled in multivariable logistic regression analysis (Range: Zero-448.39; median (IQR): T1-0.45(0.0-1.19); T2-3.75(2.83-7.38); T3-17.6(12.34-20.54)).

RESULTS: A higher proportion of participants in the highest tertile of AwLAC compared to the lowest tertile consumed tube-well water for drinking (67.7 vs. 27.9%) with purification (45.2 vs. 25.5%) and reported unsatisfactory water-quality (49.2 vs. 25.0%). These participants in the highest and in middle tertiles of AwLAC were associated with an increased risk of GBC versus the lowest tertile with OR (95%CI) of 2.43(1.30-4.54) and 2.00(1.05-3.79) respectively (p-trend=0.007). The associations remained consistent with 'average-maximum arsenic concentration (any-time)' as exposure variable and in a sub-set with block-level AwLAC estimations.

CONCLUSIONS: Despite limitations of one-time arsenic levels, sample-size and potential residual confounding, the findings indicate chronic arsenic exposure, including low-levels, is a risk factor for GBC. Tackling 'arsenic pollution' may help reduce the burden of GBC and other health outcomes.

KEYWORDS: Gallbladder cancer, arsenic, India

P-1092 The relation between air pollution and multiple sclerosis hospital admission in Kerman, Iran using generalized additive models

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BACKGROUND AND AIM: Air pollution may affect the nervous system and act as an environmental risk factor in increasing multiple sclerosis (MS) incidence and attacks. The aim of this study was to investigate the possible relation between air pollution and MS in Kerman, Iran.

METHODS: This was an ecological study. Data on ambient air pollutants and meteorological variables were inquired from the Kerman Environmental Protection Agency and the Kerman Meteorology Organization, respectively. MS attack incidence data were obtained from Kerman's Shafa hospital MS Registry. Generalized Additive Models with lags were used for estimating Relative Risks.

RESULTS: During 2008 - 2020, 4913 attacks occurred among MS patients in Kerman which 3739 were female. The strongest relation between CO with MS attacks was seen in the under 30 year's group in lag 0 (RR = 1.6544), for O3 in the over 50 year's group in lag 5 (RR =1.0181), for SO2 in lag 5 (RR =1.0237), for NO2 in females in lag 0 (RR =1.0126), for PM10 in the over 50 year's group lag 3 (RR =0.9828) and for PM2.5 in lag 5 (RR = 0.9832).

CONCLUSIONS: Ambient CO,O3, NO2 and SO2 might be important risk factors for MS attacks in Kerman.

KEYWORDS: Air pollution, Multiple sclerosis, Environmental factors, Epidemiology, Kerman

P-1093 Association of copper exposure with prevalence of chronic kidney disease among a Chinese elderly population

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BACKGROUND AND AIM: Metal exposures are suspected to associate with the risk of chronic kidney disease (CKD). Copper (Cu) is an essential yet toxic trace element in humans. Epidemiological evidence on the association of Cu exposure with CKD remains inconsistent. We aim to investigate the association of blood Cu and its co-exposure to other metals with CKD.

METHODS: A cross-sectional study was conducted among 3,286 Chinese elderly adults in Zhejiang, China. The whole blood levels of Cu as well as other 10 metals were measured by inductively coupled plasma mass spectrometry (ICP-MS). CKD events were defined as the presence of albuminuria or <60 mL/min/1.73m2 estimated glomerular filtration rate (eGFR). Multivariable logistic regression and linear regression models were applied to assess the single-metal association of Cu with kidney function. The Bayesian kernel machine regression (BKMR) was used to estimate associations of the metal mixture with CKD.

RESULTS: In the logistic models, we observed a positive dose-dependent association of blood Cu with CKD prevalence after adjusting for multiple covariates. Positive linear dose-response associations with blood Cu were also found for CKD and negative for eGFR. The positive association between blood Cu and CKD risk also observed in BKMR model and stronger at lower level of manganese (Mn).

CONCLUSIONS: The whole blood level of Cu was remarkably associated with the prevalence of CKD and showed positive dose-response relationships in the elderly Chinese population. The toxicity of Cu on kidney function could be antagonized by the exposure of Mn. These findings have provided new clues of the potential roles of Cu in kidney health, and the needs to develop not only recommended intake but also safe limits for Cu.

KEYWORDS: copper, chronic kidney disease, whole blood, BKMR analysis, manganese.

P-1102 The synergistic effects of Particle Radioactivity (Gross Beta Activity) and PM2.5 on Cardiovascular Diseases Mortality

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BACKGROUND: Although the effects of fine particulate matter (particulate matter ≤2.5 μm aerodynamic diameter; $PM_{2.5}$) on cardiovascular diseases (CVD) morbidity and mortality are well established, little is known about CVD health effects of particle radioactivity (PR). In addition, there are still questions about which of the $PM_{2.5}$ physical, chemical, or biological properties are mostly responsible for its toxicity.

METHODS: We investigated the association between PR, measured as gross β-activity from highly resolved spatiotemporal predictions, and mortality for CVD, myocardial infarction, stroke, and all-cause non-accidental mortality in Massachusetts (2001-2015). Within both difference-in-difference (DID) approach and generalized linear mixed-effect model frameworks, we fit gross β-activity-alone, PM2.5 alone, gross β-activity&$PM_{2.5}$ models and examined the interaction between $PM_{2.5}$ and gross β-activity.

RESULTS: We found significant associations between gross β-activity/$PM_{2.5}$ and each mortality cause. Using the DID approach and adjusting for $PM_{2.5}$, we found the highest associations with MI (RR=1.16, 95% CI: 1.08, 1.24) and stroke (RR=1.11, 95% CI: 1.04, 1.18) for an IQR increase (0.055 mBq/m3) in gross β-activity. We found a significant positive interaction between $PM_{2.5}$ and gross β-activity, with higher associations between $PM_{2.5}$ and mortality at a higher level of gross β-activity. We also observed that the associations varied across age groups. The results were comparable between the two statistical methods with and without adjusting for $PM_{2.5}$.

CONCLUSIONS: This is the first study that, using highly spatiotemporal predictions of gross β-activity, provides evidence that PR increases CVD mortality and enhances $PM_{2.5}$ CVD mortality. Therefore, PR can be an important property of $PM_{2.5}$ that must be further investigated. Addressing this important question can lead to cost-effective air quality regulations.

KEYWORDS: cardiovascular disease; death; particle radioactivity; death

P-1105 Serum levels of per- and polyfluoroalkyl substances (PFAS) and aggressive prostate cancer risk in the Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are group of chemicals commonly used in producing non-stick cookware, textiles, and firefighting foams. Exposure to PFAS is widespread in the U.S., with detectable serum levels in 98% of U.S. adults. Epidemiologic studies have suggested positive associations between PFAS and prostate cancer incidence and mortality, but the evidence is limited. We aimed to evaluate the association between pre-diagnostic serum concentrations of PFAS and aggressive prostate cancer risk in a large prospective study.

METHODS: We conducted a nested case-control study within the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial, which enrolled participants from 1993-2001 from 10 U.S. centers. Cases (N=750) included men diagnosed with aggressive prostate cancer (Stage III/IV or Gleason score≥8) at least 1 year after the blood collection. Male controls (N=750) were individually matched to cases based on age, race/ethnicity, study center, year of blood collection, and vial type. Pre-diagnostic serum concentrations of eight PFAS, including perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and perfluorohexane sulfonic acid (PFHxS), were measured. Conditional logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (95% CIs) for the association between PFAS and prostate cancer risk.

RESULTS: Preliminary analyses showed null associations between serum PFAS concentrations and the risk of aggressive prostate cancer (e.g., PFOS: ORcontinuous = 0.93, 95% CI: 0.83-1.05). However, differences were observed by calendar year of blood draw, with later years (1998-2004) suggesting a positive association for some PFAS, such as PFHxS (ORcontinuous = 1.12, 95% CI: 1.01-1.46) and PFOS (ORcontinuous = 1.20, 95%CI: 0.97-1.49).

CONCLUSIONS: This large prospective study did not provide evidence for an association between serum concentrations of individual PFAS and aggressive prostate cancer risk; however, an association among men with blood draws during later years, where measured serum PFAS concentrations were higher, cannot be ruled out.

P-1110 Occupational Hazards among Health Workers in Hospitals of Mukalla City, Yemen

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BACKGROUND: Occupational health is a neglected public health issue among healthcare workers in developing countries like Yemen and they may expose them to various forms of hazards, which have had negative consequences on their wellbeing and performance at work.
Objective: The study aims at exploring the forms of occupational health hazards prevalence and methods to mitigate these hazards among Health Care Workers (HCW) in governmental hospitals in Mukalla city.

METHODS: It is a cross-sectional study conducted among health workers in the main hospitals in Mukalla city in Hadhramout province in eastern Yemen. The sample size is calculated statistically as 366 workers from different categories including doctors, nurses and lab technicians. A sample of 391 workers were selected randomly who were distributed to be representative and proportional to the size of each professional category.

RESULTS: The prevalence of biological hazards among the healthcare workers accounted for 298 (76%) whereas the non-biological hazards accounted for 306 (78%). The most prevalent biological hazards are needle prick injury (80%) followed by exposure to contact with contaminated material (75%), while the most frequent non-biological hazards are back pain (79%) followed by extra-time work (72%). In logistic regression age, gender and duration of work and professional category have significant association with exposure of health workers to biological hazards while only gender is the only variable associated with non-biological hazards.

CONCLUSIONS: There is a high prevalence of occupational hazards (biological and non-biological) among health workers in hospitals of Mukalla city. A prevention and infection control and patient safety programs are highly recommended in Mukalla hospitals to save health workers and patients.

P-1122 The impact of farm animal exposures on Campylobacter jejuni antibody levels in rural agricultural communities of Iowa, USA

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BACKGROUND AND AIM: Campylobacter infections transmitted primarily through improperly cooked meat are the leading bacterial cause of diarrhea worldwide. How exposures to farm animals and animal waste (e.g., through occupational contact or residential proximity to animal feeding operations [AFOs]) contribute to infections has been relatively understudied.

METHODS: We measured antibodies against Campylobacter jejuni using an enzyme-linked immunosorbent assay in participants from Iowa in the Biomarkers of Exposure and Effect in Agriculture study (n=304 farmers; n=146 non-farming controls from similar communities). Participants self-reported occupational animal contact within the past year. We used a statewide database of permitted AFOs that included animal counts standardized by animal size and manure production to characterize the intensity of AFO exposure within 5km of participants' residences. We performed linear regressions of log-transformed optical density units (ODs) for immunoglobulin (Ig) A, G, and M antibody levels in relation to occupational animal and low/high AFO exposures, using non-farming controls with low AFO exposure (n=96) as the referent group. We adjusted for age, season, and other potential confounders. We further examined antibody levels by occupational contact with specific animal types.

RESULTS: Occupational animal contact was associated with elevated IgA and IgG OD levels in those with low AFO exposure (geometric mean ratio [95% confidence interval]; IgA:1.34[1.07-1.67]; IgG:1.34[1.13-1.57]) as well as those with high AFO exposure (IgA:1.48[1.12-1.95]; IgG:1.34[1.09-1.65]). Antibody levels were higher in farmers raising poultry (IgA:2.20[1.03-4.71]; IgG:2.11[1.35-3.32]), swine (IgA:1.52[1.04-2.22]; IgG:1.50[1.17-1.94]), and dairy cattle (IgG:1.65[1.18-2.31]), particularly for IgG levels in those who reported spending time in poultry (2.29[1.25-4.19]) or swine (1.63[1.25-2.12]) confinements within the past month. We found no significant relationships between occupational animal contact and IgM or AFO exposure alone and any antibody levels.

CONCLUSIONS: Occupational animal contact may be a stronger determinant of C. jejuni exposure than residential proximity to AFOs in agricultural communities.

KEYWORDS: Campylobacter, animal exposures

P-1125 Health Risk Assessment for Pest Control Workers Using Biocidal Products after COVID-19 Outbreak: A Comparison of EU and US

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After the COVID-19 outbreak, the workloads of disinfection have remarkably increased. As disinfectants are harmful to human, health risk assessment of disinfection workers is needed to ensure their safety. However, the acceptable operator exposure level (AOEL) for most disinfectants are not established. Moreover, the method of calculating the AOEL varies across the countries. This study aims to identify the health risks of disinfection workers based on two different risk assessment methods of EU and US after the COVID-19 outbreak.

We surveyed 533 disinfection workers to identify exposure patterns of disinfectants. The inhalation and dermal exposure were calculated based on different work types. The AOEL was calculated and compared using the EU and US methods. The health risks of workers are determined by hazard index based on whether the exposure exceeds AOEL.

Workers used 53 chemicals from 175 biocidal products, and only 34 chemicals (65%) had AOEL. 17 Chemicals with absorption factors for each route or AOEL were selected for risk assessment. When compared the estimated AOEL was calusing EU and US methods, only 2 (4%) were the same. The result of health risk assessment showed 10 (19%) were exceed 1 (acceptable level) using EU method, while 9 (17%) were exceed 1 using US method.

This study performed the health risk assessment of disinfection workers based on EU and US methods after the COVID-19 outbreak. Only 65% had an AOEL, and health risks of workers were differd according to risk calculation methods of EU and US. Given the increasing use of biocides after the COVID-19 outbreak, AOEL need to be established for health risk assessment of workers.

Biocides, Risk assessment, Reference dose, AOEL, COVID-19, pest control worker

This study was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2021R1F1A1063967).

P-1126 The Effectiveness of Occupational Health and Safety Management System (OHSMS) Application in the R.O.K. Navy and Improvement Plan

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The Republic of Korea Navy is applying OHSMS (Occupational Health and Safety Management System) to 3 type of units(repair, engineer, ammunition) for workplace safety. Several studies have argued that implementing OHSMS in the workplace is problematic and that measures are needed to improve its effectiveness. Moreover, since OHSMS focuses on corporate safety, it should be adequately reviewed when applied to the military, but studies have not been conducted yet. This study aims to confirm the effectiveness of the Navy's OHSMS and to identify improvement measures.

We surveyed 599 members of the units to determine the impact of OHSMS on unit safety conditions (systems, management, activities). for engineer and ammunition units, the safety conditions were compared according to whether they were OHSMS certified. In the repair units without the OHSMS non-certified comparator, the safety conditions according to the OHSMS application period were compared. To confirm the improvement plan of OHSMS, we surveyed 29 Naval OHSMS experts and analyzed IPA (Importance-performance Analysis) and AHP (Analytic Hierarchy Process).

There was no statistical difference in the level of safety conditions according to whether OHSMS was applied and the operating period, so the effectiveness of OHSMS could not be confirmed. The Navy's OHSMS needed gradual improvement due to its low overall performance. In particular, there was an urgent need for improvement in 1.organizational roles, responsibilities, 2.consultation and participation of members, 3.support, and 4.capabilities. Among them, consultation and participation of members was rated the most as a result of importance weight analysis through AHP.

In this study, the effectiveness of the Navy's OHSMS has not been confirmed, and consultation and participation of members was a vital improvement factor. This can be used as basic data for the practical application of OHSMS in the Navy in the future.

KEYWORDS: OHSMS, Military Health and safety, Navy, IPA, AHP

P-1133 Occupational injuries and extreme heat: An analysis from the hot desert climate of Kuwait

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BACKGROUND–Temperatures in the harsh summer times of Kuwait commonly exceed 40°C during the day. Since 2015, a ministerial law banned employees from working under the sun (11am to 4pm) from June 1st to August 31st of every year. The vast majority of the affected employees are migrant workers in outdoor jobs such as construction and hospitality.
AIM–We assessed the risk of occupational injuries associated with outdoor extreme hot temperatures during the summertime ban period in Kuwait.
METHODS–We collected daily occupational injuries that are reported to the Ministry of Health's Occupational Health Department for five years from 2015 to 2019. We examined counts of occupational injuries during the same summertime ban period from June 1st to August 31st in each of the five years. We fitted generalized additive models with a quasipoisson distribution in a time series design. A 7-day moving average of daily mean temperature was modelled with penalized splines adjusted for relative humidity, time trend and day of the week.
RESULTS–During the June-August summertime ban, the daily average temperature was 39.4°C(±1.8°C). There were 7.2, 7.6 and 9.4 reported injuries per day in the summer months of June, July and August, respectively. The exposure-response relationship was S-shaped with a decrease in risk at very extreme hot temperatures. Compared to the 10th percentile of summer temperatures in Kuwait (37.4°C), the average day with a temperature of 39.4°C increases the risk of injury by 1.38-fold (95% confidence intervals: 1.30-1.46). Similarly, temperatures of 40°C and 41°C were associated with relative risks of 1.41 (1.33-1.49) and 1.34 (1.21-1.49), respectively. The risks leveled off at 42°C (relative risk 1.21; 0.93-1.57).
CONCLUSIONS–We found substantial increases in occupational injury risk from extremely hot temperatures despite the summertime ban in Kuwait. Calendar-based rather than heat- or risk-based regulation may be inadequate to provide occupational protections for migrant workers.

P-1134 Evaluation of lung inflammation from daily exposures to fine and ultrafine particulate matter in a trade school

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BACKGROUND - Daily short-term exposure to ambient fine particles ($PM_{2.5}$; < 2.5 µm) in the general environment has been related to acute respiratory effects such as respiratory symptoms and inflammation, emergency room visits for respiratory conditions and mortality. Although exposure is higher in trade/occupational settings, acute respiratory effects of daily exposures remain unexplored.
OBJECTIVE - To evaluate the association between daily exposures to fine particles ($PM_{2.5}$) and Ultrafine Particles (UFP; < 0.1 µm), and fractional exhaled nitric oxide (FeNO), a relevant indicator of lung inflammation, in two trade settings from a construction school.
METHOD - A repeated-measure panel study was carried out on students performing welding and bricklaying activities (n=30). $PM_{2.5}$ and UFP concentrations were measured daily (area measurements with direct-reading instruments) and fractional exhaled FeNO were measured two times per day, pre-work and post-work, for 5 consecutive days. Mixed GLM models were used to assess associations.

RESULTS: - Daily geometric mean exposure to $PM_{2.5}$ from welding and bricklaying activities were respectively 183 µg/m³ (σg=3.5) and 90.8 µg/m³ (σg=1.6). Daily geometric mean UFP concentrations for these activities were 106,000 (σg=1.6) particles/cm³ and 4,400 (σg=1.7) particles/cm³. Combining bricklaying and welding activities, for a 10,000 particles/cm³ increase in UFP, there was a 0.2 ppb (95%CI: 0.05-0.3) increase in FeNO inter-day. There was also a tendency for a small increase in FeNO (0.2 ppb; 95%CI: -0.06 - 0.5) per 100 µg/m³ of $PM_{2.5}$. Further analyses will be performed with additional participants and stratified by occupational trade.
CONCLUSION - Bricklaying and welding activities expose workers daily to $PM_{2.5}$ and UFP that may contribute to recurrent pulmonary inflammation and impair respiratory health.

KEYWORDS: particulate matter, occupational exposures, short-term exposure, pulmonary inflammation.

P-1136 Association between night shift work and different categories of non-occupational physical activity in the Shahedieh cohort study

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INTRODUCTION
Shift-work has been associated with physical and mental health problems. This study aimed to explore the association between shift-work and different non-occupational physical activities in Iranian adults enrolled in the Shahedieh cohort study (SCS).

METHODS: The participants were men enrolled in the SCS (2014-2017). Different categories of non-occupational physical activity were quantified by the International Physical Activity Questionnaires and presented (as continuous by the metabolic equivalent of task [MET]), and dichotomous for defining sedentary/non-sedentary behavior based on MET). Shift-work status was asked through a face-to-face interview. The odds of having a sedentary behavior associated with shift-work, and the association between shift-working and daily MET of each category of activity were modeled using adjusted logistic regression and multiple linear regression (presented as odds ratio [OR] and beta respectively, with 95% confidence intervals [CI]). Results are based on the models adjusted for hypothesized confounders.

RESULTS: of 5132 men, 13.3% were shift-worker (more educated, and younger than non-shift-workers). Shift-workers had 20% lower odds of sedentary behavior compared to non-shift-workers (OR = 0.80; 95% CI: 0.60-0.98). Shift-working was associated with higher daily MET related to time spent on driving (ß=0.88; 95%CI: 0.75: 1.02), walking (ß=0.45; 95%CI: 0.33: 0.56), and light manual handling (ß=0.06; 95%CI: 0.01: 0.10), but the negative association with heavy sports activities (ß=-0.01; 95%CI: -0.03:-0.00), time spent on house cleaning (ß=-0.03; 95%CI: -0.06:-0.01), watching television (ß=-0.11; 95%CI: -0.20:-0.02), and working with a computer (ß=-0.13; 95%CI: -0.21:-0.06).
CONCLUSION: Shift-workers spent more energy on non-occupational activities than non-shift-workers, especially on outdoor activities. It implies the importance of considering shift-working as a possible effect modifier in the studies with hypotheses related to exposures linked to residing in outdoor environments such as the use of greenspace and ambient air pollution.

KEYWORDS: Shift-Work, Physical Activity, Occupational Health

P-1138 Occupational heat exposure and prostate cancer risk: a pooled analysis of case-control studies

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BACKGROUND AND AIM: Heat exposures occur frequently in many indoor and outdoor occupations. In our previous work, we observed some evidence for a positive association of occupational heat exposure and breast cancer risk. Here we seek to examine potential associations with prostate cancer risk in a large multi-country study.

METHODS: We performed a pooled analysis of data from 3,175 histologically confirmed prostate cancer cases and 3,529 frequency-matched controls from studies in three different countries, Spain, France, and Canada. The Finnish job exposure matrix, FINJEM, was used to apply estimates of occupational heat exposure to the lifetime occupational history of participants. Three main exposure indices were used: ever vs. never exposed, lifetime cumulative exposure (heat stress years) and duration of exposure (years) with a lag period of 5 years. We estimated odds ratios (ORs) and 95% confidence intervals (CIs), using conditional logistic regression models stratified by 5-year age groups and study and adjusted for potential confounders.

RESULTS: A total of 32% of cases and 33% of controls were classified as being ever occupationally exposed to heat. Highest heat exposed occupations included ore and metal furnace operators, firefighters, and bakers. We found no evidence for an association of ever occupational heat exposure and prostate cancer risk (OR 0.92; 95% CI 0.83, 1.03). There were also no associations observed in the highest categories of lifetime cumulative exposure or duration, and there was no evidence for a trend. Results did not change when stratifying by Gleason scores. When analysing the Spanish case-control study separately using a Spanish job exposure matrix developed for local working conditions, some odds ratios were elevated, though results were imprecise.

CONCLUSIONS: Findings from this pooled study have provided no strong evidence for an association between occupational heat exposure and prostate cancer risk.

KEYWORDS: prostate cancer, occupational exposures, heat, pooled analysis

P-1141 Oxidative stress in workers in indoor and outdoor environments

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BACKGROUND AND AIM: Occupational exposure to particles can raises important health issues for exposed workers. High concentrations of these particles can be found in a variety of occupational and environmental contexts, depending on the type of scenario, whether indoors or outdoors working environments. The aim of this study was to investigate the role that indoor and outdoor environments play in altering oxidative stress levels in workers in relation to the exposure to particles.

METHODS: 162 subjects were recruited; 62 were subjects working in indoor environments (13 employed in the handling of waste, 49 not exposed to this task), 100 subjects working in outdoor environments (65 employed in sweeping of the streets, 35 not exposed to this task). Oxidative stress was assessed by analysing 15-F2t-isoprostane concentrations in urine samples of all the recruited subjects. In addition, a questionnaire was administered to each to obtain information among which gender, age, BMI, smoking habits. Statistical analyses were done using SPSS and 15-F2t-Isoprostane concentrations were compared each other using the Kruskal-Wallis test.

RESULTS: The analyses showed a higher level of 15-F2t-Isoprostane in workers working in indoor environment when compared to workers working in outdoor environments ($P<0.01$). Furthermore, the employed in the handling of waste in indoors show the highest level of 15-F2t-isoprostane ($P<0.05$) while, subjects not exposed to this task in indoors, place themselves at intermediate 15-F2t-isoprostane levels.

CONCLUSIONS: This study shows that higher levels of oxidative stress were found in both exposed and unexposed workers in indoor environments. Analysing the responses to the questionnaire, we also controlled tobacco smoke exposure because it may have a role in the redox imbalance recorded in workers.
These results hypothesise that particle dilution in outdoor environments may be directly associated with lower levels of oxidative stress in the workers.

KEYWORDS: occupational exposure, environmental exposure, particle emissions.

P-1152 Contribution of Occupational Risk Factors to Lifespan Inequalities across Socio-Occupational Groups in France

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BACKGROUND AND AIM: Occupational risk factors can mediate the effect of socioeconomic status on mortality; however, the reduction in social disparities in mortality that could be achieved by modifying employment and working conditions has been under-studied. Our aim was to quantify the role of occupational risk factors (lack of job control, job insecurity, and unemployment; and in men only: occupational physical activity (OPA)) in producing socio-occupational inequalities in lifespan among the French population.

METHODS: We reviewed the literature on 75 occupational risk factors and selected four of them with a robust all-cause mortality effect size. We used the Health and Career Path survey (SIP-2006) to estimate differential exposures in each French socio-occupational group (SOG) by sex. Then, using the life tables published by The French Institute of Statistics and Economic Studies and developing a method based on population attributable fractions, we estimated loss in life expectancy attributed to workplace exposures by SOG and sex.

RESULTS: Based on life expectancy estimated at age 35 and depending on SOG, from one to three years of life lost for men, and from 0.6 to two years for women are attributed to a combination of high OPA, low job control, job insecurity, and unemployment compared to those who had low OPA, high job control, no concerns about job loss and were employed. The difference in life expectancy at age 35 between senior executives and manual workers would have been reduced from 6.3 to 4.4 years for men and from 3.2 to 2.2 years for women if socio-occupational exposures had been set at the theoretical minimum level for the four risk factors.

CONCLUSIONS: Our results, although based on a limited number of workplace factors due to large data gaps, show that improving employment and working conditions would substantially lessen social inequalities in life expectancies.

P-1153 Agricultural pesticide exposure assessment in Latin America and the Caribbean. A review study

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The region of the Americas shows heterogeneous agricultural labor scenarios. The measurement of pesticide exposure is a challenge and a necessary requirement for prevention. A systematic review of the scientific literature was carried out to identify the methodologies to assess exposure to agricultural pesticides in Latin America and the Caribbean (LAC).

PubMed, Scielo and Lilacs were searched (January 2010 and April 2021). Keywords selected: "pesticides", "occupational exposure", "farmers", "pesticide exposure" and "Latin America". Eighty-two publications from 11 countries were retained for analysis. The exposure assessment methods (EAMs) were analyzed, categorized into direct and indirect, analyzing the productive context of the study, according to whether it belonged to the formal or informal economy.

Most of the articles analyzed came from Brazil (41%) and Colombia (23%); cross-sectional designs predominated (64%). The term "exposure" appears as a scattered concept in the literature; 67% of the studies evaluated exposure to pesticides in informal agricultural contexts where family work was identified, in contrast to formal productive environments where it was not reported. The types of EAMs used were: a) indirect methods (58%): surveys, index construction, and measurement of environmental parameters (water and soil); b) direct methods (15%): biomarkers in blood, urine and other human matrices; c) combination of both methods (27%). Significant differences were identified between the EAMs used (direct/indirect) according to the context (formal/informal) of study (p= 0.016). The use of indirect EAM was more frequent in productive contexts of the informal economy.

Pesticide exposure assessment in LAC is heterogeneous and implemented through methods that are difficult to identify and classify. In the informal economy, family work prevails and there is less knowledge about pesticide exposure. Knowledge about these processes is necessary to reduce risks and vulnerabilities.

Pesticides - exposure - assessment methods - agriculture

P-1161 Physically strenuous work in a hot climate and reduced kidney function in the sugarcane industry

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BACKGROUND AND AIM: Sugarcane workers are reportedly at increased risk of chronic kidney disease of non-traditional causes (CKDnt). Most prior studies have focused on a limited number of jobs, yet suspected risk factors of hot climatic conditions and strenuous work are common across jobs in the industry. We examined whether reduced kidney function was associated with working in hot climatic conditions and strenuous work in an industry-wide program.

METHODS: Data from a surveillance program at a Nicaraguan sugarcane planation 2015-2020 involved random collection of blood, allowing estimation of glomerular filtration rate (eGFR), for all employees. Any eGFR <=60 mL/min/1.73m2 was classified as low. Jobs were classified by whether outside and whether physical labor. Analyses restricted to males <50 years old who were non-supervisors. Multivariable models were used to estimate adjusted odds ratios (aORs) and 95% confidence intervals (CIs) comparing odds of low eGFR for working outside with inside, either adjusted for or stratified by age. Among outside workers, odds of low eGFR for each laborer job was compared with non-laborers. Models also adjusted for repeated measures and harvest period.

RESULTS: Analyses included 2,884 employees with 6,144 eGFR measures. There was no difference in odds of low eGFR between working outside or inside. Among those outdoors, laborers had increased odds of low eGFR compared with non-laborers (OR=3.58, (95% CI 1.85-6.94)). The association was most pronounced among those <=30 years old (OR=11.89 (95% CI 1.68-84.03)). Jobs of seed loader, seeder/reseeder, and weeder had >=6-fold increased odds of low eGFR relative to outdoor non-laborers (p<0.001).

CONCLUSIONS: Physically strenuous jobs in combination with working outside in a hot climate was consistently associated with reduced kidney function, with strongest influence in younger workers. Our results suggest more research should evaluate younger workers in physically demanding jobs to help identify prevention strategies.

KEYWORDS: CKDnt, heat, work

P-1174 Assessment of Portuguese firefighters' lifestyle: results from an online survey

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Firefighters are an occupational group exposed to multiple agents, such as heat, fatigue, noise and chemical substances. Exposure to these agents can have a severe impact on their health. In addition, lifestyle behaviors may also affect their health and well-being. As such, the aim of this study was to assess health-related lifestyle behaviors in Portuguese firefighters.

Data was obtained via an online survey using an adapted version of the FANTASTIC Lifestyle Assessment Inventory that included questions on relationships with family and friends, physical activity, nutrition, tobacco and alcohol consumption, sleep and stress, career and shifts. The access link to the survey was disseminated through collaboration with the National School of Firefighters. Data was collected between April 24th and May 27th 2021.

From the 861 participating firefighters, the majority were men and had less than 40 years old. Around half were married and were firefighters for more than ten years. The majority referred to have people to talk about important things and to give and receive affection. Regarding physical activity the majority did not practice physical activity in the professional context. Only a quarter reported to have healthy eating habits and the majority reported the consumption of high-calorie foods and to be exceeding their ideal weight. More than a third reported smoking and around 16% reported driving motor vehicles after consuming alcohol. Around 40% reported to consume more than 3 caffeine drinks per day. Around a tenth reported to almost never have good quality sleep and only around 78% reported to have difficulties sleeping. About 43% didn't have capacity to manage stress in their day to day life and about 57% were not able to relax in their free time. Around 40% reported not being happy with their work and a third reported to do periodic medical exams.

P-1177 Impact of the COVID-19 pandemic on a pilot sample of women enrolled in the SEMILLA birth cohort study

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BACKGROUND AND AIM
Project SEMILLA, a community-engaged epidemiological cohort study, assesses environmental, occupational, and social factors among pregnant women in a major flower-growing region of Ecuador and the impact of these factors on child growth and development. The COVID-19 pandemic has presented an unprecedented challenge to the implementation of the SEMILLA study. This paper presents the results of a pilot qualitative study with SEMILLA participants examining the impact of the pandemic on their lives.

METHODS: SEMILLA follows pregnant women and their infants up to 18 months of age. Methods include obtaining prenatal urine samples, maternal and neonatal blood samples to assess thyroid hormone levels, and data on working conditions, environmental exposures (home/work), stress, social support, maternal health, socioeconomic factors, and infant neurodevelopment, growth and nutritional status. During the initial months of the pandemic, SEMILLA researchers observed important impacts of the pandemic in the study region and with enrolled participants. In April 2020, we conducted phone interviews with currently enrolled participants (n=11), to assess the experiences of the participants during this time. Semi-structured questions addressed concerns and worries as well as changes in activities (work/home) due to the pandemic.

RESULTS: Emergent themes from qualitative analysis include economic insecurity and job loss, food insecurity and food access issues, strained relationships at home including interpersonal violence, responsibilities at home including additional burdens for participants regarding schooling of other children. Fear and worry about being infected, about having a healthy pregnancy and a healthy delivery and baby, and fear of family members being infected prevailed.
CONCLUSION: Findings from this pilot study helped shape protocol changes and revisions to capture the new reality for women participating in SEMILLA during the pandemic; changes which are critical for understanding the impact of the COVID-19 pandemic on the lives of pregnant women and their families in the region.

P-1178 The environmental risk factors of birth defects in Iraq

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BACKGROUND AND AIM: Ever since the war started in 2003, Iraqi doctors have reported an increase in the birth of children with congenital anomalies. According to them, the rise in incidence has been attributed to war-related heavy metal pollution e.g. from depleted uranium and white phosphorus. As the war impeded quality research, the current post-conflict situation has allowed renewed space for quality research. The aim of the study is to assess to what extent exposure to environmental pollution might be associated with the incidence of congenital anomalies in Iraq.

METHODS: We conducted a case-control study in Fallujah, a heavily bombarded city, comparing 50 parents of children with birth defects and 50 parents of children without birth defects. We used a questionnaire to comprehensively document environmental exposure and history of residence of each couple. Further, we complemented the interviews with biomonitoring through hair analysis of parents on heavy metals using ICP-MS. In addition, we took soil samples of the city of Fallujah using grid sampling and compared this to a control city in northern Iraq which has been less bombarded. We used Stata to statistically assess the differences in case and control groups regarding exposure and heavy metal concentrations, correcting for confounders like age and socio-economic status.

RESULTS: Comprehensive data analysis will take place in the summer 2022. Our preliminary results already point to a striking discrepancy between the occupation of the fathers of children children with congenital anomalies and the fathers of the control group. The fathers of the birth defects are more often construction workers, working on houses often damaged or levelled by war.

CONCLUSIONS: Having a child with a congenital anomaly in Iraq might be associated with paternal environmental exposure, possibly through epigenetic pathways.

KEYWORDS: Congenital anomalies, Military pollution, Teratogenicity, Epigenetics, Exposome

P-1179 Associations between traffic-related air pollutants and preterm birth in a North Carolina birth cohort, 2003-2015

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BACKGROUND AND AIM: Preterm birth (PTB; <37 weeks completed gestation) is associated with exposure to fine particles and ozone, but less is known about associations with nitrogen dioxide (NO_2) and other traffic-related air pollutants, such as benzene, toluene, ethylbenzene, and xylene (BTEX). We estimated the associations between PTB and NO_2, with and without adjustment for BTEX.

METHODS: We examined the associations between PTB and gestational exposure to NO_2 in a North Carolina singleton birth cohort (N=1,367,507) from 2003-2015. Daily 8-hour max NO_2 concentrations from a hybrid-model with a spatial resolution of 1km² were aggregated to census tracts and linked to residential address at delivery, then averaged across each week of pregnancy. We obtained annual average ambient concentrations for BTEX for census tracts from the 2011 National Air Toxics Assessment. Modified Poisson regression models with robust errors were used to estimate risk differences (RD(95% CIs)) per 10-ppb increase in NO_2, adjusted for gestational parent marital status, race/ethnicity, age at delivery, Medicaid status, month of conception, and BTEX.

RESULTS: The median (IQR) NO_2 across each day of pregnancy was 15.0(10.2) ppb and 1.6(1.1) ppb for BTEX. The associations between NO_2 and PTB were of similar magnitude across each week of gestation. RDs with and without adjustment for BTEX varied. RDs per 10-ppb increase NO_2 exposure during each week of gestation ranged from -7(95% CI: -14,1) in weeks 17 and 23 to 0(-6,5) in week 36 per 10,000 births, respectively. Adjusting for BTEX, RDs ranged from 19(13,25) in week 36 to 36(27,44) in week 24 per 10,000 births, respectively.

CONCLUSIONS: While the association between NO_2 exposure and PTB were generally null across each week of gestation, when adjusting for BTEX, we observed a consistent pattern of increased risk of PTB with NO_2 exposure.

KEYWORDS: air pollution, preterm birth, nitrogen dioxide, reproductive outcomes

P-1181 Associations between Repeated Measures of Urinary Phthalate Metabolites with Hormones and Timing of Natural Menopause: The Study of Women's Health Across the Nation

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BACKGROUND AND AIM: Studies on phthalate metabolites and sex hormones during the menopausal transition are limited and have yielded conflicting results. We aimed to examine the associations of phthalate metabolites with hormones including estradiol, testosterone, follicle-stimulating hormone (FSH), sex hormone-binding globulin (SHBG), anti-Müllerian hormone (AMH), and the timing of natural menopause.

METHODS: We examined 1,189 midlife women from the Study of Women's Health Across the Nation aged 45-56 years in 1999-2000 who had complete information on phthalate metabolites and hormones while not receiving hormone therapy. Urinary concentrations of 12 phthalate metabolites were repeatedly measured in 1999-2000 and 2002-2003. Hormones were measured at the same time points. Linear mixed-effect models were used to calculate percent differences (%D) and 95% confidence intervals (CIs) in serum concentrations of estradiol, testosterone, FSH, SHBG, and AMH per doubling in urinary phthalate metabolites. Cox proportional hazards models were used to calculate hazard ratios (HRs) and 95% CIs of natural menopause per doubling increase in urinary phthalate metabolites.

RESULTS: We observed significant associations of phthalate metabolites with lower testosterone concentrations: mono (7-carboxy-2-methyloctyl) phthalate (MCOP) (%D: -2.08%, 95% CI: -3.66, -0.47), and mono-n-butyl phthalate (MnBP) (%D: -1.99%, 95% CI: -3.82, -0.13), after adjusting for multiple comparisons with false discovery rates < 5%. Lower AMH concentrations were also found with higher MECPP (%D: -14.26%, 95% CI: -24.10, -3.14), MEHHP (%D: -15.58%, 95% CI: -24.59, -5.50), and MEOHP (%D: -13.50%, 95% CI: -22.93, -2.90). No associations were observed for other hormones or timing of natural menopause.

CONCLUSIONS: These results suggest that exposure to phthalates may affect circulating levels of testosterone in midlife women. Exposure to phthalates may also dimmish the ovarian reserve. Given the endocrine-disrupting role of phthalates, future studies are warranted to evaluate their impact on health outcomes among midlife women.

KEYWORDS: Phthalates; endocrine-disrupting chemicals; hormones; midlife women; menopause

P-1185 Urinary concentrations of non-persistent endocrine disrupting chemicals and fecundability in a preconception cohort study

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BACKGROUND AND AIM: Non-persistent endocrine-disrupting chemicals (EDCs) are found in consumer products including personal care products, plastics, and cleaning supplies. EDCs can affect hormonal pathways involved in reproduction. We examined prospectively the association between urinary concentrations of select non-persistent EDCs and fecundability, the per cycle probability of conception.

METHODS: We used data from PRESTO and Snart Foraeldre.dk, web-based preconception cohort studies that recruited female participants who were aged 21-45 years, residents of North America or Denmark, and trying to conceive without fertility treatment (2013-2019). Participants completed a baseline questionnaire and follow-up questionnaires every 8 weeks for up to 12 months. A subset of 207 participants residing in Boston, Massachusetts (n=119), Detroit, Michigan (n=18), or Aalborg, Denmark (n=70) provided urine samples during in-person clinic visits. We measured concentrations of 7 phenols, 4 parabens, triclocarban, 15 phthalate metabolites and 2 phthalate alternative metabolites using on-line solid-phase extraction-high-performance liquid chromatography-isotope dilution-tandem mass spectrometry. We used proportional probabilities models to estimate fecundability ratios (FR) and 95% confidence intervals (CI), adjusting for potential confounders.

RESULTS: Concentrations of some non-persistent EDCs were associated with reduced fecundability. The adjusted FR for the highest vs. lowest quartile of benzophenone-3 was 0.53 (95% CI: 0.28-0.99), with evidence of a monotonic association. Bisphenol S and 2,5'-dichlorophenol, and ethyl paraben concentrations were also associated with reduced fecundability. Among phthalate metabolites, mono-ethyl phthalate (highest vs. lowest quartile: FR=0.71, 95% CI: 0.45-1.12), monocarboxyoctyl phthalate (highest vs. lowest quartile: FR=0.71, 95% CI: 0.44-1.14), and the non-phthalate plasticizer cyclohexane-1,2-dicarboxylic acid monohydroxy isononyl ester (≥0.6 µg/g creatinine vs. <limit of detection: FR=0.59, 95% CI: 0.37-0.95) were associated with reduced fecundability.

CONCLUSIONS: Biomarkers of some non-persistent EDCs were associated with reduced fecundability. Future analysis of additional urine specimens in these cohorts will enable examination of chemical mixtures on fecundability.

KEYWORDS: endocrine-disrupting chemicals, fecundability, fertility, phenols, phthalates

P-1188 Association between maternal $PM_{2.5}$ exposure and gestational diabetes mellitus in Tokyo, Japan

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INTRODUCTION
Recent epidemiological findings suggested that $PM_{2.5}$ exposure is a risk factor for diabetes, and the association between $PM_{2.5}$ and glycaemia and insulin resistance provided the biological mechanistic support. Based on these, a hypothesis has been proposed that maternal exposure to $PM_{2.5}$ contributes to the development of gestational diabetes mellitus (GDM). However, the association between $PM_{2.5}$ and GDM was controversial, and there was limited evidence regarding exposure to specific components of $PM_{2.5}$. In this study, we examined the association between the $PM_{2.5}$-GDM association in the Asian population.

METHODS: From 2013 to 2015, we had permission to the Japan Society of Obstetrics and Gynaecology, and obtained the data on all mothers who delivered births after 22 gestational weeks at 39 cooperating hospitals in 23 Tokyo wards from the Japan Perinatal Registry Network database. We collected fine particle on a filter each day at one fixed monitoring site, and analysed carbon and ion components of $PM_{2.5}$. The average concentrations of $PM_{2.5}$ and its components over the 3-month before pregnancy, the first trimester (0-13 gestational weeks) and the second trimester (14-27 weeks) were calculated, and assigned to each mother. We applied a multi-level logistic regression analysis.

RESULTS: of the 83,319 mothers (mean age at delivery = 33.7 years), the proportion of GDM was 4.8%. The median concentration of total $PM_{2.5}$ over the first trimester was 16.1 (interquartile range (IQR) = 3.6) μg/m³. When we simultaneously included three exposure windows of total $PM_{2.5}$, only exposure over the first trimester was associated with GDM (odds ratio per IQR = 1.09, 95%CI = 1.02-1.16). for specific components, we observed the association between exposure to carbon constituents over the first trimester and GDM.
CONCLUSION: Our findings provided the additional evidence for the association between maternal exposure to $PM_{2.5}$ and GDM.

KEYWORDS: fine particle, chemical element, GDM,

P-1196 Exposure to ambient sulfur dioxide during gestation and risk of preterm birth among people in North Carolina, 2003-2014

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BACKGROUND AND AIM: Coal-fired power plants are major contributors of ambient sulfur dioxide (SO2) air pollution. Epidemiological literature suggests an adverse association between SO2 exposure during gestation and preterm birth (PTB; <37 weeks completed gestation). PTB is strongly associated with infant mortality and increased risk for later life morbidities. We investigated associations between SO2 and PTB in North Carolina and evaluated whether the associations were modified by race/ethnicity.

METHODS: We assembled a retrospective, administrative cohort of singleton births in North Carolina from 2003-2014. We used USEPA CMAQ data to assign SO2 gestational exposures to eligible births for the entire pregnancy and trimesters. We used multivariable generalized linear regression to estimate risk differences (RD (95%CI)) per 1-ppb increase in SO2, adjusted for gestational parent education, marital status, and season of conception. Multi-pollutant models were additionally adjusted for criteria air co-pollutants (CO, O3, PM2.5, NO2).

RESULTS: The median SO2 across exposure windows was ~3.5 (IQR: 4) ppb. The overall baseline risk for PTB was 8800 per 100,000 live births. When stratified by race/ethnicity, the baseline risk for PTB was 12200, 7900, and 7100 per 100,000 live births among non-Hispanic Black, non-Hispanic white, and Hispanic births, respectively. Regardless of exposure window, SO2 was adversely associated with PTB with the strongest associations observed for the entire pregnancy period. RDs per 1-ppb increase in SO2 averaged across the entire pregnancy were 133.5 (95%CI: 117.0, 149.9) and 195.7 (171.6, 219.7) per 100,000 live births for single- and multi-pollutant models, respectively. for multi-pollutant models, we observed similar RDs for non-Hispanic Blacks (239.4 (200.7, 278.2)) and non-Hispanic whites (211.5 (182.4, 240.7)) with smaller RDs for Hispanics (119.8 (80.7, 158.9)).

CONCLUSIONS: Across exposure windows, the results for our adjusted single- and multi-pollutant models showed adverse associations between SO2 and PTB, with some evidence of effect measure modification by race/ethnicity.

KEYWORD: PTB

P-1197 Ambient temperature and preterm birth risk in New York City: A time-series analysis

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BACKGROUND AND AIM: Recent studies suggest an association between daily variation in ambient temperature during pregnancy and preterm birth (PTB). Our objective is to examine the short-term effects of heat and cold on PTB risk from 2008 to 2016 in New York City (NYC).

METHODS: We applied quasi-Poisson regression with distributed lag nonlinear models to estimate the cumulative relative risk (CRR) of daily counts of spontaneous PTB (<37 weeks gestation) and outdoor temperature, and to estimate the fraction of PTBs attributable to temperature, by season, using NYC Vital Statistics birth records and National Weather Service daily temperature data at LaGuardia airport. Models were adjusted for within-season trends and daily number of pregnant people at risk for preterm delivery. Heat and cold were defined as the 95th versus 50th percentile of maximum temperature during the warm season and 5th versus 50th percentile of minimum temperature during the cold season, respectively. Maternal race/ethnicity was assessed for effect modification.

RESULTS: Our analysis consisted of 38,593 spontaneous PTBs. Heat was not associated with PTB during the warm season [CRR: 0.98 (95% CI: 0.92, 1.05)]. There was a nonlinear association between cold and PTB. During the cold season, the CRR was 1.08 (0.99, 1.17) for cold up to three days before delivery (lag 0-3). The estimated fraction of PTBs attributable to cold was 9.3% (-0.6%, 17.4%), which corresponded to 81 (-2, 154) cold-attributable PTBs over the 9-year study period. Among non-Hispanic Blacks, the CRR was 1.20 (1.04, 1.39) for cold over lag 0-3 days, and an estimated 23.2% (10.3%, 34.3%) of non-Hispanic Black PTBs, equivalent to 69 (29, 105) PTBs, were attributable to cold.

CONCLUSIONS: Heat had no measurable impact. Cold potentially increased risk of PTB. Our finding for the impact of cold on non-Hispanic Black PTBs warrants additional research.

KEYWORDS:
Preterm birth
Temperature

P-1199 The association of congenital heart defects with prenatal exposure to air pollutants: An umbrella review

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BACKGROUND AND AIM: for idiopathic congenital heart defects (CHD), air pollution during fetal development is a potential risk factor. However, findings of previous epidemiological studies and consequently of systematic reviews, have been mixed. We aimed to synthesize and evaluate the extant evidence on associations between gestational exposure to air pollutants and CHD subtypes, using a systematic review of reviews approach ("umbrella review").

METHODS: We systematically searched PubMed, Embase, and Epistemonikos for published and unpublished systematic reviews. The search was supplemented by the use of internet search engines and hand-searching of reference lists. The Risk of Bias in Systematic Reviews ("ROBIS") tool was used to evaluate included systematic reviews.

RESULTS: We identified ten systematic reviews, including eight meta-analyses. Moderately strong evidence for an increased risk of coarctation of the aorta following prenatal exposure to NO2 was provided by five reviews, which reported statistically homogeneous pooled odds ratios of 1.10 to 1.20 (95% confidence interval range: 0.99 to 1.41). Also, there was limited evidence for positive associations between SO2 and coarctation of the aorta, PM10 and atrial septal defects, NO2 and pulmonary artery and valve anomalies, and for both, PM2.5 and NO2 and Tetralogy of Fallot. Findings for other pollutant-CHD associations were inconsistent. Based on the ROBIS tool, a high or unclear risk of bias rating was assigned to eight out of ten reviews.

CONCLUSIONS: Beyond the increased risk of coarctation of the aorta following exposure to NO2, a clear pollutant-outcome pattern was not identified. These incoherent findings may partly be explained by differences in methods used across the reviews (e.g., inclusion criteria) as well as between individual studies (e.g., exposure and outcome assessment methods). Further establishment of and adherence to systematic review methods for environmental exposures and children's health may improve the validity and consistency of future systematic review findings.

P-1201 Metabolome-wide association study of prenatal exposure to air pollution and adverse birth outcomes in the Atlanta African American Maternal-Child cohort

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BACKGROUND: African Americans (AA) are disproportionately exposed to high air pollution and elevated risks of adverse birth outcomes, while the underlying mechanisms are still largely unknown. We aimed to address the knowledge gaps by investigating the associations between air pollution exposures, perturbations in maternal metabolome, and preterm (PTB) and early term birth (ETB).

METHODS: In 288 participants from the Atlanta AA Maternal-Child cohort we performed metabolomic profiling using high-resolution mass spectrometry with liquid chromatography in early gestation serum samples. Using spatiotemporally-resolved machine learning models, we estimated individual residential exposures to nitrogen dioxide, fine particulate matters, and ozone during the first trimester and one-year before conception. Using the meet-in-the-middle approach, we investigated whether the maternal metabolic perturbations associated with air pollution are also associated with PTB and/or ETB.

RESULTS: After quality control, 13,980 and 11,106 metabolic features were extracted from HILIC and C18 chromatography columns, respectively. In the HILIC column, 95 and 190 metabolic features were associated with at least one air pollutant (false positive discovery corrected $q<0.2$) during the first trimester and one-year before conception, respectively, while 3 and 4 features were associated with PTB and ETB. From C18, 243 and 48 features were associated with first trimester and one-year before conception exposures, while 5 and 1 were associated with PTB and ETB, respectively. Perturbations in purine metabolism were associated with both air pollution and PTB in pathway enrichment analysis. Using chemical annotation, we confirmed inosine and inosinic acid, which were enriched in purine metabolism and involved in DNA damage and repair.

CONCLUSIONS: The findings suggested a potentially critical role of purine metabolism in connecting air pollution exposures and PTB, which may support future development of sensitive biomarker and targeted interventions to reduce adverse birth outcomes induced by air pollution exposures.

KEYWORDS: Air pollution, preterm birth, metabolomics, meet-in-the-middle, molecular mechanisms

P-1203 Cadmium may affect testosterone levels as a hormone-like disruptor in adult males

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BACKGROUND AND AIM: Sex hormones play an important role in human health, and sex hormone disorders can cause a series of relevant consequences. Cadmium is ubiquitous in the environment, while little is known on the relationship between cadmium exposure and sex hormones in adult males. The purpose of this study is to explore the potential association between cadmium exposure and serum testosterone as well as serum testosterone to serum estradiol ratio (T/E_2) among Chinese adult males.

METHODS: Adult male aged ≥18 years old who participated in China National Human Biomonitoring program from 2017 to 2018 were surveyed. Blood cadmium, urine cadmium and urine cadmium adjusted with creatinine were measured, serum testosterone and serum estradiol were measured, and T/E_2 was calculated. Multiple linear regression models were used to analyze association of cadmium exposure with serum testosterone and T/E_2 in adult males.

RESULTS: Among Chinese adult males ≥ 18 years old, the weighted geometric means (95% CI) of blood cadmium, urine cadmium and urine cadmium adjusted with creatinine levels were 1.23 (1.12, 1.35) μg/L, 0.63 (0.56, 0.71) μg/L and 0.53 (0.47, 0.59) μg/g, respectively. The geometric means (95% CI) of serum testosterone and T/E_2 were 18.56 (17.92, 19.22) nmol/L and 143.86 (137.24, 150.80). After adjusting for all covariates, tertiles of cadmium exposure were positively associated with log-transformed serum testosterone (lgT) (all Ptrend < 0.05). Moreover, tertiles of cadmium exposure were positively associated with log-transformed serum testosterone to serum estradiol ratio [$lg(T/E_2)$] (all Ptrend < 0.05).

CONCLUSIONS: In Chinese adult males, cadmium exposure may affect serum testosterone and T/E_2 as a hormone-like disruptor.

KEYWORDS: testosterone, testosterone to estradiol ratio, China National Human Biomonitoring, cadmium.

P-1211 Urinary biomarkers of inorganic arsenic exposure, inorganic arsenic metabolism, and birth weight in Tacna, Peru, 2019

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BACKGROUND AND AIM: Arsenic exposure during pregnancy has been related to adverse birth outcomes such as low birthweight. The province of Tacna is located in southern Peru. It is characterized by elevated arsenic levels in drinking water, nonetheless, its mean birth weight is greater than the country's average. Thus the aim of this study was to evaluate the effect of urinary arsenic species on birth weight in Tacna pregnant women in 2019.

METHODS: 160 pregnant women ≤24 weeks were recruited from different health centers of Tacna, and followed up to delivery. First morning voids of urine were sampled in the second and third trimester; they were encouraged to avoid consuming seafood at least three days before sampling. Arsenic species (AsIII, AsV, MMA, DMA and arsenobetaine) were analyzed by ICP-MS. Birth outcomes data was obtained from the clinical records of Hospital Hipólito Unanue. Inorganic arsenic exposure was measured as the sum of inorganic and methylated species in urine, adjusted for arsenobetaine. Inter-individual differences in arsenic toxicokinetics were measured using the principal components of the relative concentrations of inorganic, methylated, and dimethylated arsenic in urine. We considered inorganic arsenic exposure, and arsenic toxicokinetics, individually and with an interaction term as predictors of birth weight.

RESULTS: Mean birth weight was 3618.71g, while mean tAs, iAs, MMA and DMA were 41.62, 3.52, 2.49, and 35.61µg/L, respectively. The estimate of the beta coefficient for the association of arsenic with birth weight was 0.21 (95%CI -2.31;2.74) for inorganic arsenic, while for arsenic toxicokinetics it was11.88 (95%CI -22.35;46.12), and for the interaction between them was 0.33 (95%CI -0.83;1.49).

CONCLUSIONS: In this population, we did not find evidence that arsenic exposure affected birth weight. This null association could be due to study limitations as sample size or factors not measured.

KEYWORDS: Arsenic, Birth weight, Peru, Latin America

P-1215 Residential greenspace and birth outcomes in the Chemicals in Our Bodies cohort, San Francisco, California

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BACKGROUND AND AIM: Evidence from prior studies is inconclusive regarding the association between residential proximity to greenspace and birth outcomes. Psychosocial stress increases the risk of adverse birth outcomes and may modify associations with greenspace. We evaluated the effects of residential greenspace on gestational age and fetal growth and whether they differed with experiences of psychosocial stressors.

METHODS: Chemicals in Our Bodies is a demographically diverse prospective cohort of pregnant people in San Francisco, California (N = 815). Three measures of greenspace were constructed using the birth parent's residential address and secondary data: normalized difference vegetation index (NDVI) and percent green or blue space within 500m, and Euclidean distance to the nearest park. We used linear regression to estimate the association between quartiles of greenspace measures, completed gestational week and birthweight for gestational age z-scores (BWz), adjusting for parental age, education, smoking, parity, food insecurity, race/ethnicity, nativity, traffic within 500m, and noise. We stratified by perceived stress and depression.

RESULTS: Comparing quartile 1 vs. 4, NDVI and percent green and blue space were not strongly associated with differences in mean completed weeks of gestation (β=-0.05 [95% confidence interval -0.57, 0.48] and 0.09 [-0.39, 0.57]) or mean BWz (β=-0.07 [-0.35, 0.21] and -0.11 [-0.36, 0.14]). Low NDVI (quartile 1 vs. 4), low percent green and blue space (quartile 1 vs. 4), and high distance to nearest park (quartile 4 vs. 1) were weakly associated with reductions in gestational age among parents reporting high levels of stress or depression (β=-0.73 [-2.83, 1.36], -1.31 [-3.47, 0.85], and -0.47 [-1.92, 0.99] weeks). Associations were slightly stronger when we considered 1km buffer distances, but still not statistically significant.

CONCLUSIONS: We did not find strong evidence that residential greenspace is associated with reductions in gestational age or birthweight in this study population.

KEYWORDS: nature, urban, perinatal

P-1217 Maternal Vitamin D levels modify the association between pre-pregnancy Triclosan exposure and neonatal anogenital distance

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BACKGROUND AND AIM: Triclosan (TCS) is widely used as an antibacterial agent in consumer products and is suspected of having endocrine-disrupting properties, limited epidemiological studies examined the developmental effects of TCS exposure before pregnancy. Meanwhile, Vitamin D deficiency is a global health issue and the consequences of vitamin D deficiency during pregnancy cannot be underestimated. We investigated association between maternal TCS exposure and anogenital distance (AGD) and other genital measurements in infants at birth after considering maternal vitamin D status.

METHODS: Participating 258 women were recruited from Shanghai Birth Cohort between 2012 and 2013. TCS concentration was quantified from maternal urine samples collected before pregnancy. Vitamin D was measured by maternal plasma during early pregnancy. A standardized measure of AGD was obtained in infants at birth. Anogenital index (AGI) was defined as AGD divided by weight (kg) at examination. Effect modification by Vitamin D was estimated.

RESULTS: We found no significant associations between maternal TCS and AGD in male or female infants. However, after stratified by maternal plasma vitamin D status (deficiency (<20ng/ml) versus insufficiency or sufficient (≥20 ng/mL)), per unit increase in maternal lg concentration of TCS, AGI increased on average by 0.23 in male infants (95% confidence interval (CI): 0.02, 0.45) when maternal VD concentration was lower than 20 ng/mL. No significant association was observed between maternal TCS and AGD in male infants when VD concentration is higher than 20 ng/mL. Furthermore, no significant association of maternal TCS with AGD or AGI was found in female infants.

CONCLUSIONS: These data support the hypothesis that maternal TCS exposure at environmental levels can adversely affect male reproductive development especially when maternal Vitamin D status is deficiency. Further prospective cohort studies with longitudinal measures are warranted to confirm these findings.

KEYWORDS: triclosan, Vitamin D, anogenital distance, anogenital index, birth cohort

P-1219 Proximity to restorative environment: Perception vs. Reality

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Proximity to restorative environment is known to be associated with health outcomes. for couples who are trying to conceive, neighborhood environment may affect reproductive function. This study assessed the association of duration of infertility with self-perceived and actual restorative environment, respectively. We analyzed the data of 500 participants of PRegnancy and UrbaN Environment (PRUNE) study, which is an ongoing mobile-based prospective cohort study of infertile couples. We assessed the perceived proximity to park and blue space (river, lake, stream, etc.) and actual environment of home address (NDVI within 500m and distance to blue space). Most of participants were women (64.9%) and 37 years and beyond (50.8%). Duration of infertility was ≥ 2 years in 167 (40.3%). Mean distance to blue space was shorter when the participants reported proximity of blue space, while mean NDVI was not different according to the perceived proximity. When adjusting for age and body mass index, perceived proximity to blue space was associated with lower risk of infertility for ≥ 2 years (relative risk = 0.78, 95% confidence interval: 0.62, 0.97). Associations of infertility for ≥ 2 years with perceived proximity to park, NDVI, and actual distance to blue space were close to null. In a sample of infertility couples living in urban area, we observed a positive association between perceived proximity to blue space and duration of infertility which was not replicated for actual distance. To optimize reproductive health, interventions to improve perceived environment would be necessary.

P-1227 Health risk assessment of phthalates exposure through lipid peroxidation in children with asthma

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BACKGROUND: Global prevalence of asthma in children has dramatically increased in the past decades. Recent studies revealed that Taiwanese children are still exposed to considerable amounts of phthalates after the 2011 incident of phthalates-tainted food products. Up-to-date findings indicated that phthalates may increase malondialdehyde (MDA), a lipid peroxidation marker, in asthma patients. The role of phthalates in the increased occurrence of childhood asthma through lipid peroxidation remains unclear. We want to assess the association between phthalates exposure and MDA in children with asthma.

METHODS: We recruited 125 children with clinically-diagnosed asthma and around 98 controls from Taipei Hospital since January 2019. Participants provided urine specimen and questionnaire. Eleven phthalate metabolites and MDA were analyzed by liquid chromatography tandem-mass spectrometry (LC-MS/MS) and ELISA, respectively. Pearson correlation and related statistical method were used to analyze the relationship of urinary phthalate metabolites or MDA in asthma children.

RESULTS: BMI in asthma children was significantly higher than that in control (p=0.005) whereas no similar phenomena was observed for other demographic factors. Mother ever had cigarette smoking in pregnancy and current burn incense at home in the case group were marginally significantly higher than those in control. Meanwhile, the median levels of urinary MEHP (72.18 v.s 68.81 ng/mL), MiNP (28.75 v.s 23.51 ng/mL), and MDA (6.87 v.s. 5.86) in asthma children were higher than those in control, though failed to reach statistical significance. Age was positively correlated with urinary MDA (r=0.159, p=0.018) and MEP (r=0.13, p=0.058). Urinary MEP was highly correlated with the other phthalate metabolites which indicated a common exposure source.
CONCLUSION: Certain phthalates may increase lipid peroxidation markers in asthma children.

KEYWORDS: Phthalate metabolites; lipid peroxidation; asthma.

P-1232 Psychosocial stress exposure and lung function in childhood: effect modification by child sex

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BACKGROUND: Psychosocial stress is linked with adverse childhood respiratory outcomes, but the influence of exposure timing and sex differences has not been completely elucidated.
Aim: Examine the association between prenatal and concurrent maternal stress and lung function in children and explore sex differences.

METHODS: Analyses included 283 mother-child pairs from the Programming Research in Obesity, Growth, Environment and Social Stressors cohort in Mexico City. Lung function was tested at ages 8-11 years and age, height and sex adjusted z-scores were estimated for FEV1, FVC, FEF25-75% and FEV1/FVC. Psychosocial stress during pregnancy and concurrent to the lung function was assessed using the Crisis in Family Systems Revised questionnaire. Exposure to stress during both periods was categorized as low prenatal-low current, low prenatal-high current, high prenatal-low current and high prenatal-high current. Effect modification by sex was examined with interaction terms and in stratified analyses. Models were adjusted for maternal age and education at enrollment and concurrent report of a smoker in the home.

RESULTS: We found no associations between stress and lung function in our main models. There was a significant interaction between stress and sex in relation to FEV1 and FVC z-scores. In stratified models, low prenatal-high current stress was associated with lower percent predicted FEV1 in males (β: -0.509, 95%CI [-0.94, -0.08]) but not in females (β: 0.11, 95%CI [-0.35, 0.56]) when compared to low prenatal-low current stress. Low prenatal-high current stress was associated was associated with lower percent predicted FVC in males (β: -0.56, 95%CI [-0.96, -0.16]) but not in females (β: 0.31, 95%CI [-0.16, 0.78]) when compared to low prenatal-low current stress.

CONCLUSIONS: Time varying associations between stress children's lung function are sex-dependent and greater in males. Results highlight the importance of considering the emotional environment and the susceptibility by sex.

KEYWORDS: stress, respiratory, children's health

P-1234 Incident COPD and Its Disparities Associated with Low-concentration Air Pollution in American Older Adults: A National Cohort Analysis

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BACKGROUND: Risk of air pollution-related Chronic Obstructive Pulmonary Disease (COPD) and corresponding disparities associated with air pollutant exposures are less clear at concentrations below current National Ambient Air Quality Standards (NAAQS).

METHODS: We constructed a national U.S. population-based cohort of those aged ≥65 from the Medicare Chronic Conditions Warehouse (2000-2016), combined with high-resolution population-weighted air pollution datasets, to investigate the association of long-term exposure to low-level air pollution and incident COPD. We defined four distinct low-exposure sub-cohorts comprised of individuals who were always exposed to low-levels of: (1) PM2.5 (annual mean ≤12-μg/m³), (2) NO2 (annual mean ≤53-ppb), (3) O3 (warm-season mean ≤50-ppb), and (4) low levels of all three air pollutants. We further tested effect modification by individual- and community-level characteristics.

RESULTS: of the 18.8 million individuals, 64.2% (12.1-million), 99.3% (18.7-million), 75.4% (14.2-million), and 54.1% (10.2-million) were always exposed to low-level annual PM2.5, NO2, O3, and all three air pollutants, respectively. Among the single-pollutant low-exposure cohorts, a 5-μg/m³ increase in PM2.5, 5-ppb increase in NO2, and 5-ppb increase in warm-season O3 were associated with an increase in COPD rate ranging between 9-12%, 1-2%, and 11-12%. Associations with each individual pollutant were also significant in the cohort exposed to low-levels of all three pollutants. There was evidence of linearity in concentration-response relationships for NO2 and O3 at levels below the current NAAQS. for PM2.5, there was a sharp increase in risks at levels above 10-μg/m³. Further, individuals in communities with lower household incomes, lower educational attainment, and lower numbers of active doctors experienced higher risk.

CONCLUSIONS: Our study suggests exposures to low-level PM2.5, NO2, and warm-season O3 were associated with incident COPD. Subgroup differences suggest individual and contextual factors contributed to COPD disparities under effects of air pollutant exposures.

KEYWORDS: Chronic obstructive pulmonary disease (COPD), air pollution, low concentration, disparities

P-1241 Associations between exposure to ambient fine particulate matter (PM2.5) and prevalence of chronic respiratory disease in Senegalese adults: Results from the demographic health survey (DHS) 2011

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BACKGROUND AND AIM: The prevalence of chronic respiratory conditions such as asthma and chronic bronchitis has been increasing in Africa over the past decade. Recent studies show that exposure to air pollution is associated with increased risk of chronic respiratory diseases. However, very few studies have been conducted in sub-Saharan Africa using estimated measurements of particulate matter (<2.5 um; PM2.5). The aim of our study is to investigate the association between PM2.5 exposure and prevalence of asthma/chronic bronchitis in Senegal.

METHODS: This study used data from the Demographic and Health Survey (DHS 2011 collected from October 2010 to April 2011 throughout Senegal. Using their geographic location of survey clusters, we linked data for 19,843 Senegalese adults to remotely sensed and gridded annual concentrations of PM2.5. We estimated covariate-adjusted associations of PM2.5 with prevalence of self-reported asthma/chronic bronchitis using logistic regressions while accounting for survey weights and clustering. We also evaluated potential effect modification by gender.

RESULTS: The prevalence of asthma/chronic bronchitis was 2.99%.The adjusted association between PM2.5 and asthma/chronic bronchitis prevalence was 1.03 (95%CI: 0.99 – 1.06). The association between PM2.5 and asthma/chronic bronchitis significantly differed by gender (p=0.008) with stronger associations in males (prevalence odds ratio [pOR] = 1.09; 95%CI: 1.03-1.15), compared to females (pOR = 1.01; 95%CI: 0.97 – 1.05).

CONCLUSIONS: Our results suggest that increasing levels of ambient exposure to PM2.5 puts individuals at a higher risk for chronic respiratory diseases, especially men even when taking possible indoor exposures to air pollutants into account. These findings have significant policy implications and should be built upon in future research using more refined measures of PM and prospective designs.

KEYWORDS: Air pollution, PM2.5, Asthma, Chronic bronchitis, Chronic respiratory diseases, Senegal, Sub-Saharan Africa

P-1243 Effects of smoking cessation on respiratory health and related chronic diseases

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OBJECTIVE: This study aims to understand the effects of smoking cessation on respiratory symptoms and chronic diseases.

METHODS: From 2015 to 2018, 1583 male residents aged 18-70 from 7 counties of Huaihe River Basin were selected as participants. Logistic regression model was used to analyze the effects of smoking or smoking cessation on respiratory symptoms and chronic diseases.

RESULTS: The smoking rate was 49.3%, and the smoking cessation rate was 26.3%. The prevalence rates of respiratory symptoms and chronic diseases was various 3.3% to 20.0%. Compared with current smokers, never smokers had a lower risk of cough, chronic cough, expectoration, chronic expectoration, wheezing, shortness of breath, and bronchial asthma/chronic bronchitis (OR=0.25~0.62), and smokers who quit smoking had a lower risk of cough (OR=0.63), but a higher risk of shortness of breath, hypertension, coronary heart disease/stroke, and diabetes than current smokers (OR= 1.44~2.40). Smokers who quit smoking due to illness had a higher risk of wheezing, shortness of breath, bronchial asthma/chronic bronchitis, coronary heart disease/stroke, and chronic gastritis/gastrointestinal ulcer (OR=1.85~2.62), while smokers who quit smoking for other reasons had lower risks of cough (OR=0.52), chronic cough (OR=0.20) and expectoration (OR=0.53), but higher risks of hypertension (OR=1.54) and coronary heart disease/stroke (OR=2.20) than current smokers. All the above were statistically significant (P<0.05).

CONCLUSIONS: Smoking cessation without illness could reduce the risk of respiratory symptoms and chronic diseases in rural male of Huaihe River Basin. Therefore, effective strategies are needed to encourage current smokers to quit.

KEYWORDS: Huaihe River Basin; smoking cessation , rural male; respiratory symptoms; chronic diseases

P-1244 Environmental impact of microbes on Awba dam: it's effect on ecotourism

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BACKGROUND AND AIM: Recreational use of water is often given inadequate consideration and care. This is of particular concern as the recreational use of water is becoming popular in Nigeria. Many of these are increasingly contaminated by domestic sewage and industrial effluents. This study is therefore relevant in assessing the environmental impact of microbes on ecotourism in Awba dam.

METHODS: A total of nine water (n=9) and soil (n= 9) samples were collected at entry, middle and the end of the Awba dam for heavy metal analysis and microbial assay. Total aerobic plate count, Isolation and characterization of strains was
done using standard methods. The presumptive E. coli isolates were subjected to agglutination tests with specific E. coli O157:H7 . for the antibiotic sensitivity test, the Bauer-Kirby disc diffusion
method was used to test the sensitivity of the isolates. Statistical analysis of ANOVA was used and Duncan multiple range test was used to separate the means.

RESULTS: All the values obtained for the total aerobic count and total coliform count for soil and water were higher than EPA recommended value for recreational waters. for the antibiotic Sensitivity Profile, isolates from Awba dam showed the highest sensitivity (16.17mm) to ciprofloxacin while lowest was with Augmentine (8.25mm). Generally, E.coliO157:H7
isolates were highly sensitive to Oflatoxin and Ciproflaxin(93.3%) while the isolate was completely resistant to Ampicilin and Cefuroxime.

CONCLUSIONS: The presence of E.coliO157:H7 in the dam
can make the dam unfit for recreational activities and also for the community household chores, if not well treated. The University management should device means of controlling
waste water that enters into the dam by providing alternate channels of discharge to reduce the growth and spread of the microbes in the dam.

KEYWORDS: Total Coliform Count, Heavy Metals, Physico-Chemical Parameters, Ecotourism, E. coli O157:H7, Microbe

P-1251 Nitrate Ingestion from Drinking Water and Ovarian Cancer Risk in the Agricultural Health Study

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BACKGROUND AND AIM: N-nitroso compounds (NOCs) formed endogenously after nitrate/nitrite ingestion cause ovarian cancer in animals. Few epidemiologic studies have evaluated the association of drinking water nitrate with ovarian cancer risk, and the only previous investigation observed increased risks with higher intake.

METHODS: We evaluated nitrate exposure from drinking water and ovarian cancer risk in the Agricultural Health Study, a cohort of pesticide applicators and their spouses in Iowa and North Carolina. for the enrollment water source (1993-1997; N=29,408), we computed average nitrate concentrations for women on public water supplies (20% of participants) from historical monitoring data and estimated nitrate concentrations in private wells (76%) using random forest models; 4% used other water sources and were excluded. We used Cox regression models adjusted for age, body mass index, smoking status, and menopausal status to estimate hazard ratios (HR) and 95% confidence intervals (CI) for nitrate quartiles and the 90th percentile. Among those with dietary data (collected at first follow-up; N=13,465), we calculated HRs for < and ≥ median nitrate concentration (1.47 mg/L), stratified by median dietary intakes of vitamin C (145.1 mg/day), as higher intake decreases endogenous NOC formation.

RESULTS: We identified 122 ovarian cancer cases through 2018 (Iowa) and 2014 (North Carolina). Risk was elevated (HR=1.67, CI:0.82–3.37, P-trend=0.19) for women in the 90th percentile (≥6.81 mg/L NO3-N) versus the lowest quartile (≤0.75 mg/L). The association with higher average nitrate exposure (> median) was stronger among women with low vitamin C intake (HR<median=2.20, CI:0.77-6.27) versus those with high vitamin C intake (HR>median=1.14, CI:0.58-2.25), although the interaction was not significant (P-interaction=0.28).

CONCLUSIONS: Although we cannot rule out the possibility our findings are due to chance, they suggest that higher average nitrate levels in drinking water may increase ovarian cancer risk and that vitamin C intake may modify this relationship.

KEYWORDS: nitrate, ovarian cancer

P-1258 Environmental influences and prediction of *Escherichia coli* concentration in freshwater recreational beaches in Southern Ontario

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BACKGROUND AND AIM: The concentration of *Escherichia coli* is used in Canada as an indicator of fecal pollution in freshwater recreational beaches, and is associated with recreational water illness among beachgoers. This study examines the environmental predictors of *E. coli* in Toronto and Niagara Region beaches to inform beach monitoring programs and reduce beachgoer illness risks.

METHODS: Our first objective used advanced analytical methods to examine region-specific environmental predictors of *E. coli* at 18 beaches in Toronto and Niagara Region. Mixed-effects models investigated regional differences, while the application of path analysis identified intervariable relationships and pathways associated with *E. coli* in Niagara Region. Our second objective involves the development of region-specific predictive models using a novel Bayesian Network approach to provide real-time assessments of beach water E. coli concentrations in our study regions.

RESULTS: *E. coli* observations were collected from 2007-2019 for Toronto and 2011-2019 for Niagara Region. In the mixed-effects analysis, substantial clustering of *E. coli* values at the beach level was observed in Toronto, while minimal clustering was seen in Niagara, suggesting an important beach-specific effect in Toronto beaches. Air temperature and turbidity were positively associated with *E. coli* in all models in both regions. In the path analysis, we found that water turbidity was an important mediator for the indirect effect of environmental variables overall and in beach-specific models. Results from these analyses informed the development of region-specific Bayesian Network predictive models, which are currently being tested and finalized.

CONCLUSIONS: Poor beach water quality could result in an increased risk of recreational water illness among the beachgoers. The development of accurate predictive models will guide beach managers in decision-making and risk communication to reduce recreational water illness risks among beachgoers.

KEYWORDS: *E. coli*, water quality, recreational water illness

E-POSTER GALLERY

P-0007 Epigenome-wide DNA methylation assists early intervention of Coronary Heart Disease with machine learning models

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BACKGROUND AND AIM: Studies have shown American Indian communities have a disproportionally high rate of coronary heart disease (CHD) compared with other ethnic groups. Microarrays for epigenome-wide DNA methylation data have enabled researchers to model a large number of methylation sites to investigate their associations with incident CHD. However, accurate prediction of CHD from high-dimensional epigenome-wide DNA methylation data is challenging. We aim to develop a workflow to accurately predict CHD up to 30 years prior to diagnosis assist early disease intervention.

METHODS: The associations of CHD with epigenome-wide DNA methylation data were first screened using elastic-net penalized cox proportional hazard models based on a previous epigenome-wide association study to identify noteworthy CpG sites. The selected significant CpG sites were then input into our autoencoder deep learning model to learn the latent space representation (embeddings). The learned embeddings were then input to multiple machine learning models (i.e., logistic regression, support vector classifier, random forest, gradient boosted decision tree, and fully connected neural networks) to predict CHD. We also performed the same prediction on raw features.

RESULTS: Using our developed method, we achieved the state-of-the-art prediction accuracy of binary CHD outcome (best AUROC=0.872) with DNA methylation and clinical features using autoencoder combined with support vector classifier model (AE-SVC_DNAm+clinical), which is better than previous studies. Results showed that DNA methylation features alone had high prediction accuracy (best AUROC=0.867), clinical features alone had poor performance (best AUROC =0.692), and that AE-SVC_DNAm+clinical only increased the prediction results incrementally. Additionally, using the learned embedding increased the overall stability of our prediction results over raw input features.

CONCLUSIONS: Our data-driven method is highly effective in accurately predicting CHD up to 30 years in the Strong Heart Study population. We suggest using this workflow in future disease predictions from the high-dimensional DNA methylation data.

P-0022 Stratification score matching: Assessing the association of phthalates on asthma using the Human Health Exposure Analysis Resource (HHEAR) Data Repository

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BACKGROUND AND AIM: The role of certain environmental exposures may be related to the onset, severity, or progression of disease, or any combination. The assessment of exposures in relation to severity may suggest unanticipated inverse associations, perhaps due to complex confounding issues. Such was the case when assessing phthalates on asthma control among children ages 4-14, all diagnosed with asthma. To better disentangle the potential role of phthalates on asthma, we sought to use stratification score (SS) methods to find comparable controls.

METHODS: Publicly available data from the HHEAR Data Repository were used to identify studies with 9 specified phthalates measured in children ages 4-14 between 2014-2018. Multivariate control charts (MCCs) were used to determine if phthalates measured in common quality control samples were comparable across studies. SSs were calculated as the probability of having asthma, conditioned on age, sex, race, ethnicity, and body mass index percentile. Controls were matched to cases using 1:1 SS matching and differences in log2 transformed specific-gravity corrected phthalate concentrations within pairs were assessed using paired t-tests. We repeated our matching algorithm 50 times and reported the distribution of effect estimates.

RESULTS: MCCs indicated phthalate measures from our studies of interest fell within acceptable bounds of variability and thus were combinable. On average, 101 of 139 eligible cases were matched across repetitions of matching. Compared to controls, cases had significantly higher concentrations for 7 phthalates, borderline significantly higher concentration for 1 phthalate and a significantly lower concentration for 1 phthalate. Consistent with the original study findings, differences between pairs tended to be higher or no different among well controlled asthmatics pairs compared to differences among poorly controlled asthmatics pairs.

CONCLUSIONS: Most phthalates were higher among asthmatic compared to non-asthmatic children. This study warrants further investigation into phthalate exposure sources used to reduce asthma symptoms.

KEYWORDS: phthalates, asthma, matching

P-0023 Exploring exposure-outcome relationships inside the VA Normative Aging Study using graph learning

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BACKGROUND AND AIM: Contemporary health sciences draw on large-scale longitudinal studies to understand the impact of lifestyle factors and environmental exposures on the risk of disease and identify potential underlying mechanisms. While there are extensive studies on associations between exposures and outcomes, the relationships among different studies within a single cohort are less studied. A database that summarizes those relationships is important towards unifying existing knowledge and inferring new information. In this study, we aim to construct an exposure-outcome network database across multiple publications in the Veterans Affairs Normative Aging Study (NAS) to explore its various applications including discovering core exposures/outcomes and hypothesis generation.

METHODS: NAS is a well-studied ongoing longitudinal study of aging in men followed since 1963. A network or a graph G can be constructed consisting of n nodes V and edges W, with each node representing an exposure E, or an outcome O. Two nodes are only connected by an edge w if their association has been studied. The core exposures/outcomes and communities of the network are retrieved with graph learning methods. Finally, we studied the dynamic changes of network structures.

RESULTS: We collected over 130 peer-reviewed exposure-outcome related publications in the last decade with title/abstract keyword “Normative Aging Study” in PubMed. We then constructed a network database describing the exposure-outcome relationship. We identified key exposures of interest, such as short- and long-term air pollution and its components, and key outcome nodes such as DNA methylation and lung function through network analysis. We also demonstrated the possibility of using the constructed network towards hypothesis generation.

CONCLUSIONS: We constructed a graph/network database to describe the relationship between exposures and outcomes across multiple studies inside the NAS cohort. Utilizing the graph learning methods, we demonstrated various applications including identifying key exposure/outcomes as well as hypothesis generation.

P-0026 The PFAS-Tox Database: A systematic evidence map of health studies on per- and polyfluoroalkyl substances

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BACKGROUND AND AIM: PFAS (per-and polyfluoroalkyl substances) is a large class of synthetic chemicals used widely in consumer products and industrial processes. Health and toxicology literature on PFAS has increased dramatically in the last decade, and many key stakeholders could benefit from efficient access to the data. We aimed to create a systematic evidence map (SEM) of health and toxicological research on 29 PFAS that would be easily accessible for diverse audiences.

METHODS: We published a protocol a priori and conducted a PubMed database search of peer-reviewed literature through January 25, 2021. Studies were screened for inclusion and exclusion according to the Populations, Exposures, Comparators, and Outcomes (PECO) statement. Inclusion criteria were intentionally broad and included any human, animal, and/or in vitro study that investigated exposure to one of the 29 PFAS of interest and a human health or toxicological effect. Study details were extracted, with meta-data made freely available in the online, interactive SEM at https://pfastoxdatabase.org.

RESULTS: Over 15,000 studies were retrieved from the literature search. After manual screening, 1,067 studies (505 human, 385 animal, and 220 in vitro) were identified and included as investigating health or toxicological effects of one or more PFAS of interest. Most human studies were cross-sectional (48%) or cohort (39%), with body weight/size/growth (n=195), reproductive (n=158), endocrine (n=149), and metabolic/digestive systems (n=143) examined as the most common health outcome categories.

CONCLUSIONS: The PFAS-Tox Database is a useful tool for searching, filtering, and identifying peer-reviewed research on the health and toxicological effects of PFAS. The SEM provides examples of data gaps and clusters revealed by the database and will support scientists, regulatory agencies, and individuals with tools to advance future research efforts, systematic reviews, regulatory risk assessments, and cross-disciplinary coordination on the health effects of PFAS exposure.

KEYWORDS: PFAS, epidemiology, toxicology, systematic review, risk assessment

P-0040 Longitudinal Associations of Air Pollution with Body Size and Composition in Midlife Women: The Study of Women's Health Across the Nation

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BACKGROUND AND AIM: Exposure to air pollution has been suggested to be associated with obesity recently; however, epidemiologic evidence is still limited and has heavily focused on body mass index (BMI). We examined associations of fine particulate matters (PM2.5), nitrogen dioxide (NO2), and ozone (O3) with longitudinal measures of body size and composition including weight, BMI, waist circumference, fat mass, lean mass, and proportion fat mass in midlife women.

METHODS: The study population included 1,654 White, Black, Chinese and Japanese women from the Study of Women's Health Across the Nation, with the median age of 49.6 years and a total of 10,370 repeated observations followed from 2000 to 2008. Annual air pollution exposures were assigned by the residential addresses linked with hybrid estimates of air pollutant concentrations at 1-km2 resolution. Body size was measured objectively and body composition was measured using the dual-energy X-ray absorptiometry (DXA) at approximately annual visits. Linear mixed effects models were used to examine the associations between air pollution and body size and composition measures.

RESULTS: After adjusting for potential confounders, an interquartile range (IQR) increase in PM2.5 concentrations (4.5 μg/m3) was associated with 4.53% (95%CI:3.85%,5.22%) higher fat mass, 1.10% (95%CI:0.95%,1.25%) higher proportion fat mass, and 0.39% (95%CI:-0.77%,-0.01%) lower lean mass. An IQR increase in NO2 (9.5 ppb) was associated with 3.39% (95%CI:2.68%,4.10%) higher fat mass, 0.94% (95%CI:0.78%,1.10%) higher proportion fat mass, and 0.86% (95% CI:-1.26%,-0.45%) lower lean mass. Similar associations were also observed for O3. Physical activity was found to modify the associations of PM2.5 and NO2 with body size and composition: weaker associations were observed in participants who engaged in more physical activity.

CONCLUSIONS: PM2.5, NO2, and O3, are adversely associated with body composition, including higher fat mass, higher proportional fat mass, and lower lean mass, highlighting its potential role in contributing to obesity.

P-0043 Associations between traffic-related air pollution and cognitive function in Australian urban settings: the moderating role of diabetes status

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BACKGROUND: Traffic-related air pollution (TRAP) is associated with poorer cognitive function and higher incidence of diabetes in older adults, but little is known about whether diabetes moderates the impact of TRAP on older adult cognitive function.

METHODS: We analysed cross-sectional data from 4141 adults who participated in the Australian Diabetes, Obesity and Lifestyle (AusDiab) study in 2011-2012. TRAP exposure was estimated using major and minor road density (100m/km²) within residential buffers: 200, 300, 500, 1000 and 1600 metres. Cognitive function was assessed with validated psychometric scales: California Verbal Learning Test (memory) and Symbol–Digit Modalities Test (processing speed). Diabetes status was measured using an oral glucose tolerance test. Missing data were imputed. Associations of TRAP with cognitive function and the moderating effects of diabetes on these associations were estimated using generalised additive mixed models adjusted for age, sex, English-speaking background, socioeconomic status, education, living arrangement, employment status, neighbourhood self-selection indices, urban density, neighbourhood greenspace and land-use mix. Results are reported as regression coefficients, β, per single unit increase in TRAP measures.

RESULTS: We observed positive associations between 200, 1000 and 1600m TRAP and memory (β=0.003, p=0.008; β=0.003, p=0.018; β=0.004, p=0.015 respectively) but not processing speed. Minor road density was not associated with cognitive function, while major road density showed positive associations with memory and processing speed among 1000 and 1600m buffers (β=0.010, p=0.038; β=0.014, p=0.026). Within a 300m buffer the relationship between TRAP and memory tended to be positive in people without diabetes (β=0.005; p=0.062), but negative in people with diabetes (β=-0.013; p=0.026); and negatively associated with processing speed in people with diabetes only (β=-0.047; p=0.059).

CONCLUSIONS: In Australian urban areas, higher TRAP exposure may be positively associated with cognitive function in urban dwelling people, but this benefit may not extend to people living with diabetes in urban settings.

P-0045 Short-term exposure to PM2.5 and daily all-cause dementia and Alzheimer´s disease mortality in Connecticut: a time-stratified case-crossover study

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BACKGROUND: While emerging studies have examined long-term exposure to fine particulate matter ($PM_{2.5}$) and its association with various measures of morbidity of dementia and Alzheimer´s disease (AD), evidence on short-term $PM_{2.5}$ exposure and mortality caused by dementia or AD is sparse.

METHODS: We applied a time-stratified case-crossover design using conditional logistic regression to assess the association between ambient $PM_{2.5}$ concentrations and daily all-cause dementia and AD mortality in Connecticut between 2005 to 2016, while adjusting for mean air and dewpoint temperature. Our analysis included cases whose principal cause of death was all-cause dementia or AD. The daily 24-hour average $PM_{2.5}$ concentration was obtained from a well-validated model and the individual-level exposure was assigned based on the modeled $PM_{2.5}$ level in a 1 × 1 km^2 grid which contains the residential address. We also explored potential effect modification by age and sex groups.

RESULTS: A total of 28,736 all-cause dementia deaths occurred during our study period, among which 9,826 were specially coded as AD deaths. A 10 $\mu g/m^3$ increase in the 2-day moving average of ambient $PM_{2.5}$ was significantly associated with all-cause dementia (Odds Ratio [OR] =1.06, 95% confidence interval [CI]: 1.03, 1.09) and AD (OR=1.07, 95% CI: 1.02, 1.12). We did not find effect modification by age (<80 years vs. ≥ 80 years) in all-cause dementia or AD. The estimated effect of $PM_{2.5}$ was higher among the female subgroup compared to the male subgroup (P-value = 0.03) for mortality caused by all-cause dementia but not for AD.

CONCLUSIONS: Our study suggests a significant association between short-term exposure to $PM_{2.5}$ and an increase in mortality risks of all-cause dementia and AD. Further research is warranted on mechanisms that can explain the relationship between short-term $PM_{2.5}$ exposure and mortality risks of dementia.

KEYWORDS: $PM_{2.5}$; dementia; Alzheimer´s disease; mortality; short-term; case-crossover

P-0047 Para-dichlorobenzene exposure and serum α-Klotho levels among US participants in their middle and late adulthood

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BACKGROUND AND AIM: Para-dichlorobenzene (p-DCB) is a volatile compound commonly used as pest repellent and air deodorant in the home and public buildings. There has been an increasing concern about its metabolic and endocrine effects. The aim of the present study was to explore the relation between p-DCB exposure and serum levels of soluble α-Klotho, an anti-aging hormone, in US adults.

METHODS: A nationally representative subsample of 1485 adults 40-79 ages in the 2013-2016 National Health and Nutrition Examination Survey was analyzed for the association between urinary concentrations of 2,5-dichlorophenol (2,5-DCP), the major metabolite of p-DCB, and serum α-Klotho levels using multiple general linear models, adjusting for potential confounders. Age- and sex-specific analyses were further conducted.

RESULTS: The weighted geometric mean of urinary 2,5-DCP was 2.43 μg/L and the weighted mean of serum α-Klotho was 831.97 pg/mL in the study participants during 2013-2016. After adjusting for potential confounders, urinary 2,5-DCP was significantly associated with decreased serum levels of α-Klotho (regression coefficient β=-9.88; p=0.0133) in the total study population. When age- and sex-specific analyses being conducted, a significantly inverse association was found in older adults aged 60-79 years (β=-20.52; p<0.0001) and in males (β=-13.81; p=0.0097), but not in the middle ages (40-59 years) and in females. The strongest association was observed in older (60-79 years) male participants, with a 25.25 pg/mL reduction of α-Klotho levels per 1-unit increase of 2,5-DCP concentrations (p=0.0007). No statistically significant associations with α-Klotho levels were observed for urinary 2,4-dichlorophenol, another dichlorophenol pesticide.

CONCLUSIONS: Our study demonstrates a relation between p-DCB exposure, measured as 2,5-DCP, and decreased α-Klotho levels in older men. Additional studies would further explore these interactions and elucidate the pathogenesis of the potential effects of p-DCB exposure on aging.

KEYWORDS: 2,5-dichlorophenol, α-Klotho; middle and late adulthood, NHANES; para-dichlorobenzene exposure

P-0048 Associations between Air Pollution and Gait Speed in Older Adults

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BACKGROUND AND AIM: Air pollution is widely recognized as a threat to public health, particularly among older adults. Long-term exposure to air pollution may impact gait speed trajectories over time, as gait speed is a marker of physical and cognitive decline. This study examined the relationship between long-term air pollution exposure and gait speed decline among older adults and evaluated whether cardiovascular disease (CVD) status modified the effect.

METHODS: We analyzed data from 3,022 older adults residing in the US followed from 2000 to 2008. Long-term exposure to fine particulate matter (PM2.5) and nitrogen dioxide (NO2) prior to study enrollment was estimated using state-of-the-art prediction models. Gait speed at usual and rapid pace was assessed annually using a 15-foot timed walk test. Mixed-effects models were fitted adjusting for sociodemographic variables overall and in those with and without CVD.

RESULTS: Greater long-term PM2.5 and NO2 exposure was related to faster gait speed decline. One interquartile range (IQR) higher 5-year PM2.5 exposure (2 μg/m3) prior to the study enrollment was related to 0.048 m/s decline in usual gait speed (95% CI: -0.084, -0.024) and an IQR higher 5-year NO2 exposure (6.5 ppb) was associated with 0.078 m/s decline in usual gait (95% CI: -0.120, -0.042) and 0.042 m/s decline in rapid gait (95% CI: -0.078, -0.006) over the 6-year period. Longitudinal association between air pollution (5- and 10-year average PM2.5 and NO2) and rapid gait speed decline was significant only in individuals with CVD.

CONCLUSIONS: Long-term exposure to air pollution appears to be associated with faster gait speed decline among older adults in the US. Policies to reduce the emission of air pollutants and interventions to avoid air pollution exposure could contribute to the reduction in the burden of preventable institutionalization and hospitalization.

KEYWORDS: Air pollutants, Walking speed, Aged, Dementia, cognitive decline

P-0050 Incident Dementia and Long-Term Exposure to Constituents of U.S. Fine Particle Air Pollution: A National Cohort Study

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BACKGROUND: Growing evidence suggests that PM2.5 likely increases the risks of neurological disorders, yet little is known about the relative contributions of different constituents. Understanding constituent-specific effects are critical to targeting emission reductions of specific sources with the greatest health protection.
METHOD: We conducted a nationwide population-based cohort study (2000-2017), by integrating the Medicare Chronic Conditions Warehouse database and two sets of high-resolution, multiple-species, air pollution datasets to investigate the impact of long-term exposure to PM2.5 constituents on incident dementia and Alzheimer's disease (AD). and home health-care claims. Hazard ratios for dementia and AD were estimated using single- and multi-constituent Cox proportional hazards models, and penalized splines were used to evaluate potential nonlinear concentration-response relationships.

RESULTS: of the 18.5 million dementia and 19.2 million AD individuals within these cohorts, 31.5% and 14.6% developed dementia and AD events, respectively. From the single-pollutant models, an interquartile range (IQR) increase in PM2.5 mass was associated with an increase in dementia incidence ranging between 6-7% using two exposure datasets. for different PM2.5 constituents, associations remained significant in black carbon (BC), organic matter (OM), sulfate (SO42−), and ammonium (NH4+). Incident dementia was observed to have the strongest association with increases in exposure to SO42− and BC (10-11% increase and 4-6% per IQR increase, respectively). Effect estimates for AD were even larger. for both endpoints, all constituents had largely linear concentration-response relationships in the low exposure range, but most tailed off at high exposure concentrations, particularly for AD.

CONCLUSIONS: Our study suggests that long-term exposure to PM2.5 is significantly associated with increased incident dementia and AD, and that the different PM2.5 constituents may elicit differential neurotoxicity. Reduction of PM2.5 emissions, especially for the main sources of BC and SO42−, may reduce the burden of dementia or AD in the aging US population.

P-0058 Long-term Ozone Exposure and Incident Frailty in Older Adults: Findings from a Prospective Cohort Study in Chinese Elderly

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BACKGROUND AND AIM: Studies have linked elevations in short-term ozone exposure to acute adverse health outcomes. In this study, we aimed to explore whether long-term ozone exposure was linked to the development of frailty in older adults.

METHODS: A total of 15,734 participants aged ≥65-year-old and were free of frailty were included in Chinese Longitudinal Healthy Longevity Survey (CLHLS) from 2005 to 2018. Frailty was defined by a frailty index (FI) ≥0.25, which was measured by 39 health deficits. Personal ozone exposures were estimated using full-composition annual ozone covering all of China at a 0.05° resolution. County-level ozone-related burden of frailty in China was calculated by warm season hazard ratio of frailty.

RESULTS: During 78,588 person-years follow-up, 3587 incident frailties were documented. In competing risk models, each 10-μg/m³ increase in baseline warm-season (May to October) and yearly ozone exposure corresponded to 6.9% and 12.1% higher risk of incident frailty, the hazard ratios were 1.069 (1.035-1.104) and 1.121 (1.063-1.182), respectively. Monotonically increasing dose-response of warm-season and yearly ozone exposure with incident frailty and FI score were observed. With the dramatic population aging and increasing ozone exposure simultaneously in China, it was estimated that the burden of warm season ozone related incident frailty among the population aged ≥65-year-old in China were 1,818,729 and 3,700,237 cases in 2010 and 2020, respectively, and there will be 4,806,037 incident frailties in 2030.

CONCLUSIONS: This nationwide prospective cohort study established that long-term ozone exposure was associated with incident frailty and contributed to an enormously significant and increased disease burden for the older adults, suggesting that controlling ozone exposure may be a priority area for air quality regulations in China in next decade that may yield substantial health benefits.

KEYWORDS: ozone; older adults; frailty; CLHLS; disease burden

P-0059 Associations of peak season ozone with blood pressure among older adults without hypertension in a high exposure country: evidence from the Chinese Longitudinal Healthy Longevity Survey from 2005 to 2018

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BACKGROUND AND AIM: Evidence based on long-term prospective cohort studies is lacking to investigate the association between ambient ozone (O3) and blood pressure among older adults. We aim to evaluate the associations of peak season O3 with change of blood pressure in a long-term cohort study among older adults without hypertension.

METHODS: We included 5940 older adults aged ≥65 years and with repeated measurements of blood pressure from 2005 to 2018 in 23 provinces of China, estimated monthly O3 exposures at 0.05 ° ×0.05 ° resolution were matched to each participant. Peak season O3 exposure was measured as the average from April to September. Outcomes include blood pressure measurements of SBP, DBP, PP and MAP. Linear mixed models were performed to evaluate the associations between O3 exposures and blood pressure. Natural splines were applied to explore the potential non-linear concentration-response associations.

RESULTS: In this study, peak-season O3 ranges from 72.6 to 151.7 μg/m3 in China. In fully adjusted model, per 10 μg/m3 increase in peak season O3 was associated with increases of 2.46 mmHg (95% confidence interval [CI]: 1.85-3.06) in SBP, 2.46 mmHg (95%CI: 1.94-2.99) in PP and 0.74 mmHg (95%CI: 0.38-1.11) in MAP, but non-significant decrease in DBP. Female, ethnic minorities, and older adults who were not in marriage, underweight, with medium or low income levels were susceptible to O3 exposure. Non-linear curves indicated that the effect of O3 exposure on SBP, PP and MAP were monotone increasing, with faster increase in risk magnitude before WHO interim target 1 at 100 μg/m3, but slow down thereafter.

CONCLUSIONS: The study added evidence to support the World Health Organization interim targets for peak-season O3, however, lower interim targets should be set to maintain healthy blood pressure among populations in countries with high O3 concentrations.

KEYWORDS:Ozone; blood pressure; older adult; cohort study

P-0060 Association of blood mercury exposure with depressive symptoms in the Chinese oldest old

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Background:Depressive symptoms have a significant impact on the quality-of-life among the oldest old. Current research on the association of blood mercury with depressive symptoms has mainly targeted the general population. However, it is unclear whether this association is present at the oldest old.

Objective:The aim of this study was to investigate the association of blood mercury exposure with depressive symptoms in the oldest old.

Methods:We used data from the Healthy Aging and Biomarker Cohort Study carried out in 2017-2018, with 1567 participants aged ≥80 years were eligible for analysis. Blood mercury levels were measured by inductively coupled plasma mass spectrometry (ICP-MS). The CES-D10 depression scale was used to assess depressive symptoms. Multivariable logistic regression models were used to examine the association between blood mercury levels and depressive symptoms. We also used restricted cubic splines (RCS) to assess the linear or nonlinear association of blood mercury with depressive symptoms.

Results:The mean age of the 1567 participants was 91.8 years, while the geometric mean concentration of blood mercury was 1.17 μg/L. Multivariable logistic regression analysis showed a statistically significant positive association of blood mercury with depressive symptoms after adjustment for covariates. The odds ratios of blood mercury for depressive symptoms in the second and third tertiles were 1.88 (1.37-2.56) and 1.51 (1.11-2.04), respectively, compared with that measured in the first tertile. The RCS model showed that there was a non-linear association between blood mercury level and depressive symptoms.

CONCLUSIONS: Among the oldest old, we found blood mercury levels are associated positively with depressive symptoms, highlighting the importance of appropriately managing their exposure to mercury.

KEYWORDS: depressive symptoms, blood mercury, the oldest old, restricted cubic splines, multivariate logistics

P-0061 Accelerated aging modifies impact of ozone on QT interval and markers of inflammation in healthy humans

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BACKGROUND AND AIM: Older individuals often have increased health risks from environmental exposures, but this has been rarely investigated using molecular measurements of biological age. DNA methylation can be used to measure biological age and epigenetic age acceleration (EAA) in subjects. EAA accurately predicts mortality and chronic disease risk; however, it is unknown whether EAA modifies responses to environmental exposures. Here, we investigated whether cardiovascular and inflammatory responses to ozone are modified by EAA.

METHODS: LAMARCK was a controlled exposure study where 17 healthy participants were exposed to 0.3-ppm ozone or to clean air for two hours in a randomized single-blind crossover study design. Functional cardiopulmonary measures (n=3) and inflammation biomarkers (n=5) were collected immediately before and 24-hours after exposures. Epigenetic age was estimated using the Horvath method on cells that were collected from BALFs 24 hours after exposure. All outcomes were normalized to their pre-exposure values. We used mean and quantile regression to examine if EAA (calculated as epigenetic age – chronological age) measured during clean air exposure is associated with the estimated causal risk difference (CRD; Ozone – Clean Air) of cardiopulmonary and inflammatory outcomes. Regression models were evaluated with and without outliers to determine model consistency. Results are presented as percentage change relative to the mean value measured during air exposure.

RESULTS: Mean and median regression results were concordant. for mean regression, one-year higher EAA was associated with a 0.44% (95% confidence interval = 0.13%, 0.75%) increase in the CRD for QT interval in response to ozone exposure. One-year higher EAA was also associated with a -15.3% (95% confidence interval = -23.2%, -7.41%) change in the CRD for C-reactive protein in response to ozone. No other associations were observed.

CONCLUSIONS: Accelerated aging in the lung is associated with prolonged QT interval and depressed inflammatory response during short-term ozone exposure.

P-0064 Air Pollution and Trajectories of Positive and Negative Affect in Older Women

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BACKGROUND AND AIM: Exposure to ambient air pollution, including PM2.5 (particulate matter <2.5 μm) and NO2 (nitrogen dioxide), is associated with depressive symptoms in older adulthood. Depression is characterized by low positive affect and high negative affect. Elucidating how exposure may differentially impact the emotional dimensions underlying depressive symptoms will deepen our understanding of the link between air pollution neurotoxicity and emotional health of older adults. Here we examined associations between air pollution and longitudinal trajectories of positive and negative affect in older women.

METHODS: Women (N=2,114; baseline age=73.3±3.8 years), enrolled in the Women's Health Initiative Study of Cognitive Aging (2000-2010), completed up to nine annual assessments with the Positive and Negative Affect Schedule (PANAS). Three-year average annual mean concentrations (scaled by interquartile range [IQR]) of ambient PM2.5 (in μg/m3; IQR=3.64 μg/m3) and NO2 (in ppb; IQR=10.35 ppb) before baseline were estimated at participants' addresses via spatiotemporal models. Latent-class mixture models were constructed to identify subgroups of women with similar trajectories of positive or negative affect over time. Multinomial logistic regressions were used to examine whether exposures predicted latent-class membership, adjusting for sociodemographic, lifestyle, and clinical characteristics.

RESULTS: Two latent trajectories of positive affect (PA) were identified: (high-stable PA: 95% and decreasing PA: 5%). Higher exposure to NO2 (OR = 1.55, p=.008), but not PM2.5 (OR=1.23, p=.212), was significantly associated with increased odds of being classified as having decreasing PA relative to high-stable PA. Four latent trajectories of negative affect (NA; minimal-stable: 27%; mild-stable: 46%; moderate-stable:21%; and moderate-decreasing: 6%) were identified. Neither NO2 nor PM2.5 was predictive of latent class membership of NA trajectories.

CONCLUSIONS: Exposure to NO2 may contribute to reduction of PA in older adulthood. Future studies should examine brain structures and neural networks as well as behavioral mechanisms underlying PA changes associated with air pollution neurotoxicity in late life.

P-0066 Narrative Review of Long-Term Exposure to Traffic-Related Air Pollution on Dementia and Related Outcomes in Older Adults

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BACKGROUND AND AIM: As part of an extensive systematic review on the associations of important clinical health outcomes with exposure to traffic-related air pollution (TRAP), an independent Panel appointed by the Health Effects Institute considered the emerging literature on dementia-related outcomes and Parkinson's disease, two areas of significant public health interest.

METHODS: The Panel systematically searched the PubMed and LUDOK electronic databases for observational epidemiological studies from 1980 through 2019 on long-term exposure to TRAP and dementia-related outcomes and Parkinson's disease prevalence in the general population. Study selection and data extraction were conducted according to a defined protocol, and a novel framework was used to identify which studies provided information on TRAP exposure. Conclusions regarding the level of confidence in the presence of an association were based on a narrative assessment. The Panel decided a priori not to conduct formal confidence and risk of bias assessments and meta-analyses because this is an emerging area of research.

RESULTS: The Panel reviewed 15 studies on dementia-related outcomes and six studies of Parkinson's disease. Evidence for an association of dementia-related outcomes with TRAP was mixed; studies of cognition and incident dementia generally found adverse associations while findings on cognitive decline were null. Evidence for an association of TRAP with Parkinson's disease was inconsistent with some potential for systematic bias. Limitations of the body of literature included its small size, potential for bias due to outcome misclassification, selection and attrition bias, and adjustments for confounding that did not align with plausible pathways between TRAP exposure and outcomes.

CONCLUSIONS: The Panel's confidence in the association of TRAP with dementia-related outcomes was low to moderate, while confidence in the association with Parkinson's disease was low. Future systematic reviews will benefit from the continued growth in this literature.
KEYWORKS: narrative review, traffic-related air pollution, dementia, cognitive decline

P-0067 Long-Term Air Pollution Exposure and Loss of Independence in the U.S.

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KEYWORDS: Air pollution, personal help, disability

BACKGROUND AND AIM: Disabilities, especially those that result in lost independence, can result in high emotional and economic burdens to individuals and families. Although air pollution is a well-established risk factor for chronic disease, its impacts on disability are only recently being considered and current studies have not focused on lost independence. We examined associations between air pollution and receiving help for disability, in a nationally representative cohort, focusing on the highest degree of limitations.

METHODS: We used biennial self-reported data between 2006 and 2016 on receiving personal help with six activities of daily living (ADL) and five instrumental activities of daily living (IADL) or living in the nursing home due to health and memory problems from participants>50 years in the Health and Retirement Study. Using spatiotemporal models, we predicted 10-year average PM2.5, PM10-2.5, NO_2, and O_3 concentrations at participant addresses before each interview. Associations with first receipt of help due to disability were estimated with Cox models, adjusting for individual demographics, area-level characteristics, and temporal and geographic trends.

RESULTS: During 6.8±3.0 years of follow-up, 31.7% of our 20,800 participants reported newly receiving help due to disability. We observed a 4% (HR: 1.04 per 3.2 μg/m³, 95%CI: 0.99, 1.10) and 6% (HR: 1.06 per 6.73 ppb, 95%CI: 1.02, 1.11) greater rate of receiving help due to disability per inter-quartile range higher long-term PM2.5 and NO_2 concentrations, respectively. In contrast, PM10-2.5 and O_3 concentrations were not associated with increased rates of receiving help.

CONCLUSIONS: This prospective study of older U.S. adults provides evidence that air pollution is associated with an increased need for help due to disabilities, though this association varied across pollutants. Controlling air pollution might potentially divert or delay individuals from needing care in late life and prolong/enhance their ability to live independently.

P-0069 Heterogeneous impact of air pollution exposures on cognitive trajectories in Women's Health Initiative Memory Study in Younger Women

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BACKGROUND AND AIM: Late-life exposure to ambient air pollutants is a risk factor for dementia, but little is known about the associations between midlife exposure and cognitive aging. We examined the effects on trajectories of general cognitive ability and episodic memory in older adulthood, comparing midlife and late-life exposures.

METHODS: Using regionalized universal kriging models applied to the residences of women (n=881; aged 62-71) enrolled in the Women's Health Initiative Memory Study in Younger Women (WHIMS-Y) in 2009, we estimated the annual PM2.5 (particulate matter<2.5μm) and NO2 (proxy for traffic-related pollutants) aggregated exposures to 3-year averages for midlife (aged 50-59, 12 years before WHIMS-Y inception) and late-life (at WHIMS-Y inception). General cognitive ability and episodic memory were assessed annually (2009-16) respectively by modified Telephone Interview for Cognitive Status (TICSm) and California Verbal Learning Test (CVLT). Linear mixed effect models were used to examine exposure effects adjusting for socio-demographic, lifestyle, and clinical covariates and time-varying propensity scores.

RESULTS: The average performance in TICSm and CVLT improved over time (both slope=0.15/year, p<0.001). Women with higher midlife exposures had worse baseline CVLT scores, with associations statistically significant for PM2.5 (β0,midlifePM2.5=-0.58 per IQR=3.43μg/m3, p=0.02), but not for NO2 (β0,midlifeNO2=-0.44 per IQR=9.23ppb, p=0.13). Women with higher midlife exposures had less improvement in CVLT performance over time, but the associations were non-significant. Associations between late-life exposures and CLVT trajectories and between both midlife or late-life exposures and TICSm trajectories were non-significant.

CONCLUSIONS: Among women aged 62-71 with positive trajectories suggesting considerable cognitive resilience, greater midlife PM2.5 exposure was associated with lower episodic memory with no appreciable impacts on trajectory afterwards. However, recent late-life exposures were not associated with cognitive trajectories. Results suggested the adverse midlife exposure effects may not contribute to the neuropathological processes underlying cognitive decline in late-life.

KEYWORDS: Air pollution, midlife exposure, cognitive trajectory

P-0071 Residential green space, air pollution, public facility and mortality among older adults in Beijing: a longitudinal cohort study

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BACKGROUND AND AIM: Urban environment is influential towards healthy aging in China. We aimed to describe trends of greenness and air pollution in Beijing, and explore their association with mortality among the elderly.

METHODS: This study included 800 participants (mean age=88.7, SD=11.1) in China Longitudinal Healthy Longevity Survey (CLHLS) who entered the cohort in 2000, 2002, 2005 and 2008 and lived in Beijing. Residential greenness was measured as satellite-derived Normalized Difference Vegetation Index (NDVI) in 1250m-radius-buffer around individual residence; cumulative NDVI was used. Last-one-year residential PM2.5, NO2 and last-peak-season O3 were obtained from both monitors and estimating models. Counts of medical, recreational and sports facilities in 5km-radii-buffers around residence were calculated. We examined the association of NDVI, PM2.5, NO2, O3, and 10-year change in NDVI and PM2.5 with mortality using Cox models, adjusted for demographic, socioeconomic and lifestyle covariates, and counts of public facilities.

RESULTS: NDVI in Beijing increased from 0.38 in 2000 to 0.45 in 2019. PM2.5 and NO2 concentration showed an inverse-U trend, with a turning point in 2013. In fully-adjusted models, 0.1-unit increase of NDVI was associated with lower mortality (HR[95%CI]: 0.656[0.485,0.885]), and similar association was found with per 10μg/m3 increase of O3 (HR[95%CI]: 0.882[0.781,0.995]). Moreover, living with increasing NDVI in the past decade was beneficial for health (HR[95%CI]: 0.402 [0.231,0.698]). Living with decreasing PM2.5 had 88% lower mortality (HR[95%CI]: 0.121[0.039,0.372]), while increasing PM2.5 had an increase of risk by 783% (HR[95%CI]: 8.831[4.688,16.635]), comparing with those living with stable exposure in the past decade. PM2.5, NO2 and accessibility to facilities were inconsistently associated with mortality.

CONCLUSIONS: In Beijing, greenness increased over decades, and air pollution started to reduce in recent years. Besides level of residential greenness and air pollution, change in these factors also matter to elderly health.

KEYWORDS: greenness, PM2.5, healthy aging, urban environment

P-0073 Association of exposure to multiple essential trace elements with frailty in Chinese elderly

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BACKGROUND AND AIM: Deficiency and excessive intake of essential trace elements can cause a variety of adverse outcomes. This study aims to describe the levels of 6 essential trace elements, to analyze the combined and interactive effects of 6 essential trace elements on frailty and to evaluate the association between essential trace elements and frailty in the elderly in a community in Zhejiang province, China.

METHODS: Frailty was assessed by FRAIL Scale. Essential trace elements including chromium (Cr), manganese (Mn), iron (Fe), copper (Cu), zinc (Zn) and selenium (Se) were analyzed in whole blood after acid dilution pretreatment using inductively coupled plasma mass spectrometry (ICP-MS). Ordinal logistic regression models and restricted cubic spline (RCS) were used to analyze the independent association between elements and frailty. Bayesian kernel machine regression (BKMR) models was used to examine combined and interactive effects of 6 essential trace elements on frailty.

RESULTS: Participants were determined following inclusion and exclusion criteria, and 4.2% of them were considered frail. Ordinal logistic regression models indicated that Se was inversely associated with frailty while Cu was positively associated with it. RCS showed U-shaped association between Cr, Mn and Zn and frailty, showed L-shaped association between Se and frailty, while the risk of frailty increased in a Cu dose-dependent manner, decreased in a Fe dose-dependent manner. BKMR models showed similar results, the inverse association between Cr and frailty was stronger when the remaining at lower levels. Exposure to all 6 trace elements was negatively associated with frailty.

CONCLUSIONS: Deficiency and excessive intake of Mn and Cr would increase the risk of frailty, and all 6 essential trace elements mixed exposure was negatively associated with frailty.

KEYWORDS: Essential trace elements, frailty, BKMR, multiple-exposure

P-0074 Associations of cumulative exposure to metal mixtures with metabolic dysfunction-associated fatty liver disease in a Chinese aged population

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BACKGROUND AND AIM: Few studies have demonstrated the potential effects of metal mixtures on metabolic dysfunction-associated fatty liver disease (MAFLD). Here, we examined the associations between whole blood metal mixtures and prevalence of MAFLD among an aged population in China.

METHODS: a cross-sectional study of community-dwelling elderly adults were conducted in China. Whole blood concentrations of fourteen metals were measured by inductively coupled plasma mass spectrometry (ICP-MS). MAFLD was ascertained based on ultrasonographic evidence of hepatic steatosis and the presence of overweight/obesity, type 2 diabetes mellitus, or metabolic dysregulation. We performed logistic regression and restricted cubic spline (RCS) models to independently estimate the associations between metal concentrations and MAFLD prevalence. Environmental Risk Score (ERS) constructed by adaptive elastic net (AENET) and Bayesian kernel machine regression (BKMR) analysis were utilized to examine joint effects of metal mixtures and metal interactions on MAFLD.

RESULTS: In the models adjusting for multiple covariates, lower blood copper and higher selenium, iron and mercury were significantly associated with the elevated prevalence of MAFLD. Non-linear effects of copper, iron, magnesium, manganese and selenium on MAFLD were observed in RCS models. Similar metals (copper, selenium, zinc, iron, cadmium and mercury) were selected as crucial predictors for MAFLD prevalence by AENET and BKMR models. The association between ERS and MAFLD was estimated and the ERS was significantly associated with the elevated OR for MAFLD.

CONCLUSIONS: Our findings provide evidence that exposure to blood copper, iron, selenium and mercury are associated with the prevalence of MAFLD. Multiple metals exposure may adversely affect MAFLD, with copper, selenium, zinc, iron, cadmium and mercury being the major contributors. Further researches are needed to clarify the cumulative effects of metal mixture in a larger population.

KEYWORDS: Metals; Mixture; Metabolic dysfunction-associated fatty liver disease; ERS; BKMR analysis

P-0075 Association between whole blood essential trace elements and cognitive function in the elderly

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BACKGROUND
Essential trace elements (ETEs) are important for keeping nervous system function. The evidence of associations between ETEs and cognitive function among the elderly was limited. Therefore, we aimed to investigate the individual and joint association between ETEs and cognitive function among the elderly.

METHODS: An elderly population from Yiwu cohort in China was available for this study. Whole blood chromium (Cr), manganese (Mn), copper (Cu), and selenium (Se) concentrations were measured by inductively coupled plasma mass spectrometry (ICP-MS). Cognitive function was assessed using the Mini-Mental State Examination (MMSE), consisting of five specific-cognitive domains of orientation, registry, attention and calculation, recall, and language and praxis. Linear regression, restricted cubic spline (RCS) analysis, and Bayesian kernel machine regression (BKMR) were performed to explore the individual and joint associations between ETEs and cognitive function.

RESULTS: Linear regression showed that high-level Cr was positively associated with MMSE score compared to the lowest quartile, especially with recall. Further RCS analysis found an inverted-U-shaped association between Cr and MMSE score. Se was positively associated with MMSE score and particularly with registry. BKMR model showed that ETEs mixture was positively associated with cognitive function, and Se was the most important contributor within the mixture. Therefore, Se demonstrated a positive additive effect on the associations for other ETEs with cognitive function.

CONCLUSIONS: Low and high levels Cr were associated with poor cognitive function, indicating that exploring an appropriate range of Cr concentration is important. Se was positively associated with cognitive function and was the most important contributor to the association between ETEs mixture and cognitive function. Moreover, Se presented the additive effect for other ETEs. Thus, it should be considered the joint effect of ETEs mixture. Our findings provided the evidence to protect cognitive function by supplementing ETEs.

KEYWORDS: Cognitive function; Essential trace element; The elderly; BKMR.

P-0076 The Interactive Effects of Ambient Air Pollution and Residential Greenness on Overweight and Obesity in Older Adults: Findings from the Chinese Longitudinal Healthy Longevity Survey

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BACKGROUND AND AIM: Air pollution [e.g., Fine particulate matter < 2.5 μm (PM2.5)] is a risk factor for frailty, while there were limited ways to overcome it. Currently, cross-sectional studies of the European population found an inverse association of residential greenness with body mass index (BMI). However, in older Chinese adults, there was inconsistent evidence regarding the association between residential greenness and overweight/obesity. Additionally, the interaction of residential greenness and PM2.5 concentration on overweight/obesity remains unknown. This cohort study aimed to evaluate the interactive effects of normalized difference vegetation index (NDVI) and PM2.5 exposure on overweight/obesity among older Chinese adults.

METHODS: The study included a total of 23,431 participants aged ≥65-year-old from 2000 to 2018 wave of the Chinese Longitudinal Healthy Longevity Survey. The baseline NDVI for each participant was calculated, based on a region within 1000 m radius around their residence. PM2.5 concentration was calculated using 3-year average concentrations in 1 km×1 km grid resolution. The overweight/obesity was defined based on BMI ≥24.0 during follow-up. Cox proportional hazards models were used to estimate the effects of NDVI, PM2.5, and their interaction on overweight/obesity.

RESULTS: During 117,240 person-years follow-up, 2622 incidents of overweight/obesity were documented. The hazard ratio of overweight/obesity was 0.95 [95% confidence interval (95% CI): 0.92~0.99] for each 0.1-unit increase in baseline NDVI, 1.16(1.13~1.19) for each 10 μg/m³ increase in 3-year average PM2.5, and 1.04 (1.02~1.06) for the interaction term. In the sensitivity analyses, the interaction of NDVI and PM2.5 on BMI remained significant.

CONCLUSIONS: This nation-wide prospective cohort study revealed the interaction effect of greenness and air pollution on overweight/obesity, which deserve the potential to lead to the lobbying of governments to determine new ways to reduce the burden of PM2.5 air pollution for older Chinese adults.

KEYWORDS: Air pollution; Greenness; obesity; Older adults; Interactive effects; cohort

P-0081 Multiple air pollutants co-exposure and health among the older adults in China

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BACKGROUND AND AIM: We aim to examine the association between ambient air pollutants defined by the WHO guideline AQG (PM2.5, NO2, O3) and mortality, cognitive function, and activities of daily living (ADL) disability in Chinese older adults.

METHODS: We used the 2008-2018 cohort of the Chinese Longitudinal Healthy Longevity Study (CLHLS). We included 11 835 participants, covering 23 provinces of China. We ran the Cox proportional hazards model to examine the association between the ambient air pollutants exposure and all-cause mortality, generalized estimating equation to test the association between air pollutants and repeatedly measured cognitive function and ADL disability.

RESULTS: The participants had a mean age of 87 (SD:11) and 57% were females. The annual average PM2.5, NO2, and O3 were higher in northern China than in southern China. The proportion exposed under the AQG level in the last year was 0% for PM2.5, 23.7% for NO2, and 0.7% for O3. Each 10 μg/m3 increase in PM2.5 was associated with higher mortality risk in both the single-pollutant and three-pollutant model [hazard ratio: 1.17, 95% confidence interval (CI): 1.15-1.19]. NO2 was not significantly associated with mortality risk and O3 was protective for mortality in three-pollutant model. Each 10 μg/m3 increase in O3 was associated with higher odds of cognitive impairment [Odds ratio (OR): 1.04, 95% CI: 1.01-1.07] in three-pollutant model. Each 10 μg/m3 increase in PM2.5 and NO2 were both associated with higher odds of ADL disability [OR (95% CI): 1.03 (1.01, 1.06) and 1.24 (1.20, 1.28) respectively] in three-pollutant model.
CONCLUSION: China has diverse air pollution levels depending on geographical areas, and do not meet WHO AQG in the majority of regions. PM2.5 was dominant for mortality outcome, while O3 and NO2 were dominant for cognitive impairment, and ADL disability outcomes, respectively.

KEYWORDS: Air pollution, mortality, cognitive function, ADL, China

P-0082 Interactive effects of physical activity and air pollution on incident dementia

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BACKGROUND AND AIM: Accumulating evidence suggests that physical activity reduces dementia risk, but the extent to which this can be offset by residential air pollution is unknown. The aim is to determine whether residential air pollution attenuates the beneficial effects against the risk of incident dementia induced by regular physical activity.

METHODS: A population-based longitudinal study that included adults aged between 40 and 74 years without dementia at baseline. Participants were recruited to the UK Biobank study between 2006 and 2010 and followed up for an average of 9.0 years. Physical activity was categorized into regular and non-regular and residential overall air pollution with Q1 (lowest quartile, 25.6-43.6 μg/m3) to Q4 (highest quartile, 60.8-280.1 μg/m3) exposure categories. Associations between physical activity and air pollution and risk of incident dementias were assessed using Cox proportional hazards regression models.

RESULTS: 502 222 individuals (mean [SD] age, 56.5 [8.1] years; 45.6% were women) were included in the study, among which 2 502 individuals were subsequently diagnosed with all-cause dementia. Results of main effects indicate that not engaging in regular physical activity was associated with a 15% increase in dementia risk (adjusted hazard ratio, 1.15; 95%CI, 1.05-1.26) while exposure to the highest level of air pollution was associated with a 29% increase in the risk (adjusted hazard ratio, 1.29; 95%CI, 1.14-1.46). Hazard ratios associated with no regular physical activity decreased as air pollution increased; however, there was no significant interaction between the two factors (p = .05).

CONCLUSIONS: Among mid-age adults without dementia, regular physical activity was significantly associated with lower dementia risk and higher air pollution were significantly associated with higher risk. Although the benefit of physical activity was smaller among participants exposed to higher air pollution, we found no significant interaction effects.

KEYWORDS: air pollution; physical activity; incident dementia

P-0083 Mapping the complex systems that connects the urban environment to cognitive decline in older adults: a group model building study

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BACKGROUND AND AIM: The number of people living with dementia and Mild Cognitive Impairment (MCI) is increasing. A supportive urban environment can prevent or delay the progress of cognitive decline. There is evidence for the existence of mechanistic pathways between the urban environment and cognitive decline, but the interrelations between these pathways are unclear. In this study, we aimed to map the mechanistic pathways by which urban environment factors impact cognitive decline in older adults.

METHODS: This study was part of the Supportive environments for Physical and social Activity, healthy ageing and CognitivE health (SPACE) project. A 2-day workshop with the SPACE investigators was conducted based on the Group Model Building (GMB) methodology. The workshop aimed to create a causal-loop diagram (CLD) that identifies established and potential urban environment, lifestyle, health, and physiological determinants of cognitive decline in older adults. A facilitation team guided the activities. The workshop was held online following appropriately adapted scripts. After the workshop, the modelling team reviewed the CLD to ensure that main potential causal pathways and mechanisms were captured.

RESULTS: During the workshop, 12 experts from 10 different disciplines identified 83 factors and 221 connections between them. After review, the CLD presented 50 factors and 154 connections. All factors were classified in 10 main groups: urban design, social environment, travel behaviours, urban design by-products, lifestyle, disease/physiology, mental health conditions, exogenous factors, and cognitive decline outcomes. The main output was a CLD of the complex system of how the urban environment can influence cognitive decline in older adults.

CONCLUSIONS: The CLD detailed the plausible causal pathways between the urban environment and cognitive decline. Our findings suggested that GMB can engage experts and help them view problems through the lens of complex systems.

KEYWORDS: cognitive decline, urban environment, group model building

P-0085 Air pollution protective measures at personal-level affecting health outcomes: A systematic review and meta-analysis

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BACKGROUND: Evidence for the effect of health-protective measures from air pollution at the individual level is relatively scarce. We performed a systematic review and meta-analysis to investigate the effect of personal protective measures for air pollution on various health outcomes.

METHODS: We searched PubMed, Scopus, and Web of Science to find randomized controlled trial studies investigating the effect of personal protective measures for air pollution on health outcomes. Two authors independently searched and selected studies, extracted information, and assessed each study's quality and risk of bias. Meta-analyses were performed when three or more studies were available for specific pair of protective measure and health outcome.

RESULTS: Lung function was higher in groups applying air purifiers than control groups with sham/no filter: forced expiratory volume in 1 second (FEV1) by 0.25 L [95% confidence intervals (CI): 0.01, 0.49]. The application of air-purifying respirators was associated with increased heart rate variability: the root mean square of successive differences between normal heartbeats (rMSSD) by 0.36 (95% CI: 0.13, 0.59). for other pairs of measures and health outcomes, evidence was insufficient.
CONCLUSION: Our findings suggest that air purifiers and air-purifying respirators can serve as an efficient protective measure for respiratory and cardiovascular health, respectively.

KEYWORDS: air pollution, personal-level protective measures

P-0092 Association between Long-Term Ambient PM2.5 Exposure and Cardiovascular Outcomes among U.S. Hemodialysis Patients

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BACKGROUND AND AIM: Ambient PM2.5 is a ubiquitous air pollutant with established adverse cardiovascular (CV) effects. However, quantitative estimates of PM2.5 exposure associations on CV outcomes in susceptible populations are limited. This study assessed the impact of long-term PM2.5 on CV events and cardiovascular disease (CVD)-specific mortality among patients receiving maintenance in-center hemodialysis (HD).

METHODS: We conducted a retrospective cohort study with 314,079 adult kidney failure patients initiating HD between 2011 and 2016 identified from the United State Renal Data System. Estimated daily ZIP code-level PM2.5 concentrations were used to calculate each participant's annual-average PM2.5 exposure based on the dialysis clinics visited during the 365 days prior to the outcome. CV event and CVD-specific mortality were ascertained based on ICD-9/ICD-10 diagnostic codes and recorded cause of death from form 2746. Discrete time hazards models were used to estimate hazards ratios (HRs) per 1 µg/m3 in annual-average PM2.5 adjusting for temperature, humidity, day of the week, season, age at baseline, race, employment status, and geographic region. Effect measure modification was assessed for age, sex, race, and baseline comorbidities.

RESULTS: Annual-average PM2.5 of 1 µg/m3 was associated with increased hazard rates in CV events (HR: 1.02, 95% CI: 1.01, 1.02) and CVD-specific mortality (1.02, 95% CI: 1.02, 1.03). The association was more pronounced for people who initiated dialysis at an older age, had COPD at baseline, or were Asian. Evidence of effect modification was also observed across strata of race, and other baseline comorbidities.

CONCLUSIONS: Long-term ambient PM2.5 exposure was positively associated with CV outcomes among patients receiving maintenance in-center HD. Patients who had advanced age, COPD, or reported to be Asian, appeared to be more susceptible to long-term PM2.5 adverse effects.

KEYWORDS: Air pollution, long-term, vulnerable population, dialysis patients

P-0095 Short-Term Coarse Particulate Exposure and Daily Cardio-Respiratory Hospital Admissions in the Helsinki Capital Region

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BACKGROUND AND AIM: Short-term exposure to coarse inhalable particles (2.5 µg/m3>PMcoarse<10 µg/m3) has been suggested to increase the risk of respiratory disease independently of fine particles, but studies present mixed findings which are even less clear for other outcomes.
This study aims to assess the relationship between short-term exposure to PMcoarse and total admissions for cardio-pulmonary diseases.

METHODS: We conducted a seventeen-year (01/2001-12/2017) time-series study of the daily admissions for cardio-respiratory disease in relation to the mean levels of coarse particles. We obtained air pollution data from the Helsinki Region Environmental Services Authority, meteorological data from the Finnish Meteorological Institute, and hospital exit records from the Finnish Institute for Health and Welfare. We modelled the association between particles and cardiorespiratory admissions using log-linked quasi-Poisson regression. Penalised splines were used to adjust for the time-trend and the meteorological variables. These models were also adjusted for the weekday, pollen concentration, and influenza outbreaks. Different lag structures were explored in both single-pollutant and multipollutant models. The multipollutant models were simultaneously adjusted for PM2.5, NO2, and O3.

RESULTS: The mean(standard deviation) concentration of PMcoarse was 6.6(5.9) (µg/m3), while the mean (standard deviation) daily numbers of cardiovascular and respiratory admissions were 25.9(7.3) and 21.3(7.4), respectively. A 10 µg/m3 increase in the same day PMcoarse was associated with a 1.7% (95% CI, 0.4%—3.1%) and a 1.9% (95% CI, 0.5%—3.4%) excess daily risk of respiratory admissions in the single-pollutant and multipollutant models, respectively; same-day excess cardiovascular admissions risks were 0.6% (95% CI, -0.5%—1.7%) and 0.3% (95% CI, -0.9%—1.4%) in similar models.

CONCLUSIONS: Short-term exposure to PMcoarse can increase respiratory admission risks independently of co-pollutants but has a less determinate effect on cardiovascular admissions. A guideline framework should be considered for PMcoarse.

KEYWORDS: Coarse Particles, Cardiovascular Admissions, Respiratory Admissions, Time-Series, Fine Particles

P-0096 Particulate matter, albumin/creatinine ratio, and chronic kidney disease in a prospective cohort study

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BACKGROUND: Many studies have investigated the association between exposure to particulate matter (PM) and kidney dysfunction, but the relationship is inconsistent due to the variations in exposure assessment, the use of renal-function indices, and study design.
OBJECTIVES: This study elucidated the associations between exposure to PM10, PM2.5, and PM1 with albumin/creatinine ratio (ACR) and the incidence of chronic kidney disease (CKD) in a community-based cohort in Taiwan.

METHODS: A total of 704 residents living in Taichung were recruited as study subjects at the baseline of 2004 and followed up to the end of 2018. Questionnaire and health examination was used to collect personal information and renal-function indices at baseline and follow-up. Land-use regression models were established to predict individual levels of PM10, PM2.5, and PM1 annually during studying periods. The multivariable linear regression and Cox regression were conducted to investigate the associations between PM exposures, ACR, and the incident CKD (creatinine-based estimated glomerular filtration rate, [eGFRcr] < 60ml/min/1.73m2).

RESULTS: We found that an increase of 1 μg/m3 in PM10, PM2.5, and PM1 was associated with the decreased ACR of 1.10±1.14 mg/g (p=0.080), 4.66±2.17 mg/g (p=0.032), and 6.05±2.82 mg/g (p=0.032), respectively. The similar associations were identified for the cumulative exposure of 1 μg/m3-year to PM10, PM2.5, and PM1, which decreased the ACR of 0.14±0.10 mg/g (p=0.157), 0.55±0.27 mg/g (p=0.040), and 0.72±0.35 mg/g (p=0.040), respectively. Per 1 μg/m3 increase in PM10, PM2.5, and PM1 was associated with the elevated risk of 1.07-fold (95% confidence interval [CI]=1.00-1.15, p=0.055), 1.19-fold (95% CI=1.04-1.37, p=0.011), and 1.26-fold (95% CI=1.05-1.50, p=0.011) in the incident CKD, respectively.

CONCLUSIONS: The present study showed that exposure to PM2.5 and PM1 was associated with the decreased renal function to increase the risk of developing CKD.

P-0097 Fine particulate matter infiltration at skilled nursing facilities during wildfire season in the Western USA

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BACKGROUND AND AIM: Wildfire air pollution is a growing public health concern as wildfires increase in size, intensity, and duration in the USA (US). Residents of skilled nursing facilities (SNFs) are vulnerable to wildfire smoke due to common pre-existing health conditions and advanced age of these populations. We assessed the impact of wildfire smoke on SNFs by estimating ambient fine particulate matter ($PM_{2.5}$) infiltration into SNFs during wildfire season.

METHODS: We measured continuous outdoor and indoor $PM_{2.5}$ concentrations from July-October 2021 at six SNFs in the US states of Idaho and Montana using PurpleAir monitors. We calculated infiltration efficiency (range 0-1; higher values indicate more ambient $PM_{2.5}$ infiltration to the indoor environment) at each facility using paired outdoor/indoor $PM_{2.5}$ samples in a validated recursive modeling approach. Analyses were conducted separately for each facility, by time of day (8am-5pm work hours versus after hours), and by days impacted by wildfire smoke.

RESULTS: Median outdoor $PM_{2.5}$ at the SNFs ranged from 7.9 $\mu g/m^3$ (25th percentile=4.4, 75th percentile=21.6) to 16.0 $\mu g/m^3$ (25th percentile=7.4, 75th percentile=30.6). Median indoor $PM_{2.5}$ at the SNFs ranged from 2.1 $\mu g/m^3$ (25th percentile=1.7, 75th percentile=3.9) to 8.4 $\mu g/m^3$ (25th percentile=2.0, 75th percentile=15.8). Infiltration efficiency at the facilities ranged from 0.13 (95% Confidence Interval: 0.10, 0.18) to 0.74 (95% Confidence Interval: 0.64, 0.85). Infiltration efficiency was similar during work hours versus after hours, but was higher during wildfire-impacted days than non-wildfire-impacted days for all but one facility.

CONCLUSIONS: The high variability of indoor $PM_{2.5}$ and infiltration efficiency across the facilities suggests that indoor exposures to wildfire smoke may be a modifiable risk factor for SNF residents. Future work will assess building characteristics and behavioral factors among residents and staff that may be related to wildfire smoke infiltration.

KEYWORDS: smoke, wildfires, indoor air pollution, vulnerable populations, infiltration efficiency, $PM_{2.5}$

P-0099 Educational intervention to promote air pollution knowledge and personal exposure mitigation strategies using wearable sensors

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BACKGROUND AND AIM: Although strategies to reduce air pollution have focused on policy regulations and population-level controls, personal exposure mitigation is an approach that has not been well-explored. The aim of this study was to determine the feasibility of conducting an educational intervention to promote knowledge regarding air pollution, its health effects, and preventive behaviors.

METHODS: We recruited participants from Seattle, Washington from September-November 2021 for a 5-week study. Participants were asked to use Plume Labs Flow 2 wearable air pollution sensors, watch educational videos (intervention at week 3), and receive Air Quality Index (AQI) alerts. Questionnaires were administered pre- and post-intervention to assess air pollution knowledge and Health Belief Model (HBM) constructs for perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy. McNemar and signed-rank tests were used to determine pre- and post-intervention differences.

RESULTS: A total of n=20 participants were included in this study (n=18 were never-smokers). Participants were knowledgeable regarding air pollution (≥35% of participants responded correctly to any given knowledge item at baseline). There was an increase in knowledge of AQI (of the 7 participants who answered incorrectly at pre-intervention, 6 answered correctly at post-intervention; p=0.01). There were no differences in HBM constructs, although pre-intervention responses showed participants perceived air pollution as a personal health threat (perceived severity mean score 8.7 ± 1.3; score range 1-10). Post-intervention personal NO2 levels (mean 11.62 ppb ± 5.89) were lower compared to pre-intervention levels (mean 13.49 ppb ± 3.00) (p=0.02). There were no differences in VOCs, PM1, PM2.5, or PM10 exposures at post-intervention.

CONCLUSIONS: This study demonstrated high feasibility in conducting an educational intervention to promote air pollution knowledge and reduce NO2 exposure. Future research could scale this intervention to subgroups disproportionately impacted by air pollution (e.g., vulnerable populations).

KEYWORDS: intervention; air pollution; sensors; wearables; behavioral science

P-0107 A hybrid model for estimating number concentrations of ultrafine particles in central Taiwan

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BACKGROUND AND AIM: The epidemiological studies for assessing ultrafine particles (UFP) and health effects are scarce. The reasons are that the instrument for measuring UFP is expensive and the previous studies generally relied on a small number of fixed monitoring stations or short-term measurements. Modeling is a cost-effective measure to precisely estimate personal concentration in large-scale epidemiological studies, while the previous UFP estimation generally relied on the land-use regression model (LUR) and lacked temporal resolution. In this study, we conducted in-situ measurements for UFP in Taichung city, Taiwan, and developed a UFP estimation model by using machine learning algorithms.

METHODS: A scanning mobility particle sizer (SMPS Model 5.500, GIMM Aerosol Technik, Gmbh, Germany) was used to measure UFP number concentrations hourly in two sites (urban and rural sites) from 2017 to 2021. Random forest, XGBoost, and deep neural network were used to build the model. Ten-fold cross-validation was used to evaluate model performance. Coefficient of determination (R^2) and normalized root mean square error (nRMSE) were utilized to compare models.

RESULTS: A total of 1488 observations were collected. The average number concentrations of UFP was 23505.4±14643.9 (mean±sd). The XGBoost model had the best performance with a fitting R^2 of 1.00 (nRMSE: 0.20%) and a cross-validation R^2 of 0.63 (RMSE: 3.84%). The top important variables were temperature, surface pressure, Julian date, nitrogen dioxide, wind direction (X direction), fine particulate matter, sulfur dioxide, relative humidity, ozone, year, and aerosol optical depth (AOD).

CONCLUSIONS: Our results provided basic descriptions of UFP in Taiwan and identified several important features for UFP. Although the XGBoost model displayed overfitting, it still outperformed the previous models and provided accurate estimates. These estimates can be used to assess both the short-term and long-term effects of UFP on health outcomes.

KEYWORDS: Aerosol optical depth, estimation model, machine learning, ultrafine particles

P-0113 Household Cooking Fuel Choices and Associated Factors in a Rural and Peri-Urban Community in Western Kenya

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BACKGROUND AND AIM
Polluting fuels such as biomass and kerosene are used for cooking by approximately 85% of the population in sub-Saharan Africa (SSA) despite the well-known associated adverse health effects. Many governments across SSA aim to scale up domestic use of liquefied petroleum gas (LPG), a cleaner-burning fuel in terms of black carbon and fine particulate matter emissions, to promote public health and protect the environment by reducing deforestation. We sought to determine factors associated with household fuel choice in-order to make recommendations that could promote uptake of LPG in rural and peri-urban settings within Uasin Gishu County.

METHODS: The study was part of the CLEAN-Air(Africa) project designed to address barriers to transitioning populations way from reliance on polluting biomass for cooking. A quantitative survey was administered to over 2000 households in peri-urban and rural sub-counties of Uasin Gishu County, West Kenya, to determine cooking characteristics and factors associated with the primary cooking fuel choice (biomass versus LPG).

RESULTS: We found that the majority (72%) of the households still use biomass as a primary fuel while about one third use clean fuels. Predictors for use of clean fuel include; residing in a peri-urban area (aOR 2.5,C.I: 1.933-3.162), education (aOR: 1.9, C.I 1.095-3.602), connection to electricity (aOR: 2.2, C.I: 1.649 -3.189), regular income (aOR:1.4,C.I: 1.117-1.886). Supply factors such as the ease of accessing refills affects duration of LPG use.

CONCLUSIONS: Urbanization at a sub-county level may lead to increases in the use of LPG for cooking. Socio-economic factors and LPG supply factors also predict LPG use. Policies that would increase the availability of LPG to rural communities need to be enacted in order to reduce the time and transportation costs that are likely to affect access and hence low usage.

KEYWORDS: Cooking fuel, factors associated, peri-urban and rural, Western Kenya

P-0121 Particle Radioactivity: A potential driving factor for PM2.5 toxicity

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BACKGROUND AND AIM: Fine particulate matter (PM2.5) is associated with adverse human health outcomes. However, little is known about the mechanism(s) for the toxicity or which components of the PM2.5 cause the health effects. The ability of particles to cause oxidative damage may play a role.

METHODS: We evaluated the associations between the oxidative potential (OP) of PM2.5 particles (N=60) as measured by the dithiothreitol (DTT) assay, and different properties of these particles, including α- and β-activity, PM2.5 mass, and chemical components.

RESULTS: We found that Pearson correlation coefficients (r) between OP and the different variables were the strongest for α- and β-activities (Pearson's r=0.49 and 0.47, respectively), with a weaker correlation for PM2.5 mass (Pearson's r=0.33). Correlations between OP and the 25 PM2.5 elemental concentrations were weaker, ranging from 0.32 for Zinc to -0.21 for Barium. Bivariate regression models including radiation (either α- or β-activity) and one other variable (mass or chemical component) showed that only the radiation component was a significant predictor ($p<0.001$). None of the PM2.5 mass and elemental concentrations were significant.

CONCLUSIONS: The findings here suggest that radionuclides play a role in the toxicity of the particles. Gross α- and β-activity may help explain the association found between PM2.5 and detrimental health outcomes. This is the first study to link particle radioactivity to an oxidative stress assay.

KEYWORDS: particulate matter; radioactivity; oxidative potential; PM2.5; dithiothreitol assay; particle toxicity

P-0124 Causal relationship between PM 2.5 and diabetes mellitus: Two sample Mendelian Randomization using MR-Base platform

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BACKGROUND AND AIM: Many studies have shown air pollution has emerged as one of the major environmental risk factors for diabetes mellitus; however, studies on the causal relationship between air pollution and diabetes mellitus based on genetic approaches are scarce. The study estimated the causal relationship between diabetes and fine particulate matter (PM2.5) using Mendelian randomization (MR).

METHODS: We collected genetic data from European ancestry publicly available genome wide association studies (GWAS) summary data through the MR-BASE repository. The IEU GWAS information output (PM2.5) from the Single nucleotide polymorphisms (SNPs) GWAS pipeline using pheasant-derived variables (Consortium=MRC-IEU, sample size: 423,796). The annual estimates of PM2.5 (2010) were modeled for each address using a Land Use Regression model developed as part of the European Study of Cohorts for Air Pollution Effects. Diabetes GWAS information (Consortium=MRC-IEU, sample size: 461,578) were used, and the genetic variants were used as the instrumental variables (IVs). We performed three representative MR

METHODS: Inverse Variance Weighted regression (IVW), Egger, and Weighted median for causal inference using genetic variants. Furthermore, we used a novel method called MR Mixture to identify outlier SNPs.

RESULTS: From the IVW method, we revealed the causal relationship between PM2.5 and diabetes (Odds ratio [OR]: 1.041, 95% CI: 1.008-1.076, p=0.016), and the finding was substantiated by the absence of any directional horizontal pleiotropy through MR-Egger regression (β=0.016, p=0.687). From the IVW fixed-effect method (i.e. one of the MR Mixture methods), we excluded outlier SNP (rs1537371) and showed the best predictive model (AUC=0.72) with a causal relationship between PM2.5 and diabetes (OR: 1.028, 95% CI: 1.006-1.049, p=0.012).

CONCLUSIONS: We identified the hypothesis that there is a causal relationship between PM2.5 and diabetes in the European population, using MR methods.

KEYWORDS: Causal relationship; Particulate matter; Diabetes; Mendelian Randomization

P-0125 Short-term effects of fine particulate matter constituents on pulmonary function among adolescents

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BACKGROUND: Expose to fine particle matter (PM2.5) has been associated with adverse effects on pulmonary function. Especially, it has been recently focused on the effects of PM2.5 constituents on human health. However, it is unclear whether healthy adolescents are affected by the expose to PM2.5 constituents in daily life. We investigated the association between PM2.5 constituents and pulmonary function in healthy adolescents.

METHODS: We conducted a panel study for about one month, in every spring and fall from 2014 to 2016, in Yuge Island, Japan. Pulmonary function measurements were conducted every morning in 48 healthy adolescents. PM2.5 samples were collected every 24 h during the study period, and the concentrations of 27 constituents in PM2.5 were analyzed. Mixed effects model were used to estimate the associations of pulmonary function with the average concentrations of PM2.5 constituents for 24h before a pulmonary function measurements.

RESULTS: The mean (SD) of PM2.5 mass concentration was14.9 (7.5) μg/m3 during the study period. A total of 4155 pulmonary function measurements were conducted by 48 healthy students. The peak expiratory flow (PEF) decreased significantly in relation to increases in concentrations of 12 constituents in PM2.5. The largest decrease of PEF with an interquartile range increase was observed for potassium (-4.01L/min [95% confidence interval: -6.07, -1.94]). The force expiratory volume in 1 s (FEV1) also decreased significantly in relation to increases in 11 constituents in PM2.5, and potassium had the most prominent effects among the constituents in PM2.5.

CONCLUSIONS: Our results suggest that many constituents in PM2.5 were associated with significant reduction in pulmonary function among healthy adolescents. Further studies are needed to clarify the source of the constituents in PM2.5 that affect respiratory system, and the reduction of the substances is desired to prevent the health effects of PM2.5.

P-0128 Triggering of ST-elevation myocardial infarction by ultrafine particles in New York: changes following Tier 3 vehicle introduction

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BACKGROUND AND AIM: Previously, we found increased rates of ST-elevation myocardial infarction (STEMI) associated with increased ultrafine particle (UFP; <100nm) concentrations in the previous few hours in Rochester, New York. Rates were higher after air quality policies and a recession reduced pollutant concentrations (2014-2016 versus 2005-2013), suggesting PM composition had become more toxic. Tier 3 light duty vehicles, which should produce less primary organic aerosols and oxidizable gaseous compounds, likely making PM less toxic, were introduced in 2017. Because of this, we hypothesized we would observe a lower relative STEMI rate in 2017-2019 than 2014-2016.

METHODS: Using STEMI events treated at the University of Rochester Medical Center (2014-2019), local UFP and other pollutant concentrations, a case-crossover design, and conditional logistic regression models, we separately estimated the rate of STEMI associated with increased UFP and other pollutants in the previous hours and days in the 2014-2016 and 2017-2019 periods.

RESULTS: An increased rate of STEMI was associated with each 3121 particles/cm3 increase in UFP concentration in 2014-2016 (lag hour 0: OR=1.23; 95% CI = 1.08, 1.41), but not in 2017-2019 (OR=0.93; 95% CI = 0.79, 1.09). There were similar patterns for black carbon, UFP11-50nm, and UFP51-100nm. In contrast, increased rates of STEMI were associated with 0.6ppb increases in SO2 concentrations in the previous 120 hours in both periods (2014-2016: OR=1.25, 95% CI = 1.00, 1.36; 2017-2019: OR=1.22, 95% CI = 0.88, 1.68).

CONCLUSIONS: Greater rates of STEMI were associated with short term increases in concentrations of UFP and other motor vehicle related pollutants before Tier 3 introduction (2014-2016), but not afterwards (2017-2019). This change may be due to changes in PM composition, to increased exposure misclassification and greater underestimation of effects from 2017-2019, and/or changes in therapeutic approaches such as preventive aspirin use.

KEYWORDS: myocardial infarction, air pollution, ultrafine particles, case-crossover

P-0129 Ambient fine particulate matter exposure and risk of incident breast cancer in the NIH-AARP Diet and Health Study

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BACKGROUND AND AIM: Fine particulate matter (PM2.5) has been inconsistently associated with breast cancer risk, however few studies have considered historic exposure levels which may be more relevant given the long latency of breast cancer.

METHODS: Outdoor residential PM2.5 concentrations were estimated using a nationwide spatiotemporal model for women in the NIH-AARP Diet and Health Study, a cohort located in 6 states (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and 2 metropolitan areas (Atlanta, Georgia, and Detroit, Michigan) and enrolled in 1995-1996. Annual average PM2.5 concentrations were estimated for a 5-year historical period 10 years prior to enrollment (1980-1984). We used Cox regression to estimate adjusted hazard ratios (HRs) and 95% confidence intervals (95% CIs) for the association between a 10µg/m3 increase in PM2.5 and incident breast cancer risk overall and by estrogen receptor (ER) status and extent of the tumor (invasive vs. ductal carcinoma in situ (DCIS)). Models were adjusted for age, body mass index, race/ethnicity, smoking status and catchment area. We also conducted analyses stratified by catchment area.

RESULTS: With follow-up through 2011, 13,246 breast cancer cases were diagnosed. A 10ug/m3 increase in PM2.5 was significantly associated with overall breast cancer risk (HR=1.07, 95% CI:1.01-1.13). No significant differences were observed between invasive tumors and DCIS (p-for-heterogeneity=0.40). The association was evident for ER+ tumors (HR=1.09, 95% CI:1.02-1.17), but not ER- tumors (HR=0.97, 95% CI:0.80-1.17; p-for-heterogeneity=0.31). Overall breast cancer HRs were >1 across all cohort catchment areas; ranging from a HR=1.47 (95%CI: 0.73-3.00) for Georgia to a HR=1.04 (95% CI:0.97-1.11) for California (p-for-heterogeneity=0.66).

CONCLUSIONS: In this large U.S. cohort with historical air pollutant exposure, PM2.5 was associated with ER+ breast cancer risk. Future work should consider region-specific associations and the potential contribution of PM2.5 chemical constituency in modifying the observed association with breast cancer.

KEYWORDS: breast cancer, outdoor air pollution

P-0135 Source apportionment of ambient PM2.5 using positive matrix factorization (PMF) model in Cape Town, South Africa

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BACKGROUND AND AIM: Particulate matter (PM) with an aerodynamic diameter <2.5µm (PM2.5) is an indicator of air pollution that threatens global population health. In 2017, exposure to PM2.5 was attributed to 2.9 million premature deaths and 83 million DALYs globally. The dearth of data on PM2.5 sources and quantification presents a significant gap in knowledge for Africa and South Africa in particular. This study identified the sources and their contributions to ambient PM2.5 in Cape Town, South Africa.

METHODS: PM2.5 samples were collected every third day for 121 days in an urban background site in the Kraaifontein suburb in Cape Town. Filters were analyzed for black carbon, organic carbon, and trace elements using Model OT21 Optical Transmissometer and a Xepos 5 Energy-dispersive x-ray fluorescence (EDXRF) spectrometer, respectively. Concentration and uncertainty data for PM2.5, BC, OC, and trace elements (S, Cl, Si, K, Ca, Ti, V, Fe, Ni, Cu, Zn, As, Se, Br, Sr, Sb, Ba, Pb, U) were used in the PMF, version 5.0 from the US Environmental Protection Agency to identify sources by markers.

RESULTS: The mean PM2.5 concentration was 13.4 ± 8.2 µg/m3 (1.2 to 39.1µg/m3) above the stipulated WHO air quality guideline of 5µg/m3. The PM2.5 mean seasonal concentration were 17.37µg/m3 (spring), 16.1 µg/m3 (winter), 11.25 µg/m3 (autumn) and 9.12 µg/m3 (summer). Sulfur had the highest mean concentration of 346.95ng/m3 followed by chlorine (288.21ng/m3) then silicon (204.52ng/m3). Uranium had the lowest mean concentration of 0.62ng/m3. Seven sources of PM2.5 were quantified including point source emission (24.6%), biomass burning (22.3%), traffic emission (16.8%), secondary sulphate (13.1 %), sea salt (9.3%), diesel combustion (8.4%) and crustal sources (5.5%).

CONCLUSIONS: The main PM2.5 emitters are combustion sources. Therefore abatement strategies should focus on improving the combustion processes.

KEYWORDS: Air pollution, PM2.5, Trace elements, Source apportionment, South Africa

P-0139 Chronic exposure to air pollution and semen quality in an Asian population

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BACKGROUND AND AIM: Evidence concerning the association between air pollution and semen quality is sparse, and findings in previous studies remain inconsistent. This study aims to investigate the associations between exposure to ambient air pollution and semen quality in Asia.

METHODS: A cross-sectional study was conducted among 7,658 male participants (aged ≥15 years) who participated in a standard medical examination program in Taiwan and Hong Kong between 2000 and 2018. The 2-year average concentration of $PM_{2.5}$, NO_2, and O_3 was estimated at each participant's address using satellite-based spatial-temporal models. Semen quality was assessed according to the WHO 1999 guidelines, including sperm concentration, total motility, progressive motility, and morphology. Generalized linear mixed models were used to examine the association between air pollution and sperm quality, with a region-level random intercept used in all models to control within-region clustering effects.

RESULTS: Every 10 ug/m³ increase in NO_2 was associated with a decrease of -1.72% [95% confidence interval (CI): -2.68% to -0.75%] in sperm concentration. However, each 10 ug/m³ increase in $PM_{2.5}$ and O_3 was associated with an increase of 3.13% (95%CI: 0.76% to 5.55%] and 2.88% (95%CI: 0.75% to 5.05%) in sperm concentration, respectively. In addition, each 10 ug/m³ increase in $PM_{2.5}$ was associated with a lower percentage of normal sperm morphology, with a coefficient of -1.54 (95%CI: -2.41 to -0.68). There were no consistent associations between air pollution and other semen parameters.

CONCLUSIONS: We found that exposure to ambient NO_2 was associated with a lower level of sperm concentration and exposure to ambient $PM_{2.5}$ was associated with a lower level of normal sperm morphology. Further studies are warranted to validate our findings.

KEYWORDS: Air pollution, ozone, male infertility, semen quality

P-0145 Associations between long-term air pollution exposure and physical function in older adults

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BACKGROUND AND AIM: Epidemiological studies concerning the relations between exposure to air pollutants especially in ozone and disability in older adults were limited. Thus, this study aims to investigate the associations between exposure to long-term air pollution and the risk of disability among the community-dwelling older adults.

METHODS: Study participants were adopted from the third to sixth wave surveys (1996, 1999, 2003 and 2007 year) in Taiwan Longitudinal Study on Aging (TLSA) (n=2241). We estimated 1-year and 2-year exposure window for ozone levels from 1994 to 2007 by using daily concentration data at air quality monitoring stations in the administrative zone of participants' residences. The status of disability for each participant was evaluated on the activities of daily living scale (ADLs) and instrumental activities of daily living scale (IADLs). Generalized linear mixed models were used to investigate the associations between long-term ozone exposure and disability after adjusting for covariates.

RESULTS: We found that long-term (1-year moving average or 2-year moving average) ozone exposure was positively associated with the risk of disability in the elderly. for example, when the average concentration of ozone increased 1 ppb in 1-year exposure window, the risk of disability for ADL scores ≥1 and IADL scores ≥7 in the elders increased 5.4% (OR=1.054, 95% CI:1.022-1.086) and 4.3% (OR=1.043, 95%CI:1.016-1.071), respectively. As compared to quartile 1 (Q1) of 1-year moving average for ozone levels, quartile 4 (Q4) of ozone exposure was significantly associated with the risk of disability for ADL scores ≥1 and IADL scores ≥7 in older adults (OR=1.858, 95% CI:1.404-2.459 for ADL scores ≥1; OR=1.700, 95%CI:1.331-2.171 for IADL scores ≥7).

CONCLUSIONS: Our results indicated that the long-term exposure to ozone could be a risk factor of disability in older adults. More researches on the biological mechanism of ozone-disability associations are required in the future.

P-0146 Adoption of innovative energy efficiency pots to enhance sustained use of clean cooking with gas in resource-poor households in Kenya: perceptions from participants of a randomized controlled trial

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BACKGROUND AND AIM: Initial equipment purchase and recurrent fuel costs, as well as cultural cooking preferences (including perceived fuel wastage for long cooking duration foods) are recognized barriers to adoption and use of gas and electricity for clean cooking. Scaling clean cooking is now a priority for many sub-Saharan African countries to address the substantial health burden from exposure to household air pollution from reliance on polluting solid fuels.
METHOD: To facilitate transition to clean cooking with liquefied petroleum gas (LPG) innovative cooking pots with a revolutionary new fuel saving design were tested by LPG using cooks in an informal settlement in Nairobi, Kenya who currently also used polluting fuels for their cooking. Semi-structured interviews (SSIs) were conducted with 22 of 200 cooks who took part in a randomized control trial of the pots to test the impacts of the pots on exclusive clean cooking with LPG. The SSIs explored positive and negative perceptions of the technology in aiding clean cooking and potential time savings.

RESULTS: Universal appreciation of the benefits of the pots for cooking, fuel and time saving and prestige were reported by the cooks with all cooks reporting advantages over their traditional locally available pots (Sufurias). Willingness to pay for the pots and the potential for scale in the local community was a key outcome from the thematic analysis.

CONCLUSIONS: This study highlights the potential role for energy-efficient pots as a solution to sustained /exclusive clean cooking with LPG in resource poor settings. The documented positive impacts on time and fuel savings are substantiated and contextualized through the results of this qualitative study. In addition, the findings are directly relevant to scale of the cooking pots in local markets through both import and local manufacturing.

KEYWORDS: Household Air pollution, energy-efficient pots, LPG, adoption, enhanced cookware, gas.

P-0150 Malodour and health risks in the surroundings of an animal rendering plant

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BACKGROUND AND AIM. Volatile Organic Compounds (VOCs) emitted from animal rendering processes, may be hazardous and/or malodorous. This study was conducted in the vicinity of a rendering plant in Southwest Greece, during operation and after its compulsory cessation. The aim was to assess the odour annoyance and the possible carcinogenic and toxic risks, derived from VOCs in ambient air.

METHODS: VOCs were absorbed onto Tenax TA/Sulficarb sorbents via active sampling and analyzed by Thermal Desorption-Gas Chromatography-Mass Spectrometry. Odour Activity Values (OAVs) were calculated for odorants. Health risks were determined by probabilistic risk assessment. Past and present odour nuisance perceived by residents was assessed through a questionnaire.

RESULTS: A substantial reduction in ambient air concentrations of VOCs (47 %) was found after closure of the plant. Seventeen compounds totally disappeared, of which four (propanoic and butanoic acids, dimethyl trisulfide, 2-nonenal) were immensely malodorous. The total odour burden, as expressed by the sum of OAVs, decreased by 70 %. Residents reported a definite drop in the frequency, intensity, duration and annoyance of the odour. Non-specific health symptoms (nausea, respiratory problems, etc.) that participants were experiencing in the past, no longer occur. During the operation period, the cumulative Lifetime Cancer Risk (LCR) for the general population was calculated to be 10 times higher than the acceptable risk. The cumulative mean Hazard Quotient (HQ = 3.3), indicated a high risk of adverse health effects. After activity termination, LCR decreased by 3-fold, while HQ remained almost the same.

CONCLUSIONS: Three major issues, odour disturbance, cancer and toxic risks were imposed on the surrounding population by a rendering plant, which was not operating under the Best Available Techniques framework. A significant amelioration of life quality was reported by residents after activity termination.
Keywords Odorous compounds; Health risk assessment; Rendering; VOCs; Residents' perception

P-0156 Pregnant women's exposure to 1-hydroxypyrene predicted by airport-related source indicators in an area with low ambient air pollution

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BACKGROUND: Gestational exposures to polycyclic aromatic hydrocarbons (PAHs) are associated with adverse health effects among mothers and infants. Although outdoor air pollution is a known contributor to the general population's exposures to PAHs, it is unclear whether residential proximity to local pollution sources predict PAH exposure in pregnant women, especially in areas with low-level pollution.
AIM: To determine the associations of residential proximity to vehicular traffic and a nearby airport with urinary 1-hydroxypyrene (1-OHP) among pregnant women living in Rochester, New York.

METHODS: We used 743 urine samples measured for 1-OHP (once per trimester) from a pregnancy cohort study of 313 women. We calculated the distance between participants' residences and the Rochester Airport and annual average daily traffic volumes (AADT) within different buffer distances from the residence (100m increments). Associations between 1-OHP and these proximity measures were examined using linear regressions, adjusting for age, body mass index, and smoking status.

RESULTS: Residential proximity to the airport and AADT within a 300m buffer distance were associated with 1-OHP concentrations. One IQR increase in log-distance (i.e., from 6.3 to 14.0 km) was associated with an 11.0% increase in 1-OHP concentration (95%CI: 4.4%, 17.2%), while each IQR increase in the square root of AADT was associated with an 8.3% increase in 1-OHP concentration (95%CI: 1.41%, 15.73%). We found greater increases in 1-OHP levels associated with IQR increases in residential proximity to the airport when participants lived downwind (15%) than upwind (12%) of the airport, suggesting a substantial contribution of airport-related sources to PAH exposures.

CONCLUSIONS: Emissions from an airport and local traffic activities likely contributed to increased PAH exposures among pregnant women living in a Northeastern US city with low air pollution levels (average participant exposure PM2.5 = 6.1 μg/m3).

KEYWORDS: PAH, 1-hydroxypyrene, pregnant women exposure

P-0161 Hospital admission risks and costs for neuropsychiatric disorders attributable to fine particulate matter in New York State: a community-level cross-sectional study

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BACKGROUND AND AIM Neuropsychiatric disorders are a huge and growing public health concern during the recent years. However, evidence is limited for air pollution and related excess medical costs for neuropsychiatric disorders. We aimed to investigate excess risks and costs of hospital admission for neuropsychiatric disorders associated with long-term exposure to fine particulate matter (PM2.5) in New York State and examine disproportionate impact of PM2.5 on neuropsychiatric disorders by individual characteristics.

METHODS: We collected non-elective annual hospital admission counts and costs for six neuropsychiatric disorders—fatigue, headache, behavior disorder, mood disorder, Parkinson's diseases, and epilepsy— from the Statewide Planning and Research Cooperative System (SPARCS) database from 2010 to 2016. We also obtained county-level annual average of PM2.5 from the high-quality prediction model. We performed a generalized linear mixed model to estimate the association between annual average PM2.5 and the number of annual hospital admissions for neuropsychiatric disorders and calculated the excess medical costs attributable to PM2.5 based on the estimated association.

RESULTS: We found that higher exposure to PM2.5 was associated with higher hospital admission risks of neuropsychiatric disorders, and the risk was more evident in behavior disorder and Parkinson's disease, RRs: 1.08 (95% CI: 1.02, 1.16) and 1.08 (95% CI: 1.00, 1.17). Meanwhile, the excess medical cost attributable to annual PM2.5 was the highest in mood disorder (309.8 million dollars with 95% CI: -48.4, 599.4 million dollars) and epilepsy (255.5 million dollars with 95% CI: 55.9, 405.2 million dollars).

CONCLUSIONS:This study provides the excess hospital admission risks due to exposure to long-term PM2.5 for neuropsychiatric disorders, together with the excess costs attributable to PM2.5 which have a different pattern from the estimated risks.

KEYWORDS: Fine particulate matter, PM2.5, Neuropsychiatric disorders, Economic burden.

P-0167 Individual and regional vulnerability for hospitalization with cardiovascular and respiratory diseases in association with short-term ambient PM2.5 exposure

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BACKGROUND AND AIM: Short-term effect of ambient $PM_{2.5}$ exposure on cardiovascular and respiratory hospitalization has a high scientific evidence. However, further evaluation for the vulnerability in terms of individual and regional characteristics is still needed.
METHOD: We covered 166 municipalities, in which has ambient $PM_{2.5}$ monitoring sites, in Republic of Korea from 2015 to 2019. We used daily means of $PM_{2.5}$ concentration, temperature, relative humidity data, and daily hospitalization [ischemic heart disease (IHD), stroke, chronic obstructive pulmonary disease (COPD), and asthma] count data from the National Health Insurance Sharing Service. Quasi-Poisson generalized additive models for overall population and the strata [individually identified; sex, age, social economic status (SES)] in each municipality and meta-analyses using regional-level variables (over aged 65, obesity, current smoker, and greenspace rate, Gross Regional Domestic Product(GRDP) per capita, employment rate, and untreated medical need rate) were implemented.

RESULTS: The pooled risk according to increase of 10 $\mu g/m^3$ of $PM_{2.5}$ concentration was increased by 0.62% (95%CI, 0.44–0.81), 0.16% (95%CI, -0.09–0.40), 0.75% (95%CI, 0.49-1.02) and 0.59% (95%CI, 0.32–0.86) based on the model with 0-1 lag day exposure, for IHD, stroke, COPD, and asthma, respectively. We found higher risks in female for IHD (0.76%), male for COPD (1.19%), in lower SES for IHD (0.88%) and stroke (0.47%), and in older group aged 65 or more for IHD (0.97%), stroke (0.36%), COPD (1.31%), and asthma (1.85%). In the regions with higher rates of older group over aged 65, obesity,and GRDP per capita, the higher risks were shown for IHD, stroke, and asthma, while in the regions with lower employment rate, those were for IHD, stroke, and COPD.

CONCLUSIONS: We explored to identify the vulnerable factors in terms of individual and regional characteristics.

KEYWORDS: Short-term exposure, $PM_{2.5}$, susceptibility, multi-city time-series, meta-regression

P-0171 Impact of the wood-burning Justa stove on Fractional Exhaled Nitric Oxide: A stepped-wedge randomized trial in Honduras

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BACKGROUND: In 2019, household air pollution from combustion related to household energy needs (e.g., cooking) was estimated to be responsible for 2.3 million premature deaths globally, including nearly 400,000 from chronic respiratory diseases. In rural Honduras, we demonstrated substantially reduced personal fine particulate matter [PM2.5] concentrations following a 3-year wood-burning Justa stove (engineered combustion chamber and chimney) intervention (e.g., 24-hour PM2.5 median [25th, 75th percentiles]: Justa, 43 [27, 73]; traditional stove, 81 [50, 141] µg/m3). We evaluated the impact of the intervention and PM2.5 and black carbon (BC) concentrations on fractional exhaled nitric oxide (FeNO), a noninvasively collected biomarker of eosinophilic airway inflammation previously associated with exposure to ambient air pollution.

METHODS: With 6 visits per household over 3 years, the individual-level, stepped-wedge randomized controlled trial was conducted among 230 primary female cooks aged 24-59 years and using traditional stoves at baseline. In addition to 24-hour gravimetric personal and kitchen PM2.5 and BC concentrations, we longitudinally assessed FeNO levels with the NIOX Vero device at each visit in a random sample of 90 participants. Among participants reporting no use of anti-inflammatory medications, we explored FeNO impacts of the intervention in intent-to-treat (adjusted for time trends) and exposure-response (adjusted for potential confounders) linear mixed effect models (n=414 observations).

RESULTS: We did not observe an effect of the intervention on FeNO levels (3% higher geometric mean among those assigned to the Justa compared to the traditional stove, 95% confidence interval [CI]: -12%, 21%). Associations between pollution concentrations and FeNO were consistent with the null association (e.g., we observed a difference of 4% lower FeNO per 1-unit higher log-transformed personal PM2.5, 95% CI: -9%, 1%).

CONCLUSIONS: Evidence from ambient and HAP studies regarding associations with FeNO is inconsistent, and may be attributable to differing study populations, exposures, and FeNO measurement procedures.

P-0173 Long-term trends in mortality risks associated with short-term exposure to air pollution in 10 Japanese cities between 1977 and 2015

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BACKGROUND AND AIM: Short-term associations between air pollution and mortality have been well reported in Japan, but the historical changes of mortality risks remain unknown while Japan undergoes rapid aging. We examined temporal changes in the mortality risks associated with short-term exposure to four criteria air pollutants in selected Japanese cities.

METHODS: We collected daily mortality data for non-accidental causes (n=5,748,206), cardiovascular (n=1,938,743) and respiratory diseases (n=777,266), and air pollutants – SO_2, NO_2, suspended particulate matter (SPM) and oxidants (Ox) – of 10 cities from 1977 to 2015. We performed a two-stage analysis with 5-year stratification to estimate the relative risk (RR) of mortality per 10 unit increase in 2-day moving average of air pollutant concentrations. In the first stage, city-specific associations were assessed using a quasi-Poisson generalized linear regression model. In the second stage, the city-specific estimates were pooled using a random-effects meta-analysis. Ratio of relative risks (RRR) was computed to examine temporal changes.

RESULTS: Average concentrations in each stratified period decreased for SO_2, NO_2, and SPM (14.2–2.3 ppb, 29.4–17.5 ppb, 52.1–20.6 μg/m³, respectively) but increased for Ox (29.1–39.1 ppb), over the study period. When stratifying the analysis by every 5 years, the estimated risks of non-accidental mortality with these pollutants remained positive but did not show any clear trend. Meanwhile, the risk of respiratory mortality with SPM had increased (RRR of the latest period to that of the earliest period: 1.008, 95% CI: 1.002–1.015). The risks posed by these pollutants were slightly to moderately heterogeneous for the different cities.

CONCLUSIONS: The respiratory mortality risk per 10 unit increase of SPM concentration was significantly higher in the latest period than in the earliest period. Other pollutant–mortality associations indicated either decrease or non-significant risk change in Japan between 1977 and 2015.

KEYWORDS: air pollution, daily mortality, time-varying effects, long-term trend

P-0174 Long-Term Association of Air Pollution and Incidence of Lung Cancer in American Elderly Population: A National Study in Medicare Cohort

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BACKGROUND AND AIM: Despite growing evidence of the association of fine particulate matter [PM2.5] to an increased risk of lung cancer mortality, few studies have investigated associations of multiple pollutants simultaneously. We aim to investigate the long-term effects of PM2.5, nitrogen dioxide [NO2], and warm-season (i.e. May to October) ozone [O3] on lung cancer incidence in a large national cohort.

METHODS: We conducted a prospective study in a nationwide cohort with Medicare beneficiaries (aged ≥ 65 years) enrolled in the fee-for-service program in the contiguous US from 2000 to 2016. Air pollution exposure was averaged across three years and assigned to each subject based on their ZIP code of residence. We fitted single-, bi-, and tri-pollutant Cox proportional hazards models to estimate the hazard ratios (HRs) for lung cancer incidence, adjusted for potential confounders.

RESULTS: Over the study period, we identified 172,371 lung cancer cases (n= 12,827,068). We found a significant increase in lung cancer risk for all three pollutants in the single-pollutants model. HRs associated with 1 μg/m3 increase in PM2.5 (μg/m3) was 1.015 (1.013, 1.018), and with 1 ppb increase in NO2 and O3 was 1.013 (1.012, 1.014) and 1.007 (1.006, 1.009) respectively. In bi- and tri-pollutant models, we observed potential confounding by NO2 on PM2.5¬, which was no longer significantly associated with lung cancer incidence. Subgroup analysis revealed significantly stronger effects for PM2.5 for those who were men, aged ≥ 75 years, black, eligible for Medicaid, and living in neighborhoods at the lowest quartile of median household income.

CONCLUSIONS: Long-term exposure to elevated concentrations of PM2.5, NO2, and O3 was significantly associated with an increased risk of lung cancer incidence among the Medicare population. Improving air quality in the US could yield substantial health benefits for the aging American population.

KEYWORDS: air pollution, lung cancer, Medicare

P-0177 Estimate High-Spatial Resolution of Ground-Level Ozone in Korea during 2001-2020 using Ensemble Model

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BACKGROUND AND AIM: Estimating ground-level ozone concentrations with high spatial resolution is crucial to assess the adverse health effects associated with exposure to ozone. Despite its importance, there is no study estimating high spatial resolution of ozone concentration in Korea. This study aims to estimate monthly average of daily maximum 8 hours (8 h) ozone at a resolution of 1 km × 1 km across Korea from 2001 to 2020.

METHODS: This study used an ensemble model that integrated multiple machine learning algorithms (random forest, light gradient boosting, and neural network) to estimate monthly average of daily maximum 8 h ozone at a resolution of 1 km × 1 km across the contiguous Korea. We used a generalized additive model that accounted for geographic difference to combine ozone estimates from random forest, light gradient boosting, and neural network. The three machine learning models include multiple predictors with satellite data, meteorological variables, spatially weighted ground-level air pollutants, land-use variables, reanalysis datasets for meteorological variables, and others.

RESULTS: Total number of monitoring stations for ozone was 480 during the period 2001-2020. In the total area, our ensemble model showed a 10-fold cross-validated R2 of 0.840 during the entire study period. Urban areas showed the better prediction performance (R2 of 0.842), compared to the non-urban areas (R2 of 0.764).

CONCLUSIONS: This study can provide the high-resolution ozone prediction estimates with excellent performance, and our estimates can be used to estimate the more precise health impacts attributable to ozone.

KEYWORDS: Ground-level Ozone, High spatial resolution, Machine learning model, Republic of Korea

P-0178 Long-term and short-term exposures to ambient ozone and sleep quality in China

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BACKGROUND: Compelling evidence has documented that ground-level ozone has various adverse health impacts, causing elevated mortality and morbidity. However, few studies have focused on the effect of ozone on sleep quality.
METHOD: We assessed the causal relationship between short-term and long-term exposure to ozone and sleep quality in a national representative sample from the China Family Panel Study, using a difference-in-difference study design. We further followed ninety healthy Chinese adults from September 2020 to June 2021, ascertained their daily ozone exposure, and measured average daily accelerometer-based sleep architecture and resting-state EEG signals in 4 one-week-long sessions.

RESULTS: In the national sample, we found that every 1-□g/m3 increase in yearly and monthly ozone exposure was causally associated with 0.0047 (p = 0.047) and 0.0021 (p = 0.014) hours decline in night-time sleep duration, respectively. In the small sample with objective sleep measurements, we found that every 1-□g/m3 increase in daily ozone exposure was associated with 0.19 minutes decrease in night-time sleep duration (p = 0.031), 0.058 percentage decrease in sleep efficiency (p < 0.001), 0.071 minutes increase in sleep latency (p = 0.007) and 0.20 minutes increase in wake after sleep onset (p = 0.0016) in a quasi-linear pattern. Interestingly, we also found that short-term ozone exposure was directly associated with altered EEG pattern, with sleep quality playing as a potential mediating role.

CONCLUSIONS: This study indicates that long-term and short-term ozone exposure has adverse impact on sleep health and might impair brain functioning. More hidden adverse health effects of ozone are worth exploring.

P-0179 Exposure to outdoor $PM_{2.5}$ and Risk of Upper Gastrointestinal Cancers in a Large Prospective U.S. Cohort

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BACKGROUND AND AIM: Studies of outdoor air pollution and upper gastrointestinal (UGI) cancers are limited, and few have evaluated heterogeneity in effects by histologic subtype. We investigated the relationship between ambient fine particulate matter ($PM_{2.5}$) and UGI cancer risk in a large prospective cohort.

METHODS: Our analysis included 456,472 participants of the NIH-AARP Diet and Health Study in 6 U.S. states (California, Florida, Louisiana, New Jersey, North Carolina, and Pennsylvania) and 2 metropolitan areas (Atlanta, Georgia and Detroit, Michigan). We used annual estimates from a historical spatiotemporal model to assess average residential $PM_{2.5}$ concentrations during a 15-year period (1980-1994) prior to enrollment in 1995-1996. We used Cox regression to estimate hazard ratios and 95% confidence intervals (HR [CI]) for risk of incident UGI (esophageal and gastric) cancers overall and by histologic subtype per 10µg/m3 increase in $PM_{2.5}$. Models were adjusted for age, smoking, alcohol intake, body mass index (BMI), race/ethnicity, and catchment area and separately adjusted for residential nitrogen dioxide (NO_2) concentrations. We ran models stratified by smoking status, sex, and BMI, and evaluated statistical interaction via Wald tests.

RESULTS: We found no overall $PM_{2.5}$-UGI cancer association in follow-up through 2011 (N=2,352 cases). Increased risk of esophageal squamous cell carcinoma (N=244) was suggested (HR:1.50 [0.95-2.37] per 10µg/m^3) and stronger among men (HR=1.80 [1.06-3.07]) than women (HR=1.01 [0.50-2.09]), although the interaction was non-significant (p-interaction=0.4). There was no association with esophageal adenocarcinoma (n=774). We observed a small, nonsignificant increased risk for gastric noncardia adenocarcinoma (n=898; HR=1.06 [0.84-1.35]); risk of gastric cardia adenocarcinoma (N=577) was increased only among never smokers (p-interaction=0.01). There were no differences in relationships by BMI, and NO_2 adjustment did not change associations.

CONCLUSIONS: Our novel investigation provides evidence of a relationship between $PM_{2.5}$ and specific UGI cancer subtypes. Stratified findings suggest important areas for future research.

KEYWORDS: gastrointestinal cancer, air pollution

P-0184 Long-term air pollution exposure and the incidence of cardiovascular diseases among American elderly population

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BACKGROUND AND AIM: Numerous studies have linked PM2.5, NO2, and ozone with cardiovascular diseases. Fewer studies have examined the multi-pollutant effects and effects at low pollutant levels, as well as potential effect modifications.

METHODS: Our study population included all Medicare enrollees continuously enrolled in the fee-for-service (FFS) program and both Medicare part A and part B in the contiguous U.S. from 2000 to 2016. We looked at the association between population-weighted ZIP code level annual average PM2.5, NO2, and warm-season ozone (May-October) and the first diagnosis of atrial fibrillation (AF), congestive heart failure (CHF), and stroke using Cox proportional hazards models. We adjusted for individual demographic characteristics and area-level covariates. We further examined these associations at low pollutant levels (PM2.5: <10 µg/m3¬, <8 µg/m3; NO2: <25 ppb, <18 ppb; warm-season ozone: <50 ppb, <40 ppb) and potential modifications by race and comorbidities (diabetes, hypertension, hyperlipidemia).

RESULTS: In the full cohorts, elevated PM2.5 and NO2 levels were associated with increased incidence of AF, CHF, and stroke. for each µg/m3 increase in annual PM2.5, HRs were 1.0059 (95%CI: 1.0054, 1.0064), 1.0260 (95%CI: 1.0256, 1.0264), and 1.0279 (95%CI: 1.0274, 1.0284), respectively. for each ppb increase in annual NO2, HRs were 1.0057 (95%CI: 1.0056, 1.0059), 1.0112 (95%CI: 1.0110, 1.0113), and 1.0095 (95%CI: 1.0093, 1.0096), respectively. Each one ppb increase in warm-season ozone was associated with an increased risk of CHF (HR=1.0035, 95%CI: 1.0033-1.0037) and stroke (HR=1.0026, 95%CI: 1.0023-1.0028). The effect estimates were stronger when we restricted the analyses to low pollutant levels. We also found generally higher risks for enrollees who are black or have diabetes.

CONCLUSIONS: Long-term exposure to PM2.5, NO2, and warm-season ozone were associated with risks of cardiovascular diseases, even at low pollutant levels. These associations were modified by race and several comorbidities.

KEYWORDS: Air Pollution, PM2.5, NO2, Ozone, Cardiovascular Diseases

P-0187 Fine particulate matter (PM2.5) levels in Brits, North West province, South Africa

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BACKGROUND AND AIM: Air pollution is a major threat to human health globally. In 2021, the World Health Organization (WHO) reported that 7 million premature deaths, mainly from non-communicable diseases are due to air pollution. Air quality studies on PM2.5 and its composition are lacking in South Africa and Africa. In order to find ways to reduce PM2.5 sources and its associated health impact in Brits, South Africa, it is necessary to determine PM2.5 levels and its chemical composition, followed by a source apportionment study.

METHODS: 24-hour PM2.5 filter samples were collected on the roof of a home in Brits every sixth day. In total, 61 samples and 10 duplicate samples were collected during 10 May 2020 and 5 May 2021. GilAir5 pumps and PM2.5 cyclones were used in the sampling. PM2.5 levels were determined with gravimetric analysis at the Air Quality Laboratory, School of Health Systems and Public Health, University of Pretoria. The yearly average was compared to the Averages were compared across seasons.

RESULTS: The average PM2.5 level during the sampling period was 17.7 µg/m³ (range: 3.6 -52.7 µg/m³), which is higher than the yearly WHO guideline (5 µg/m³), but lower that the yearly South African standard (20 µg/m³). The 24-hour PM2.5 levels exceeded the daily WHO guideline (15 µg/m³) and daily South African standard (40 µg/m³) on 17 and 2 occasions, respectively. The highest PM2.5 levels were observed during dusty spring season (52.7 µg/m³: September 2021) and winter (43.4 µg/m³: June 2021). Possible outdoor sources include industrial and mining activities. The lowest PM2.5 level (3.6 µg/m ³) was observed in May 2021 (autumn).

CONCLUSIONS: The PM2.5 levels in Brits exceeded the yearly and daily WHO guidelines on several occasions. This may pose a public health risk to the population.

KEYWORDS: PM2.5, outdoor air pollution, South Africa.

P-0188 Source apportionment of PM2.5 and PM2.5-bound trace elements in Pretoria, South Africa

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BACKGROUND AND AIM: Source apportionment studies are an important step in understanding primary sources and contributions of fine particulate matter (PM2.5). However, there is still research needed on the topic in South Africa. The aim of this study was to identify the possible sources of PM2.5 in Pretoria, during a 46-month study period.

METHODS: PM2.5 samples were collected on the roof of the School of Health Systems and Public Health (SHSPH), University of Pretoria in Pretoria from 18 April 2017 to 12 February 2021. Gravimetric analysis was done at the SHSPH Air Quality Lab. The trace element composition was determined with X-ray fluorescence at the University of Gothenburg, Sweden. Source apportionment was conducted using the US EPA 5.0 software.

RESULTS: The average PM2.5 concentration during the 46-month study period was 21.8±17.9 µg/m3 (range 0.29–138.9 µg/m3). The identified sources and their contribution to PM2.5 were mining (43.2%), biomass/coal burning (14.2%), secondary sulphur (12.1%), road traffic (11.3%), industry/base metal (8.7%), resuspended dust (8.5%) and vehicle exhaust (2.0%). Mining and biomass burning contributed to over half of the PM2.5 and higher contributions were observed during cold winter months. South Africa primarily depends on fossil fuel burning (i.e. coal) for energy through mining and production.

CONCLUSIONS: Reduction of PM2.5 at both local level in Pretoria can be implemented through the adjustments of the national air quality management act. Particularly introducing more safe national air quality standards that could lead to lower PM2.5 levels in Pretoria.

KEYWORDS: source apportionment, air pollution, PMF, South Africa

P-0192 Patterns of fuel use, cooking practices and factors associated with the use of LPG for cooking in peri-urban Cameroon

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BACKGROUND AND AIM: Over three billion people, mostly living in low and middle income countries (LMICs), are exposed to household air pollution from reliance on polluting fuels (e.g. wood, charcoal). There is a dearth of information on barriers to adoption and sustained use of clean cooking fuels, (e.g. liquefied petroleum gas (LPG)) in remote locations in sub-Saharan Africa.

METHODS: A cross-sectional demographic and fuel use survey was completed by approximately 1500 household cooks from peri-urban Mbalmayo in Central Cameroon. Stratified random sampling was conducted to identify approximately 200 clean (LPG) and 200 polluting (e.g. wood) cooking fuel users who completed in-depth surveys on individual and household characteristics that were potentially associated with cooking behavior and fuel choice.

RESULTS: Among households using solid fuels (n=196), the main reported barrier to LPG adoption included the initial cost of LPG equipment (n=87; 59%). Concerns over LPG safety were a significant concern in both users and non-users of LPG (n=366; 83.6% perceived LPG to be dangerous). Decision making over choice of cooking fuel was approximately equally split between the main cook (typically women) and the head of household (usually men); men were in charge of decision making regarding cooking fuel adoption among 41.4% (n=121) LPG users and 56.2% (n=82) of biomass users. Stacking was universal (100%) amongst LPG users, with 70% LPG use. Free secondary fuel and a distance 20-30minutes from retail point reduced LPG use by 20% and 10% respectively. Household head unemployed (O.R 2,057, p-value .000), No formal education (O.R 15.200,p-value .006), and Cost (O.R 2.489, p-value 0.000) were all associated with the non-adoption of LPG.

CONCLUSIONS: Addressing safety concerns through education, and financially supporting households (e.g. through microfinance) will considerably scale LPG adoption in peri-urban Cameroon. Policies to facilitate LPG adoption should be targeted to both genders.

KEYWORDS: LPG, clean cooking, adoption

P-0193 Long-term Total and Source-specific PM2.5 in Relation to Incident Dementia in the U.S.

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BACKGROUND AND AIM: Emerging, but sometimes inconsistent, associations have been observed between PM2.5 and incident dementia. One possible explanation for differing associations across studies could be differing toxicity by source. We investigated the associations of long-term exposures to total and source-specific PM2.5 with incident dementia in a national, population-based cohort.

METHODS: We used biennial data between 1998 and 2016 from participants >50 years in the Health and Retirement Study. Incident dementia was identified using a validated algorithm based on cognitive testing and informant information. We predicted 10-year average total PM2.5 at participant residences before each interview using spatiotemporal modeling. Then, we derived source-specific PM2.5 by leveraging spatially refined fractions of PM2.5 from agriculture, traffic, energy, industry, open-fire and windblown dust as estimated by GEOS-Chem. Associations with incident dementia were estimated with Cox models, adjusting for individual demographics, area-level characteristics, time, and geographic trends.

RESULTS: Among 27,857 participants, 4,105 (15%) developed dementia during follow-up. Mean PM2.5 levels were 11.5+3.7 µg/m3 overall, with the largest contributing individual sectors of agriculture (1.6+0.6) and the smallest of windblown dust (0.2+0.4). In single-source models, we observed a hazard ratio of 1.16 (95% CI: 1.05 to 1.29), 1.20 (1.01 to 1.41), 1,65 (0.98 to 2.77), 1.07 (0.94 to 1.22) and 1.07 (1.02 to 1.13) for incident dementia per 1-µg/m³ greater PM2.5 from agriculture, road traffic, non-road traffic, energy coal, and open fires, respectively. These associations remained after adjustment for the sum of PM2.5 from other sources. Associations corresponding to PM2.5 from other sources were inconsistent with adverse effects.

CONCLUSIONS: We found evidence that specific emission sources may be more important in the relationship between PM2.5 and dementia risk, suggesting the possibility of targeted interventions to reduce the burden of dementia in the future.

KEYWORDS: Air Pollution, Source-specific PM2.5, Dementia

P-0195 Forecasting greenhouse gas emissions from road traffic in 2040 across the Greater Montreal Region of Canada

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BACKGROUND AND AIM: Road traffic is a major source of ambient air pollution and greenhouse gas (GHG) emissions in urban areas and is linked with human health impacts and climate change. Urban land-use planning and travel behavior greatly influence on-road traffic. The aim of this study was to map the spatial distributions of on-road traffic and its associated GHG emissions across the Greater Montreal Region (Canada) for the year 2040 under different population growth and land-use scenarios.

METHODS: A random forest model was developed to estimate the annual average daily traffic (AADT) for each road segment based on the 2018 traffic count data collected from in-situ monitoring stations and Google aerial images, an origin-destination travel survey, points of interest from OpenStreetMap, and sociodemographic census data. The spatial distribution of the population in 2040 was then predicted under three population growth scenarios. According to the forecasted population distributions in 2040, we modified the population-related predictors in the 2018 random forest model to map AADT distributions for 2040. Finally, vehicle induced GHG emissions in 2040 were estimated based on AADT.

RESULTS: Our random forest model performed well for AADT prediction, resulting in an R2 of 0.66 in leave-one-out cross-validation. Vehicle induced GHG emissions will increase 13.28% in 2040 compared to 2018 if population growth maintains past trends. GHG emissions will only increase 4.30% and 2.36% with 60% of the new population located within one kilometer of subway stations and with telecommuting increasing by 12.5% and 40% respectively.

CONCLUSIONS: Allocating new population in areas with transportation infrastructure and increasing telecommuting can reduce traffic-associated GHG emissions. Our modelling work demonstrates the potential influences of travel behaviors and land use planning on human health and climate change.

KEYWORDS: greenhouse gas emission, traffic count, air pollution, population, land use.

P-0197 A Review of studies using Air Q software for prediction of Air Pollution Health effects in Iran

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BACKGROUND AND AIM: Exposure to air pollutants may lead to various health effects and is a major public health issue. Concerns about these effects exist in both developed and developing countries. The Air Q software was developed to estimate the health impacts of air pollution based on reported levels of air pollutants in real world studies. In Iran several studies have been conducted to estimate human morbidity and mortality based on this software. We conducted this review to summarize articles which have predicted the effects of air pollution on human health in Iran using Air Q.

METHODS: We conducted a systematic search for relevant studies published until 24 April 2021 in Web of Science, PubMed, Scopus and SID (Scientific Information Database which includes articles in Farsi language). We applied no time or language restrictions.

RESULTS: 44 studies out of 525 identified articles met our inclusion criteria. The main air pollutants under investigation were particulate matter (PM), NO2, O3 and SO2. Most studies were conducted in metropolitan areas, such as Ahvaz (9 studies), Tehran (9 studies), and Shiraz (7 studies). In all studies the levels of most air pollutants were higher than the 2005 WHO guideline levels and were predicted to be related to considerable health effects. However, it was not possible to aggregate the results and report the total number of casualties during these years, because studies were done in different cities with fluctuating levels of multiple pollutants and in different years and time frames.

CONCLUSIONS: This systematic review showed that air pollution remains at unacceptably high levels resulting in substantial detrimental health effects in various Iranian cities. Using clean renewable energies, increasing human capital and increasing green spaces and vegetation can help improve air pollution and decrease human casualties in Iran.

KEYWORDS: Air Pollution, Air Q, Iran

P-0200 Ambient air pollutants and pulmonary function in children after COVID-19 pandemic

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BACKGROUND AND AIM: The acute effects of air pollutants on pulmonary function remain unclear. After COVID-19 spreads, fear drives patients away from hospitals. Smartphone applications may help asthma care. This study investigated the acute effects of ambient air pollution on pulmonary function among asthma in children by smartphone applications.

METHODS: We designed a smartphone app to provide timely support for patients with asthma. Peak expiratory flow (PEF) recordings were made twice daily and was corrected by age and gender. The severity of asthma by GINA guideline and asthma control test (ACT) test score were also monitored. Ambient air pollution parameters of particulate matter (PM), ozone(O3), oxides of nitrogen (NO2),carbon monoxide (CO), and sulfur dioxide (SO2) were measured from each nearby air monitoring station at each time while PEF recordings by linking to Global Positioning System. Allergen-specific IgE were also measured by MAST. Effects of exposure to pollutants on PEF were assessed in person-days of observations by GEE model.

RESULTS: In lag 0 (the same day), PM10, NO2, CO, and SO2 were negatively correlated with PEF (p=0.030, 0.031, 0.008, 0.017). In lag1 (one day before), NO2, CO, and SO2 were found to be correlated PEF (p=0.005, 0.010, 0.025). In lag2, PM2.5, PM10, NO2, and SO2 were associated with PEF (p=0.031, 0.023, 0.031, 0.005). Analyses stratified by mite allergen sensitization revealed that PM10, NO2, CO, and SO2 air pollutant levels negatively correlated with PEF only in mite sensitization children.

CONCLUSIONS: Exposure to air pollutants can lead to acute effects on the pulmonary function in children with asthma. Pollutants may reduce lung function and have different effects over time. Mite sensitization might modify the effect of air pollutant exposures on lung function on asthma. Smartphone applications are readily available tools to help individual air monitoring and asthma care after COVID-19 pandemic.

P-0202 Measurement of indoor and outdoor SO2 and NO2 and indoor BTEX/VOC concentrations at pre-schools in Mabopane Township, Tshwane Metropolitan Municipality, Gauteng Province, South Africa

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INTRODUCTION: Children spend approximately 7 hours a day at pre-schools, mostly indoors. The aim of the study was to assess indoor and outdoor SO2 and NO2 and indoor BTEX/VOC at pre-schools situated in Mabopane, Tshwane Metropolitan Municipality, Gauteng Province, South Africa
Methodology: Six pre-schools in the study area were purposively selected to participate in the study. Indoor and outdoor levels of SO2 and NO2, and indoor BTEX/VOC were assessed over 24hrs for two weeks using Radiello passive samplers. Indoor temperature and relative humidity were also monitored using temperature data loggers. The outdoor temperature and relative humidity data was provided by South African Weather Services.

RESULTS: The indoor and outdoor SO2 median levels were 0.22 µg.m-3 and 1.12 µg.m-3 The indoor and outdoor NO2 median levels were 21.10 µg.m-3 and 17.22 µg.m-3, respectively. The indoor/outdoor ratios for NO2 and SO2 were 0.20 and 1.07, respectively. The infiltration factor parameter estimates of NO2 and SO2 were 0.48 and 0.01. The indoor and outdoor temperature and relative humidity levels were 2.11 °C and 22.4 °C, and 43.14% and 57%. The median concentrations of BTEX ranged from 0.5µg/m3 to 43.19µg/m3. The Kruskal-Wallis test showed that the level of benzene in the six schools differed significantly - χ^2=13.87,p-value=0.016. The levels of toluene at the six school did not differ significantly - χ^2=5.96,p-value=0.310. There was no statistically significant difference between the six schools in terms of ethylbenzene - χ^2=6.30,p-value=0.2710. The p-value for Xylene showed there was no statistically significant difference between the six schools - χ^2=6.01,p-value=0.2967..

CONCLUSIONS: The levels of outdoor NO2, SO2 and BTEX/VOC were below the South African National Ambient Air Quality Standards and WHO Air Quality Guidelines. However, they still pose a health risk for children attending pre-school in the area.

KEYWORDS: Air pollution; SO2, NO2, BTEX/VOC, Temperature; Relative humidity; South African

P-0203 Health Risk Assessment and Projection of Municipal Solid Waste Disposal in China

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BACKGROUND: China's Municipal solid waste (MSW) is growing rapidly. Incineration and landfill are two main approaches of MSW disposal and both of them emit different types of ambient pollutants and threaten human health. There lacks systematic health risk assessment and projections of MSW incineration and landfill in China.

METHODS: We established the historical MSW incineration and landfill emission inventories from 2015 to 2017 and used the Gaussian Diffusion Model to simulate the spatial distribution of ambient pollutants. We then used Risk Quotients Model to assess the non-carcinogenic and carcinogenic health risks through inhalation exposure. Besides, we set seven possible MSW incineration development scenarios to predict health risk levels in 2035, considering the effect of population growth, incineration rate, waste classification and recycling, and technology progress.

RESULTS: The results show that non-carcinogenic risk caused by MSW incineration from 2015 to 2017 was lower than landfill at the national level. Both of them were meet the maximum acceptable level (HI ≤ 1). From 2015 to 2017, carcinogenic risks caused by landfill were 9.42 × 10-6, 9.40 × 10-6, 9.37 × 10-6, nine times larger than the maximum acceptable level (CR ≤ 1×10-6). Carcinogenic risks caused by incineration were 5.71 × 10-6, 7.92 × 10-6, 9.44 × 10-6, five to nine times larger than the maximum acceptable level. Projection results show that compared to the baseline scenario, through classification and recycling, changing incinerator furnace, and improving, national health risk levels will be decreased by 24%, 94% and 97%.

CONCLUSIONS: We assessed the health risks caused by MSF disposal and found MSF incineration a relatively low risk alternative disposal approach compared to waste landfill. In the future, local government should reduce MSF disposal health risks by optimizing the selection of incinerators locations, improving the garbage sorting recycling system, and strengthening information disclosure and communications.

P-0214 Demonstration project to transition from gas to electric induction stoves in affordable housing units: the 'Out of Gas' pilot study

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BACKGROUND: Natural gas-fueled stoves are a major source of indoor residential NO_2, which has been associated with asthma exacerbations. WE ACT for Environmental Justice launched 'Out of Gas' in 2021 to investigate the feasibility of transitioning from fossil fuels to renewable energy in affordable housing. 20 families in New York City Housing Authority units in the Bronx, New York City were selected to receive electric induction stoves to replace existing gas stoves. Air pollution (primarily NO_2 and PM2.5) and stove usage are being monitored before and after the transition. The pilot will be repeated in Buffalo, NY.

METHODS: In-kitchen stationary monitoring of NO_2, PM2.5, CO_2, and CO was conducted for 7 days at baseline and after stove switch-out using the Home Health Box (Access Sensor Technologies, Fort Collins, CO). Cooking events were identified using temperature loggers (Wellzion Electronics Technology Co, China). Pollutant concentrations were analyzed during cooking vs. non-cooking times and compared to ambient levels from nearby New York Department of Environmental Conservation stations.

RESULTS: Mean (SD) [median] NO_2 kitchen concentrations at baseline (before appliance switch-out) were 47.0 (60.6) [34.6] ppb, 27.8 ppb higher than ambient levels during the monitoring period. PM2.5 concentrations were 17.2 (40.1) [7.3] $\mu g/m^3$, 7.9 $\mu g/m^3$ higher than ambient levels. Levels of both pollutants were higher during cooking, with NO_2 averaging 117.5 (125.5) [82.3] ppb during cooking versus 35.5 (25.8) [32.5] ppb otherwise. The corresponding values for PM2.5 were 33.4 (63.7) [11.5] $\mu g/m^3$ during cooking and 14.5 (33.8) [7.0] $\mu g/m^3$ otherwise. On average, cooking was associated with an increase of 63.3 ppb NO_2 and 18.3 $\mu g/m^3$ PM2.5 above baseline levels.

CONCLUSIONS: Cooking with gas stoves contributes substantially to indoor residential NO_2 and PM2.5 concentrations. Switching to efficient electric induction stoves could reduce the exposure of potentially vulnerable populations to these pollutants.

KEYWORDS: NO_2, PM2.5, cookstoves

P-0217 “[Classes] are highly affected because of the smoke”: Impacts of cooking on air pollution and health among three schools in Nairobi, Kenya

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BACKGROUND AND AIM: Links between cooking with polluting fuels (e.g., wood, charcoal), air pollution and health are well-established. However, few studies have been conducted in schools that rely on such fuels for catering. This study presents the first investigation of air pollution, cooking, and health in schools in Nairobi, Kenya.

METHODS: We carried out an in-depth study in three schools (two primary schools and a college) in an informal settlement using wood and/or charcoal for catering. 24-hour air pollution measurements (particulate matter (PM2.5) and carbon monoxide (CO)) were collected to assess concentrations in the main kitchen and a nearby classroom, and personal exposure of the main cook. Surveys with catering staff collected data on the health impacts on air pollution. Focus groups with catering staff, teachers and senior management were used to understand impacts on health and the school environment, perspectives, and pathways for clean fuel transitions.

RESULTS: Mean 24-hr PM2.5 cook exposures ranged from 97.6 -343.7 µg/m3, and 24hr concentrations ranged from 64.9-171.7 µg/m3 and 66.3-903.9 µg/m3 in classrooms and kitchens, respectively –all exceeding WHO 24-hr air quality guidelines. Reported impacts from the pollution by catering staff included eye irritation, wheezing and headaches, leading to the frequent avoidance of smoke. Focus groups highlighted disturbance to teaching from smoke and how students experienced coughing and sneezing. While the impact of cooking with polluting fuels was understood, opportunities for fuel transitions were limited by catering needs and external organisations’ agendas.

CONCLUSIONS: Despite cooking not occurring in classrooms, minimum concentrations were similar to kitchens, suggesting students are exposed to unhealthy air pollution levels. Transitions in schools to clean fuels can likely advance health and minimize disturbances to teaching. Building awareness on links between cooking, air pollution and health and developing solutions that support schools catering needs is vital to support transitions.

P-0221 Correlation between extreme/unusual ozone events and corona effect from electric power transmission & distribution grids. Assessing the health and environmental impact of high-voltage direct current (HVDC) grid on ozone ground levels in Sao Paulo metropolitan area, Brazil.

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BACKGROUND AND AIM: 1- Ozone ground levels pose a risk for public health
2- The increasing ozone levels measured in parts of the metropolitan area of Sao Paulo have brought the attention of researchers. Proposed mechanisms do not provide a clear outcome for establishing root causes, and for clarifying sources of ozone. Spatial distribution of ozone also depends on wind patterns.
3- As an alternate hypothesis for explaining unusual high levels of ozone, the corona discharge from electric transmission grid, known as corona effect, can play a significative role in the absence of, or in coincidence with other concomitant factors, to explain ozone (O3) and nitric oxide (NO) unusual levels. Negative coronas emits more ozone than Positive coronas.
4- The Environmental Protection Agency- EPA, found in a report of 1973 (EPA-650/4-73-003), following a research carried out in areas of high concentration of transmission lines that "under minimal wind conditions, such transmission line concentrations can produce sizeable local ozone levels."
5- Research applies geospatial and statistical analysis with the aim of better understanding correlations between exposures and ozone levels.

METHODS: Geographic Information System (GIS)-based systems with average grid cell edge length of 10 km minimum. Global InMAP (Intervention Model for Air Pollution) with a variable resolution grid (4 km horizontal grid cell widths) in combination with GEOS- Chem simulations. Data analysis by machine-learning model.

RESULTS: Applying Predictive Machine Learning algorithm as regression models, research found that coronas could generate significant ozone levels downwind of the power line.

CONCLUSIONS: Evidence of correlation between unusual ozone measurements and location of key power electric grid transmission lines and distribution centers with potential for corona effect are found in Sao Paulo state and Sao Paulo city metropolitan area.

KEYWORDS: Corona effect, ozone, electric grids, spatial simulation, wind patterns, air pollution

P-0222 Exposure to Household Air Pollution (HAP) and measures of central hemodynamic parameters among Bangladeshi population- A cross-sectional study.

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Household Air Population (HAP) has been linked to an array of adverse health hazards, including cardiovascular mortality and morbidity. We have assessed whether household air pollution (HAP) is associated with hemodynamic parameters as part of the Bangladesh Global Environmental and Occupational Health (GEO Health) project.

We assessed central hemodynamic parameters-Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Heart rate (HR) using a standard cuff sphygmomanometer (Omron) and Mean Arterial Pressure (MAP) and Pulse Pressure (PP) using the standard formula. The exposures to particulate matter < 2.5µm (PM2.5) and Black Carbon (BC) from biomass fuel were measured for 24 hours using a personal monitor, RTI MicroPEM (RTI International, NC), among healthy, non-smoking women (n=400) and men (n=200). A multiple linear regression model adjusted for potential confounders was used to examine the association between HAP exposures and hemodynamic outcomes.

The average 24-hour PM2.5 concentration was 167.7 µgm-3 for females and 98.0µgm-3 for males. The average 24-hour concentration of BC was 14.1µgm-3 for females and 10.3µgm-3 for males. In the adjusted multivariable regression model, an 1% increase in BC resulted in a 1.6 mm of Hg reduction in MAP (95% CI: -3.24, -.03 mm of Hg, P=0.04), 2.8 mm of Hg increase in PP (95% CI: 1.55, 4.22 mm of Hg, P=0.00) and 2.6 mm of Hg reduction in DBP (95% CI: -4.09, -1.10 mm of Hg, P=0.00). No association was observed between BC and SBP as well as BC and HR. PM2.5 was not associated with any of the hemodynamic parameters even after adjusting for age, cooking duration, household income, and Body mass index (BMI).

This population-based study provides evidence that exposure to HAP (BC) is linked with central hemodynamic parameters, especially MAP and PP, which have negative implications for cardiovascular health when they become high and low.

HAP, Hemodynamics, Bangladesh

P-0228 Fine particulate matter shown to influence cytokine and chemokine levels during pregnancy

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BACKGROUND AND AIM: Pregnancy is a period vulnerable to environmental exposures like air pollution that disrupt immune regulation or induce inflammatory responses.

METHODS: Participants were 148 mother–child pairs from MARBLES (Markers of Autism Risk in Babies – Learning Early Signs), a high familial risk ASD cohort. Self-reported maternal address history was obtained for the entire pregnancy period and the 3 months prior to pregnancy. Daily PM2.5 (particulate matter < 2.5 µm in diameter) exposure values were spatially interpolated from the U.S. Environmental Protection Agency's (EPA) Air Quality System (AQS) monitoring stations' locations to the residence locations using inverse distance-squared weighting. Trimester-specific PM2.5 averages were assigned. Maternal plasma samples from each trimester were quantified for 29 cytokines and chemokines using Luminex multiplex analysis technology. Cytokines and chemokines were natural log transformed and standardized. Betas and 95% confidence intervals (CIs) for an interquartile range (IQR) change in PM2.5 were estimated using confounder-adjusted linear regression.

RESULTS: Pre-pregnancy PM2.5 was associated with a statistically significant increase in first trimester IL-8, IL-1β, MIP-1β, and TNFα values and in second trimester IL-7 and EGF values, and with a statistically significant decrease in third trimester IL-10. Trimester 2 PM2.5 was associated with a statistically significant decrease in second trimester IL-12 (p40) and EGF and with third trimester GM-CSF, IL-10, and IL-15. Trimester 3 PM2.5 was associated with a statistically significant decrease in third trimester IFN-γ, IL-2, IL-1ra, and IL-5.

CONCLUSIONS: PM2.5 appears to be associated with a shift from typical cytokine and chemokine levels that differs by trimester. Future studies should examine the ramification of such changes in cytokine and chemokine profiles associated with air pollution exposure.

P-0229 Ultrafine particulate matter exposure during second year of life associated with increased risk of autism spectrum disorder in mixtures model

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BACKGROUND AND AIM: Prenatal and early life exposure to air pollution has been shown to be associated with autism spectrum disorder (ASD) risk, but the results have been mixed and to our knowledge, no study has reported on effects of combined exposures to multiple air pollutants using a mixtures approach. We applied a multidomain, multipollutant approach to assess the association between ASD and air pollution.

METHODS: The study consisted of 484 TD children and 707 children with ASD from the CHARGE case-control study. Air pollution exposures for NO2, and Ozone, fine (PM2.5) and ultrafine (PM0.1) particles were predicted using a chemical transport model with statistical bias adjustment based on ground-based monitors. Averages were calculated for each pregnancy period (pre-pregnancy, each trimester of pregnancy, and first and second year of life) for all births between the year 2000 and 2016. The air pollution (AP) variables were natural log transformed and then standardized. We estimated individual and joint effects of AP exposure with ASD and evaluated potential interactions among AP variables for each pregnancy period, using component-wise and hierarchal Bayesian Kernel Machine Regression (BKMR) models.

RESULTS: In component-wise BKMR models that included PM0.1, NO2, and Ozone, we found a strong increasing risk of ASD in year 2 of life with increasing PM0.1 (Posterior inclusion probability, PIP, = 0.99). This held true in hierarchal models when grouped by time or by pollutant. In component-wise BKMR models that included PM2.5, NO2, and Ozone, we found that NO2 and Ozone in years 1 and 2 were associated with ASD in an inverted U shape. No robust associations were observed in the prenatal or pregnancy periods.

CONCLUSIONS: PM0.1 appears to be associated with an increased risk of ASD in year 2 of life. Future research should examine ultrafine particulate matter in relation to ASD.

P-0231 Evaluation of adult and pediatric burns from domestic fuel use at the Douala General Hospital, Cameroon

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BACKGROUND AND AIM: Burns have a significant contribution to the global burden of death and disability accounting for over 300,000 deaths occurring yearly, with majority in low-and middle-income countries where solid fuels are widely used for cooking. The aim of this study was to characterize burns from domestic fuel among burns patients received at the Douala General Hospital (DGH), Cameroon

METHODS: A descriptive study involving adult and paediatric burn patients admitted in the burn unit during a 6 months period at the DGH was conducted. A consecutive sampling was used to include the participants. The Global burn registry data collection tool with closed and open ended questions was used for data collection between September 2021 and February 2022.

RESULTS: A total of 61 patients participated, with a mean age of 25.8±20.3 years; majority were aged 1 to 10 years (31.1%) and 31 to 40 years (24.6%). Majority of the participants were males with 41(67.2%) participants. Majority of the burns were due to electrical causes (n=21; 34.4%) while flame from cooking were involved in 10 subjects (16.4%). The main parts of the body involved were the trunk (75%), arms (67.2%) and legs (67.2%). Among the participants with burns from cooking, the main sites were head (90%), arms (80%) and legs (70%). The total body surface was less than 20% in 29 participants (47.5%) and 21-40% in 16 (26.2%). The mortality rate was 24.6%, although insignificant (P=0.21), this rate was higher for burns from flame cooking than burns of other causes.

CONCLUSIONS: Burn injuries are frequent in Cameroon, with cooking fuels being responsible for 16.4% of them. The related mortality rate remains very high. It is therefore necessary to create awareness and reinforce strategies to reduce the burden of burn accidents.

KEYWORDS: Burns, cooking fuel, Africa, epidemiology

P-0244 Multiple Air Pollutants Exposure and Leukemia Incidence in Tehran, Iran

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BACKGROUND AND AIM: Leukemia is one of the most common cancers and may be associated with exposure to environmental carcinogens, especially outdoor air pollutants. The objective of this study was to investigate the association of ambient air pollution and leukemia in Tehran, Iran.

METHODS: In this ecological study, data about the residential district of leukemia cases diagnosed from 2010 to 2016 were inquired from the Ministry of Health cancer database. Data from a previous study was used to determine long-term average exposure to different air pollutants in 22 districts of Tehran. Latent profile analysis (LPA) was used to classify pollutants in two exposure profiles. The association between air pollutants and leukemia incidence was analyzed by negative binomial regression.

RESULTS: The districts with higher concentrations for all pollutants were near the city center. The incidence rate ratio (IRR) was positive but non-significant for most of the air pollutants. However, annual mean NOx was directly and significantly associated with total leukemia incidence in the fully adjusted model (IRR (95% CI): 1.03 (1.003, 1.06) per 10 ppb increase). Based on LPA, districts with a higher multiple air-pollutants profile were also associated with higher leukemia incidence (IRR (95% CI): 1.003 (0.99, 1.007) per 1 ppb increase).

CONCLUSIONS: Our study shows that districts with higher air pollution (nitrogen oxides and multi-pollutants) have higher incidence rates of leukemia in Tehran, Iran. This study warrants conducting further research with individual human data and better control of confounding.

KEYWORDS: Air pollution; multiple pollutants; pollutant profile; Leukemia; Latent profile analysis

P-0253 Association between historical redlining and neighborhood deprivation in North Carolina

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BACKGROUND AND AIM: In the late 1930s, the Home Owners' Loan Corporation created maps that ranked neighborhoods considered high risk for mortgage lending; these ratings denied residents, usually racial, ethnic, and religious minorities, the opportunity to become homeowners and accumulate wealth. We explored whether historical designation as a redlined neighborhood predicted contemporary (2010) neighborhood-level deprivation in North Carolina (NC) cities (Asheville, Charlotte, Durham, Greensboro, Winston-Salem).

METHODS: We examined 142 NC census tracts with historical redlining data. Because neighborhoods can be disadvantaged in many ways, a composite index representing poverty, occupation, housing, employment, and education was used for determining the relationship between neighborhood deprivation and having been previously redlined. To create the exposure, we overlayed a census tract shapefile layer on high-resolution digital maps of historical redlining, assigning a redlining rating of Best (N=15), Still Desirable (N=14), Declining (N=73), or Hazardous (N=40). The ratings were further combined to create exposure categories as follows: Best or Still Desirable (BSD, referent), Declining, Hazardous, and a combined redlined areas category that included both Declining and Hazardous (DH). Linear models estimated the associations between historical redlining ratings and contemporary neighborhood deprivation.

RESULTS: Neighborhood deprivation scores ranged from -1.78 to 2.72, with a higher score indicating worse neighborhood deprivation. When comparing the combined redlined areas (DH) to BSD areas, we observed increasing neighborhood deprivation (1.34 increase in index score [95% CI: 1.01, 1.67]). We observed increasing neighborhood deprivation score when comparing Declining or Hazardous ratings individually to BSD areas (1.24 increase in score [95% CI: 0.93, 1.55]; 1.57 increase in score [95% CI: 1.15, 1.98], respectively).

CONCLUSIONS: Results suggest that redlined neighborhoods are associated with increased neighborhood deprivation 70 years later and may contribute to disparities in exposure to detrimental environments and associated effects on health and well-being.

KEYWORDS: Redlining, neighborhood deprivation, built environment

P-0261 Reduction of noise-induced change in cardiovascular functions and subjective sensations when using passive and active hearing protection devices

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Impulse and continuous noise occur frequently in the workplace and harm the physiological and psychological capability of the workers. This study investigated how the exposure to noise of varying acoustic pressure and frequency influenced cardiovascular functions and subjective sensations of people and how the use of passive and active hearing protection devices (HPDs) reduced the impacts.
Twenty participants (10 males and 10 females) were exposed to three levels of sound for 5 min each level in the order of ascending acoustic pressure, 65, 85, or 100 dBA. The participants used either foam earplugs or electronic earplugs that compressed noise while allowing transmission of speech. The experiment was first conducted at a noise frequency of 200 Hz and repeated at 1,000 Hz. Changes in cardiovascular functions (blood pressures, heart rate, and metabolic rate) and those potentially involved in local hemodynamics (skin capillary blood flow and transepidermal water loss) of the participants were measured intermittently. Subjective perceptions of noise intensity, harshness, annoyance, and reduction in attention and short-term memory were also evaluated.
The noise exposure significantly increased the blood pressures and heart rate and the sensations of noise intensity, annoyance and sharpness. The most prominent increase was observed in the first 5 min of exposure, even though the acoustic pressure during this stage was the same as that of the background (white noise). The cardiovascular functions of the participants returned to the baseline 15 min after the exposure ended. The foam earplugs provided better reduction in sounds of low frequency whereas the electronic plugs performed better against those of high frequency.
The physiological impacts of noise exposure were determined by the physical characteristics of the noise. On-site evaluation of the acoustic environment and job requirements should be performed before HPDs were selected to manage the exposure.

KEYWORDS: Noise exposure, hearing protection devices.

P-0279 Heat Policies and AC Availability in US Prison Systems

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BACKGROUND AND AIM: Climate change will increase the number of hot days and heatwaves leaving incarcerated populations particularly vulnerable to extreme heat due to their lack of agency and control over their heat exposure. Previous prison heat policy analysis has not utilized Heat Index to provide context for the implementation of policies or had access to air-conditioning data. We aimed to examine the coverage and gaps of US prison system heat policies and air-conditioning access.

METHODS: Prison heat policies were identified using 52 prison system (50 states, DC, and Federal Bureau of Prisons) websites and complemented by state legislation. Heat policies were analyzed using the National Weather Service's (NWS) Heat Index Calculator on maximum reported temperature values. Facility-level air-conditioning data for 18 prison systems were public or received through public records requests by UCLA's COVID-19 Behind Bars, with facility function, capacity, and heat risk collected from federal, state, and the Intercept's Climate and Punishment datasets.

RESULTS: Half of the prison systems had publicly-available heat policies (n=52), of which 81% included temperature values (n=21). 64% of heat indices using maximum indoor temperature (n=14) would be classified as "caution" and 63% of heat indices using temperatures when respite resources would be provided (e.g. extra water) (n=8) were classified as "extreme caution" by the NWS assuming 50% relative humidity. 18% of facilities (n=374) lacked AC access completely. Among these, 55% of non-air-conditioned facilities (41,000 operational capacity) are at "severe or extreme heat risk". Overall, 23% of facilities whose function includes serving heat-sensitive populations (n=202), lack any air-conditioning despite their heat risk.

CONCLUSIONS: This study emphasizes the need for national correctional temperature policies and air-conditioning requirements to protect the thermal health of those who live and work in carceral facilities.

KEYWORDS: environmental justice built environment prison

P-0287 Modeling energy and exposure benefits through integrated ventilation upgrades and rooftop gardens in a high school in Boston, MA

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BACKGROUND AND AIM: Many U.S. schools have poor indoor ventilation, impacting air quality (IAQ), which is associated with adverse learning outcomes for children (e.g. reduced cognition, academic performance). However, increased ventilation results in increased energy consumption, which conflicts with goals to lower utility bills and carbon emissions. Addressing these challenges requires innovative and sustainable solutions. We propose a novel approach to simultaneously implement indoor ventilation upgrades and rooftop gardens, and model the impacts on energy use, financial costs, and carbon cycling in a Boston, MA high school.

METHODS: We measured CO2 concentrations continuously for a week in 13 classrooms and at exhaust rooftop vents during a two-month period in Spring 2019. We calculated baseline school-level average ventilation rates and estimated the energy needed to increase indoor ventilation to reduce CO2 to recommended indoor values (i.e. <1000 ppm). We then compared to yearly modeled energy savings and carbon emissions reductions occurring through plant carbon capture at a rooftop garden.

RESULTS: The baseline median classroom CO2 concentration was 840 ppm and exceeded 1000 ppm 33% of the school day. The estimated ventilation rate during occupancy was 4 L/s/person, below the recommended 7 L/s/person. Increasing ventilation to recommended levels would increase yearly total energy, cost, and carbon emissions (1-4%). A rooftop garden would provide net decreases of energy (12%), cost (13%), and carbon emissions (23-46%) with the higher end of this range attributed to plant growth enhancement.

CONCLUSIONS: Our analyses demonstrated the potential for integrated interventions in school buildings that can improve IAQ while capturing carbon through rooftop gardens. We found that CO2 levels of concern persist in schools, but could be vented to rooftops to reduce exposures and benefit plant growth. Future studies should evaluate alternative rooftop garden configurations that yield maximal energy and carbon reduction benefits.

KEYWORDS: Schools, CO2, energy, rooftops

P-0292 The changes of lipid profiles among Chinese adults may be associated with legacy and emerging per- and polyfluoroalkyl substances: Evidence from China National Human Biomonitoring

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BACKGROUND AND AIM: In the past decade, the levels of cholesterol and lipid profiles have drastically changed. Whether these changes may be associated with legacy and emerging PFASs is worth exploring. In this study, we aimed to explore the associations of single and mixed exposure to legacy and emerging PFASs with lipid profiles in general Chinese adults.

METHODS: A total of 10855 adults aged 18 and older from China National Human Biomonitoring (CHBNM) were recruited. Weighted multiple linear regression was used in single-pollutant models to explore the associations of PFAS with lipid profiles. Qgcomp was used to explore the joint associations of 8 PFAS mixtures (PFOA, PFNA, PFDA, PFUnDA, PFHxS, PFHpS, PFOS, 6:2Cl-PFESA) with lipid profiles.

RESULTS: Single and multiple pollution models showed that legacy and emerging PFASs were positively associated with lipid profiles. The adjusted β (95% confidence intervals: CI) of log(10) transformed PFOA, PFOS, PFNA and 6:2 Cl-PFESA with TC were 0.123 (0.058, 0.187), 0.214 (0.151,0.277), 0.227 (0.159, 0.295) and 0.115 (0.066, 0.164). The adjusted estimated changes (95%CI) of PFAS mixtures with TG, TC, LDL-C, HDL-C, and non-HDLC were 0.023 (0.009, 0.037), 0.253 (0.225,0.281), 0.149 (0.125,0.174), 0.081 (0.07,0.092), and 0.172 (0.145,0.199), respectively. Qgcomp model showed that PFNA (67.7%) contributed the most to TG, PFUnDA (30.2%) contributed the most to TC, PFHpS (36.7%) contributed the most to LDLC, PFUnDA (74.8%) contributed the most to HDLC, and PFHpS (38.6%) contributed the most to non-HDLC. However, compared with legacy PFASs, 6:2 Cl-PFESA contributed less to the lipid profiles.

CONCLUSIONS: The changes of lipid profiles among Chinese adults may be associated with legacy and emerging PFASs. Compared to legacy PFASs, emerging PFASs such as 6:2 Cl-PFESA may be less harmful to lipids.

KEYWORDS: Per- and polyfluoroalkyl substances, Lipid profiles, Joint effects, emerging PFAS.

P-0297 Greenspace exposure and depressive symptoms: findings from the French CONSTANCES cohort

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BACKGROUND AND AIM: The association between greenspace exposure and different dimensions of depression is yet to be established. We aimed to explore this association in a large population-based cohort.

METHODS: Data from the enrollment phase of the French CONSTANCES cohort (2012-2020) were analyzed cross-sectionally. Depressive symptoms were measured by the Centre of Epidemiologic Studies Depression (CES-D) questionnaire allowing to compute a total CES-D score (≥19 used as a cutoff score to identify individuals at risk for clinical depression), and including four dimensions (depressed affect, disturbed interpersonal relations, low positive affect, somatic complaints). Residential surrounding greenspace exposure was quantified using the satellite-based Normalized Difference Vegetation Index (NDVI) at 300m buffer during the enrollment year. Adjusted multiple logistic and linear regression models were developed, reported as odds ratio [OR] for dichotomized total depressive symptoms, and ß for dimension-scores, with a 95% confidence interval [CI] for an interquartile range [IQR] increase in exposure. Analyses stratified by personal and socioeconomic variables were performed.

RESULTS: In total 185,781 participants were included (age: 46.80±13.61 years, 53.5% women). Residential surrounding greenness (average NDVI: 0.53; IQR=0.28) was significantly associated with lower odds of having depressive symptoms (OR [95%CI]: 0.94 [0.90-0.99]). This exposure was also associated with a lower scores for all dimensions (ß [95% CI]: -0.043 [-0.053: -0.033]; -0.016 [-0.026:-0.006]; -0.020 [-0.030:-0.010]; and -0.019 [-0.029:-0.009] for depressed affect, disturbed interpersonal relations, low positive affect, and somatic complaints, respectively). We found suggestions for potentially stronger protective associations in men and participants with lower income.

CONCLUSION: Residential surrounding greenspace was associated with lower depressive symptoms in general, and all four dimensions especially depressed affect and somatic complaints. Considering depression prevalence, its burden, and the increasing trend of urbanization, our finding is of importance for policymakers.

KEYWORDS: Nature; Greenspace; Mental health; CONSTANCES Cohort

P-0302 Comparing greenspace metrics and buffer methods in Metro Vancouver, Canada: Implications for environmental health research

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BACKGROUND AND AIM: Access and exposure to greenspace has been shown to promote mental and physical health; however, not all studies have found these benefits, with some studies reporting no association and others reporting associations with adverse health outcomes. It has been suggested that the use of diverse greenspace metrics, the varied quality of these metrics, and the specific methods used to quantify exposure or access, may contribute to these inconsistent findings. This project sought to compare the results of using different metrics in Metro Vancouver, Canada.

METHODS: Greenspace metrics were calculated from the centroid of each 6-digit postal code. Average buffer normalized differences vegetation index (NDVI), green landcover, tree canopy cover, and park count were calculated using circular and network buffers, at both 400m and 1000m. Pearson's correlation coefficients were calculated to compare the results for each metric and method.

RESULTS: The number of parks was only weakly positively correlated with each of the other three greenspace metrics for 1000m circular buffers (NDVI $r = 0.12$; green land cover $r = 0.07$; tree canopy $r = 0.14$, $p < .01$). for 1000m network buffers (NDVI $r = -0.34$; green landcover $r = -0.12$; tree canopy $r = 0.05$, $p < .01$) two of the correlations became negative. Circular and network buffer were most highly correlated for the tree canopy (1000m $r = 0.92$; 400m $r = 0.86$, $p < .01$), whereas park count had the weakest correlation (1000m $r = 0.66$; 400m $r = 0.66$, $p < .01$).

CONCLUSIONS: The associations between greenspace metrics vary. Selection of buffering method may be particularly influential when using park count data. These findings support the importance of intentional selection of greenspace metric and measurement method in environmental epidemiological research.

KEYWORDS: greenspace metrics, NDVI, tree canopy cover, parks, network buffers, and circular buffers

P-0311 Source tracking swine fecal waste on household surfaces proximal to swine concentrated animal feeding operations in southeastern North Carolina, USA

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BACKGROUND AND AIM: In North Carolina, swine industrial livestock operations (ILOs) are located disproportionately in low-income and communities of color. Swine ILO neighbors have raised concerns about emissions from ILOs. We aim to compare the detection frequency and quantity of a swine-specific Bacteroides fecal microbial source-tracking marker (pig-2-bac DNA) contamination on outdoor and indoor household surfaces at ILO worker (ILO) compared to ILO neighbor (ILO-N) and metropolitan resident (metro) homes in North Carolina.

METHODS: at enrollment, ILO, ILO-N, and metro participants collected 2 outdoor and 2 indoor household surface settled dust samples wiping a Copan flocked swab across a 10 cm2 area. Using quantitative real-time PCR, pig-2-bac DNA copy number per area was estimated in household samples. We used logistic and linear regression to evaluate differences in pig-2-bac prevalence and quantity between the three household groups and on outdoor compared to indoor surfaces.

RESULTS: Ninety-one households (354 swabs) were sampled: 30 ILO (113 swabs), 31 ILO-N (119 swabs) and 30 metro (122 swabs). Prevalence of Pig-2-bac detection on >=1 household surface was 33%, 39%, and 0% among ILO, ILO-N, and metro households, respectively. Compared to metro households, higher log-10 pig-2-bac DNA copy number per 10 cm2 was observed at ILO (beta=0.5; 95% confidence interval [CI]=0.2, 0.7) and ILO-N households (beta=0.2; 95% CI=0.06, 0.4). Compared to indoor surfaces, higher log-10 copy number per 10 cm2S was observed on outdoor surfaces (beta = 0.181, 95% CI=0.02, 0.3).

CONCLUSIONS: Swine-specific fecal contamination was detected at a higher prevalence in ILO-N compared to ILO workers and metro resident homes. Both ILO and ILO-N groups had statistically significant increases in copy number compared to the metro group.

KEYWORDS: microbial contamination, pig-2-bac, industrial livestock operations, concentrated animal feeding operations

P-0312 Trends and Patterns in Industrial and Commercial Sources of Lead (Pb) in the US

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BACKGROUND AND AIM: Lead (Pb) exposures in the US have declined over the last 40 years due to phaseout of Pb in gasoline, residential paint, and plumbing. However, Pb still circulates in commerce (batteries, ammunition, glass, pigments, e-waste). While the Environmental Protection Agency (EPA) tracks large industrial movements of Pb (>25,000lbs), modest Pb movements are not identified and may translate to substantial cumulative exposure and public health significance due to proximity to residences, schools, or places of work. This research aims to identify and evaluate trends in commercial sources of Pb in the US.

METHODS: Peer-reviewed literature was used to identify relevant commercial sources of Pb and link to corresponding Standard Industrial Classification (SIC) codes. Counts of each SIC code were calculated per census tract, using geolocations from Dun and Bradstreet (D&B) from 1990-2018. Data capturing measurable Pb emissions (Toxics Release Inventory (TRI)) and area-level socioeconomic measures (CDC's Social Vulnerability Index) were further linked by census tract. Data were analyzed using R and ArcGIS.

RESULTS: A total of 31 unique SIC codes were identified, corresponding to >1,300 potential Pb-emitting businesses in 1,265 census tracts. The most common commercial businesses represented shooting ranges (n=838) and refuse systems (n=221). Preliminary analyses data indicate widespread current Pb-emitting industries are widespread but further socioeconomic and Pb-emission data will be analyzed. Preliminary data show a decline in some identified industries over time.

CONCLUSIONS: Preliminary results show the number of Pb-emitting industries has decreased over time in the US. However, certain geographic areas of the USA yield higher densities of Pb-emitting industries and commercial businesses, which could have a profound public health significance. The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.

KEYWORDS: Lead (Pb) exposure, environmental justice

P-0320 Case-cohort study of the association between PFAS and cancers of the kidney and bladder among participants in the American Cancer Society's Cancer Prevention II cohort

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BACKGROUND AND AIM: Some per- and polyfluoroalkyl substances (PFAS), including perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), have been associated with genitourinary system cancers in some, but not all previous studies. Many studies did not consider histology. We examined associations between PFAS exposure and risk of histologic subtypes of kidney and bladder cancer.

METHODS: We conducted a case-cohort study within the American Cancer Society's prospective Cancer Prevention Study II (CPS-II) LifeLink cohort for which serum specimens were collected during 1998-2001 (ages ≥54 years). This study included a subcohort (500 men, 499 women) randomly selected from cohort members without prior cancer diagnoses at serum collection, and all persons with incident (after serum collection) first cancers of the kidney (n=158, including 109 renal cell carcinoma/adenocarcinomas [RCC] and 47 transitional cell carcinomas [TCC]) and bladder (n=401, including 390 TCC). Concentrations of PFOA, PFOS, perfluorohexane sulfonic acid, perfluorononanoic acid, perfluorooctane sulfonamide and perfluoroheptanoic acid were measured in stored serum. Multivariable Cox proportional hazards regression was used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for associations between PFAS concentrations and risk of RCC and TCC. Models accounted for the study design and controlled for sex (using stratification), age and year at blood draw, education, race/ethnicity, smoking and alcohol use, and occupational exposures (coal dust/tar, dyes, and diesel/gasoline; TCC only).

RESULTS: Serum PFOA concentrations were positively associated with RCC among women [HRs (95% CIs) for PFOA quartiles 2-4, respectively, vs. quartile 1: 1.33 (0.42-4.19), 1.66 (0.54-5.13), 3.14 (1.02-9.65)] but not men. TCC (bladder or kidney) was not significantly associated with the measured PFAS, although PFOS-TCC HRs were elevated among men.

CONCLUSIONS: This study provides additional evidence for an association between PFOA and RCC. Consideration of histologic types might help clarify inconsistencies in the literature on PFAS exposure and cancer.

KEYWORDS: PFAS, cancer

P-0321 Biomonitoring Legacy and Emerging Contaminants and Local Fish Consumption in Susceptible Great Lakes Populations, 2010-2020

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BACKGROUND AND AIM: Over the past century, the Great Lakes, the world's largest fresh surface water system, has been contaminated with numerous chemical pollutants. From 2010 to 2020, the Agency for Toxic Substances and Disease Registry conducted the Biomonitoring of Great Lakes Populations program to assess exposure to legacy and emerging contaminants in susceptible populations who consumed fish caught in contaminated waterbodies.

METHODS: The Program consists of a series of cross-sectional studies conducted collaboratively with health departments in Michigan, Minnesota, New York, and Wisconsin. The target populations–including various angler and refugee populations in different areas with known contamination–were sampled and recruited independently using sampling strategies that were tailored for the specific populations. Participants completed questionnaires focusing on fish consumption and provided biological samples. Selected blood metals and polychlorinated biphenyls (PCBs) were measured in all participants. Some chemicals of emerging concern, such as per- and polyfluoroalkyl substances (PFAS), were also measured in several studies.

RESULTS: Body burden levels of mercury, lead, and perfluorooctane sulfonic acid (PFOS) in most target populations were elevated compared to the U.S. population. Locally caught fish consumption was associated with blood mercury and serum PFOS in most cohorts. Serum PCB was elevated only in the Detroit shoreline angler cohort and was associated with eating locally caught fish.

CONCLUSIONS: Most target populations in this program had higher exposures to some metals and PFOS, and the exposures were generally associated with eating fish caught in local, contaminated waterbodies. The results generated from this program helped guide public health actions to reduce chemical exposures in vulnerable Great Lakes populations, including updated fish advisories and targeted education and outreach on risk and benefit of fish consumption.

KEYWORDS: Fish consumption, exposure, metals, PFAS, susceptible populations, Great Lakes

P-0326 Exposure to four metals and depressive symptom in adults: NHANES epidemiological study

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BACKGROUND AND AIM: Although some of the heavy metal are known to have an adverse effect on neurobehavioral symptoms, studies on the exposure to multiple metal and depression are limited. This study purposed to evaluate the association between individual and multiple heavy metal and depression in the adult population by using National Health and Nutrition Examination Survey (NHANES) dataset.

METHODS: This study used the data from the U.S. NHANES between 2007 to 2014 to examine cross-sectional relationships between metal exposure and depression in adult over 20 years. After applying exclusion criteria, 6021 subjects were included in the final analysis. We used four urinary metals including mercury, cadmium, lead, and arsenic as exposure variables. Patient Health Questionnaire (PHQ-9) was used to assess the depression symptom of the participants. Multivariate linear regression (MLR) for each heavy metal exposure and quantile g-computation model for multiple exposure to four heavy metals were applied. Stratification analysis according to the alcohol habit of the subjects was also performed.

RESULTS: MLR models indicated that urinary cadmium was positively associated with continuous depression score (β = 0.39, 95% confidence interval (CI): 0.24-0.53). Other urinary metals showed positive relationship with continuous depression score, but it was not significant. In the quantile g-computation model, statistically significant positive association were found between the mixture of urinary metals and depression score (Difference in PHQ-9 score increase: 0.32, 95% CI: 0.14-0.50). When stratified the model by alcohol consumption habit, a stronger association was found in a heavy alcohol consumption group.

CONCLUSIONS: When comparing the results from different models, not only individual urinary heavy metal was related to depression score, but also four heavy metals mixture was positively associated with a depression. Future cohort studies are needed to clarify the effect of metal mixture.

KEYWORDS: Heavy metal, depression, quantile g-computation, alcohol consumption

P-0330 Predicting Cumulative Lead (Pb) Exposure Using the Super Learner Algorithm

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BACKGROUND AND AIM: Chronic lead (Pb) exposure causes long term health effects. While recent exposure can be assessed by measuring blood lead (half-life 30 days), chronic exposures can be assessed by measuring lead in bone (half-life of years to decades). Bone lead measurements, in turn, have been measured non-invasively in large population-based studies using x-ray fluorescence techniques, but the method remains limited due to technical availability, expense, and the need for licensing radioactive materials. Thus, we developed prediction models for bone lead concentrations using a flexible machine learning approach--Super Learner, which combines the predictions from a set of machine learning algorithms for better prediction performance.

METHODS: The study population included 695 men in the Normative Aging Study, aged 48 years and older, whose bone (patella and tibia) lead concentrations were directly measured using K-shell-X-ray fluorescence. Ten predictors (blood lead, age, education, job type, weight, height, body mass index, waist circumference, cumulative cigarette smoking (pack-year), and smoking status) were selected for patella lead and 11 (the same 10 predictors plus serum phosphorus) for tibia lead using the Boruta algorithm. We implemented Super Learner to predict bone lead concentrations by calculating a weighted combination of predictions from 8 algorithms based on selected predictors.

RESULTS: In the nested cross-validation, the correlation coefficients between measured and predicted bone lead concentrations were 0.58 for patella lead and 0.52 for tibia lead, which has improved the correlations obtained in previously-published linear regression-based prediction models. We evaluated the applicability of these prediction models to the National Health and Nutrition Examination Survey for the associations between predicted bone lead concentrations and blood pressure, and positive associations were observed.

CONCLUSIONS: These bone lead prediction models provide reasonable accuracy and can be used to evaluate health effects of cumulative lead exposure in studies where bone lead is not measured.

P-0331 Interactions between chemical mixtures and the overall antioxidant and inflammatory capacity of the diet in the association between dietary exposure to chemical mixtures and mortality risk in the E3N French prospective cohort

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Since food is contaminated by many chemicals which may interact, resulting in additive, synergistic or antagonistic effects, it is necessary to study the exposure to chemical mixtures. These mixtures can interact with nutrients by targeting the same molecular signalling pathways and biological functions. Chemicals and nutrients may impact oxidative stress and chronic systemic inflammation, both associated with non-communicable diseases.
Our objective was to investigate the association between dietary exposure to chemical mixtures and mortality risk in the E3N (Etude Epidémiologique auprès de femmes de l'Education Nationale) prospective cohort, and to study the interactions between these mixtures and nutrients.
We considered 72585 women from the E3N cohort who completed a food frequency questionnaire in 1993. Using sparse non-negative matrix under-approximation, we identified the six main chemical mixtures to which these women were exposed through the diet. We analysed the association between dietary exposure to these mixtures and all-cause and cause-specific mortality with Cox proportional hazard models. We investigated the interactions between these exposures and the overall antioxidant and inflammatory capacity of the diet.
During the follow-up (1993-2014), 6441 deaths occurred. We observed statistically significant interactions between some chemical mixtures and the overall antioxidant and inflammatory capacity of the diet which modified the relationship between dietary exposure to the mixtures and mortality. for example, when considering a mixture characterised by the exposure to persistent organic pollutants, no association was highlighted with all-cause mortality for women with an anti-inflammatory diet (HR 1.02, CI 0.90-1.15), while a positive association was found for women with a pro-inflammatory diet (HR 1.16, CI 1.02-1.31).
This study highlighted for the first time the existence of interactions between chemical mixtures and the overall antioxidant and inflammatory capacity of the diet in a human-based study. More studies are needed to clarify the underlying biological mechanisms.
chemical mixtures; diet; oxidation; inflammation.

P-0333 Positive association between dietary exposure to polybrominated diphenyl ethers and breast cancer risk in the French E3N cohort: the role of vegetable oil consumption

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BACKGROUND AND AIM: Exposure to endocrine-disrupting chemicals, like Polybrominated diphenyl ethers (PBDE), is suspected to play a role in the occurrence of breast cancer. Moreover, there is growing evidence that food chemical contaminants could interact with different components of the diet, especially lipophilic ones, such as PBDE. In an in-vitro study, vegetable oil has been shown to increase the bioaccessibility of PBDE. The objective of the present study was to assess the association between dietary intake of PBDE and breast cancer risk in the French E3N cohort study, and to investigate the potential modification of this association by vegetable oil consumption or lipid intake.

METHODS: The study included 67 879 women. Intake of individual PBDE were estimated using food consumption data from a validated semi-quantitative food frequency questionnaire. Hazard Ratios (HR) and 95% Confidence Intervals (CI) were estimated for the association between total PBDE dietary intake and breast cancer risk. Interaction measures for vegetable oil consumption were estimated on both additive and multiplicative scales.

RESULTS: The women were followed for a maximum of 21.4 years, and 5 686 developed an incident breast cancer. A positive linear trend was highlighted between dietary intake of PBDE in quintile groups and breast cancer risk, borderline with statistical significance (p-trend=0.06, HRQ5vsQ1 and 95%CI: 1.09 [0.99;1.20]). Interaction measures for vegetable oil consumption were significant both in additive and multiplicative scales. Higher effect sizes of the association were highlighted in high consumers of vegetable oil, i.e. ≥4.6 g/day (HRQ5vsQ1 and 95%CI: 1.23 [1.08; 1.40]), and almost no effect were found in low consumers (HRQ5vsQ1 and 95%CI: 0.97 [0.86; 1.10]).

CONCLUSIONS: Highlighting such interactions between nutrients and chemicals is crucial to develop efficient dietary recommendations to limit the negative health effects associated to exposure to food chemical contaminants.

KEYWORDS: Polybrominated diphenyl ethers; Breast cancer; Endocrine-disrupting chemicals; Interaction

P-0335 Ovarian volume mediates associations of phthalate metabolites with anti-Mullerian hormone in midlife women

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BACKGROUND AND AIM: We previously reported positive associations of phthalates with anti-Mullerian hormone (AMH), a biomarker of ovarian reserve, in midlife women. Growing follicles produce AMH, so we evaluated associations of phthalates with ovarian volume (indicating folliculogenesis), considering whether this relationship explained associations of phthalates with AMH.

METHODS: Midlife women had a transvaginal ultrasound of right and left ovaries to calculate ovarian volume. Women provided one blood sample for AMH quantification and up-to-four urine samples across one menstrual cycle, which we pooled to quantify nine phthalate metabolites. We assessed AMH as a binary variable (above/below the level of detection). Covariate-adjusted linear regression models were used to evaluate associations of phthalates with mean left/right ovarian volumes (both ln-transformed). Using a formal mediation analysis, we estimated the proportion of overall associations between phthalates and high AMH (total association) explained by relationships of phthalates and mean ovarian volume (indirect association).

RESULTS: In 666 midlife women, 65% were non-Hispanic White, 67% were premenopausal, and 33% perimenopausal. Only mono(3-carboxypropyl) phthalate (MCPP) and monobenzyl phthalate (MBzP) were positively associated with mean ovarian volume. In adjusted models, each two-fold increase in MCPP and MBzP was associated with 4.13% (95%CI: -0.75, 9.01) and 7.12% (95%CI: 0.83, 13.40) larger ovarian volume, respectively. These relationships partially explained associations of MCPP or MBzP with high AMH. The indirect association between MCPP and ovarian volume (β=0.03, 95%CI: 0.00, 0.07) explained 19% of the total association between MCPP and high AMH (OR=1.16; 95%CI: 0.96, 1.37). Similarly, the indirect association between MBzP and ovarian volume (β=0.06, 95%CI: 0.00, 0.13) explained 17% of the total association between MBzP and high AMH (OR=1.37; 95%CI: 1.05, 1.70).

CONCLUSIONS: Phthalates may induce folliculogenesis, with implications for midlife hormone production. Future prospective studies are needed and could consider mediation approaches using complex chemical mixtures.

KEYWORDS: phthalates, ovarian volume, AMH

P-0336 Urinary phthalate metabolites and melamine are linked to early renal injury in pregnant mothers in Taiwan

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BACKGROUND: Pregnant women exposed to two regularly encountered toxicants, melamine and phthalate, could potentially be at risk of kidney damage.
AIM
This study investigated the effects of melamine and phthalates, specifically di-(2-ethylhexyl) phthalate (DEHP), alone and interactively, on early renal injury in a nationwide cohort of pregnant women during their third trimester, participants in Taiwan's Maternal and Infant Cohort Study (TMICS).

METHODS: Participants received questionnaires, physical examinations, and blood and one-spot overnight urine tests during regular routine checkups their third trimester between October, 2012 and May, 2015. The specimens were analyzed for melamine, eleven phthalate metabolites, microalbumin and N-acetyl-beta-D-glucosaminidas (NAG), two markers of renal injury. We calculated estimated daily DEHP intake using measurements of three urinary DEHP metabolites. If a participant was found to have urinary albumin/creatinine ratio (ACR) higher than 3.5 mg/mmol, she was defined as having microalbuminuria.

RESULTS: In total, we analyzed data collected from 1433 pregnant women, who were found to have a median urinary melamine value of 0.63 μg/mmol Cr and estimated DEHP intake of 1.84 μg/kg/day. Compared to those in the lowest quartile of estimated DEHP intake, those belonging in the highest quartile had significantly increased urinary ACR (β = 0.095, p = 0.043) and microalbuminuria (adjusted OR = 1.752, 95% confidence interval = 1.118–2.746). A significant interactive effect between urinary melamine and estimated DEHP intake on urinary ACR and NAG was also found.

CONCLUSIONS: There is a strong association between exposure to these two pervasive toxicants, both independently and interactively, and the urinary indicators of early kidney injury we measured in this nationwide birth cohort of pregnant women.

KEYWORDS: Melamine, Phthalates, Urine albumin-creatinine ratio, N-Acetyl-beta-D-glucosaminidas, Renal injury, Pregnancy

P-0340 Urinary biomonitoring of glyphosate exposure among male farmers and non-farmers in the Biomarkers of Exposure and Effect in Agriculture (BEEA) study

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BACKGROUND AND AIM: Glyphosate is the most widely applied herbicide worldwide. Despite potential health effects of glyphosate, biomonitoring data of glyphosate exposure in agriculture and other settings are limited. We measured urinary glyphosate concentrations and assessed their determinants among male farmers and non-farmers from Iowa and North Carolina in the BEEA study.

METHODS: Based on questionnaire-assessed pesticide exposure histories, we selected four groups of BEEA participants: recently exposed farmers with occupational glyphosate use in the last 7 days (n=98), farmers with high cumulative lifetime days of glyphosate use (>80th percentile) but no use in the last 7 days (n=70), farmers with minimal lifetime glyphosate use (n=100), and non-farmers with no occupational pesticide exposure (n=100). We quantified glyphosate in first-morning void urine samples using ion chromatography isotope-dilution tandem mass spectrometry. We estimated geometric mean urinary glyphosate concentrations across groups and evaluated associations with potential determinants using linear regression.

RESULTS: Glyphosate was detected in urine of most recently (91%), high-lifetime (93%), and low-lifetime (88%) exposed farmers, as well as non-farmers (81%); geometric mean concentrations were 0.86, 0.58, 0.44, and 0.37 µg/L, respectively. Compared to non-farmers, urinary glyphosate concentrations were significantly elevated among recently exposed farmers (P<0.0001), particularly those who used glyphosate within 1 day of urine collection [age- and creatinine-adjusted geometric mean ratio (GMR)=6.4, 95% confidence interval (CI)=4.3-9.3] and those not wearing gloves during glyphosate application (GMR=2.6, 95% CI=2.0-3.4).

CONCLUSIONS: Preliminary results suggest that a high proportion of both farming and non-farming populations may be exposed to glyphosate. Substantial exposure contrast between those with and without recent occupational glyphosate use was detectable in urine. Given the short elimination half-life of glyphosate, the exposure differences between groups may be even greater than those reflected by measured urine concentrations. Continued biomonitoring of glyphosate in various settings is warranted.

KEYWORDS: Glyphosate, exposure assessment, pesticide biomonitoring

P-0346 Hazard and risk assessment for indoor air pollutants: dimethylsiloxanes, glycols, butanediol, hydrocarbons, trimethylbenzenes, benzene, naphthalene, and ethyltoluene

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Individuals living in an indoor environment are typically exposed to a greater variety of air pollutants than in an outdoor environment. Numerous sources of chemical emissions are found in the indoor environment, depending on the building materials as well as the lifestyle of the occupants. The quality of the indoor environment considerably impacts public health. Japan has established indoor air quality guidelines for 13 chemicals, including formaldehyde, acetaldehyde, xylene, ethylbenzene, styrene, 1,4-dichlorobenzene, and toluene. However, the types and concentrations of indoor pollutants have not been consistent over time due to alterations in lifestyle and development of novel household products and building materials. Therefore, a comprehensive approach and action plan for the overall reduction of health risks caused by indoor air pollutants are required for public health protection. To determine the high-risk indoor air pollutants that should be reduced, we conducted a preliminary risk assessment using data from nationwide exposure assessments and existing hazard data. In this assessment, identifications of the critical effects and the reference values obtained from reviewing the hazard or toxicological data are crucial. We identified indoor air pollutants that appeared with high frequency and high concentration in the nationwide exposure assessments. We previously reported the critical effects and reference values for acute and chronic effects of eight indoor air pollutants, including ethyl acetate, butyl acetate, propylene glycol monomethyl ether, 3-methoxy-3-methylbutanol, diethylene glycol methyl ether, diethylene glycol ethyl ether, propylene glycol monomethyl ether acetate, and methyl isobutyl ketone. In this study, the critical effects and the reference values of nine indoor air pollutants, including octamethyl cyclotetrasiloxan, decamethyl cyclopentasiloxan, propylene glycol, 1,3-butanediol, aliphatic saturated hydrocarbons (C8–C16), trimethylbenzenes, benzene, naphthalene, and ethyltoluene and the results of risk assessment are reported.

P-0348 Acetylcholinesterase activity and serum lead concentrations in pregnant women enrolled in the Rio Birth Cohort pilot Study, Brazil

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BACKGROUND AND AIM: Lead (Pb) is considered one of the main chemicals of interest to public health, given its potential for neurotoxicity, especially in vulnerable populations such as pregnant women (WHO, 2020). One of the mechanisms proposed for Pb toxic effects on the nervous system is the acetylcholinesterase enzyme inhibition (AChE), considering that this metal mimics and inhibits the action of calcium in this enzyme (Breslller et al. 1991). Despite evidence from experimental studies, little is known about the effects of lead on AChE in humans (Nwobi et al. 2019). We evaluated the association between blood levels of Pb and erythrocyte AChE activity in pregnant women in an urban area of Rio de Janeiro.

METHODS: Cross-sectional study with 139 pregnant women enrolled in the Rio Birth Cohort Pilot Study in the third trimester of pregnancy. Socioeconomic and lifestyle data were obtained from a structured questionnaire. AChE activity was measured by the Ellman (1961) method modified by Oliveira-Silva (2000). Lead concentrations were measured in whole blood using inductively coupled plasma mass spectrometry (ICP-MS). Linear regression and Spearman correlation were used to assess the association between lead levels and erythrocyte AChE activity.

RESULTS: The median of lead concentrations in the whole blood of pregnant women was 3.9ug/dL (n=119). A weak negative correlation was observed between lead levels and AChE activity (rho= -0.289; p= 0.002). Elevated levels of lead seems to inhibit erythrocyte AChE activity (β= -0.30; 95%CI: -0.54, -0.06) in age-adjusted models.

CONCLUSIONS: Our results suggest that lead can inhibit erythrocyte AChE activity in pregnant women. This evidence reinforces the need to investigate a relationship little explored in the literature may indicate mechanisms of lead toxicity in humans.

P-0349 Persistent organic pollutant levels in maternal blood, umbilical cord blood, and breast milk: Results from the Rio Birth Cohort pilot Study, Brazil

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BACKGROUND AND AIM: Environmental exposure to 11 polychlorinated biphenyls (PCB) and 17 organochlorine pesticides (OCP) were evaluated in maternal blood, umbilical cord blood, and breast milk of women living in Rio de Janeiro, Brazil.

METHODS: The concentration of PCBs 28, 31, 52, 101, 105, 118, 128, 138, 153, 156, 180 and the OCPs DDT, chlordane, HCH, dicofol, dieldrin, endosulfan, metoxichlor, mirex, and pentacloroanisol, as well as some isomers and metabolites, were measured in 135 samples of maternal blood, 116 samples of umbilical cord blood, and 40, 47 and 45 breast milk samples during 1st, 3rd, and 6th follow-up months using gas chromatography triple quadrupole mass spectrometry (GC-MS/MS). Women were also asked to answer an enrollment questionnaire that included reproductive, lifestyle, residential, and sociodemographic questions.

RESULTS: The most commonly detected OCPs metabolites in the maternal blood were 4,4'-DDE (22.2%); β (8.9%); ɣ-HCH (7.4%); PCB 28 (4.4%); and PCB 153 (2.2%). In the umbilical cord blood, the most frequently found compounds were 4,4'-DDE (15.6%); 4,4'-DDT (10.4%); 4,4'-DDD (7.9%); β-HCH (11.2%), PCB 28 (4.3%); and PCB 153 (5.2%). In addition, p,p'-DDE was detected in 45, 47, and 13% of breast milk samples of the 1st, 3rd, and 6th follow-up months. Although not statistically significant, ∑DDT levels were higher among women with a pregestational BMI ≥30, non-white, and those older than >40 years. On the other hand, newborns with an Apgar score ≤8 at minute 5 of life showed significantly higher levels of ∑DDT in the umbilical cord blood.

CONCLUSIONS: Several persistent OCPs and PCBs were detected in the umbilical cord and maternal blood, and only p,p'-DDE was quantified during the three follow-ups. Although the concentrations of OCPs and PCBs were relatively low, they still pose a risk to the mothers' health, the pregnancy outcome, and the infants' post-natal development.

P-0350 The role of epidemiology studies in chemical risk assessment to inform risk characterization of vulnerable populations in Canada

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BACKGROUND AND AIM: The enhanced protection of vulnerable populations through the assessment of chemicals was a commitment made by the Government of Canada in 2018. Health Canada considers vulnerable populations in the assessment of existing chemical substances under the Canadian Environmental Protection Act (CEPA) (1999). Vulnerable populations include those in the general population with greater levels of exposure levels and/or increased biological susceptibility, resulting in the need for additional risk characterization. The populations considered in Screening Assessment Reports (SAR) may include infants and children, pregnant females, Indigenous communities and communities in close proximity to point source exposures, including commercial or industrial facilities. The aim of this abstract is to summarize and highlight the use of epidemiology data in risk characterization of chemical substances in vulnerable populations.

METHODS: An exploratory review of both draft and final SARs published by Health Canada and Environment and Climate Change Canada, as well as special publications was conducted. This review investigated the use of epidemiology data in chemical risk assessment, highlighting the use of epidemiology data in the assessment of vulnerable populations.

RESULTS: Several reports were identified that used observational data such as Zinc and Selenium. Observational data is used in numerous ways in these reports including characterizing exposure (concentrations of exposure, identification of exposure scenarios), informing the hazard of a substance (outcomes that cannot be assessed in animal models, populations with increased susceptibility), and characterizing risk (clarifying the mechanism of action, supporting the relevance of animal data to humans).
CONCLUSION: The consideration of epidemiological data in the risk assessment of chemical substances is an emerging area that requires further evaluation and research efforts to address the needs of vulnerable populations.

KEYWORDS: vulnerable populations
Health Canada
risk assessment

P-0353 Exposure to mercury and associated factors in Portuguese adolescents

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Due to its well-known neurotoxicity and endocrine disrupting potential mercury has been recognized as a chemical of concern by governments and citizens alike, leading to the adoption of the Minamata Convention on Mercury in 2017 by 127 countries. This work aimed to evaluate exposure to mercury in Portuguese adolescents and simultaneously to increase their knowledge and awareness about the possible effects of mercury exposure and ways to reduce it. for that, the research team together with a group of teenagers from a school in Lisbon and their teachers developed and implemented a human biomonitoring survey.

Students from the 11th and 12th grades performed recruitment at the school under the supervision of their biology teachers and after having received training from researchers. Hair samples and data on possible mercury exposure sources (e.g. seafood consumption, dental amalgams) were collected. Atomic absorption spectrometry with thermal decomposition and gold amalgamation was used to analyse samples, alongside with human hair certified reference material. The study was approved by the school's Pedagogical Board and the National Data Protection Authority.

A total of 92 students were recruited. They were aged 12-18 years, 56.5% were females, most lived in urban areas (91.3%) and the majority (97.8%) didn't have dental amalgam fillings nor used hair dye. Participants' BMI ranged from 15.1 to 28.4 kg/m2, with a mean of 20.6 ± 2.6 kg/m2. Total mercury in hair ranged from 0.01 to 3.32 µg/g, with a mean of 1.09 ± 0.66 µg/g. Around 40% of the students had mercury levels higher than US-EPA reference limit (1 µg/g), while 9.8% exhibit levels higher than WHO reference dose (2 µg/g). Higher mercury levels were significantly associated with higher consumption of fish, namely seawater fish, and with having dental amalgam fillings, but not with shellfish or seaweed consumption.

KEYWORDS: mercury, students, citizens science, Portugal

P-0358 Low-level cadmium exposure and atherosclerosis in the carotid arteries: results from the Swedish population-based cohort SCAPIS

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BACKGROUND AND AIM: Cadmium exposure is associated with atherosclerosis and cardiovascular mortality. Few studies have, however, examined how cadmium affects the atherosclerotic burden. We investigated the association between cadmium exposure and atherosclerotic burden in a Swedish population-based cohort.

METHODS: We performed a cross-sectional study using data from the Swedish CardioPulmonary bioImage Study (SCAPIS), including 5622 middle-aged men and women, enrolled 2013-2018. Cadmium was measured in whole blood (B-Cd) using inductively coupled plasma mass spectrometry. Presence of atherosclerotic plaque (yes/no, uni-/bilateral), total plaque area (mm²) and presence of large plaques (>25 mm²), all measured in the carotid arteries by high-resolution ultrasonography, were used as outcomes. Associations between B-Cd (in quartiles, Q1-4) and the different outcomes were analyzed using Poisson (for dichotomized outcomes) and linear (for continuous outcomes) regression and adjusted for cardiovascular risk factors and confounders.

RESULTS: Atherosclerotic plaques were present in 57% of the individuals, for whom the median total plaque area was 16 mm² (range: 0.2-222). The median B-Cd concentration was 0.24 µg/L (range: 0.01-8.5). In multivariable-adjusted models, individuals in the fourth quartile of B-Cd (Q4) had a prevalence ratio (PR) for plaque of 1.10 (95%CI: 1.01, 1.19) when compared with the first quartile (Q1). Individuals in Q4 had on average 3.8 mm² larger plaques (95%CI 0.78, 6.7) and a 27% increased risk of having large plaques (95%CI 0.93, 1.74) compared with individuals in Q1. The PR for bilateral plaques for individuals in Q4 vs Q1 was larger than that for unilateral plaques [PR 1.21 (95%CI 1.06, 1.4) and PR 1.09 (95%CI: 0.96, 1.24), respectively]. Estimates were larger for men and for current smokers.

CONCLUSIONS: Our study shows that increasing cadmium exposure is associated with a larger atherosclerotic burden and reinforces the urgent need of public health measures to reduce cadmium exposure in the general population.

KEYWORDS: cadmium, atherosclerosis.

P-0359 Tattoos: a new ancient carcinogen?

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Tattoo prevalence has been rising steeply during the last decades, a development seen worldwide mostly in the younger age groups. However, only few are aware that tattoo inks may contain harmful environmental and chemical contaminants classified as (probably) carcinogenic to humans. Amongst them are polycyclic aromatic hydrocarbons, primary aromatic amines and metals. However, as studies underlying this classification did not consider subcutaneous exposure, it remains to decipher whether tattoos might cause cancer in humans.
As it is known that the largest part of the nano- and microparticle sized injected tattoo pigments travels to the local lymph node and, from there, potentially to other organs, the systemic exposure is not restricted to the skin. Especially in young individuals exposure to tattoo ink is worrisome as they will have a long-term exposure to these substances. To understand the potential relationship of tattoos and certain kinds of cancer, epidemiological studies are needed, which are scarce worldwide. A sound study design needs to assure a long-term follow-up of (young) tattooed cohort participants, prospective and objective recruitment of medically confirmed cancer outcomes and the inclusion of major sociodemographic, medical and lifestyle confounders.
This in mind, the first longitudinal population based cohort study on tattoos and cancer is currently being set-up in the framework of the French national cohort “Constances”. The CRABAT (Cancer Risk Associated with the Body Art of Tattooing) study is led by the International Agency for Research on Cancer (IARC) and leverages the infrastructure of the French national cohort “Constances”. Here we present its conceptual framework, study design and exposure assessment.

P-0360 Detection of 4-hydroxychlorothalonil in human serum

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BACKGROUND AND AIM: Chlorothalonil (CHT) is an organochlorine fungicide that has been widely used, e.g. in agriculture but also as wood protectant and paint additive. It has recently been banned in the European Union due to its potential impact on the environment and human health. The transformation product 4-hydroxychlorothalonil (4-OH-CHT) was recently identified using nontargeted analysis in human serum and breastmilk samples. Large knowledge gaps exist, but there are indications that 4-OH-CHT is more toxic and has a higher environmental persistency than CHT. Our aim was to investigate serum levels of 4-OH-CHT in a large human population.

METHODS: We developed a quantitative method for 4-OH-CHT analysis using liquid chromatography-triple quadrupole mass spectrometry (LC-MS/MS). We measured 4-OH-CHT in 1,815 serum samples collected from pregnant women between 1997-2015, which were originally stored in the Swedish Rubella Screening Program Biobank and analyzed as part of the NIH R01 funded Autism and Prenatal Endocrine Disruptors study. Linear regression models were used to assess time trends of 4-OH-CHT.

RESULTS: The validated analytical method performed well and the LOD was 0.1 ng/ml. 4-OH-CHT was detected in all serum samples with a median concentration of 4.1 ng/ml (range: 0.16-38 ng/ml). Concentrations showed clear seasonality, with higher concentrations in the first half of each year. A linear regression of log-transformed 4-OH-CHT by year showed no linear trend.

CONCLUSIONS: To the best of our knowledge, this is the first study to quantify a chlorothalonil metabolite in human serum. 4-OH-CHT does not seem to degrade after 25 years of storage. Concentrations of 4-OH-CHT were higher than expected and suggest a widespread and continuous chlorothalonil exposure in the general Swedish population. More research is needed to explore possible sources of exposure to CHT and 4-OH-CHT, as well as their persistency.

KEYWORDS: Chlorothalonil, emerging chemicals of concern, human biomonitoring

P-0362 The Use of Potentially Toxic Skin Bleaching Products Among Women In Urban and Rural Areas In Lagos State and Investigation of Active Chemicals In Selected Skin Lightening Products

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BACKGROUND AND AIM: The prevalence of skin lightening SL is higher in African nations especially Nigeria and it cuts across all socio-demographic and geographical characteristics. Studies have reported various regulatory failures that remains unabated. This study was aimed at determining the use of SL products among women in urban and rural areas in Lagos state of Nigeria and assessment of SL compounds in selected SL products.
Methodology:
A comparative cross-sectional study carried out in Lagos State, among 1100 women within the age range 18-65 years who resided in rural and urban areas . Respondents were selected using a multi-stage sampling technique and data was collected using exploratory parallel mixed method. The study also involved laboratory analysis of SL compounds in SL products.

RESULTS: Knowledge of SL was significantly higher among rural (83.1%) than urban (87.9%) women ($p<0.05$). Conversely, about half of the respondents in the urban area (45.8%) had positive attitude to SL than rural respondents (36.2%; $p<0.05$). The reported prevalence (82.9%) was significantly higher in rural area than the urban area.
There were very elevated levels of the SL compounds in all categories of SL products. About 90% of the SL chemical compounds analysed were not declared on the ingredient list of the SL products. Similarly, 75% of the SL products had SL chemicals greater than the permissible limits on laboratory analysis.

CONCLUSIONS: There is outstanding gap in the knowledge and attitude to SL in both rural and urban areas of Lagos though there is a shift in the demography of users of SL products. The reported prevalence however is still higher among the rural women. The study highlights huge regulatory failure in cosmetic products. Advocacy, health information literacy and regulatory reinforcement can contribute to the control of SL in Nigeria.

KEYWORDS: skin lightening, skin bleaching, skin toning, cosmetics, chemicals

P-0368 Per- and polyfluoroalkyl substances (PFAS) exposure and sleep health in U.S. adults, NHANES 2005-2014

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BACKGROUND AND AIM Per- and polyfluoroalkyl substances (PFAS) are synthetic chemicals that may induce oxidative inflammatory responses and disrupt the endocrine and the central nervous systems, all of which can influence sleep. This study aims to investigate the association between PFAS exposure and sleep health in adults using the U.S. National Health and Nutrition Examination Survey (NHANES).

METHODS: We analyzed serum concentrations of four PFAS [perfluorooctane sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA)] in 8,015 adults enrolled in five waves of NHANES between 2005 and 2014. Self-reported outcomes include diagnosis of sleep disorder (e.g., apnea, insomnia), insufficient sleep (<6 hours/day), and excessive sleep (>9 hours/day). Weighted multivariate logistic regression was utilized to estimate the association between the sleep outcomes and PFAS (individual compounds and mixtures) modeled continuously (log2) or in exposure tertiles, adjusting for potential confounders. A quantile g-computation was used to estimate the joint effects of PFAS mixtures on the sleep outcomes.

RESULTS: Overall, 8.4% (N=674) of participants had sleep disorder diagnosis, and 14.7% (N=1,177) and 2.8% (N=227) were classified as insufficient or excessive sleep, respectively. A doubling of serum-PFOS concentrations (ng/ml) was associated with lower odds of having diagnosed sleep disorder (OR=0.87, 95%CI: 0.81, 0.93) and experiencing insufficient sleep (OR=0.92, 95%CI: 0.85, 0.99). These inverse associations were also observed for PFAS mixtures, but only among male adults aged 60 and above. Adults with higher exposure tertiles of PFOS, PFOA, and PFNA were associated with higher odds of excessive sleep compared to those in the lowest tertiles.

CONCLUSIONS:PFAS exposure was linked to sleep outcomes in NHANES, but the effect direction varied by the chemical and outcome assessed. Potential influence from reverse causation and selection bias due to pre-existing sleep conditions needs to be considered.

KEYWORDS: Sleep; Chemical Mixtures; Endocrine Disruptors; Exposome

P-0369 Association between lead and cadmium exposure and kidney function and mediation effects of atherosclerosis

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BACKGROUND AND AIM: Environmental lead and cadmium exposure has been associated with reduced kidney function and chronic kidney disease as well as with a higher risk of atherosclerosis. The role of atherosclerosis in the associations between these metals and kidney function has not been studied before. The aim of this study is therefore to assess the associations between lead and cadmium exposure and kidney function and the role of atherosclerosis as a mediating factor.

METHODS: This cross-sectional study used data from the population-based Swedish CArdioPulmonary bioImage Study (SCAPIS) and involved 4804 men and women (50-65 years old), recruited in 2013-2017. Blood cadmium (B-Cd) and lead (B-Pb) concentrations, analyzed using inductively coupled plasma mass spectrometry, were used as exposure biomarkers. Estimated glomerular filtration rate (eGFR) based on serum creatinine and Cystatin C was used as marker of kidney function. Associations between B-Cd and B-Pb (in quartiles, Q1-4) and eGFR was assessed using linear regression models adjusted for known risk factors of renal disease and confounders. Mediation analysis was conducted to evaluate the indirect effect (via atherosclerosis) of lead and cadmium on kidney function.

RESULTS: The median B-Pb and B-Cd was 14µg/L (range: 0.75-178) and 0.24 µg/L (range: 0.0098-8.5), respectively. The median eGFR was 88 ml/min/1.73m2 (range: 17-122). In multivariable-adjusted models, individuals in Q4 of B-Pb had a -1.26 ml/min lower eGFR (95%CI: -2.24, -0.28) compared to those in Q1. This estimate remained unchanged after adjustment for cadmium. In stratified analyses, the effect size was similar for both never and current smokers. The mediation analyses showed that the effect of lead on eGFR is not mediated by atherosclerosis. There were no associations between eGFR and B-Cd.

CONCLUSIONS: Increased lead exposure was associated with a reduced eGFR. This association does not seem to be mediated by atherosclerosis.

KEYWORDS: heavy metals, kidney function, atherosclerosis

P-0370 The association of urinary nickel concentrations with type 2 diabetes and fasting blood glucose levels: A cross-sectional study from the China National Human Biomonitoring

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BACKGROUND AND AIM: Epidemiological studies on the effect of nickel exposure on the prevalence of type 2 diabetes (T2D) in the general population are scarce and remain controversial. We aimed to assess the association of nickel exposure with the odds of T2D and fasting blood glucose (FBG).

METHODS: The study included a total of 10,890 adults aged 18 years or older from the China National Human Biomonitoring conducted in 2017-2018. The urinary nickel concentrations and FBG were measured and lifestyle and demographic data were collected. Weighted multiple regression analyses were used to estimate the associations of urinary nickel concentrations with the odds of T2D and increased FBG.

RESULTS: The weighted median concentration (interquartile range) of urinary nickel was 1.74 μg/L (0.85-3.37 μg/L). After adjusting for potential confounding factors, the urinary nickel concentrations were correlated positively with the prevalence of T2D, and the odd ratios of T2D associated with the highest quartile of nickel concentrations were 1.84 (95% confidence interval (CI), 1.33-2.54) when compared to the lowest quartile. Elevated urinary nickels were associated with higher FBG, each one-unit increase in log10-transformed urinary nickel concentration was associated with a 0.39 (95%CI: 0.20-0.58) mmol/L elevation in FBG in the most adjusted categorical model. In addition, restricted cubic spline analysis showed a significant linear association between nickel exposure and the odds of T2D and FBG levels.

CONCLUSIONS: Our findings suggested that elevated urinary nickel levels may be related to an increase in FBG levels and T2D prevalence in Chinese adults.

KEYWORDS: Urinary nickel levels; type 2 diabetes; fasting blood glucose; China National Human Biomonitoring

P-0377 Exposure to perfluoroalkyl substances, incident Type 2 Diabetes risk and associated metabolic pathway dysregulation in a multiethnic population

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BACKGROUND AND AIM: Growing experimental and epidemiology evidence suggests that exposure to perfluoroalkyl substances (PFAS) increase type 2 diabetes (T2D) risk; however, effects of PFAS-mixtures and underlying mechanisms are unclear. We examined associations of exposure to PFAS-mixture with incident T2D-risk and underlying plasma metabolic-pathways using untargeted metabolomics.

METHODS: We conducted a nested case–control study within BioMe, an electronic health record-linked biobank of >60,000 patients seeking primary care at Mount Sinai Hospital, New York, since 2007. A total of 180 incident T2D cases (33% African Americans, 33% Hispanics, 33% Whites) were matched to 180 controls by age, sex and ancestry. We used liquid-chromatography with high-resolution mass spectrometry, to quantify seven PFAS (PFOS, PFOA, PFHxS, PFHpA, PFDA, PFHpS and PFNA) and measured untargeted metabolomic profiles in prediagnostic plasma. Cases had an average of ~6 years between blood draw and T2D diagnosis. We used (1)Weighted Quantile Sum(WQS) regression to evaluate the PFAS-mixture association with incident T2D risk; (2)performed metabolome-wide association analysis using Hierarchical-Bayesian WQS and logistic regression to separately analyze PFAS-mixture and T2D associations with 656 annotated metabolites, adjusting for confounders. Pathway enrichment analyses were performed using Mummichog. We used inverse probability weighting to account for nested case-control design in PFAS-metabolites analysis. Multiple comparisons were accounted by calculating q-values.

RESULTS: Each tertile increase in PFAS-mixture(ng/mL) was associated with increased odds of incident T2D (OR[95%CI]=1.45[1.01, 2.09]) with PFOS and PFHpA having highest contributions to PFAS-mixture. T2D risk and PFAS-mixture associated top metabolites were aminoadipic acid, cortisol, gamma-glutamylglytamine, sulfolithocholylglycine, n-acetylaspartic acid and top pathways were alanine and aspartate metabolism, C21-steroid hormone biosynthesis and metabolism, androgen and estrogen biosynthesis and metabolism(p-value<0.05;q-value >0.2).

CONCLUSIONS: Exposure to PFAS mixtures may dysregulate pathways of amino acid metabolism and steroid-hormone biosynthesis and metabolism, increasing risk of T2D diagnosis in multiethnic populations.

KEYWORDS: Perfluoroalkyl-substances; Endocrine disrupting chemicals; Type 2 Diabetes; Metabolomics

P-0379 The Breast Milk Perfluorome is Associated with Infant Growth in the First Year of Life

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BACKGROUND AND AIM: Early life exposure to poly- and perfluoroalkyl substances (PFAS) has significant obesogenic effects that are manifested in early life. However, PFAS examined do not include the wide range of PFAS used in commercial applications.

METHODS: This pilot included 56 Hispanic mother-child pairs from Southern California. Maternal and infant characteristics were assessed, including infant weight, length, and fat mass. All mothers were breastfeeding, and breast milk was collected at 1-month postpartum. The perfluorome was characterized using untargeted high-resolution mass spectrometry. Organofluorine compounds were identified using the EPA CompTox Dashboard. Multivariable linear and logistic regression analyses were used to examine associations between PFAS with growth measures (12-months, change in first year, rapid growth) after adjusting for infant age, sex, pre-pregnancy BMI, gestational age, and formula feedings. Results are reported for associations with $p<0.05$ and were considered statistically significant using a false discovery rate (FDR) of 20%.

RESULTS: 484 suspect PFAS compounds were detected in ≥75% of samples. PFAS were associated with 12-month weight [n(%): 10(2.1%) positive, 12(2.5%) negative], change in weight [10(2.1%) positive, 22(4.5%) negative], 12-month length [21(4.3%) positive, 17(3.5%) negative] change in length [22(4.5%) positive, 25(5.2%) negative], 12-month fat mass [9(1.9%) positive, 12(2.5%) negative], and change in fat mass [18(3.7%) positive, 21(4.3%) negative]. Additionally, 12(2.5%) and 13(2.7%) of PFAS compounds were associated with an increased (OR=2.0-3.8) and decreased odds (OR=0.28-0.47) of rapid growth in the first, respectively. After FDR, three compounds, each detected in >98% of samples, were associated with change in length (q=0.01; n=2 positive, n=1 negative). Tentative annotations of these compounds identified novel PFAS, including methyl 4,4,5,5,5-pentafluoropent-2-ynoate3,4,4,5,5-Pentafluoro-2-methoxycyclopent-2-en-1-one, ethyl [5-(heptafluoropropyl)-1-methyl-1H-pyrazol-3-yl]acetate, and ethyl 2-acetyl-4,4,5,5,5-pentafluoro-3-oxopentanoate.

CONCLUSIONS: Results from this pilot suggest that a wide range of PFAS are present in human breast milk, which may impact infant growth in the first year of life.

KEYWORDS: breast milk, PFAS, infants

P-0380 Lindane use and the incidence of thyroid cancer in the USA; an ecological study

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INTRODUCTION: The increased thyroid cancer incidence rate may potentially be partially attributable to exposure to chemicals with endocrine disruptive properties. Lindane is an organochlorine pesticide with endocrine disruptive properties that has been classified as carcinogenic to humans. The aim of this ecological study was to evaluate potential correlation between Lindane exposure and thyroid cancer incidence in the USA (US).

METHODS: Data on age-adjusted thyroid cancer incidence rate (per 100,000 people) was obtained from the Centers for Disease Control and Prevention for all US states for 2018. Lindane use was obtained from the US Geological Survey and presented in quintiles for the years 1992 and 2007 to consider latency period. Trend of Lindane use between 1992 and 2007 was calculated using Mann Kendall correlation test. Lindane use estimates per cropland (kg/acres cropland) were overlaid on the map of age-adjusted thyroid cancer incidence rate using ArcGIS. Correlation between statewide Lindane use and age-adjusted thyroid cancer incidence rates was calculated using Spearman correlation.

RESULTS: Overall Lindane use decreased significantly between 1992 and 2007 ($T = -0.617$; $p < 0.001$). Statewide differences in the patterns of Lindane use as well as thyroid cancer were found, with high rates of thyroid cancer and Lindane use reported in several states including Delaware and Georgia. There was no statistically significant correlation between thyroid cancer incidence rates in 2018 and Lindane use in 1992 ($r=0.075$; $p=0.689$) nor Lindane use in 2007 ($r=0.01$; $p=0.935$), among males and females combined.

CONCLUSIONS: Restrictions clearly seem to be effective in reducing Lindane use. While, overall, there was no evidence of a correlation between thyroid cancer and Lindane use, more research is needed to explore this further specifically in highly exposed populations (e.g. rural areas) with longitudinal studies that assess the effects of long-term exposure to Lindane and other organochlorine pesticides.

P-0385 Exposure of adults aged 18 to 44 years to personal care products (PCPs) in Beijing, China: urinary levels, exposure patterns and risk evaluation.

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BACKGROUND AND AIM: PCPs, including parabens, benzophenones and antimicrobials, are a group of typical EDCs that widely applied in various consumer products and industrial applications. Concern for adverse effects on human health arises from results of in vitro and in vivo experiments. The purpose of this study was to assess the characteristics of exposure to PCPs and to provide a preliminary assessment of exposure levels and health risks within typical PCPs in the target population in combination with estimated daily intake (EDI) and risk entropy (HQ).

METHODS: 15 PCPs were measured in 127 spot urine samples collected from Beijing residents aged 18 to 44 years from November 2021 to January 2022. Individual specific gravity (SG) was used to correct for urinary dilution. Since distributions of PCPs concentration were right skewed, non-parametric statistics were used. The relationships between different parabens and benzophenones were determined using the Spearman correlation coefficient. The difference of PCPs concentration in various demographic characteristics, such as gender and age, were compared by Mann-Whiney test.

RESULTS: We found that PCPs were ubiquitous in all urine samples, with methyl paraben(MP), ethyl paraben(EP) and propyl paraben(PP) being the main compounds with median concentrations of 27.08 μg/L, 0.76 μg/L and 1.16 μg/L, respectively. Non-parametric tests showed statistically significant differences in gender for 8 PCPs. There was a significant positive correlation between MP and PP concentrations, Benzophenone-1、Benzophenone-3 and Benzophenone-4 concentrations. The median EDI-urine values of PCPs varied in the range of 20.01~88,295 ng/kg-bw/day. More than 5% of the target population exhibited greater HQs > 1 for individual PCPs.

CONCLUSIONS: The high correlation between the different PCPs suggests that they may have the same and/or similar original sources. Exposure to PCPs might be a critical factor contributing to adverse health effects in Beijing residents.

KEYWORDS: PCPs, EDI, risk assessment

P-0386 Persistent Organic Pollutants and Dysregulation of microRNAs Expression in Humans and Animals - A Systematic Literature Review

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BACKGROUND: MicroRNAs (miRNAs) are key regulators in many physiological processes. Evidence suggests that exposure to persistent organic pollutants (POPs) is associated with miRNA dysregulation. Exposure to POPs is ubiquitous and these chemicals are characterized by their environmental persistence. It is therefore of public health concern to understand the relationship between POPs and miRNA as it relates to health outcomes.
OBJECTIVES: The objective of this systematic review is to evaluate the relationship between exposure to POPs including per- and polyfluoroalkyl substances (PFAS), polychlorinated biphenyls (PCBs), dichloro-diphenyl-trichloroethane (DDT), hexachlorobenzene (HCB), and polybrominated diphenyl ethers (PBDEs), with miRNA expression in both human and animal studies.

METHODS: The systematic search of the literature was conducted in PubMed and Embase. Search results of human and animal studies were included if they included at least one POP of interest in relation to at least one miRNA. Data were synthesized to determine the direction and statistical significance of associations between POPs and miRNA. Finally, a review of disease pathways was conducted for miRNAs that were consistently associated with POPs.

RESULTS: Our search identified 35 studies, 8 of humans and 27 of model organisms. PFAS were associated with decreased expression of miR-144, miR-19 and miR-193, and increased expression of miR-26b, miR-199a-3p, miR-122 and miR-128 across studies. PCBs were associated with increased expression of miR-15a, miR-21, miR-1537 and decreased let-7b in both humans and animals. Pathway review suggested that PFAS-associated miRNAs are all involved in prostate cancer, hepatocellular carcinoma and nonalcoholic fatty liver disease, while PCB-associated miRNA are associated with gastric cancer.

CONCLUSIONS: This is the first systematic review of the association of POPs with miRNAs in humans and model organisms. Large-scale prospective human studies are now warranted to examine the role of miRNAs as mediators between POPs and health outcomes.

KEYWORDS: persistent organic pollutants, miRNAs, systematic review

P-0388 Associations of blood lead and cadmium co-exposure and hepatic dysfunction: A cross-sectional study among Chinese adults aged 18 and older

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BACKGROUND AND AIM: Lead (Pb) and cadmium (Cd) were once toxic metals of occupational importance, but are now more harmful as environmental pollutants. Current evidence on the relationship between Pb and Cd co-exposure on liver function are still limited and findings remain conflicting. This study focused on studying the effects of Pb and Cd alone and co-exposure on liver function among Chinese adults aged 18 years and older.

METHODS: The study used data from the China National Human Biomonitoring (CNHBM) in 2017-2018. Pb and Cd levels were measured in whole blood. Alanine aminotransferase (ALT), Aspartate aminotransferase （AST） and γ-glutamyl transpeptidase （γ-GT） were selected as the hepatic function biomarkers. Combined effect of blood Pb and Cd were assessed using logistic regression.

RESULTS: The median of blood lead and blood cadmium in the population were 23.38 μg/L and 0.83 μg/L, respectively. In the joint association analyses of blood Pb and Cd, significant p-interaction values were found in all elevated hepatic biomarkers, indicating there was an interaction between these two metals. for biomarker ALT, in full adjusted model, the ORs of subjects with low Pb and high Cd, and high Pb/Cd were 1.37(1.03, 1.84) and 1.55 (1.16, 2.07), compared to those with low Pb/Cd, respectively. Similar results were exhibited in the biomarker AST. for biomarker γ-GT, the ORs of subjects with high Pb and low Cd, and high Pb/Cd, were 2.02(1.26, 3.23) and 1.97(1.27, 3.05) after adjusting for confounders.

CONCLUSIONS: Co-exposures of Pb and Cd were associated with hepatic dysfunction, efforts should be made to further reduce environmental Pb and Cd exposure in order to weaken the interaction effect.

KEYWORDS: lead, cadmium, co-exposure, liver, Chinese adults

P-0392 Relationships between urinary phthalate metabolites and lipidomic profile in a Taiwanese elderly population

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BACKGROUND AND AIM: Phthalate exposure has been associated with circulating lipid composition. However, limited epidemiological study has been carried out in elderly people. Therefore, we conducted a cross-sectional study to examine the associations between urinary phthalate exposure and lipidomic profile in Taiwanese elderly people.

METHODS: A cross-sectional survey of the elderly (age >= 65 years) was conducted in Taipei city, New Taipei City, Hualien County, Chiayi County, and Kaohsiung City in Taiwan. A total of 11 urinary phthalates metabolites and 86 lipids (phosphatidylcholines (PCs) and sphingomyelins (SMs)) were assessed. Demographic information was obtained by a structured questionnaire. Serum lipidomic profile was identified using principal component analysis (PCA). A two-step analysis was performed. We first performed multiple linear regressions to evaluate whether urinary phthalate metabolites were related to the PCA-derived components of serum lipid concentrations. Then we performed multiple linear regressions to investigate each of the lipids that were suggestively correlated with some of the phthalates in PCA. Urinary concentrations of phthalate metabolites were log-transformed to normalize distributions.

RESULTS: A total of 886 participants (58.9% women) were included in the final analysis. There were ten components identified by PCA, which accounts for 63.2% of total variance. After adjusting for age, sex, body mass index, urinary creatinine, urinary phthalate metabolites were correlated with 6 components. Among them, component 7 was correlated with the most phthalates metabolites (Bonferroni corrected p-value < 0.007). Monomethyl phthalate (MMP) and monobutyl phthalate (MnBP) were negatively correlated with component 7, whereas monoisobutyl phthalate (MiBP), monobenzyl phthalate (MBzP), and monoisononyl phthalate (MiNP) were positively correlated with component 7. Among component 7, PC(16:0/16:0), PC(16:0/17:1), PC(16:0/18:1), PC(16:0/19:5), PC(16:0/20:5), PC(16:0/22:4), PC(38:0), PC(P-16:1/22:5), PC(P-40:4), and PC(P-40:5) were highly loaded.

CONCLUSIONS: Urinary phthalate metabolites were correlated with the lipidomic pattern. Most of them were diacyl-phosphatidylcholines, which might play a role in hepatic lipid metabolism.

P-0401 Exploratory Analysis of Relationship of Trihalomethane Levels in Water for Human Consumption and Health Profile in Municipalities of Sao Paulo State in Brazil

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Presence of chemicals, heavy metals (such as lead, arsenic) and agrochemicals in various regions are causing environmental and human health impacts. Water used for human consumption has been seen as a serious public health problem in Brazil, like in several countries. High levels of sanitary higienization products have been dumped into our effluents, with chlorine as the main halogen in its composition. The degradation of chlorine with the formation of trihalomethanes has been the object of study in several regions of Brazil, especially for its potential in carcinogenesis. The state of SP has a population of about 50 million people and has the best levels of sanitation in the country. Nevertheless, it does not analyze the relationships between levels of trihalomethanes and their impacts on public health. The objective of this study was to analyze the database referring to the presence of trihalomethanes in water for human consumption in 645 municipalities in the state of São Paulo in the last decade. The information was with exploratory analysis associated to the main pathologies responsible for the mortality profile in each municipality. The information banks of the national health system - DATASUS and the national water information system - SISAGUA were used. In the results we founded specific clusters of some specific groups of pathological, as compared to the international ICD 10 classification. Conclusion : In Brazil, the legislation is in a process of recent change with the confrontation of the current databases, contributing in the discussion on preventive measures in public health

KEYWORDS: Chemicals, Trihalomethanes, Water, Public Health

P-0403 Astrocyte-derived extracellular vesicles: novel biomarkers of CNS metal exposure and elimination with applications in discerning the pathogenesis of neurodegenerative diseases

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BACKGROUND AND AIM: Amyotrophic lateral sclerosis (ALS) is a fatal neurodegenerative condition, and though environmental exposure to metals has been associated with ALS, there are no existing biomarkers for these potentially causal environmental exposures – a biomarker for toxicant load in the central nervous system is greatly needed. Upon exposure to toxic metals in vitro, central nervous system (CNS) astrocytes, critical in metallohomeostasis, were observed to produce extracellular vesicles loaded with metals, potentially as a cellular elimination pathway. Metals are known to bioaccumulate in the CNS; EVs originating from the CNS (CNS-EVs) are readily found in peripherally drawn blood and can be isolated using cell-specific surface proteins. This study examines whether blood-borne CNS-EV metal cargoes can serve as reliable biomarkers of CNS metal exposure and reveal a link between metal metabolism and neurodegenerative disease (i.e., ALS).

METHODS: Precautions were undertaken to ensure EV protocols were completed under metal-free conditions. CNS-EVs were isolated from human whole blood and plasma samples via direct immunoprecipitation using biotinylated antibodies for proteins expressed on astrocytes. Once EVs were isolated, ELISA analysis generated protein concentrations, ViewSizer Nanoparticle Tracking analysis quantified abundance, and Transmission Electron Microscopy visualized particles. EVs were analyzed for metal contents using a Perkin-Elmer NexION 350S via an ICP-MS/MS dynamic reaction cell method.

RESULTS: Results demonstrate that it is feasible to quantify the small quantities of metals within these CNS-derived EVs, particularly in terms of toxic metals known to be associated with neurodegenerative disorders, including copper, zinc, lead, aluminum, manganese, and iron.

CONCLUSIONS: CNS-derived EVs isolated from peripheral blood draws show promise as a potential biomarker of metal exposure and/or elimination in the brain and spinal cord, with promising applications in understanding the potential environmental pathogenesis of neurodegenerative disorders (i.e., ALS) among patients with relevant elevated CNS metal loads.

P-0404 Determinants of exposure to phenols, phthalates, parabens and triclosan in pregnant women, Colombia

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INTRODUCTION: Phenols, phthalates, parabens and triclosan are endocrine disruptors (1) and human beings are exposed daily through contact with skin, water, food and the air they breathe, these compounds are measured in urine (2).
OBJECTIVE: to determine the sources of exposure to phenols, phthalates, parabens and triclosan in pregnant women.

METHODS: study carried out in 400 women with ≤12 weeks of pregnancy from two institutions in Medellín. Demographic, nutritional and environmental exposure characteristics were investigated and 37 metabolites in urine were quantified at the Norwegian Institute of Public Health (NIPH), by means of ultra-high resolution liquid chromatography coupled to tandem mass spectrometry (UPLC-MS- MS) and dilution correction for specific gravity. Using t-student, differences were observed in the geometric measurements according to exposure determinants.

RESULTS: significant differences were found in the geometric means of Propyl Paraben (PRPA) according to the use of floor cleaners (yes: 7.94ng/mL 95% CI: 4.70-13.43; no: 18.76ng/mL 95% CI :9.21-38.21), Mono-iso-butyl phthalate(MiBP) given exposure to second-hand tobacco (yes:12.56ng/mL 95% CI:10.00-15.78; no:19, 94ng/mL 95% CI:14.86-26.76) and from exposure to the use of cosmetics, the GM of some phthalates were, Mono-4-methyl-7-oxooctyl phthalate(oxo-MiNP) [si:3, 03ng/mL 95% CI: 2.35-3.92; no:5.58ng/mL 95% IC:2.28-13.67], Mono-4-methyl-7-carboxyoctyl-phthalate(cx-MiNP) [yes:7.08ng/mL 95% IC:6.24- 805; no:11.28ng/mL 95% CI:5.57-23.26], 6-Hydroxy-Monopropylheptylphthalate(OH-MPHP) [yes:1.68 ng/mL 95% CI:1.51-1.86; no: 2.18ng/mL 95% CI: 1.39-3.41].

CONCLUSIONS: the determinants of exposure to phenols, phthalates, parabens and triclosan in pregnant women in the study were the use of floor cleaners, second-hand tobacco and the use of cosmetics.

KEYWORDS: phenols, parabens, triclosan, endocrine disruptors, urine

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P-0405 Descriptive analysis of victims of poisoning, suicide attempts and deaths from pesticides in Brazil between 2010 and 2020

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Between 2010 and 2021, 3,474 new pesticides were registered and authorized in Brazil, of which 76.5% were only between 2016 and 2021. An increase of 540% in registrations of new pesticides when compared to 2010. As a result of this policy and with the approval in the first vote, in 2022, by the Brazilian Congress of the so-called poison package, this scenario could be even worse in the short and long term, with incalculable impacts on the health of the population and the environment. OBJECTIVES: To describe and analyze the profile of victims of pesticide poisoning, suicide attempts and deaths from agricultural, domestic, public health, rodenticide and veterinary pesticides between 2010 and 2020.

METHODS: Descriptive cross-sectional study. Data were collected from the Ministry of Health database – DATASUS.

RESULTS: There were 135,803 cases of intoxication, 73.2% of intoxications were not due to exposure at work; 71,009 suicide attempts and 3,944 deaths from poisoning, with 48.8% of the deaths being between black/brown and 36% white; 74.6% of intoxications were in urban residents and 21.9% in rural areas and 94.5% of deaths were not related to work. 712 of the victims of attempted suicides were younger than 1 year and 4 years old, 10,834 of the victims were between 10 and 14 years old.

CONCLUSIONS: The results point to higher rates of poisoning, suicide attempts and deaths from pesticide poisoning among black/brown children, with low schooling and, for the most part, living in urban areas and belonging to black/brown color/ethnicity. and no exposure to work.

KEYWORDS: Pesticides, intoxications, deaths, suicide, ethnicity.

P-0407 Mixture effects of gestational synthetic phenol and phthalate exposures on the neuro-behavior of children in the Healthy Start cohort

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BACKGROUND: Simultaneous exposure to multiple endocrine disruptors may be harmful even when individual exposures for which individual effects may be below observable levels. We sought to assess the effects of prenatal exposure to a mixture of phthalates and phenols on the neuro-behavior of preschool-aged children.
METHODOLOGY: In a sample of 293 mother-infant pairs from the Healthy Start pre-birth cohort, sixteen phthalate metabolites and phenols were assessed in maternal spot urine samples from mid-pregnancy. Behavioral outcomes in preschool children (4-5 years) were assessed using the child behavior check list (CBCL). We computed 3 composite scales for total behavioral, externalizing and internalizing problems. Covariate-adjusted weighted quantile sum (WQS) regression was used to estimate associations between the mixture of phenols and phthalates and the behavioral scales.

RESULTS: WQS regression indicated a positive trend with the externalizing scale. We observed a 0.15 points (95% CI: -0.02; 0.33, p-value = 0.09) increase in the externalizing problems' score for one tertile increase in the WQS index. The major contributors to this mixture effect were Di-isononyl phthalate (DiNP) (with a weight of 24%), Benzophenone-3 (22%), triclosan, methyl paraben (11%), MEP (7%) and bisphenol A (6%). No statistically significant (p-values > 0.1) associations were observed with the total (beta = 0.06(CI 95% -0.04; 0.16)) and internalizing (beta = -0.09(CI 95% -0.29; 0.11)) composite scores.

CONCLUSIONS: Exposure to mixtures of phenols and phthalates in utero may induce behavioral problems during early childhood. Future policy guidelines on exposure limits to these compounds should consider mixture effects as they are increasingly being reported in epidemiological studies.

P-0410 The effects of combined exposure of lead and stress during pregnancy on cognitive development in offspring

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BACKGROUND AND AIM: To assess the current exposure levels of lead and stress during pregnancy, and compared the effects of prenatal combined exposure of lead and stress during different stages of pregnancy on the neurodevelopment of offspring.

METHODS: A total of 5270 mother-child pairs were assessed in the Shanghai Birth Cohort, maternal blood lead in early pregnancy and umbilical cord blood lead were measured. Assessments of prenatal maternal stress, the Center for Epidemiological Studies-Depression Scale and the Self-Rating Anxiety Scale during mid-pregnancy, postnatal maternal stress using the Edinburgh Postnatal Depression Scale were conducted, and groups of prenatal single exposure to lead/stress and combined exposure were therefore formed. The Ages-Stages-Questionnaires (at 6- and 12-months-of-age) and the Bayley-III (at 24-months-of-age) were performed to assess the offspring neurodevelopment.

RESULTS: The geometric means of maternal blood lead in early pregnancy and umbilical cord blood lead were 1.45 μg/dL and 1.53 μg/dL, respectively. A total of 1.86% and 0.18% of the mothers were screened positive for depression and anxiety. Adjusting for related confounders, the prenatal combined exposure in early pregnancy was associated with more deficits in infant communication skills and social-emotional skills, especially in social-emotional at 24-month-old (P=0.016); the prenatal combined exposure around birth was adversely associated with infant neurodevelopment levels in multiple domains.

CONCLUSIONS: The prenatal combined exposure to lead and stress may affect offspring neurodevelopment more profoundly (especially on social-emotional development), and the combined exposure in early pregnancy may induce more deficits in offspring social-emotional development than the combined exposure around birth.

KEYWORDS: Lead exposure; Maternal stress; Pregnancy; Prenatal exposure; Cognitive development; Birth cohort;

P-0412 Early life organophosphate ester exposures and bone health at age 12 years: The Health Outcomes and Measures of the Environment (HOME) Study

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BACKGROUND AND AIM: No human studies have evaluated early life organophosphate ester (OPE) exposures with bone health outcomes, despite evidence of osteotoxicity. We assessed associations of urinary OPE metabolites measured across early life with bone mineral content (BMC) and areal bone mineral density (aBMD) at age 12 years.

METHODS: Among 223 mother-child dyads enrolled in the Health Outcomes and Measures of the Environment (HOME) Study, we quantified concentrations of bis-2-chloroethyl phosphate (BCEP), bis-(1,3-dichloro-2-propyl) (BDCIPP), di-n-butyl phosphate (DnBP), and diphenyl phosphate (DPHP) in urine collected from mothers during pregnancy and children at ages 1, 2, 3, 5, and 8 years. at age 12 years, we performed dual energy x-ray absorptiometry and calculated BMC and aBMD z-scores at six skeletal sites. Using a multiple informants framework, we estimated overall and sex-stratified BMC/BMD z-score differences per interquartile range (IQR) increase in OPE concentrations at multiple exposure timepoints: gestation (average) and 1–3 (average), 5, and 8 years.

RESULTS: In adjusted models, overall associations of BCEP and BDCIPP with total hip and 1/3rd distal radius aBMD varied significantly by exposure timepoint, as did BDCIPP with whole body aBMD. for example, differences (95% CI) in total hip aBMD z-score per IQR increase in BDCIPP were 0.33 (0.01, 0.65), -0.10 (-0.34, 0.14), -0.17 (-0.40, 0.05), and 0.14 (-0.09, 0.38) for concentrations during gestation and at 1–3, 5, and 8 years, respectively. Overall DnBP and DPHP associations were generally null at all timepoints. We observed sex-specific associations for some timepoints and skeletal sites. for example, an IQR increase in 8-year DPHP was associated with a 0.24 (0.08, 0.39) greater total hip aBMD z-score among females and a -0.15 (-0.39, 0.08) lower z-score among males.

CONCLUSIONS: Early life OPE exposures may be associated with sex- and exposure period-dependent alterations in early adolescent bone mineral accrual and strength.

P-0422 Prenatal exposure to emissions from a coalmine fire and childhood lung function

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BACKGROUND AND AIM: Studies linking early life exposure to air pollution and impaired lung health have focused on chronic, low-level exposure in urban settings. We have previously shown that early post-natal exposure to an acute, high-intensity air pollution episode was associated with mild impairments in peripheral lung mechanics. We aimed to determine whether in utero exposure to the same pollution event impaired lung function 7-years later.

METHODS: We conducted a prospective study in a cohort of children who lived in the vicinity of a coalmine fire that burned for 6 weeks in 2014. Individual exposure to $PM_{2.5}$ from the fire were estimated using dispersion and chemical transport modelling. Respiratory function was measured in children who were in utero during the fire, or conceived after the fire (unexposed), using the forced oscillation technique. Z-scores for resistance at 5Hz(R5), reactance at 5Hz(X5) and area under the reactance curve(AX) were calculated. Regression models were fitted to compare Z-scores of unexposed and in utero exposed children, and to examine the relationship between in utero $PM_{2.5}$ exposure and lung function.

RESULTS: of the 72 children, 22 who were unexposed and 50 exposed in utero, and had acceptable lung function measurements. Medians (interquartile ranges) for daily average and peak $PM_{2.5}$ for the children exposed in utero were 9.2(7.6–20.2) and 124(74–252) $\mu g/m^3$. There were no statistically significant differences between mean R5, X5 or AX Z-scores of unexposed and in utero exposed children. There were no associations between R5, X5 or AX Z-scores and in utero exposure to daily average or peak $PM_{2.5}$. This lack of association was maintained after inclusion of covariates in the models.

CONCLUSIONS: There was no detectable effect of in utero exposure to $PM_{2.5}$ from a local coalmine fire on post-natal lung function 7-years later.

KEYWORDS: Particulate matter, respiratory function, early life, long-term effects

P-0426 The impact of heat waves on children’s kidney health: Systematic review and meta-analysis

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BACKGROUND: Children are known to be particularly sensitive to heat waves, but still there has been little research interest in this area . In particular, a systematic review and meta-analysis is needed to identify the relationship between climate change-related heatwaves and children's kidney health.
METHOD: Papers published between 2000 and 2022 was identified using keywords in PubMed. 320 of 2406 publications searched for "climate change", "heat wave", "children", "kidney" met the selection criteria.
RESULT: In our study we included kidney stones and urolithiasis as kidney disease. This study lists the consistent definitions of heatwaves in each literature from the perspective of children's health impact. Our study explores detailed outcome measures to quantify the effects of heatwaves on children's kidney health, and analyzes the literature to evaluate the effects of heatwaves

CONCLUSIONS: Through this study, the effect of heat wave on children's kidney health, with regards to age, gender and income, and vulnerability to heat wave between countries can be understood. In addition, it will be helpful in predicting the burden of children's kidney disease due to heat wave with respect to climate change, and developing effective heat wave damage mitigation and adaptation strategies.

P-0427 Comparative Analysis of Health Patterns and Gaps due to Environmental Influences in South Korea and North Korea, 2000-2017

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BACKGROUND AND AIM: Children's metabolism is immature and vulnerable to environmental stressors creating a larger burden of diseases. South Korea and North Korea have been isolated from each other and while sharing the same ethnicity and early history, this provides a rich ground for comparative research. The study aims to conduct a comparative study of children's health in South Korea versus North Korea with a focus on air pollution.

METHODS: The study used mortality rate, prevalence, and environmental indicators data from 2000 to 2017 from the World Bank and World Health Organizations. Comparative analysis and trend analysis of the two Koreas were conducted to evaluate changes in health status over time. Spearman's correlation analysis was used to find out the correlation between environmental indicators and children's health status.

RESULTS: The study found a distinct gap in children's health status. While North Korea reported a higher death rate of children than South Korea, it showed a decreasing trend and the gap in children's health status between them narrowed from 2000 to 2017. The prevalence of overweight and obesity increased and that of thinness decreased in both Koreas. Except for PM2.5 exposure, South Korea reported much higher figures in most indicators of air pollutant emissions (South Korea, mean (SD) = 28.3 (2.0); North Korea, mean (SD) = 36.5 (2.8), p-value=0.002).

CONCLUSIONS: The study empirically discovered the gaps and patterns of children's health between South Korea and North Korea. The findings imply epigenetic modification caused by environmental stressors affects children's health in the two Koreas despite sharing similar genetic characteristics. Considering the gaps in children's health between them, more attention and resources need to be directed towards North Korea because the necessary commodities and services to improve children's health are lacking in North Korea.

KEYWORDS: Children's Environmental Health, Child Health, Public Health, Environment

P-0428 Indoor coal ash and school and social competency among children aged 6-14 years old

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BACKGROUND AND AIM: Coal ash, a waste product generated when burning coal for energy, is comprised of small particles with neurotoxic heavy metal(loid)s found to be risk factors for learning and social problems in school. The purpose of this novel study was to assess the association of coal ash in children's homes with school and social competency.

METHODS: We recruited children aged 6-14 years old from communities located within 10 miles of two coal-burning power plants. In homes of the participants, coal ash was collected on polycarbonate filters using personal modular impactors. We measured school competency and social competency using the validated Child Behavioral Checklist. Using Tobit and linear regression we investigated the relationship of indoor coal ash with school and social competency.

RESULTS: Forty-three percent of children in the study had coal ash in their homes. In Tobit models that were adjusted for age, sex, self-reported race, mother's education, and traffic exposure, children with coal ash in their homes scored on average 2.5 (-4.9 to -0.1) points lower on the school competency scale than peers without ash in their homes (p=0.04). We did not observe that coal ash in homes was related with lower social competency.

CONCLUSIONS: Children with coal ash in their homes had poorer performance in the school setting, compared to peers without coal ash in homes. Coal ash consists of small particles, that contains neurotoxins and may be a contributing factor to poor school performance, which potentially impairs children's academic achievement. There are limited regulations on the storage of coal ash and this study provides impetus for more research.

KEYWORDS: coal ash, fly ash, school competency, social competency, school performance, environmental exposure

P-0441 Early life exposure to coal smoke and hospital visitation: findings from a data linkage cohort study

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BACKGROUND AND AIM: The extent to which air pollution exposure in early life could engender modifications of immune responses with long-term health consequences is still largely unknown. The aim of this study was to analyse emergency department (ED) visits and hospitalisations following prenatal and postnatal exposure to severe smoke from the Hazelwood coal mine fire (9 Feb-25 Mar 2014).

METHODS: The Victorian Emergency Minimum Dataset and the Victorian Admitted Episodes Dataset were linked to the Victorian Perinatal Data Collection to obtain ED visits and hospitalisations of children born in the Latrobe Valley, Australia from March 2012 to December 2015. Exposure to fire-related PM2.5 was assigned from gridded modelled estimates based on residential address at birth. Children exposed in utero and in infancy (<1 year old) were investigated separately. Associations between exposure to fire-related PM2.5 and ED presentations and hospitalisations for any cause, respiratory outcomes, respiratory-related infections, any infections, and allergies/skin rash in the first year of life (in utero) or in the year following the end of the fire (infant) were estimated with logistic regression models. Adjustment for potential confounders was performed through multiple regression in the dose-response analysis, and with propensity score weighting when comparing exposure groups.

RESULTS: A dose-response relationship was found between prenatal exposure to PM2.5 and ED presentations for allergies/skin rash (OR=1.14, 95%CI=1.01-1.27 per 100µg/m³) in the first year of life. A cumulative exposure >25 µg/m³ in infancy was associated with higher risks of presenting to the ED for respiratory causes (OR=1.39; 95%CI=1.06-1.81), respiratory-related infections (OR=1.41, 95%CI=1.07-1.86), and any infections (OR=1.21, 95%CI=0.98-1.49) in the year following the fire.

CONCLUSIONS: Exposure to large concentrations of smoke in early life could be associated with allergic and infectious conditions up to one year after return to normal levels of ambient air pollution.

KEYWORDS: Particulate matter; Long-term exposure; Infections; Allergies;

P-0442 Prenatal and early postnatal exposure to air pollution associations with primary care and prescription usage

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BACKGROUND AND AIM: Health consequences of air pollution in early life have been mostly studied in hospital settings, with less focus put on primary care and prescribed medications. The aim of this study was to investigate general practitioner (GP) consultations and prescriptions dispensed following exposure in utero and in the first year of life to the Hazelwood coal mine fire, a severe air pollution episode lasting six weeks.

METHODS: The Victorian Perinatal Data Collection was linked to the Medicare Benefits Schedule and the Pharmaceutical Benefits Scheme for a cohort of children born in the Latrobe Valley, Australia between March 2012 and December 2015. Modelled estimates of fire-related PM2.5 exposure were assigned at the residential address at birth. The total numbers of GP visits and of prescriptions of antibiotics, asthma inhalers and steroid skin creams dispensed in the first year of life or in the year following the fire were extracted for children exposed in utero and in infancy (<1 year old), respectively. Negative binomial regression models estimated associations between each outcome and exposure to fire-related PM2.5, with adjustment made for potential confounders.

RESULTS: Higher levels of PM2.5 in utero were associated with increased asthma inhalers dispensed (IRR=1.07, 95%CI=1.00-1.14 per 100µg/m³ of cumulative PM2.5; IRR=1.27, 95%CI=1.01-1.58 per 50µg/m3 of peak 24-h PM2.5) in infancy. Surprisingly, a cumulative exposure >25 µg/m³ in infancy was linked to fewer GP visits (IRR=0.83, 95%CI=0.68-0.99) in the year following the fire.

CONCLUSIONS: Our findings indicate that prenatal exposure to time-limited severe air pollution could be linked with increased need of asthma medications in infancy. They also suggest that such exposure in infancy could be associated with less GP consultations following extreme events, which could be due to increased needs of specialised and hospital care.

KEYWORDS: Particulate matter; Long-term exposure; Infections; Asthma;

P-0443 Associations of Prenatal First-Trimester Metal Mixtures and Childhood Adipokines in the Project Viva Cohort

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BACKGROUND AND AIM: The adipokines leptin and adiponectin, mainly produced in adipose tissue, are involved in energy homeostasis and insulin sensitivity. Lower adiponectin and higher leptin correlate with older childhood and adult adiposity, while the relationship in young children is less clear. Higher prenatal heavy metals and lower nonessential metals have been associated with childhood adiposity, but it is unclear if prenatal metals influence childhood adipokines.

METHODS: Six nonessential (As, Ba, Cd, Cs, Hg, Pb) and four essential (Mg, Mn, Se, Zn) metals were measured in first trimester red blood cells from pregnant participants in the Boston MA-area Project Viva cohort. Blood leptin and adiponectin were measured in early-childhood (N=527-526; mean 3.3 (SD 0.3) years), mid-childhood (N=426; 8.0 (0.8) years), and early-adolescence (N=477; 13.1 (0.9) years). Linear regression and quantile g-computation models estimated associations between individual and mixtures of metals and adipokines, adjusting for confounders.

RESULTS: Mean (SD) leptin was 1.9 (1.9) ng/ml in early-childhood, 5.6 (6.8) ng/ml in mid-childhood and 11.9 (14.7) ng/ml in early-adolescence. Mean (SD) adiponectin was 22.4 (5.5) µg/ml in early-childhood, 15.7 (8.5) µg/ml in mid-childhood and 6.4 (2.8) µg/ml in early-adolescence. A doubling in arsenic was associated with lower adiponectin at the early-childhood visit (β=-0.40 µg/ml, 95% CI: -0.73, -0.07), while cesium was associated with higher leptin at the early-adolescence visit (β=2.76 ng/mL, 95% CI: 0.22, 5.30). In mixture analyses, adjusting for metals not in the mixture, a quartile increase in nonessential metal mixture was associated with lower adiponectin (β=-0.18 µg/ml, 95% CI: -0.33, -0.03) at the mid-childhood visit.

CONCLUSIONS: Our findings suggest that certain prenatal metals are associated with adipokines in childhood, which might influence cardiometabolic risk. Future work will evaluate if adipokines mediate associations of prenatal metals with adiposity and cardiometabolic risk.

KEYWORDS: Heavy metals, Mixtures analysis, Children's environmental health

P-0444 Newborn Metabolomics linking prenatal air pollution exposure and autism spectrum disorder risk in children

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KEYWORDS: Metabolomics, Autism spectrum disorder, air pollution exposure, pregnancy, oxidative stress.

BACKGROUND: Prenatal PM2.5 and near-roadway air pollution (NRAP) exposures, particularly nonfreeway NRAP, have been associated with increased autism spectrum disorder (ASD) risk in children. However, the underlying biological mechanism is unclear.

Aim: To investigate neonatal metabolic pathways altered by prenatal PM2.5 and NRAP exposures that increase ASD risk.

METHOD: Using electronic medical records, 50 ASD cases diagnosed before age 5 and 50 controls matched on birth year, medical center, sex, and race/ethnicity were randomly selected from all children born at Kaiser Permanente Southern California between 2007-2009. Weekly PM2.5 and monthly nonfreeway NRAP exposures during pregnancy were estimated based on residential history using spatiotemporal prediction and California line-source dispersion models, respectively. Untargeted, high-resolution metabolomics was analyzed in archived newborn dry blood spots, resulting in 26,578 HILIC-positive and 27,614 C18-negative metabolomic features.

Conditional logistic regression was used to identify metabolomic features associated with ASD diagnosis. Linear regression was used to investigate associations between prenatal air pollution exposure and metabolomic features. Beyond matching factors, maternal age, education level and household income categories were adjusted in the analyses. Mummichog pathway analysis was performed to identify metabolic pathways associated with prenatal air pollution exposure and ASD.

RESULTS: Dysregulated aspartate and asparagine metabolism was associated with increased ASD risk($p=0.01$) and higher PM2.5 exposure during the 1st trimester and the entire pregnancy($p<0.001$). Glutamate metabolism was associated with PM2.5 during pregnancy($p=0.028$) and increased ASD risk($p=0.03$). Prenatal nonfreeway NRAP was associated with altered nitrogen ($p=0.027$) and sialic acid metabolism($p=0.038$), while nitrogen metabolism was also associated with increased ASD risk($p=0.02$).

CONCLUSIONS: Dysregulated metabolism reflected in aspartate, asparagine and glutamate was associated with both prenatal air pollution exposure, particularly PM2.5, and increased ASD risk, suggesting newborn oxidative stress and inflammation may be pathways of effects of prenatal air pollution exposure.

P-0445 Neonicotinoid, pyrethroid and organophosphate urinary metabolites in relation to neurobehavioral performance in Ecuadorian adolescents

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BACKGROUND AND AIM: Insecticides, including organophosphates and pyrethroids, have been found to affect the neurobehavioral development of children, but limited evidence exists among adolescents. These insecticides have been slowly replaced by neonicotinoids, but there is little epidemiological data regarding their effects on neurobehavior. We examined the associations between urinary insecticide concentrations and neurobehavioral performance amongst adolescents living in agricultural communities in Ecuador.

METHODS: This study included 522 participants aged 11-17 years who were examined in 2016. Urinary insecticide metabolites were measured using mass-spectrometry and neurobehavior was assessed using the NEPSY-II (domains: Attention/Inhibitory Control, Language, Memory/Learning, Visuospatial Processing, Social Perception). Associations were adjusted for creatinine and demographic, anthropometric, and socioeconomic characteristics. Multiple imputation was used for values below the level of detection.

RESULTS: The mean(SD) neurobehavior scores ranged from 7.03(2.04) to 8.69(2.28). Among organophosphate metabolites, 3,5,6-Trichloro-2-pyridinol (TCPy) was inversely associated with Language (score difference per 50% increase in metabolite concentration [β] = -0.11 [95%CI: -0.50, -0.02]) and para-Nitrophenol (PNP) was inversely associated with Social Perception (β = -0.26 [95%CI: -1.07, -0.20]). There was also evidence of a threshold: TCPy and PNP had significant inverse associations with Attention/Inhibitory Control only at concentrations above the 60th percentile (β = -0.22 [95%CI: -0.43, -0.00] and β = -0.29 [95%CI: -0.54, -0.04], respectively). The pyrethroid, 3-phenoxybenzoic acid (3-PBA), was inversely associated with Language (β = -0.11 [95%CI: -0.48, -0.05]) and had a negative quadratic association with Attention/Inhibitory Control ($p<0.01$). The neonicotinoid, 5-Hydroxy imidacloprid (OHIM), was positively associated with Memory/Learning (β = 0.21 [95%CI: 0.12, 0.93]). These associations did not differ by gender.

CONCLUSIONS: Organophosphate and pyrethroid metabolites were associated with lower performance on Language, Social Perception and Attention/Inhibitory Control, while neonicotinoids were associated with better Memory/Learning scores. These findings highlight the importance of limiting environmental insecticide exposures during developmental years.

KEYWORDS: Insecticides, adolescents, neurobehavior, pesticides

P-0448 Urinary metabolites of volatile organic compounds and polycyclic aromatic hydrocarbons increases the risk of nonalcoholic fatty liver disease in Korean adolescents: A Korean National Environmental Health Survey (KoNEHS) 2015-2017 analysis

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Non-alcoholic fatty liver disease (NAFLD) is one of the most common liver diseases in adolescents and is an urgent public health issue. Several animal studies have suggested that volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) led to NAFLD. However, few epidemiological studies have confirmed the associations of VOCs and PAHs with NAFLD in the general adolescent population. Therefore, we analyzed 798 adolescents from the Korean National Environmental Health Survey (KoNEHS) 2015-2017 to examine the associations of urinary metabolites for VOCs and PAHs with serum alanine aminotransferase (ALT) activity and NAFLD prevalence. We employed linear, logistic regression, and Bayesian kernel machine regression (BKMR) to evaluate the association of urinary VOCs and PAHs metabolites with ALT activity and NAFLD. After adjusting for all covariates, urinary benzylmercapturic acid level and 2-hydroxyfluorene level increased serum ALT activity and NAFLD prevalence. Additionally, the BKMR analyses showed a significantly positive overall effect on ALT activity and NAFLD prevalence with urinary concentrations of VOCs and PAHs metabolites, and 2-hydroxyfluorene contributed the most. Our study suggests that exposure to low-level VOCs and PAHs may have a detrimental effect on NAFLD risk in adolescents. Given the increasing prevalence of NAFLD in adolescents, future cohort studies are warranted to understand these chemicals' impact on NAFLD risk.

KEYWORDS: volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), adolescents, Non-alcoholic fatty liver disease, Korean National Environmental Health Survey (KoNEHS)

P-0450 Effect of prenatal PM2.5 and its constituents exposure and fetal growth pattern on children's accelerated growth in the first three years

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BACKGROUND: No study investigated the effect of prenatal exposure to PM2.5 and its constituents on accelerated childhood growth, with consideration of fetal growth pattern in utero. We aimed to examine the effect of prenatal PM2.5 and its constituents exposure, fetal growth pattern on children's accelerated growth in the first three years.

METHODS: The study was embedded in a population-based birth cohort in China, including 5,424 mother-child pairs. Prenatal PM2.5 and its constituents [organic carbon (OC), elemental carbon (EC), sulfate (SO42-), nitrate (NO3-), and ammonium (NH4+)] concentrations were estimated. Estimated fetal weight (EFW) Z-score by fetal ultrasound examination in second and third- trimester was calculated and then K-means algorithm was used to cluster the fetal growth pattern. Children's accelerated growth was defined as the change of BMI Z-score from birth to three years >0.67. Generalized logistic regression was used to analyze the effect of prenatal PM2.5 and its constituents exposure and fetal growth pattern on children's accelerated growth.

RESULTS: Compared with higher fetal growth, children with lower fetal growth had 1.706 (95%CI: 1.520, 1.915) times higher risk of children's accelerated growth from birth to three years old. An IQR increase in PM2.5, OC, NH4+, and SO42- was associated with 1.147 (95%CI:1.012, 1.300), 1.360 (95%CI:1.113, 1.662), 1.127 (95%CI:1.017, 1.248), and 1.257 (95%CI:1.012, 1.561) times higher risk of children's accelerated growth, respectively. Prenatal PM2.5 and its constituents exposure and fetal growth had joint effect on children's accelerated growth from birth to three years old, especially for OC (RERI:0.485, 95%CI: 0.018,0.952).

CONCLUSIONS: The study suggested that prenatal PM2.5 and its constituents exposure and fetal growth in utero had individual and joint effect on children's accelerated growth from birth to three years old.

KEYWORDS: PM2.5, constituents, accelerated childhood growth, fetal growth

P-0456 Systematic review in 2000-2020 on early childhood developmental conditions of environmental noise exposure

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BACKGROUND AND AIM: Early childhood is a crucial stage of human development. Exposure to noise can alter their development and affect their health, reducing their quality of life. Information to facilitate decision making in this regard is still scarce in several countries, so the aim of this study was to characterize the developmental conditions in early childhood that have been related to environmental exposure to noise based on population-based studies.

METHODS: An exhaustive systematic review was carried out using Cochrane methodology during the period 2000-2020. Publications were included without restriction of language, country or publication type, with information on adverse developmental outcomes in early childhood (0-8 years of age) due to prenatal or concurrent exposure to environmental noise.

RESULTS: Thirty-four studies were selected that addressed early childhood with prenatal or postnatal exposure, grouping the effects into three groups: fetal period (malformations and miscarriage), neonatal period (premature birth, low birth weight, small for gestational age and physiological alterations) and childhood (physiological, constitutional, learning and behavioral alterations). Information sources for both, outcome and exposure events varied between direct and indirect measurements. Five articles address biological plausibility mechanisms. In Eight articles, no significant findings are reported, and in no study the impact on the quality of subsequent life stages was investigated.

CONCLUSIONS: Sufficient evidence was found to support the presence of conditions in early childhood due to prenatal and concurrent environmental exposure to environmental noise. The need to generate policies that allow routine monitoring of noise levels and their regulation to mitigate exposure and protect children's health is evident.

KEYWORDS: environmental noise, child development, early childhood, child developmental impairment, noise pollution.

P-0470 Multiple air pollutants and renal health in children and adolescents: An 18-year longitudinal study in Asia

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BACKGROUND AND AIM: Few studies have examined the effects of multi-pollutant air pollution on renal health, especially in children and adolescents. This study investigated the association between long-term ambient air pollution exposure and renal health in Asian children and adolescents.

METHODS: This study included 10,942 children and adolescents aged ≤ 25 years from Taiwan and Hong Kong from 2000 to 2017. PM2.5, NO2 and O3 concentrations were estimated using satellite-based spatiotemporal regression models. Two-year average concentrations, those of the year of visit and the preceding year, were used. Linear mixed models were used to examine the association between air pollution and yearly changes in estimated glomerular filtration rate (eGFR). Cox regression models with time-dependent covariates were used to examine the association between air pollution and the development of chronic kidney disease (CKD). Both single- and multi-pollutant models were used.

RESULTS: for the single-pollutant models, each 10μg/m3 increase in PM2.5 was associated with a 0.45μL/min/1.73 m2 [95% confidence interval (CI): 0.28−0.63] reduction in the yearly increase in eGFR and 53% [hazard ratio (HR): 1.53 (95%CI: 1.07–2.2)] greater risk of CKD. Each 10μg/m3 increase in NO2 was associated with a 7% [HR (95%CI): 1.07 (1.00–1.15)] higher risk of CKD, while an equivalent increase in O3 was associated with a 19% [HR (95%CI): 0.81 (0.67–0.98)] lower risk of CKD. for multi-pollutant models, the air pollution–CKD associations were slightly attenuated.

CONCLUSIONS: Long-term exposure to ambient PM2.5 and NO2 was associated with a slower growth of eGFR and a higher risk of CKD in children and adolescents. Our findings suggest that air pollution control in early life is imperative to improve lifelong renal health and alleviate the CKD burden.

P-0471 Prenatal air pollution exposure and infant weight trajectories from 3rd trimester to 2 years of age

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BACKGROUND AND AIM: Prenatal exposure to air pollution is increasingly viewed as harmful to fetal development and leads to childhood obesity. However, few studies have evaluated in utero growth measures and postnatal weight trajectories along a continuum in statistical models. This study aims to evaluate associations between prenatal air pollution and weight trajectories from the 3rd trimester through 2 years of life among infants in the Maternal and Development Risks from Environmental and Social Stressors (MADRES) pregnancy cohort, which comprises a low-income, primarily Hispanic population in Los Angeles, California.

METHODS: Fetal weights during the 3rd trimester were abstracted from maternal ultrasound records. Infant weight measures were abstracted from medical records and measured by staff at study visits. Ambient particulate matter ≤2.5 µm and ≤10 µm in diameter (PM2.5 and PM10) concentrations were assigned using spatial interpolation from the regulatory air monitoring stations. Piecewise linear spline models were used to assess non-linear associations between prenatal air pollution exposure and infant weight trajectories.

RESULTS: Weight increased most rapidly from 3 months prior to birth through 3 months of age, slowing thereafter. Pregnancy-averaged PM2.5 and PM10 were associated with a slower rate of growth from the 3rd trimester until age 2 years. A one IQR increase in PM2.5 (1.65 ug/m3) and PM10 (7.48 ug/m3) exposure were associated with a 0.28 kg and 0.38 kg lower weight at 2 years of age, respectively. In sex-stratified models, the effects of PM2.5 and PM10 were only significant in females.

CONCLUSIONS: Our findings suggest that prenatal exposure to PM2.5 and PM10 could impact infant weight gain trajectories and thus, impact childhood obesity, with potentially more pronounced impacts among females.

KEYWORDS: prenatal air pollution, growth trajectory

P-0480 The Season of Conception and Cerebral Palsy Risk in California

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BACKGROUND AND AIM: Cerebral palsy (CP) is the most prevalent, severe, costly neuro-motor disability in children, and it is permanent. The majority of CP cases have an unknown etiology. This is the first study to investigate whether season of conception is associated with CP in California.

METHODS: We analyzed a California birth cohort of 5,089,216 children born in 2005-2015. A total of 5,508 children diagnosed with CP were identified by linking their California birth records with the diagnostic records from the California Department of Developmental Services. We used multivariate logistic regression analyses to estimate the odds ratio (OR) and 95% confidence interval (CI) for CP according to the month and season of conception, controlling for maternal characteristics (age, race/ethnicity, education), child's sex, and the year of conception. Month of conception was estimated from the child's date of birth and length of gestation and was grouped into seasons (winter: Jan-March, spring: April-June, summer: July-Sept, fall: Oct-Dec). We performed stratified analyses by child's sex (females, males), disease subtypes (spastic, ataxic, hypotonic, other), limb involvement (unilateral, bilateral), and geographical locations of birth (Northern, Central, Southern) in California.

RESULTS: Having been conceived in winter and spring was associated with 9% higher odds of having CP (OR=1.09, 95% CI winter: 1.01-1.18, spring: 1.01-1.17) compared to summer conceptions. When considering months, consistent increases of CP with >10% higher odds were observed for each month from January to June compared to September, except for March. We observed no apparent differences in the stratified analyses.

CONCLUSIONS: This is the first study to show winter and spring conceptions to be associated with higher CP occurrence in the offspring. Environmental factors and/or infections that predominate in winter/spring in California may underly this increased CP risk and need to be further explored.

KEYWORDS: Cerebral Palsy, Seasonal Variation, Environment, Neurodevelopment, Birth cohort

P-0482 Congenital malformations of the male genital system and risk of attention deficit hyperactivity disorder

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BACKGROUND: Accumulating evidence suggests that gestational exposure to environmental anti-androgenic endocrine disrupting chemicals has important neurodevelopmental effects. Specifically, androgens have extensive influence on brain development in regions that are relevant for attention deficient hyperactivity disorder (ADHD), yet their specific involvement in the etiology of this common disorder remains unclear. Hypospadias (abnormal positioning of the urethral opening) and cryptorchidism (undescended testes) are two common male birth defects that are strongly associated with deficiencies in prenatal androgen exposure. Thus, having cryptorchidism or hypospadias is a proxy indicator of atypical gestational androgen exposure, yet the association between these disorders and ADHD has not been extensively studied.

METHODS: We analyzed singleton live births (boys=203,728; girls=199,065) born in 1999-2012 in a large Israeli healthcare organization. Boys with cryptorchidism (n=3,945) or hypospadias (n=2,860) were identified via a validated algorithm based on diagnosis and medical procedure records. ADHD cases (n=59,272) were identified through diagnosis records and verified through review of medication dispensing data. Analyses were conducted using Cox proportional hazard models with robust standard error to account for family clusters.

RESULTS: In multivariable-adjusted analyses, the hazard ratio (HR) for ADHD among boys with cryptorchidism was 1.10 (95% CI:1.02-1.18) and among boys with hypospadias was 1.16 (95% CI:1.07-1.25) compared with boys without these conditions. ADHD hazard was also higher among reproductive condition-free brothers of cryptorchidism cases (aHR=1.15, 95% CI:1.06-1.25) and sisters of hypospadias cases (aHR=1.14, 95% CI:0.99-1.30).

CONCLUSIONS: Boys with cryptorchidism or hypospadias had an elevated ADHD hazard compared with boys without these conditions. Results among unaffected siblings suggest that these associations were potentially partly driven by parental or environmental factors present outside of the pregnancy period. Understanding the links between these congenital malformations, androgen homeostasis, and ADHD could shed light on the etiology of the disorder and allow for early detection and intervention.

P-0490 Early-life exposure to phthalates among infants in Italy: characterization and time trends

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BACKGROUND AND AIM: Human exposure to phthalates, endocrine disruptors, and reproductive toxicants,is ubiquitous. Urine is the matrix of choice for biomonitoring and in utero exposure is well documented. Evidence of early life exposure to phthalates is scarce.
The aim of this study is to assess phthalate exposure and its changes over time in a cohort of healthy infants in the province of Modena, Italy.

METHODS: In this prospective birth-cohort study, we assessed phthalate exposure(8 metabolites of 6 phthalates)in urine samples collected from mothers just after delivery and in infants at birth, 3 and 6 months using phthalate-free bags. Mother-infant pairs were enrolled in a university hospital in Modena(Italy)between January 2019 and May 2020. After solid-phase extraction, samples were analyzed by triple Quad LC/MS Mass Spectrometry.

RESULTS: 188 mother-infant pairs were enrolled. MEP was always detectable and showed the highest levels, increasing over time. MMP and DEHP metabolites showed as well an increasing trend, however, they were detected at lower levels, while MnBP and MBzP showed intermediate concentrations and decreasing trends over time.
Significant associations between mother-infant pairs at birth were found only for a few metabolites(MMP, MEP, and MnBP). Infant levels at 3 and 6 months appeared more related, suggesting a continuative exposure to these chemicals inside the indoor environment.

CONCLUSIONS: Phthalate exposure appears wide and extended over time. Infants were exposed to several phthalates, including those more toxic and strictly regulated in infant toys, personal care products and food contact materials in the European Union. Their unregulated use in other consumers'products, building and decorating materials or home furniture may explain the potential exposure of at-risk groups, such as infants or pregnant women. To effectively protect the most vulnerable subjects, public health preventive and regulatory actions should address this specific issue as well.

KEYWORDS: Phthalates, Biomonitoring, Urine, Newborns, Postnatal Exposure.

P-0491 Prenatal exposure to poly- and perfluoroalkyl substances and serum concentrations of vaccine antibodies in early childhood

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BACKGROUND AND AIM: Prenatal exposure to certain poly- and perfluoroalkyl substances (PFAS) have been associated with a reduced humoral response to tetanus and diphtheria vaccines. Whether this is observed for other childhood immunizations is unknown.

METHODS: In a sample of 120 children in the Healthy Start cohort, we measured semi-quantitative antibody titers to measles, mumps, rubella, and varicella in child serum at 4-6 years old. We employed separate Cox proportional hazards models to estimate associations between maternal serum concentrations of five PFAS and the risk of a non-protective antibody titer, based on time since most recent dose (stratified by number of doses received).

RESULTS: Maternal PFAS concentrations were generally at or below the US median. Most children had protective vaccine titers (rubella 100%, measles 98%, mumps 90%, varicella 80%). Unadjusted associations between individual PFAS and the hazard of non-protective antibody titers had wide confidence intervals including the null [e.g. after two doses, lnPFOA HR, 95% CI: mumps 1.09 (0.21, 5.54); varicella 1.09 (0.33, 3.61): lnPFOS mumps 1.87 (0.22, 16.12); varicella 2.12 (0.55, 8.23): lnPFNA mumps 1.63 (0.21, 12.64); varicella 1.68 (0.36, 7.79): lnPFHxS mumps 6.05 (0.86, 42.75); varicella 1.36 (0.59, 3.13): lnPFDA mumps 1.71 (0.27, 10.84); varicella 2.74 (0.83, 9.07)]. Sensitivity analyses adjusting for the potential confounders of child sex or age at collection did not meaningfully change the effect estimates. We were unable to estimate associations with measles and rubella antibodies due to the small number of children with non-protective titers.

CONCLUSIONS: In this cohort of young children with background levels of PFAS exposure, higher prenatal PFAS concentrations were not significantly associated with greater risk of non-protective mumps and varicella antibody titers. This study demonstrates the utility of time-to-event models for examining associations between environmental chemicals and loss of disease protection.

KEYWORDS: Per- and polyfluoroalkyl substances, vaccines, childhood, immune

P-0495 Air Pollution Exposures and Executive Function in Middle Childhood: A U.S. Multi-Cohort Study

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BACKGROUND AND AIM: Prior studies examining the association between spatiotemporally resolved air pollution and child executive function (working memory, inhibitory control, and cognitive flexibility) are limited. We aimed to fill this gap using data from the ECHO-PATHWAYS Consortium.

METHODS: We included 1,241 children from three U.S. pregnancy cohorts (CANDLE, TIDES, and GAPPS). Exposure to particulate matter ≤2.5μm in aerodynamic diameter ($PM_{2.5}$), nitrogen dioxide (NO_2), and ozone (O_3) at age 0-4 were derived from spatiotemporal models. at age 8-9, child working memory and inhibitory control were assessed using the Digit Span subtest from the Wechsler Intelligence Scale for Children, 5th Edition and the NIH Toolbox Flanker Inhibitory Control and Attention test, respectively. Cognitive flexibility was quantified by percent accuracy and mean latency of the Hearts and Flowers Task mixed block condition. We fitted linear regression models adjusted for sociodemographic, behavioral, and maternal psychological factors, and examined potential modification by child sex, maternal education, and neighborhood education quality.

RESULTS: Mean $PM_{2.5}$, NO_2, and O_3 were 8.9 (SD:1.7) μg/m³, 9.2 (SD:2.8) ppb, and 25.7 (SD:2.8) ppb, respectively. Overall, each 2-ppb increase of NO_2 was associated with a 1.1% lower percent accuracy in cognitive flexibility (95%CI: -1.8%, -0.3%), whereas other associations were all null. We found sex-specific inverse associations of NO_2 with working memory (Pinteraction: 0.019) and cognitive flexibility (Pinteraction: 0.017), and between $PM_{2.5}$ and inhibitory control (Pinteraction: 0.022), only in boys. The positive association between $PM_{2.5}$ and mean latency was stronger in children whose mothers completed high school or less (Pinteraction: 0.045). The protective association between $PM_{2.5}$ and cognitive flexibility was shown exclusively in children residing in neighborhoods with better education quality (Pinteraction: 0.004).

CONCLUSIONS: Our study contributes to a nascent literature on common air pollution exposures, notably NO_2, and child executive function.

KEYWORDS: Air pollution exposures, executive functions, child health

P-0499 Residential green space as a positive influencer on early childhood bone mineral density

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BACKGROUND AND AIM The most crucial contribution to lifelong bone health is attained during the first decades of life by achieving the highest possible peak bone mass. Besides a solid genetic impact, this process is sensitive to environmental and behavioral influences. We explored whether exposure to the surrounding residential green space is related to a change in bone density in young children.

METHODS Within the ongoing Belgian ENVIRONAGE (Environmental influence on Ageing in Early Life) birth cohort, we followed up 471 children aged 4-to-6-years and assessed their radial bone mineral density with ultrasonic speed of sound measurements. Green spaces surrounding their residence were calculated based on high-resolution land cover data within multiple radii (50m to 3000m). Multivariable linear regression modelling was used to explore the association between green space exposure and children's bone density adjusted for relevant confounders.

RESULTS Children's radial bone mineral density was on average (SD) 3682 (112.4) m/sec, and the mean total green space for a 50 to 3000m radius around the residence ranged from 46.20% to 60.02%, respectively. An interquartile range (IQR) increment in high growing (>3m) and total (sum of <3m and >3m) residential green space in a 500m radius was associated with a corresponding increase of 19 m/sec (95% C.I.: 4.3 – 33.0 m/sec) and 17 m/sec (95% C.I.: 3.0 – 31.9 m/sec) in bone density. Moreover, significant results were noted within extended radii with long-term exposure to the surrounding green space, viewed in a subgroup of children who did not relocate between birth and follow-up phase.

CONCLUSIONS We found a positive association between children's bone mineral density and the surrounding residential green space exposure. These results contribute to unravelling factors increasing peak bone mass in early life and improving lifelong bone health.

KEYWORDS: Green Space, Bone Mineral Density, Bone Health, Childhood

P-0502 Study on the concentration of polybrominated diphenyl ethers in serum of teenagers in Zibo, China

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BACKGROUND: Polybrominated diphenyl ethers (PBDEs) can lead to thyroid dysfunction. Teenagers are in a critical period of growth and development. So we should pay more attention to the concentration of PBDEs in the serum of teenagers.
AIM: This study is to evaluate the distribution and concentration of PBDEs in the serum of teenagers and to gain a preliminary understanding of the exposure of PBDEs in teenagers.

METHODS: The 255 serum samples of teenagers (age=15 years) were collected from Zibo in 2018. The 14 PBDEs (including BDE17, 28, 47, 66, 71, 85, 99, 100, 138, 153, 154, 183,190,209) were analyzed with high resolution gas chromatography-high resolution mass spectrometry (HRGC-HRMS) based on CDC method.

RESULTS: The results showed that the PBDEs concentrations were higher in males than in females. The mass concentration of PBDEs in serum was in the range of 2.4-123.9 ng/g lipid, the median concentration of ∑PBDEs was 12.4 ng/g lipid and the geometric mean concentration was 19.2 ng/g lipid. BDE-47 was detected in the serum samples with a relatively high detection frequency, followed by BDE-28 and BDE-99. Although the BDE-209 detection rate was relatively low but contribute the most abundant to the total concentration of PBDEs. There is a correlation between ∑PBDEs and each component, as well as between the components of PBDEs. BDE-28 was correlated to BDE-99 (r=0.558), BDE-47 was correlated to BDE-99 (r=0.599), and BDE-28 was correlated to BDE-47 (r=0.477). ∑PBDEs was correlated to BDE-28, BDE-47, and BDE-99 (r=0.471, 0.423, and 0.484), respectively.

CONCLUSIONS: Compared with other studies, the serum ∑PBDEs levels were close to the level in South China, lower than in America, slightly higher than in Japan and Switzerland. The results imply that there had some PBDEs exposure to teenagers in this region.

KEYWORDS: polybrominated diphenyl ethers, serum, teenagers

P-0504 Launching of CHildren's Environmental health Clinic in Korea (CHECK) and Institute of Ewha-Seoul Clinical Laboratories for Environmental Health (IESEH): The first clinic to research model of pediatric environmental health in South Korea

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BACKGROUND: In recent years, environmental hazards affecting children's health have been a public health concern. Since the 1990s, the Pediatric Environmental Health Specialty Units (PEHSUs) in the USA have provided rigorous research, clinical care, and public health interventions; nevertheless, this systematic network is scarce globally, especially in Asia. Thus, we established South Korea's first integrated "clinic to research" network for protecting children's health.

METHOD

The first children's health and environmental clinic in South Korea, CHildren's Environmental health Clinic in Korea (CHECK), was established. CHECK aims to develop 1) a pediatric-environmental medical examination system with a biobank, 2) a consultation system by specialized pediatricians, 3) medical guidelines for pediatric-environmental diseases, and 4) clinic operation models in this field. Subsequently, we founded the Institute of Ewha-Seoul Clinical Laboratories for Environmental Health (IESEH) to perform multidisciplinary pediatric-environmental research in collaboration with CHECK and medical departments, including Pediatrics, Internal Medicine, Obstetrics and Gynecology, and Environmental Medicine.

RESULTS: CHECK promotes pediatric patients' health by providing medical examinations, laboratory tests (including heavy metals, volatile organic compounds, and endocrine-disrupting chemicals), and specialized counseling and education for patients and parents concerned about environmental risks. IESEH will build a big-data resource by integrating data systematically collected from CHECK, Korea's national health insurance, and the Korean CHildren's ENvironmental health Study (Ko-CHENS)—a nationwide birth cohort. Through this, IESEH undertakes divergent pediatric-environmental studies ranging from data science-based epidemiology to genetics and validation studies for clinical intervention.

CONCLUSION: CHECK is the first pediatric environmental health clinic in Korea. IESEH performs research on pediatric-environmental health in collaboration with multidisciplinary experts, utilizing integrative data from CHECK and national cohorts. CHECK and IESEH will provide a gold standard for pediatric environmental health clinics and laboratories as a standardized and specialized "clinic to research" model.

KEYWORDS: CHECK; IESEH; children; environmental health; clinic to research model.

P-0505 A joint analysis of school neighbourhoods' exposure to urban environment factors in Greater London

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BACKGROUND AND AIM: Schools and their immediate neighbourhoods are places where children spend the most time outside their homes. Depending on the school location, there are variations in exposure to multiple urban environment features that can create and widen health inequality among children. Our aim was to identify and characterize clusters of schools with similar exposure profiles within 400 m (5-10 minutes walking distance) of schools in Greater London. We then explored association between clusters characteristics, ethnicity, and socioeconomic status.

METHODS: We modelled joint exposure to air pollution (NO2 and PM2.5), access to public greenspace, food environment, and road safety for 2,929 schools, employing a Bayesian non-parametric approach based on the Dirichlet Process Mixture (DPM) modelling. We identified clusters with similar exposure profiles, computed the summary statistics for each cluster, and uncovered urban features that were dominant contributory factor to each cluster.

RESULTS: We identified 12 clusters of schools with similar exposure profiles and were able to make probabilistic statements on the magnitude of exposures. We found that schools with relatively high exposures to harmful factors and a low exposure to beneficial factors (greenspace) were located in the most deprived areas.

CONCLUSIONS: Schools have a crucial role in providing equitable and healthy environment for children. We provided a tool to help schools, public health officials, and policy-makers to understand schools joint exposure to specific urban environment features. Our study highlighted the presence of distinct subgroups of schools with respect to exposure. This helps prioritize interventions and design local policies, with the aim of targeting the schools most in need.

KEYWORDS: Air quality; greenspace; food environment; pedestrian child crash; school exposure; Bayesian nonparametrics

P-0506 The association between per-/polyfluoroalkyl substances in serum of teenagers and thyroid function parameters near a Chinese fluorochemical industrial plant: A cross-sectional study

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As the global pollutant, per-/polyfluoroalkyl substances (PFASs) are widely detected in population, inducing some adverse health effects, such as endocrine disruption. However, there are few studies on the exposure characteristics and health effects of PFASs on population with relatively high internal exposure of PFASs. In the current study, 906 teenagers (11-15 years old) living near an industrial plant were included, the concentrations of 18 PFASs had been determined, and the association between PFAS concentrations and thyroid function was explored. PFOA was found to be the predominant PFAS with a median concentration of 138 ng/mL, followed by PFOS (2.08 ng/mL), PFBA (1.12 ng/mL) and 6:2 Cl-PFESA (1.08 ng/mL). for the thyroid function parameters of participants, the abnormal rates of FT3 (29.7%) and FT4 (19.7%) were relatively high, but those of TSH (2.2%), TPO-Ab (2.1%) and TG-Ab (3.3%) were relatively low. Furthermore, logistic regression analysis showed that abnormal FT4 was significantly correlated with higher concentrations of PFOA. Results of multiple linear regression analysis showed that levels of FT4 were significantly and negatively correlated with concentrations of PFOA and PFHpA, and positively correlated with concentrations of PFHxA ($p < 0.05$) by adjusting gender, age, BMI, outdoor activity time and average sleep time. and there was a significantly positive correlation between FT3 levels and concentrations of PFHxA and PFHxS. for TSH, the levels of which were significantly and negatively correlated with PFOA concentrations, but positively correlated with PFHxS concentrations. In conclusion, PFOA may be the risk factor for decreased FT4 for the participants, but the evidence is not enough to demonstrate that other PFASs are the risk factor of thyroid function, local government should pay more attention to the above findings and take measures to reduce the PFASs external exposure of local residents. The present study is of great significance for the epidemiological findings.

P-0509 Clusters of small-scale sources of air carcinogens emissions increase the risks of acute lymphoblastic leukemia (ALL) in children and teenagers at a small area level in urban areas

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Vehicle exhaust emissions, small-scale commercial business (gasoline, paints, or pigments distributers), manufacturing of brick kilns, use of wood or coal for cooking, and hazardous waste management (incinerators, crematories), are some contributors to air carcinogens. Air exposure to benzene, polycyclic aromatic hydrocarbons (PAHs), fine respirable matter, and nitrogen dioxide have been associated with an increased risk of acute lymphoblastic leukemia (ALL) in children. The aim of this study was to identify clusters of ALL cases and examine possible relationships between clustered small-scale sources of carcinogens emissions in the metropolitan area of San Luis Potosi, Mexico.

METHODS: Hospital based-cancer registry (2010-2020) of ALL cases < 19 years old were geocoded. An inventory of fixed sources of air carcinogens emissions was created from governmental data sources. Also, information on air pollutants was taken from community air monitoring stations. ALL clusters' cases were identified through the Kernel density scan test. Multivariable spatial modeling assessed the effect of fixed urban sources and air pollutants controlling for socioeconomic status on ALL risk.

RESULTS: We identified five ALL clusters with excess risk (ranging from 1.1 to 2.3). The downtown area, brick kilns neighborhood, high-density vehicle areas, and vicinity to industrial sites. Clustered sources of brick kilns, crematories, incinerators, municipal landfills, and/or wood-coal commercial businesses were located close to ALL cases (less than 500 meters). Fine respirable matter (PM 2.5), nitrogen dioxide and wood use were contributing sources to the incidence of ALL cases.

CONCLUSIONS: Cumulative and aggregate environmental carcinogens from diverse sources increase the risk for ALL for the youth population. The gaps in our knowledge of the environmental ALL causes pose a major challenge for designing prevention strategies. Until now, pollution reduction has received scant attention in programs for cancer control and has been largely absent from prevention guidelines, which have focused almost exclusively on treatment.

P-0511 Prenatal exposure to Nitrogen Oxides and Waist-to-Height Ratio (WHtR) as a cardiovascular risk factor in school-aged children participants of the POSGRAD Cohort

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BACKGROUND AND AIM: Prenatal exposure to NOx may increase the risk of obesity and cardiovascular risk factors in children. This study aims to evaluate the relationship between prenatal exposure to NOx and its effect on the behavior of the WHtR in school-aged children from the ages of 7 to 12 years old and to determine if the prenatal supplementation with docosahexaenoic acid (DHA) influences the outcome.

METHODS: We included 642 mother-child from the POSGRAD cohort. Land use regression models were performed to estimate exposure to NOx (NO, NO2 and NOx) using the results of passive outdoor monitoring from a representative sample of participant households. Child anthropometrics were taken yearly and WHtR was calculated. The association between prenatal exposure to NOx and WHtR was measured through a logistic random-effects model by tertiles of exposure and considering the prenatal supplementation status.

RESULTS: We found a significant difference in the risk of having a WHtR >= 0.5, on the second tertile of exposure for NOx between the supplemented (OR= 0.59, IC 95%: 0.10-3.49, p = 0.56) and placebo (OR=13.74, IC 95%: 1.94-97.24, p=0.01) groups when compared with the lowest tertile; in the third tertile the ORs were bigger for both groups, however, these were not significant.

CONCLUSIONS: Prenatal exposure to NOx can affect the WHtR outcome in children and prenatal supplementation with DHA can decrease this effect. The lack of protection of DHA at higher levels of exposure could suggest a need for higher doses of supplementation.

KEYWORDS: Prenatal, Waist-to-Height Ratio, Nitrogen Oxides, Cardiovascular Risk

P-0514 Nocturnal temperature range and in children asthma exacerbations in Lima, Peru, 2011-2016

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BACKGROUND AND AIM: Asthma is the most common chronic disease in children <5-years-old, especially in LMIC's as Peru. Although the etiology of asthma is not known, environmental factors are considered one of its main triggers. Different studies have determined that temperature is associated with asthma exacerbations, but there is still low evidence about the effect of temperature variability. Thus, the aim of the study was to evaluate the association between nocturnal temperature range (NTR) and asthma in children <5 years-old in Lima, Peru, 2011-2016.

METHODS: Ecological study. Satellite mean (Tprom), minimum (Tmin) and maximum (Tmax) daily temperature and relative humidity (HR) for Lima were obtained from the NASA POWER platform; daily asthma exacerbation counts per district were obtained from Peru´s CDC; and daily district PM2.5 from WRF-Chem model. PM2.5 was grouped in quintiles, and present-day-Tprom in P5 (reference category), P95 and quartiles. NTR was calculated as present-day Tmin minus the previous day Tmax. The association was evaluated with negative binomial regression models clustered by districts, and adjusted for PM2.5, HR, and interaction terms between NTR and present-day-Tprom categories.

RESULTS: Nocturnal Temperature Range acted as a risk factor in the crude model (RR: 1.06, 95%CI 1.05-1.08, p<0.001). While in the adjusted model, there was a strong interaction effect of Tprom over NTR, in which for hotter days, NTR acted as an asthma risk factor in a semi-monotonic manner: RR 1.06 (95%CI 1.01-1.13) in present-day-Tprom Q1, 1.10 (95%CI 1.04-1.16) in Q2, 1.14 (95%CI 1.09-1.19) in Q3, 1.20 (95%CI 1.15-1.26) in Q4, and 1.09 (95%CI 1.01-1.18) in P95.

CONCLUSIONS: NTR acted as a risk factor for asthma exacerbation in children <5 year-old, with increasing risks for hotter days, since it could be related to airway inflammation thus leading to asthma.

KEYWORDS: Asthma, Nocturnal Temperature Range, Peru, Latin America

P-0517 Combined exposures to air toxics in early-life and academic achievement in childhood

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BACKGROUND: Previous research has found associations between exposure to single air pollutants and children's cognitive health but has often lacked the ability to investigate combined impacts of pollutants. Characterizing the effects of combined exposures can provide a more realistic assessment of health effects for burdened communities, as well as identify interactions between pollutants. Identifying interpretable associations and interactions within the context of high-dimensional exposure data presents a computational challenge. Methods from domains such as data science can be incorporated into our analytic toolbox to address this challenge. Results from these data-driven approaches need to produce interpretable results that can be followed by targeted techniques. The objective of this research is to utilize tree-based methods, such as random forest, to develop an analytic pipeline to discover interpretable combinations of air toxics associated with children's academic outcomes.

METHODS: Residence at birth was used to link EPA data on estimated ambient concentrations of 40 air toxics to an administrative data linkage of public health and education registries for approximately 220,000 children born and raised in New York City. The random forest algorithm was applied to a 1/3 subset of the data to generate a collection of regression trees that identify the combinations of air toxics associated with 3rd grade standardized test scores in math and English language arts. Methods to account for confounding and validation of identified combinations were assessed and compared in a second 1/3 subset, with the remaining data held out for final analyses.

RESULTS: Our results suggest that early-life exposure to air toxics is associated with lower test scores but high correlation between pollutants and with social factors remains a challenge for interpretation.

CONCLUSIONS: Enhancements to the analytic pipeline, including incorporation of toxicological knowledge of pollutants, will be discussed.

KEYWORDS: mixtures, interactions, urban health

P-0518 Thyroid Nodules and Cancers in Fukushima: Analysis with Updated UNSCEAR Thyroid Dose Estimates

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BACKGROUND AND AIM: After the Fukushima–Daiichi nuclear power plant (NPP) disaster, thyroid ultrasound examination (TUE) has been performed on subjects who were aged ≤18 years. In the 1st round of TUE (October 2011 to March 2014) and the 2nd round of TUE, 115 and 71 malignancies were detected, respectively. Following to previous study (Hamaoka 2021), I analyzed the same data with updated thyroid absorbed dose estimates (UNSCEAR 2022) that are about 1/8 lower than the previous estimates (UNSCEAR 2013).
DATA AND

METHODS: The relationship between radiation dose and the number of participants with thyroid nodule or malignancy was analyzed using publicly available municipality-level data without regional grouping (N=59). To analyze two-wave screening data, the multi-level random-effect Poisson regression model was applied. Interaction between dose and screening round dummy (0 for first and 1 for second screening) was also introduced to take into account latency.

RESULTS: UNSCEAR(2022) re-estimated thyroid dose to incorporate the latest information on ingestion of contaminated food, the flow of radiation plumes, and other factors. Although magnitudes were reduced, previous and re-estimated thyroid dose have a positive and significant correlation of 0.314. The number of participants with small nodules (≦5.0mm) was regressed on screening round dummy, estimated thyroid dose, and their interaction term. Although thyroid dose was insignificant (β=-0.017, z=-1.463), the interaction term was positive and significant (β= 0.033, z=4.42). Similar results were obtained for larger nodules (≧5.1mm) and malignancy.

CONCLUSIONS: These robust results are consistent with the conjecture: due to latency, the relationship between radiation exposure and impact on the thyroid will be observed in the later screening. Although this was an ecological study, health follow-up for children in Fukushima is urgent. Since the third screening, municipality-level data has been undisclosed because of privacy concerns. Data disclosure is necessary to understand the effect of the Fukushima disaster.

P-0521 Effect modification of greenspace on the associations between environmental exposures and childhood asthma: an intra-city study

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BACKGROUND AND AIM: Greenspace may have a protective effect against the adverse health effects of non-optimal environmental exposures (EEs) such as temperature extremes and air pollution. However, inter-relations between these EEs and asthma haven't been quantified. This study aimed to examine if greenspace modifies the effects of EEs on childhood asthma.

METHODS: We conducted a population-based cross-sectional study among preschool and primary school children from 13 districts of Shanghai in 2019. The International Study of Asthma and Allergies in Childhood questionnaire was adopted to assess the childhood asthma. We collected the data on annually average climate conditions, air pollutants, and greenspace rate at different districts. Bayesian spatial models were used to evaluate the associations between environmental exposures and childhood asthma and the effect modification of greenspace.

RESULTS: There were 16,606 children aged 3-11 years in this study, including 8,709 (52.4%) boys. The prevalence of ever diagnosed asthma was 14.2%. An interquartile range (IQR) increase in mean temperature was associated with increased odds ratio (OR) of asthma (1.14, 95% confidence interval (CI): 1.04, 1.25). Greenspace rate was negatively associated with the OR of childhood asthma (0.244, 95% CI: 0.067, 0.887), and appeared to modify the associations between EEs and childhood asthma to various extents.

CONCLUSIONS: Non-optimal environmental exposures (e.g., temperature and NO2) could be the triggers of childhood asthma, and greenspace seemed to modify the adverse effects of EEs on childhood asthma.

P-0524 Prevalence of asthma and asthma symptoms among rural and urban pre-school children in Mpumalanga Province, South Africa

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BACKGROUND AND AIM: Asthma is the most common chronic illness in South African children and its prevalence is increasing in both urban and rural areas. Little is known about the prevalence of asthma amongst pre-school children living in Mpumalanga province, South Africa, which forms part of the Highveld region, a priority area in terms of air pollution. The area is known for poor air quality and elevated concentrations of criteria pollutants. The aim of the study was to investigate the prevalence of asthma and asthma symptoms among rural and urban pre-school children and the association with environmental risk factors.

METHODS: This analytical cross-sectional study that included 3145 pre-school children from Mpumalanga Province, South Africa. Parents of the children were requested to complete a modified ISAAC questionnaire. We analyzed the influence of potential risk factors on dependent variables using bivariate analysis. Significant risk factors identified in the bivariate analysis were included in a multiple logistic regression to develop a final model.

RESULTS: Self-reported prevalence of asthma was 2.3% (66/2810), with pre-school children in rural areas reporting a higher rate than pre-school children in urban areas (1.3% vs 1%), $\chi 2=10.86$, $P <0.001$). The prevalence of asthma symptoms was 15.1% (467/3084), with rural pre-school children reporting a higher prevalence of symptoms than urban pre-school children (10% vs 5%), $\chi 2 = 24.45$, $P < 0.001$). Risk factors for asthma and asthma symptoms were vigorous physical activity (odds ratio (OR) 2.31, 95% CI 1.14-4.66), home smoking exposure (OR 2.94, 95% CI 1.40-6.19) and male parent smoking (OR 1.46, 95% CI 1.01-2.12).

CONCLUSIONS: Pre-school children in rural areas reported a higher prevalence of asthma compared to pre-school children in urban areas. Risk factors for asthma included physical activity and smoking exposure in the home.

KEYWORDS: asthma, pre-school children, risk factors

P-0533 Early-life exposure to cadmium and onset of puberty in girls: a longitudinal mother-child cohort study in Bangladesh

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BACKGROUND AND AIM: Cadmium is a toxic metal with endocrine disrupting properties, but there are few studies about its impact on puberty onset. We aimed to evaluate if early-life exposure to dietary cadmium is associated with the timing of female puberty.

METHODS: In a mother-child cohort in rural Bangladesh (n=935), we assessed the exposure to cadmium during pregnancy through concentrations in erythrocytes (half-life 3-4 months) and in the daughters at 5y and 10y through concentrations in urine, a marker of long-term exposure. Cadmium was measured with inductively coupled plasma mass spectrometry. Between the ages of 12 and 15 years, the girls were interviewed twice with a 6-month interval about their date of menarche, and they self-assessed their pubertal development according to Tanner stages. Associations with age at menarche were evaluated with Kaplan-Meier analysis and multivariable-adjusted Cox regression, and associations with pubertal stages with ordered logistic regression.

RESULTS: Median age at menarche was 13.0 years. We found no association between maternal exposure to cadmium during pregnancy and the daughters' age at menarche. Median urinary cadmium concentrations at 10y were 0.25 µg/L. Girls belonging to the highest quartile of urinary cadmium at 10y attained menarche 3.8 months later than girls in the lowest quartile. In multivariable-adjusted analysis, the corresponding hazard ratio of reaching menarche comparing girls in the highest and the lowest quartile of urinary cadmium was 0.77 (95% CI 0.60, 0.98). Similar associations were found for urinary cadmium at 5y. Urinary cadmium at 10y was also associated with delayed breast development; the odds ratio of reaching more advanced breast development stages comparing girls in the highest and the lowest quartile of urinary cadmium was 0.63 (0.40; 0.99).

CONCLUSIONS: Elevated childhood exposure to cadmium was associated with a pubertal delay in girls.

KEYWORDS: Cadmium, early-life, female puberty, menarche, longitudinal

P-0534 Nearby wildfire impacts, social vulnerability, and birthweight in a rural population

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BACKGROUND AND AIM
Wildfires are increasing across the world and are associated with adverse impacts on vulnerable populations including pregnant people and young children. Wildfires may exert their harmful effects by elevating air pollutant exposure and may also fuel stress by disrupting daily activities and, if extreme, threatening or forcing evacuation. We aimed to estimate exposure disparities by social vulnerability and quantify the impact of nearby wildfires during pregnancy on birthweight.

METHODS: Our study population included 139,671 maternal-infant dyads from birth certificate records between 2008 and 2019 in Montana, USA. We classified pregnant people as "exposed" if they had an active, large (≥ 1000 acres) fire within 5 kilometers of their home detected by Moderate Resolution Imaging Spectroradiometer (MODIS) sensors. We characterized the population by neighborhood social vulnerability index (SVI), rurality, and race and estimated associations between nearby fires and birthweight in linear regression analyses adjusted for gestational and maternal age, education, race, parity, prenatal visits, and SVI.

RESULTS: Exposure to at least one large wildfire within 5 km of home occurred for 0.5% (n=712) of births in Montana between 2008 and 2019. Mean neighborhood SVI as well as rates of both rural residence and American Indian/Alaska Native maternal race were all significantly greater in "exposed" pregnancies. . Having at least one large nearby fire during pregnancy was associated non-significantly with a 21 gram (95% CI: -52.2, 10.2) lower birthweight in adjusted analyses.

CONCLUSIONS: Social vulnerability appears greater in those experiencing nearby wildfires during pregnancy. Although wildfire exposure within 5 km of home does not appear to influence birthweight, future work should evaluate whether the effects of nearby fires are felt more strongly in socially vulnerable populations.

KEYWORDS: wildfire, birthweight, social vulnerability, rurality

P-0536 Allergic rhinitis, rhinoconjunctivitis and hayfever symptoms among pre-school children are associated with school transport mode: an analytical cross sectional study

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BACKGROUND: Allergic rhinitis (AR) is a common condition affecting many people in the globally. In addition, the condition is mostly prevalent amongst children. The aim of the study was to investigate the association between the school transport mode and allergic rhinitis symptoms, rhinoconjunctivitis and hayfever among pre-school children living an in Mpumalanga Province, which in an area known for high levels of air pollution in South Africa.

METHODS: An analytical cross-sectional study consisting of 3145 participants was conducted in Mpumalanga South Africa. A modified ISAAC questionnaire was used to collect data. Bivariate analysis was performed between potential risk factors and dependent variables. Risk factors that showed association in the bivariate analysis were included in the multiple logistic regression to develop a final model.

RESULTS: The prevalence of self-reported rhinitis ever, current rhinitis rhinoconjunctivitis and hayfever was 21, 7, 8 and 4 % respectively. Rhinitis ever, current rhinitis, current rhinoconjunctivitis and hayfever were significantly associated with the frequent use of motorcar to school, (OR 1.45 95 % CI: 1.15 − 1.83), (OR 1.62 95 % CI: 1.27–2.08), (OR 1.64 95 % CI: 1.17–2.29) and (OR 3.36 95 % CI: 2.16–5.21) respectively. No associations were observed between trucks/buses/taxis traffic in resident area and allergic rhinitis symptoms in the multiple analyses.

CONCLUSIONS: The study shows a high prevalence of allergic rhinitis symptoms amongst Pre-schoolers. The results have shown that frequent use of motorcar pays a role in the prevalence of allergic rhinitis symptoms in preschool children.

KEYWORDS: Allergic rhinitis, Rhinoconjunctivitis, Hayfever, Traffic, Air pollution, South Africa

P-0540 Prenatal exposure to PM2.5 and childhood cognition assessed using the NIH Toolbox: A pooled analysis of ECHO cohorts in the Northeastern USA

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BACKGROUND AND AIM: Emerging studies investigated the adverse health effects of fine particulate matter (PM2.5) using data from multiple cohorts. However, associations often are not generalizable across cohorts. Our objective was to assess associations between prenatal PM2.5 and childhood cognition in two U.S. cohorts while accounting for between-site heterogeneity.

METHODS: We included 349 mother-child dyads enrolled from the dual-site (New York City and Boston) PRogramming of Intergenerational Stress Mechanisms (PRISM) study and the First Thousand Days of Life (FTDL) study participating in the Environmental influences on Child Health Outcomes (ECHO) consortium. Daily PM2.5 was estimated using satellite-based models linked to each woman's residential address during pregnancy. Children's cognition was assessed using the NIH Toolbox Cognition Battery between ages 3 and 8 years. We used a log-linear model applied to contingency tables formed by cross-classifying covariates by site to examine between-site heterogeneity. Multivariable linear regression was used to estimate the coefficients and 95% confidence intervals for the trimester-specific PM2.5 exposure and age-corrected standardized cognition scores (mean=100, SD=15), stratified by study site, child sex, and urbanicity.

RESULTS: The log-linear model indicated that inter-study associations were similar between PRISM-NYC and FTDL, which were different from those in PRISM-Boston. Accordingly, we combined the PRISM-NYC and FTDL cohorts. Findings showed that 1 μg/m³ increase of 3rd trimester PM2.5 was associated with -4.75 (95% CI= -11.86, -0.50) mean early childhood cognition scores in females in PRISM-Boston. We additionally observed a significant association between PM2.5 and picture vocabulary scores [-3.82, (-13.75, -0.01)] in males in NYC+FTDL non-urban areas.

CONCLUSIONS: We found associations between prenatal PM2.5 and impaired childhood cognition in this pooled analysis. Given that multi-site analyses are increasingly conducted, our findings suggest expanding the awareness of between-site heterogeneity, including site-specific confounders and effect modifiers.

KEYWORDS: air pollution, childhood cognition, log-linear model

P-0542 Air Pollution Mixture and Birth Outcomes: Modification of Placenta Leukocyte Telomere Length and Infant Sex

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BACKGROUND AND AIM: Multiple air pollutants such as fine particles matter (PM2.5), nitrogen dioxide (NO2), and ozone (O3) were associated with adverse birth outcomes, and their associations were potentially modified by the cellular aging of placenta and infant sex. But the joint association of those factors was less examined.
METHOD: This analysis included 310 mother-infant dyads (142 girls and 168 boys) enrolled in the PRogramming of Intergenerational Stress Mechanisms (PRISM) study. We applied Bayesian Kernel Machine Regression (BKMR) to examine the independent and mixed effects of prenatal PM2.5, NO2, O3, and placenta relative leukocyte telomere length (rLTL) on two birth outcomes (i.e., birth weight for gestational age z-score and preterm birth defined as less than 37 gestational weeks). The mixed effect was examined using an exposure index calculated as the summed multiplicities of the quintiles of pollutant and pollutant-specific weights estimated using Bayesian Weighted Quantile Sum (BWQS). The associations between exposure, outcome, and rLTL were examined for boys and girls separately.

RESULTS: NO2 drove the exposure effect on birth weight z-score in girls and on preterm birth in boys. Sex differences were observed. The estimated exposure index was negatively and positively associated with birth weight z-score and preterm birth in girls. These associations were inversed for boys. The observed modification effects of rLTL were varied by pollutant, outcome, and infant sex. for example, the results of the exposure index suggested stronger modification effects in boys, in which mothers with lower rLTL and higher exposure index jointly contribute to the higher birth weight z-scores and preterm birth.

CONCLUSIONS: Co-exposure to elevated air pollution and lower LTL during prenatal may contribute to adverse birth outcomes, especially among boys.

KEYWORDS: air pollution, birth outcomes, mixture analysis

P-0548 Prenatal Ambient Air Pollutant Mixture Exposure and Neurodevelopment in Urban Children in the Northeastern USA

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BACKGROUND AND AIM: Prior studies of prenatal air pollution (AP) exposure on child neurodevelopment largely focus on a single pollutant. We leveraged daily exposure data and implemented novel data-driven statistical approaches to assess effects of prenatal exposure to a mixture of seven air pollutants on cognitive outcomes in children from an urban pregnancy cohort in the Northeastern USA.

METHODS: Analyses included 236 children born at ≥37 weeks gestation. Maternal prenatal daily exposure levels for nitrogen dioxide (NO_2), ozone (O_3), and constituents of fine particles [elemental carbon (EC), organic carbon (OC), nitrate (NO_3-), sulfate (SO_4^{2-}), ammonium (NH_4+)] were estimated based on residential addresses using validated satellite-based hybrid models or global 3-D chemical-transport models. Children completed the Wechsler Intelligence Scale for Children (WISC-IV), Wide Range Assessment of Memory & Learning (WRAML-2), and Conner's Continuous Performance Test (CPT-II) at 6.5±0.9 years of age. Time-weighted pollutant exposure levels were estimated using Bayesian Kernel Machine Regression Distributed Lag Models. Resulting weighted exposures were used in Weighted Quantile Sum regressions to examine AP mixture effects on cognitive outcomes, adjusted for sex, maternal age, education, and temperature. Sex-stratified models were explored.

RESULTS: Mothers were primarily ethnic minorities (81% Hispanic and/or black) reporting ≤12 years education (68%). Prenatal exposure to AP mixture (per decile increase) was associated with decreased WISC-IV IQ (β=-0.94, 95%CI=-1.69 to -0.19), decreased memory-related attention/concentration (β=-1.03, 95%CI=-1.78 to -0.27) and general memory (β=-0.64, 95%CI=-1.40 to 0.00) indices from WRAML-2, and increased CPT-II omission errors (β=1.55, 95%CI=0.34–2.77). When stratified by sex, associations with IQ and omission errors were significant in boys only, while associations with memory-related indices were significant in girls only. Sulfate, NO_2, and EC were major contributors.

CONCLUSIONS: Prenatal exposure to an AP mixture was associated with child cognitive outcomes in a sex- and domain-specific manner.

KEYWORDS: air pollution, mixture, prenatal, neurodevelopment

P-0549 Associations between Exposure to Prenatal Air Pollution Mixtures and Behavioral Problems in Urban Children

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BACKGROUND AND AIM: Previous studies investigating associations between prenatal air pollution and childhood behavior mainly focused on PM2.5, while little is known about the effect of air pollution mixtures and exposure timing throughout pregnancy. We used individual-level daily exposure data and implemented novel weighting approaches to assess effects of prenatal exposure to a mixture of seven air pollutants on behavioral outcomes in children from a Northeastern USA urban pregnancy cohort.

METHODS: Participants included 234 full-term
singleton children (≥37 weeks gestation). Children completed the Behavior Assessment System for Children 2nd Edition (BASC-2) at age 6.5±0.9 years. Daily exposure levels for nitrogen dioxide (NO_2), ozone (O_3), and constituents of fine particles [elemental carbon (EC), organic carbon (OC), nitrate (NO_3-), sulfate (SO_4^{2-}), ammonium (NH_4+)] were estimated based on residential addresses using satellite-hybrid models and 3D chemical-transport models. Time-weighted exposure levels of the seven air pollutants in the mixture were estimated using Bayesian Kernel Machine Regression Distributed Lag Models. We subsequently used in multivariable linear regressions including time-weighted exposures for all pollutants in the mixture., adjusted for sex, maternal age, education, and temperature. Effect modification by sex was also examined.

RESULTS: Participants were primarily Hispanic (59%) and Black (25%), with ≤12 years of education (68%). Time-weighted O_3 level (per one standard deviation increase) was associated with 4.77% increase in External Problems (95%CI= 0.7%–9%), 4.41% increase in Aggression (95%CI=0.9%–8.1%), 4.36% increase in Internal Problems (95%CI=0.5%–8.3%), and 4.18% increase in Anxiety (95%CI=0.1%–8.4%). When stratified by sex, these associations were only significant in boys. Time-weighted OC level was significantly associated with Internal Problems in girls only (4.6% increase, 95%CI=1.7%–7.7%).

CONCLUSIONS: In a prenatal air pollution mixture, ozone is associated with child behavioral problems, and the association is specific to sex and measured outcome scale.

KEYWORDS: mixture, air pollution, prenatal, children behavior

P-0550 Proximity to coal flyash disposal site and infant neurodevelopment in Sri Lanka

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BACKGROUND: Fly ash from coal-fired power plants (CPP) often consist of trace heavy metals such as arsenic and lead which have been linked with deleterious health effects in exposed communities.
Objective. A cross-sectional study examined relationship between proximity to CPP, an indirect measure for environmental exposure to flyash, and neurodevelopment in infants 1- 3 years of age, measured using 'Bayley Scales of Infant and Toddler Development, third edition (BSID-III)'

METHODS: Set in Puttalam District in Sri Lanka, the study enrolled 208 children: 108 from the buffer zones around the CPP with radii of '<5kms' and 100 from '≥10kms', respectively. In a multivariable general linear regression, we analyzed the relationship between proximity to CPP and BSID-III cognitive, motor and language scores, adjusting for maternal age, ethnicity, wealth index, and child's age, sex and birthweight.

RESULTS: On average, children were 23.4 months (±6.4) old and 60.2% were female. Compared to children residing away from the CPP (≥10 kms), children residing in close proximity (<5 kms) had lower composite scores for BSID-III language (adj. means: 93.7 vs. 88.8, p= 0.0057), motor (88.0 vs. 86.0, p=0.2126) and cognitive (84.4 vs. 83.1, p= 0.4395) but only language was significant, after adjusting for covariates.
DISCUSSION. Our findings suggest lower developmental scores among children residing closer to CPP compared to those further away. Results of the study have scientific and policy implications for low- and middle-income countries as well as developed countries like US, where low-income, minority, rural and inner-city urban communities continue to disproportionately be exposed to higher levels of trace heavy metals released from industrial effluents, mining, fertilizers, and pharmaceuticals.

KEYWORDS: Flyash, Coal, Children, Infant neurodevelopment, Bayley

P-0551 The mortality burden of nervous system diseases attributed to ambient temperature: a multi-city study in China

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BACKGROUNDS: Studies on the association between ambient temperature and human mortality have been widely reported, focusing on common diseases such as cardiopulmonary diseases. However, multi-city studies on the association between both high and low temperatures and mortality of nervous disorders were scarce, especially on the evidence of vulnerable populations.

METHODS: Weekly meteorological data, air pollution data and mortality data of nervous system were collected in 5 cities in China. A quasi-Poisson regression with distributed lag non-linear model was applied to quantify the association between extreme temperatures and mortality of nervous system diseases. Multivariate meta-analysis was applied to estimate the pooled effects at overall level. The attributable fractions (AFs) were calculated to assess the mortality burden attributable to both high and low temperatures. Stratified analyses were also performed by gender and age-groups through the above steps.

RESULTS: A total of 12,132 deaths of nervous system diseases were collected. The overall minimum mortality temperature was 23.9 ℃ (61.9th), the cumulative relative risks of extreme heat and cold for nervous system diseases were 1.33(95%CI: 1.10, 1.61) and 1.47(95%CI: 1.27, 1.71). The mortality burden attributed to non-optimal temperatures accounted for 29.54% (95%eCI: 13.45 %, 40.52%), of which the mortality burden caused by low temperature and high temperature accounted for 25.89% (95%eCI: 13.03%, 34.36%) and 3.65% (95%eCI: 0.42%, 6.17%), respectively. The mortality burden attributable to ambient temperature was higher in both males and the elderly (> 74 years old), with the AF of 31.85% (95%eCI: 20.68%, 39.88%) and 31.14% (95%eCI: -6.83%, 49.51%), respectively.

CONCLUSIONS: The non-optimal temperature can increase the mortality of nervous system diseases and the males and the elderly over 74 years have the highest attributable burden. The findings add the evidence of vulnerable populations of nervous system diseases against ambient temperatures.

KEYWORDS: temperature; nervous system diseases; mortality burden; vulnerable population

P-0557 Association of heat wave exposure with increased risk of hospitalization for dehydration or heat-related illness in young children in South Korea: A Time-series study

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BACKGROUNDS
Numerous studies have investigated the association between summer temperatures and increased heat related hospitalizations in the general population. However, little is known about the heat-related morbidity of heat waves in children. We aimed to evaluate the association between hospitalization for dehydration or heat-related illness in children and heat wave exposure in South Korea.

METHODS: We used the National Health Insurance Service (NHIS) database, which provides medical records from 2015 to 2019 in South Korea. We defined daily hospitalizations for dehydration or heat-related illness of children younger than five years of age during the summer period (June to August). A heat wave was defined using a total of six criteria from a maximum temperature 28°C or higher to 33°C or higher per day. A time-series analysis was used to investigate the association between the maximum temperature and a heat wave and hospitalization for dehydration or heat-related illness of children younger than five years of age. We used a two stage design involving a meta-analysis after modeling by each city.

RESULTS: We included 16,879 daily hospitalizations for dehydration or heat-related illness among children younger than five years of age during 2015 to 2019. The relative risk (RR) of hospitalization for dehydration or heat related illness was 1.023 [95% confidence interval (CI): 1.013, 1.034] per 1°C increase in the 3-day moving average maximum temperature during summer. The RR due to heat wave exposure (6 definitions: 28°C to 33°C) was ranged from 1.10 (95% CI: 1.06, 1.15) to 1.05 (95% CI: 0.98, 1.12). In the subgroup, we did not observe statistically significant gender differences.

CONCLUSIONS: Exposure to a heat wave during summer is associated with an increased risk of hospitalization for dehydration or heat-related illness among children younger than five years of age.

KEYWORDS: Climate change, Children, Heat wave, Time-series

P-0559 Seasonal Temperature Variability and Mortality across the USA

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BACKGROUND: Seasonal temperature variability remains understudied and is set to be modified by climate change. Most temperature studies consist of short-term exposures using time series data. These studies are limited by an inability to observe longer-term trends in temperature and mortality along with regional adaptation and short-term mortality displacement. Cohort studies can address these limitations, but no countrywide cohort study has been conducted to study these long-term temperature trends, especially in a cohort with differing climatic zones.
AIM:
We aimed to examine the association between seasonal temperature variability and mortality across the contiguous US with its five defined regional climate zones. Further, we aimed to investigate effect modification by race, poverty, population density, and green space.

METHODS: We carried out this analysis in the US Medicare cohort (age 65+) from 2000-2016 with 622,427,230 years of person time. Our exposure was seasonal temperature variability or the standard deviation of warm (April to September) and cold (October to March) season temperature.
We used adapted difference-in-difference, quasi-experimental methods to reduce unobserved confounding at the ZIP-code level. We employed a clustering approach based on climate zone and socioeconomic factors, combined with a meta-analysis.

RESULTS: We showed that for every 1 °C increase in warm and cold season temperature variability, the mortality rate increased by 1.54% and 0.69% in over 65s, respectively. Over 270 million Americans are exposed to at least one form of seasonal temperature variability. These effects were most pronounced in low-income individuals, low green space residents, and those in lower population density areas such as rural locations. Further, these effects were not modified by one's climate zone of residency.
CONCLUSION: Seasonal temperature variability was associated with an increased risk of mortality in over 65s across the US.

KEYWORDS: Mortality; Temperature Variability; Climate Change; Medicare Cohort; Race; Poverty; Green Space.

P-0564 Is short-term exposure to heat associated with mental health compared to other conditions?

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BACKGROUND AND AIM: Health impacts of heat exposure are increasingly important due to climate change. Anxiety and depression are common and understudied mental health conditions, possibly associated with heat exposure. We examined associations between short-term (5-day) apparent temperature and health visits for anxiety and/or depression in North Carolina.

METHODS: We linked electronic health records from a random sample of adults seen at University of North Carolina Healthcare System hospitals 2004-2018 in the EPA CARES resource with climate data from PRISM Climate Group. We examined 5-day mean apparent temperature (incorporating temperature and humidity) at the ZIP code level for patients diagnosed with anxiety and/or depression compared to first recorded visit for those with any other diagnosis. We used log binomial regression models adjusted for personal (age, sex, race, health insurance status), environmental (season, annual PM2.5 concentration, climate division) and neighborhood (median household income, percent Bachelor's degree or more, percent urban) covariates.

RESULTS: We included 17,145 patients, 2219 of whom were diagnosed with anxiety and/or depression. Those with anxiety and/or depression were, on average, younger (46.4 vs 48.0 years), more likely to be female (69.7% vs 59.7%), and White (74.7% vs 62.4%), compared to those with other diagnoses. Mean five-day apparent temperature was 17.6 degrees C (SD 10.4). The prevalence of having a diagnosis of anxiety and/or depression was 1% higher per degree increase in five-day mean apparent temperature (PR 1.01, 95% CI 1.00, 1.02) compared to other diagnoses. Results were similar when limiting to anxiety, depression, and geographic region.

CONCLUSIONS: We did not observe substantial associations between apparent temperature and anxiety or depression relative to other outcomes. Future studies should expand this work to larger areas with more temperature variability and consider mental health trends independent of other outcomes. This abstract does not reflect EPA policy.

KEYWORDS: climate, heat, mental health

P-0569 Temporal Variation in the Association between Temperature and Cardiovascular and Respiratory Mortality in 15 German cities

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BACKGROUND AND AIM: There is limited evidence of temporal changes in the association between air temperature and the risk of cause-specific cardiovascular [CVD] and respiratory [RD] mortality. We explored temporal variations in the association between short-term exposures to air temperature and cause-specific CVD and RD mortality in the 15 largest German cities from 1993 to 2016.
METHOD: We applied time-stratified time-series analysis using city-specific confounder-adjusted Poisson models and estimated the temperature–mortality associations with distributed lag non-linear models with 14 lag days and then pooled by a multivariate meta-analytical model. We performed age- and sex-stratified analysis. A meta-regression with socioeconomic and demographic effect modifiers is currently being performed. Cold and heat effects are reported as relative risks [RR] at the 1st and the 99th temperature percentile, relative to the 25th and the 75th percentile, respectively.
RESULT: We analyzed a total of 1,003,305 CVD and 173,154 RD deaths. Cold-related RR for CVD mortality was seen to rise consistently over time from 0.98 (95% confidence interval [95% CI] 0.96, 1.01) in the period 1993-2004 to 1.10 (95% CI 1.08, 1.10) in the period 2005-2016. A similar increase in cold-related RR was also observed for RD mortality. The heat-related RR for RD mortality increased from 1.44 (95% CI 1.22, 1.70) to 1.83 (95% CI 1.66, 2.00). Males were particularly susceptible to cold for all causes of death and heat for total and RD mortality. The age group >64 years was susceptible to cold mainly for CVD mortality, whereas the younger age group (0-64 years) showed stronger effects of heat for RD mortality.

CONCLUSIONS: We found evidence of rising population susceptibility to both heat- and cold-related CVD and RD mortality. These findings may be useful to design targeted heat- and cold- adaptation plans in Germany.

KEYWORDS: Cardiovascular mortality, respiratory mortality, temperature, temporal variation

P-0570 Projecting future risk of dengue related to hydrometeorological conditions in mainland China under climate change scenarios

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BACKGROUND AND AIM: Limited knowledge is known about the impact of hydrometeorological conditions on dengue incidence in China, and the associated disease burden in the climate-changing future. This study projects the attributable excess risk of dengue in 365 cities across mainland China under climate change scenarios.

METHODS: The association between Palmer drought severity index (PDSI) and dengue in the historical period (2013-2019) was estimated with a spatiotemporal Bayesian model. We developed a dengue transmission biological model to project the potential risk area of dengue by 2100 under three representative concentration pathways (RCP 2.6, 4.5, and 8.5). The association combined with biological model was then used to project the annual excess risks of dengue related to PDSI by 2100. We further calculated attributable excess risk for dry and wet conditions.

RESULTS: A total of 93,101 dengue cases were reported between 2013-2019 in mainland China. Dry and wet conditions within three months lag were associated with increased risk of dengue. Locations with potential dengue risk in China will expand in the future. The hydrometeorological changes are projected to substantially affect the risk of dengue in regions with mid-low latitude, especially the coastal areas under high emission scenarios. By 2100, the annual average increased excess risk is expected to range from 7.49% (95% empirical CI: 4.55-16.64) in northwest to 71.89% (55.66-123.62) in south under RCP 8.5. Moderate dry is predicted to have the greatest impact on dengue risk across all regions.

CONCLUSIONS: Hydrometeorological conditions are predicted to increase the dengue risk in the future in the south, east, and central areas of mainland China in disproportional patterns. Our findings have implications for the preparation of public health interventions to minimize the health hazards of non-optimal hydrometeorological conditions under climate change context.

KEYWORDS: Climate change; Dengue; Hydrometeorology; Palmer drought severity index

P-0571 The association between ambient temperature and cause-specific cardiovascular disease admissions in Japan: a nationwide study

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BACKGROUND AND AIM: Substantial evidence suggests that non-optimal temperatures increase the risk of cardiovascular disease (CVD) mortality and morbidity. However, limited studies have reported inconsistent results for hospital admissions depending on study locations that also lack investigations on cause-specific CVDs at a national level. We aim to examine the short-term associations between temperature and acute CVD hospital admissions by specific categories [ischemic heart disease (IHD), heart failure (HF) and stroke] in 47 prefectures of Japan from 2011 to 2018.

METHODS: We performed a two-stage meta-regression analysis. First, we estimated prefecture-specific associations between temperature and CVD admissions using the time-stratified case-crossover design with a distributed lag nonlinear model over the lag of 21 days. Then we used a multivariate meta-regression model to obtain national average associations.

RESULTS: During the study period, a total of 2,416,707 CVD admissions were reported. We found significant cold risks on all CVD admissions and cause-specific categories. Compared with minimum hospitalization temperature (MHT) at 95th percentile of temperature, the cumulative relative risks (RRs) of cold (5th) and heat (99th) on all CVD were 1.222 [95% confidence interval (CI): 1.190, 1.255] and 1.003 (95% CI: 0.996, 1.011), respectively. The cold risk for HF [RR=1.566 (95% CI: 1.477, 1.660)] was higher than IHD [RR=1.136 (95% CI: 1.048, 1.231)] and stroke [RR=1.107 (95% CI: 1.057, 1.160)]. The MHTs varied by the specific causes. We also observed significant heat risk of temperature on HF with RR of 1.069 (95% CI: 1.030, 1.110). The subgroup analysis showed the ≥ 85-year age group was more vulnerable to the risk of temperature.

CONCLUSIONS: This study indicated that exposure to cold and heat could increase the risk of CVD hospital admissions, varying depending on the cause-specific, which may provide new evidence to reduce the burden of CVD.

KEYWORDS: Temperature; Morbidity.

P-0574 Childhood cognitive and behavioral effects of high summer temperatures

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BACKGROUND AND AIM: As climate change accelerates, the frequency of high summer temperatures will increase, affecting nearly every domain of health, including behavioral health. Research suggests high temperatures increase aggressive behaviors and decrease cognitive performance in adults, but these effects in children remain poorly understood. Our work addresses this knowledge gap.

METHODS: We derived daily maximum heat indexes using meteorologic data from the PRISM Climate Group and linked them to cognitive and behavioral data from 4,387 children aged 9-10 who completed assessments from June-August in the Adolescent Brain Cognitive Development Study baseline wave, 2016-2018.
At 21 sites in the USA representing 5 climate types identified by the U.S. Department of Energy (Cold, Marine, Mixed-Humid, Hot-Dry, Hot-Humid), children completed NIH Toolbox neurocognitive assessments (age-normed total cognition score; mean=100.5; sd=17.9), and their caregivers completed the Achenbach Child Behavior Checklist (aggressive behavior subscale t-score; mean=52.2; sd=4.0).
We modeled site-specific 6-day lagged relationships using distributed lag nonlinear models adjusted for known confounders, then used meta-regression to estimate climate-specific associations.

RESULTS: for participants living in the Cold climate (n = 1886), the overall cumulative association for heat indexes in the 99th percentile (vs. the 90th percentile) of the site-specific summertime heat index distribution was a -11.5 (95% CI: -21.7, -1.2) unit lower cognition score and a 2.6 (95% CI: -1.0, 6.2) unit higher aggressive behavior score. Both point estimates are more than half a standard deviation from Cold climate means.
In other climate types, which included fewer participants (n = 288 to 1017), we found no consistent evidence of any association.
CONCLUSION: Hot summer temperatures were associated with decreased cognitive performance and increased aggressive behavior in children living in a Cold climate. These results suggest a novel mechanism by which climate change may impact childhood neurodevelopment.

KEYWORDS: Climate change, temperature, children, cognition, behavior

P-0579 Impact of Wildfire Exposure on Preterm Births Identified in MarketScan Claims-Based Cohort, 2010-2015

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BACKGROUND AND AIM: Wildfire smoke is a growing contributor to ambient particulate matter and may lead to elevated risk of preterm birth. Studies that have investigated the effects of gestational wildfire smoke exposure (WSE) on preterm birth are inconsistent and inconclusive. This study aimed to estimate the effect of near-birth and trimester-based WSE on preterm births using a large-scale claims database.

METHODS: We linked IBM's MarketScan Commercial Claims and Encounters database with smoke plume data from NASA MODIS satellites using metropolitan statistical area (MSA) of residence at birth. Children born in an MSA in six Western states between 2010-2015, whose gestational age (GA) and birthdate were estimable from claims data were included (N=115,469); 759 births with <32 weeks gestation were excluded. MSA, GA, and birthdate were used to estimate average weekly days of WSE for each trimester and two near-birth periods (2 and 4 weeks pre-birth). Preterm birth was defined as live birth at GA between 32 and 37 weeks. Odds ratios were estimated using logistic regression models accounting for clustering by MSA and adjusted for maternal age (restricted cubic spline), birth season, and average temperature within each exposure period.

RESULTS: WSE in the first or second trimesters was associated with reduced likelihood of preterm birth (0.96 [95% CI: 0.91, 1.02] and 0.92 [95% CI: 0.87, 0.98], respectively), while WSE in the third trimester was associated with increased risk of preterm birth (1.05 [95% CI: 0.98, 1.12]). There was no evidence of association for the 2- and 4-week periods before birth. Sex-stratified analyses of near-birth and trimester exposures were not different from overall effect estimates.

CONCLUSIONS: We observed evidence of an association between WSE and pre-term birth that varied based on trimester of exposure, with increased risk seen for exposures during the third trimester.

KEYWORDS: Wildfire Exposure, Preterm Birth, Claims-data

P-0583 Comparison of heat-related mortality estimated using ambient temperature and wet-bulb globe temperature in Japan: Supporting evidence for heat health warning system

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BACKGROUND AND AIM: Wet-bulb globe temperature (WBGT) receives attention as a criterion in heatstroke alert system in Japan. However, epidemiological evidence related to its suitability as a heat indicator for all-cause mortality is insufficient. This study compares temperature and WBGT based on (1) their association with all-cause mortality (relative risk; RR) and (2) heat-related mortality burden (attributable fraction; AF) at high percentiles, such that a heat alert is issued. In addition, it evaluates if there are any regional tendency in the suitability of WBGT.

METHODS: A three-stage time-series analysis using data from 47 prefectures in Japan during the warm months (May-October) of 2010-2019 was conducted. First, we performed a time-series regression analysis for each prefecture to obtain prefecture-specific temperature- and WBGT-mortality associations. Second, we quantified prefecture-level RRs and AFs for the 90th percentiles of temperature and WBGT, respectively. Third, the prefecture-level RRs and AFs were pooled into region-level results, and a meta-regression analysis was conducted to compare the differences in prefecture-level RRs and AFs derived from temperature and WBGT.

RESULTS: The RRs for the 90th percentile of WBGT were 0.02% (95% confidence interval [CI]: -0.29%, 0.32%) higher than those for the 90th percentile of temperature. In addition, the AFs above the 90th percentile of WBGT were 0.16% (95% CI: -0.32%, 0.63%) lower than those above the 90th percentile of temperature. In Western Japan, temperature-related risk measures were higher than WBGT-related risk measures.

CONCLUSIONS: We found no evidence that which heat indicator shows higher risk measures for all-cause mortality. As a policy implication, it is advisable to consider practical aspects other than the magnitude of temperature- and WBGT-mortality association for the development of the heat health warning system that targets all-cause mortality.

KEYWORDS: Wet-bulb globe temperature, Heat Health Warning System

P-0585 Meteorological Factors Associated with Visceral Leishmaniasis in São Paulo State, Brazil

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BACKGROUND AND AIM: Human visceral leishmaniasis (VL) is a vector-borne disease of significant public health concern in Brazil. Areas of high prevalence have shifted in recent decades due to rapid development, changing socioeconomic conditions, and climate change. Emerging evidence suggests that incidence is affected by regional weather patterns such as the El Niño-Southern Oscillation, which has profound impacts on local meteorological conditions in Brazil. However, understanding of the effects of short-term weather variability remains inadequate, particularly in the context of VL. Accordingly, we explored the relationship between local weather conditions and VL in São Paulo State, Brazil.

METHODS: We obtained monthly cases of VL in São Paulo State from the Ministry of Health Information System for Notifiable Diseases for each municipality from 2010-2020. We extracted monthly average temperature, precipitation, and specific humidity from ERA5. We used conditional quasi-Poisson regression models to assess the relationship between meteorological variables and VL, conditioning on municipality and adjusting for temporal trends. We assessed lagged effects of meteorological variables from 0 to 6 months, corresponding with the long incubation period for VL in humans.

RESULTS: There were 1,958 documented cases of VL from 2010-2020. We observed higher rates of VL associated with increased precipitation and humidity and decreased temperatures. Specifically, a 1˚C decrease in average monthly temperature was associated with a 4.6% (95% CI: 2.5%, 6.7%) increase in VL cases two months later. A 1 mm increase in precipitation and 1 g/kg increase in humidity led to a respective 2.5% (1.2%, 3.8%) and 3.3% (1.3%, 5.2%) increase in VL cases one month later.

CONCLUSIONS: Local weather patterns are associated with the incidence of human VL in São Paulo State. These results highlight the potential importance of continued climate change on the fluctuating distribution of VL.

KEYWORDS: Climate Change, Visceral Leishmaniasis, Infectious Disease, Meteorology

P-0586 Climate change and migrant workers: Projections of temperatures and mortality in Kuwait

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BACKGROUND–It is uncertain what climate change could bring to populations and countries in the hot desert environment of the Arabian Peninsula. Not only because they are already hot, countries in this region also have unique demographic profiles, with migrant populations potentially more vulnerable and constituting a large share of the population. In Kuwait, two-thirds of the population are migrant workers and record-high temperatures are already common.

AIM–We quantified the temperature-related mortality burdens in Kuwait in the mid- (2050-2059) and end-century (2090-2099) decades under moderate (SSP2-4.5) and extreme (SSP5-8.5) climate change scenarios.

METHODS–We fitted time series distributed lag non-linear models to estimate the baseline temperature-mortality relationship which was then applied to future daily mean temperatures from the latest available climate models to estimate decadal temperature-mortality burdens under the two scenarios.

RESULTS–By mid-century, the average temperature in Kuwait is predicted to increase by 1.80°C (SSP2-4.5) to 2.57°C (SSP5-8.5), compared to a 2000-2009 baseline. By the end of the century, we could see an increase of up to 5.54°C. In a moderate scenario, climate change would increase heat mortality by 5.1% (95% empirical confidence intervals [eCI]: 0.8, 9.3) by end-century, whereas an extreme scenario increases heat mortality by 11.7% (2.7, 19.0). Heat mortality for non-Kuwaiti migrant workers could increase by 15.1% (4.6, 22.8). for every 100 deaths in Kuwait, 13.6 (-3.6, 25.8) could be attributed to heat driven by climate change by the end of the century.

CONCLUSION–Climate change induced warming, even under more optimistic mitigation scenarios, may markedly increase heat related mortality in Kuwait. Migrant worker, who are already vulnerable, could borne a larger impact from climate change.

KEYWORDS: -Climate change; Kuwait; Arabian Peninsula; Gulf; Heat; Mortality

P-0592 Nonlinear Association between summer high Temperature and Mortality in people aged 65 or more: Past and Recent periods

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BACKGROUND AND AIM: Climate change induces extreme weather including frequent heat waves in summer. We aimed to examine how the impact of high air temperature exposure to mortality of older people, a vulnerable group, has been changed from the past to recent periods.

METHODS: Temperature data from the Korea Meteorological Administration and mortality data from Statistics Korea were used. The time-series analysis was performed for the periods 1991–1995 and 2015–2019, in which included the recorded heat wave. We used the distributed lag non-linear models (DLNM) to estimate cumulative relative risks (CRRs) to see an association between daily temperature for July to August and mortality of people aged 65 or more. The CRR was estimated at each province and pooled the CRRs of all provinces using a random effect meta-analysis.

RESULTS: The CRRs on mortality of the daily mean temperature in summer for the population aged 65 or more for the whole 10-year period (1991-1995 and 2015-2019) were 1.098 (1.012, 1.192), 1.124 (1.027, 1.231), and 1.172 (0.986, 1.392) at 90%tile, 95%tile, and 99%tile, compared to 50%tile of the temperature. When the nonlinear associations between temperature and mortality were plotted in the past and recent periods separately, the CRR in the past increased substantially with temperature increases, while the increase of CRR in the recent appeared to be relatively small.

CONCLUSIONS: The effects of high temperatures in summer on mortality of people aged 65 or more have changed from the past to recent periods, and further studies are needed to explore factors potentially related with resilience of the society against climate change.

P-0607 Projections of temperature-attributable suicide under climate change scenarios in Japan

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BACKGROUND AND AIM: Recent studies have projected all-cause mortality attributable to non-optimal temperature under climate change scenarios. However, the impact of climate change on mental health remains to be assessed. The short-term association between suicide and temperature has been reported, but there is a lack of future projections of temperature-attributable suicide. We projected the excess temperature-related suicide mortality in Japan under three climate change scenarios until the 2090s.

METHODS: Daily time series of mean temperature and the number of suicide deaths in 1973-2015 were collected for 47 prefectures in Japan. A two-stage time-stratified case-crossover analysis was used to estimate the temperature-suicide association. We obtained the modeled daily temperature series using five general circulation models (GCMs) under three climate change scenarios from the latest Coupled Model Intercomparison Project Phase 6 (CMIP6) Shared Socioeconomic Pathways scenarios (SSPs): SSP1-2.6, SSP2-4.5, and SSP5-8.5. We projected the excess temperature-related suicide mortality until 2099 for each scenario and evaluated the net relative changes compared with the 2010s.

RESULTS: During 1973-2015, there was a total of 1,049,592 suicides in Japan. Net increases in temperature-related excess suicide mortality were estimated under all scenarios, with the highest increase under the high-emission scenario (SSP5-8.5). The net change in 2090-99 compared with 2010-19 was 0.6% (95% empirical confidence interval [eCI]: 0.1, 1.6) for a low emission scenario (SSP1-2.6), 1.3% (95% eCI: 0.6, 2.4) for an intermediate scenario (SSP2-4.5), and 2.4% (95% eCI: 0.7, 3.9) for a high emission scenario (SSP5-8.5). The increases were greater the higher the emission scenarios were. The increase in excess temperature-related suicide mortality was minimized under the SSP1-2.6 scenario assuming mitigation strategies.

CONCLUSIONS: The comparison of projection results under different scenarios underscores the importance of mitigation, with the higher the emissions, the greater impact on the temperature-related suicide mortality.

KEYWORDS: Climate change, non-optimal temperature, mental health, projections, DLNM

P-0608 Prediction of the impact of climate change on the number of heatstroke patients in Tokyo, Japan with heat-adaptation effects

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BACKGROUND AND AIM: Heatstroke has become a serious issue in Japan. To plan future adaptation measures, it is essential to understand to what extent the number of heatstroke patients will increase. Previous studies have predicted the number of heatstroke patients; however, they did not consider the effect of heat-adaptation. In this study, we conducted a future prediction study taking the effect of heat-adaptation into consideration.

METHODS: Japan, with its long north-south range, has a variety of climates, and it is necessary to explore its heat-adaptation effects. Our previous study showed that there was a positive correlation between the wet bulb globe temperature (WBGT) value at which heatstroke patients start to increase (WBGT threshold) and regional climate (average daily maximum WBGT between May and September: RCWBGT). Using the relationship, we translated this geographical effect of heat-adaptation to temporal adaptation by shifting the WBGT threshold to a higher side when the RCWBGT increases in the future owing to climate change. We focused on the age groups of 65+ yr, constituting the most vulnerable age group. Five future climate change scenarios and RCP8.5 scenario were adopted. All the data utilized in this study were public domain data and are available from the corresponding website.

RESULTS: In Tokyo, the number of heatstroke patients by mid-21st century will be 2.2 times as high as that of heatstroke patients at present and 6.9 times by the end of the century without heat-adaptation; however, the corresponding numbers will be 1.4 times and 2.5 times, respectively, with heat-adaptation.

CONCLUSIONS: The increase in the number of heatstroke patients was projected to substantially reduce owing to the effect of heat-adaptation.
Acknowledgement: This work was supported by the Climate Change Adaptation Research Program of the National Institute for Environmental Studies.

KEYWORDS: Climate change; Wet bulb globe temperature; Heatstroke; Impact assessment

P-0609 Long-Term Exposure to Temperature, Residential Heating and Diabetes Incidence among the elderly population in China

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BACKGROUND: Mounting evidence has shown that short-term exposure to ambient temperature can increase mortality. However, the health effects associated with long-term temperature are less clear. Furthermore, more research has been focused on the mortality instead of prevalence of chronic diseases.

METHODS: We constructed two cohorts using China Family Panel Study (CFPS) and assigned annual means of wet bulb temperature and PM2.5 to study participants based on their ID code of residential. Cox proportional hazards models were used to examine the association between long-term exposure to ambient temperature, residential heating and diabetes incidence, adjusting for potential confounders.

RESULTS: We found a non-linear relationship between the long-term temperature and diabetes in multipollutant model, which is a U-shaped curve ($p<0.001$). The optimal temperature to lower diabetes risk was around 12°C. In addition, spring temperatures were negatively associated with diabetes risk, with warm temperature being protective of diabetes; while autumn temperatures were positively associated with diabetes incidences, with warm temperature being harmful. Apart from the long-term temperature, residential heating was also great threat to the diabetes incidence, with a HR = 1.18 (95% CI: 1.03, 1.36). Finally, we evaluated the extra diabetes cases in China if (1) central heating is installed in Southern China and (2) under different climate change scenarios.

CONCLUSIONS: Using two representative cohorts, we found that either higher or lower annual temperature deviating 12°C is harmful to the diabetes incidence. Therefore, the climate change will contribute different influence in Southern China and Northern China. To our surprise, residential heating is also bad for the diabetes incidence, which alert us that if it is necessary about the installing of residential heating in those areas without residential heating.

P-0616 Seasonal variation in the association between temperature variability and emergency department visits: a multi-site study in China

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BACKGROUND AND AIM: Seasonal variation of temperature variability (TV) on emergency department visits (EDVs) remains unclear. We aimed to quantify the association between TV and cause-specific EDVs in China during 2014-2018, and explore seasonal variation, vulnerable populations, and sensitive diseases.

METHODS: We collected data on EDVs, weather, and air pollution from 20 sites in China. TV was calculated from the standard deviation of the minimum and maximum temperatures during exposure days. We applied a quasi–Poisson regression with a distributed lag nonlinear model to evaluate the TV-EDVs association. We used meta-analysis to pool site-specific estimates. We also conducted seasonal analysis and assessed the effects of modifiers.

RESULTS: A 1 ℃ increase in TV0-1 was associated with 0.36% [95% confidence intervals (CI): 0.24%, 0.48%)] increase in total EDVs. The effects became larger as exposure days increased and reached 0.59% (CI: 0.20%, 0.99%) for TV0-7. Male and people aged 0–17 were sensitive to TV with 0.40% (CI: 0.29%, 0.51%) and 0.58% (CI: 0.27%, 0.89%) increase per 1 ℃ increase in TV0-1. In seasonal analysis, effects of TV on total EDVs were lower in summer. People aged 60+ were vulnerable in winter. A 1 ℃ increase in TV0-1 corresponded to 1.84% (CI: 0.54%, 3.21%) increase of mental disease in spring, 0.43% (0.08%, 0.79%) increase of injury in autumn, and 0.63% (0.04% and 1.24%) increase of circulatory diseases in winter.

CONCLUSIONS: Exposure to TV was associated with increased risk of EDVs in China but varied in different seasons. Our results provided seasonal periods and vulnerable populations to conduct adaptive strategies and preventive measures.

KEYWORDS: Temperature variability; Emergency department visits; Seasonal variation; China

P-0617 Effect modification of diabetes as a comorbidity on temperature variability and hospitalization for cardiovascular disease

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BACKGROUND AND AIM: Evidence has accumulated that large temperature variability (TV) is associated with an increased risk for hospitalization or death. However, no previous studies examined whether the association for TV is modified by diabetes comorbidity, which is particularly vulnerable to cardiovascular disease (CVD). We aimed to explore the short-term association between TV and CVD hospitalization, stratified by presence of diabetes as a comorbidity in 47 prefectures of Japan from 2011 to 2018.

METHODS: A two-stage meta-analysis was used. First, we used a time-stratified case-crossover design to estimate the association between TV and CVD admissions with and without diabetes comorbidity for each prefecture. We then pooled the estimates using a multivariate meta-regression model across the prefectures. The associations were also stratified by sex, age, smoking status, and season.

RESULTS: A total of 4,482,583 hospitalizations for CVD were included in this study. Each 1°C increase in 0–7 days TV exposure was associated with a 0.58% (95% confidence interval, CI= 0.20% to 0.96%) increase in risk for total CVD admission and a 2.07% (95% CI= 1.16% to 2.99%) increase in risk for heart failure admission in subjects with diabetes, while the respective increases in subjects without diabetes were 0.37% (95% CI= 0.12% to 0.63%) and 0.61% (95% CI= -0.02% to 1.23%). These patterns were broadly similar to those stratified by age, sex, and smoking status, while the association for TV was greater in spring in the season-stratified analysis.

CONCLUSIONS: Susceptibility to TV in relation to CVD onset may be stronger in subjects with diabetes than those without. Our findings may suggest that subjects with diabetes should be more cautious to sudden temperature changes.

KEYWORDS: Temperature variability; Comorbidity.

P-0623 The association between ambient temperature and snakebites in Georgia, USA: a case-crossover study

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BACKGROUND AND AIM: The World Health Organization has identified snakebite as a highest priority neglected tropical disease, yet there is a dearth of epidemiologic research on environmental risk factors, including outdoor temperature. Temperature may affect snakebites through human behavior or snake behavior; snakes are ectotherms, meaning outdoor temperatures influence their internal body temperature and thus their behavior. Here we investigate the relationship between short-term temperature and snakebites in Georgia, one of the most biodiverse US states in terms of herpetofauna.

METHODS: We acquired emergency department visit data for Georgia between January 1, 2014 and December 31, 2018. Visits for venomous and non-venomous snakebites were identified using diagnosis codes. for comparison, we also considered visits for non-snake (e.g. insects, spiders, scorpions) envenomation. Daily meteorology from the Daymet 1km product was linked to patient residential ZIP codes. We applied a case-crossover design to estimate associations with maximum temperature.

RESULTS: During the five-year study period, there were 2,785 visits for venomous snakebites, 825 visits for non-venomous bites and 48,248 visits for non-snake envenomation. Across the entire period, a one-degree Celsius increase in same-day maximum temperature was associated with a 6.2% (95%CI: 4.0-8.5) increase in the odds of venomous snakebite and a 7.4% (95%CI: 3.5-11.4) increase in non-venomous snakebite. Associations were most robust in the spring and fall, particularly for venomous snakebites. We also observed a positive and significant association for non-snake envenomation, albeit slightly weaker and more consistent across seasons compared to those for snakebites.

CONCLUSIONS: Our study indicates an association between outdoor temperature and snakebites in Georgia. The results suggest that climate change could alter snakebite patterns in the future; however, impacts are likely to be dependent on the local climate and snake ecology (amongst other factors).

KEYWORDS: temperature, heat, morbidity, snake, climate change, one health, planetary health

P-0624 Decrease and seasonal changes of suicides and suicide attempts in France over the last 10 years

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INTRODUCTION: The objective of this study was to examine the evolution of suicides and suicide attempts over the last 10 years in France, according to the season.

METHODS: We analyzed the number of deaths by suicide and suicide attempts in metropolitan France (2009-2018) from French national databases, on a daily, weekly or monthly basis. Seasonal variation in suicide rates was modeled using a cosinor function. Based on this model, we determined the association of suicides and suicide attempts with geographic characteristics of the departments, age, gender, and psychiatric disorders. We also collected data on the means of suicide and suicide attempt.

RESULTS: The number of suicides and suicide attempts decreased over the last ten years in France (mean decrease of 14.49% and 11.69% per year). We observed a significant and recurrent seasonal pattern of suicides and suicide attempts in France, with a peak in spring. The suicide and suicide attempt rates were higher in the northern departments of France. Suicides are more common among men (75%) and middle-age individuals (45-54 years old), while suicide attempts affected more frequently women (62%) and young adults (15-19 and 40-49 years old). Nearly two-thirds of the patients who attempted suicide suffered from comorbid psychiatric disorder, with mood disorders being the most frequent psychiatric disorder. Voluntary drug intoxication was the most common means of suicide attempt (80%), while hanging was the most common means of suicide (54%).

CONCLUSIONS: The number of suicides and suicide attempts decreased in France over the last 10 years, with large seasonal variations. Further studies are warranted to better understand the underpinning physiological and meteorological factors that may influence these seasonal variations.

P-0625 Impact of meteorological factors and psychiatric disorders : a French exploratory study.

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INTRODUCTION: The objective of our work was to study the link between meteorological factors (temperature, sunshine duration, rain, wind, humidity) and psychiatric disorders. for this purpose, we conducted two exploratory studies in France : the first one, studying the link between the weather and suicidal behaviors (suicides and suicide attempts); the other one between alcohol use disorders (AUD) and the weather.

METHODS: We analyzed the number of deaths by suicide and suicide attempts in metropolitan France (2009-2018) from French national hospitalization databases; patients who were admitted to an emergency department for an alcohol related condition were included using the Oscour database, and we used meteorological database from national weather services. Based on this model, we determined the association of suicides and suicide attempts with weather factors, and then between AUD and meteorological factors.

RESULTS: The number of suicides and suicide attempts decreased over the last ten years in France (mean decrease of 14.49% and 11.69% per year). We observed a significant and recurrent seasonal pattern of suicides and suicide attempts in France, with a peak in spring. The suicide and suicide attempt rates were higher in the northern departments of France. We found significant positive correlations between the number of alcohol-related ED visits and the mean temperature ($r = 0.55$; $p = 1.87e$) and the duration of sunlight ($r = 0.42$; $p = .0015$). Negative correlations were also found significant with rain ($r = −0.40$; $p = .0014$), humidity ($r = –0.41$; $p = .0023$) and wind speed ($r = −0.40$; $p = .0031$).

CONCLUSIONS: The number of suicides and suicide attempts decreased in France over the last 10 years, with large and recurrent seasonal variations. Emergency visits for AUD seem to increase with the temperature and duration of sunlight, and decrease with rain, humidity and wind speed.

P-0626 Long term associations of climatic factors on cognition in olderadults: Results from the Reasons for Geographic and Racial Differences in Stroke (REGARDS) Cohort

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BACKGROUND: Evidence suggests that short term exposures to extreme heat and/or cold are associated with declines in cognition among older adults. However, the effect of long term exposures are not well understood.

METHODS: The Reasons for Geographic and Racial Differences in Stroke (REGARDS) study is a nationwide cohort study exploring regional and racial differences in stroke and cognitive function over time. ~30,000 people from all areas of the US were enrolled at age 45. Word List Learning (WLL) and Word List Delayed Recall (WLD) tests were administered on a yearly basis. Continuous cognition scores were produced using factor analysis based methods and applied to each measured time point for each individual. Associations of cognition with the number of extreme hot and cold days relative to region were tested using regression models of the continuous measure of cognition within a directed non linear Distributed Lag Non-linear Modelling framework.

RESULTS: Cognition data was available for 20,091 people with a mean age of 64.6 years over miltiple time points. of these, 39.2 percent were Black. On average, respondents experienced 25.4 and 14 extremely hot and cold days the year previous to the last date of survey. Cognition was significantly and negatively impacted by same year exposure to increased numbers of extreme heat days. No association of long term heat and/or cold exposure was found for exposure days greater than one year, or for exposure to cold or precipitation for all time periods tested.

CONCLUSIONS: Evidence suggests that the greatest impacts of temperature on cognition occurs within one year of exposure. Future work should explore the potential role of climate change in increasing incidence of cognitive decline in older adults.

P-0630 Heat Exposure and Emergency Department Visits for Sepsis in Phoenix, Arizona

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BACKGROUND AND AIM: Climate change is increasing exposures to high temperatures, which can lead to death and illnesses requiring emergency care. Sepsis, the body's response to severe infection, is usually diagnosed in emergency departments (EDs). Little is known about outdoor temperatures as a risk factor for sepsis. Here, we assessed the association between temperature and sepsis-related ED visits in Phoenix, Arizona during 2016-2019.

METHODS: We acquired ED visit data for Arizona and selected visits among patients residing within the two-county Phoenix area with a diagnosis of sepsis present on arrival at the ED. We characterized the focus of infection (FOI, respiratory, urogenital, abdominal, bone and soft tissue, blood) for each sepsis visit through diagnosis codes. Using daily population-weighted average maximum temperature data from Daymet, we estimated associations with sepsis and FOI-specific sepsis ED visits via Poisson time-series regression.

RESULTS: During 2016-2019, there were 97 sepsis-related ED visits per day in Phoenix; the average daily maximum temperature was 30.5 degrees Celsius. Overall, we observed a positive association between same-day maximum temperature and sepsis-related ED visits (rate ratio: 1.014, 95% confidence interval: 1.000-1.028 for a 5 degree increase from 24 to 29 degrees Celsius). Associations were strongest in the warmer seasons of Spring, Summer, and Autumn. When stratifying by FOI, associations of same-day maximum temperature and ED visits for sepsis with infection of the urogenital area were positive; other FOIs showed null or negative (for blood) associations with temperature.

CONCLUSIONS: Results suggest that outdoor heat exposure may be an important risk factor for sepsis, in particular during the warm season and for urogenital-based infections. During times of high heat, exposure mitigation measures may reduce emergency care needs, and emergency department preparedness may be needed to ensure positive outcomes for patients.

KEYWORDS: Climate, Heat, Temperature, Sepsis, Morbidity

P-0632 Central heating in China and protection against cold temperature mortality: a longitudinal cohort study of older adults

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Central heating in northern China during the months is reliant on biomass combustion and causes air pollution. Prior studies using natural experiment design (north and south of Huai river) attribute higher pre-mature mortality due to central heating-related air pollution. However, the original intention of central heating is to protect against the cold. We used the 2000-2018 Chinese Longitudinal Healthy Longevity Survey (CLHLS), a nationwide cohort of older adults aged 65. We focused on five provinces that are between heating and non-heating areas. The heating status was measured according to the resided city. We obtained daily meteorological data from the closest national station and measured residential air pollution. Cox proportional hazards models were used to assess the effects of central heating and air pollution. We further compared the mortality risk of long-term and short-term cold temperatures for participants with and without central heating. Winter average temperature and temperature variability were used to measure the long-term cold temperature. for the acute exposure, we used a distributed lag non-linear model. We included 5,334 participants, totaling 34,608 person-years of follow-up. We recorded 6,667 deaths, and 2,051 occurred in winter. In the adjusted model, the mortality hazard ratio (HR) for central heating was 0.80 (95% CI 0.76, 0.85). In our subgroup analyses, the HR for each 1℃ increase in winter temperature variability was higher for participants without central heating than for participants with central heating (1.21 vs.1.08), but the HR for each 10 μg/m³ increase in PM2.5 was similar(1.13 vs. 1.14). Participants without central heating also had for higher mortality risk of extremely cold at the 5th percentile compared to the 60th percentile than participants with central heating (1.48 vs.1.14). Our results suggested that central heating significantly decreased winter mortality, which may partly be achieved by attenuating the mortality caused by cold temperatures.

P-0634 Allostatic load and climate change: analyzing epidemiological confounding variables, health effects and adaptative response in osteoporosis and kidney disease associated with NDVI greenness index

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BACKGROUND AND AIM: To explain individual response to stressors, research has brought attention to the common underlaying mechanisms for catecholamine- dependent adaptive response. Under this perspective, a trigger factors is the adaptation to extreme weather events linked to climate change (droughts, long warm summers, heat waves, etc) closely connected with the related concept of "allostasis" defined as “the physiological or behavioural changes required to stabilize the biological systems". As long as allostasis implies resilience (Karatsoreos, McEwen, 2011) it can be connected, conversely, with the negative effect of “allostatic load”. Nevertheless, its concurrence with confounding variables should be also evaluated: Allostasis can influence occurrence of osteoporosis-related fracture and changes on Bone mineral density (BMD) where researchers have found the apparently beneficial effect of greenness in relation to the positive impact of outdoor exercise as a stress reduction mechanism, also identified as a factor influencing BMD (Follis, Bea, Klimentidis et al. 2019)
Other example is the beneficial effect in kidney disease incidence and air pollution, where results shown that stricter air quality standards benefit kidney patients. (Lee, W, 2022)

METHODS: Systematic review on cases involving BMD and kidney disease and subsequent the catecholamine-dependent response following a two stage analysis. Residential proximity is defined as average of satellite-based Normalized Difference Vegetation Index (NDVI) in buffers of 50 m, 100 m and 250 m, 500 m

RESULTS: Evidence of beneficial effect of the greenness estimated from analysis of Normalized difference Vegetation Index- NDVI has

CONCLUSIONS: The influence of allostasis should be supported by clinical research evidence(Ramsay et al 2014). A number of studies estimating beneficial effects or greenness suggest that allostasis, as a measure of catecholamine-dependent response could be a valid approach for understanding the underlying mechanisms in environmental stressors

KEYWORDS: Allostasis, allostatic load, NDVI, greenness, behavioural changes

P-0638 Knowledge, Attitude and Practice of Health Workers and Shopping mall operators towards Decontamination during COVID -19 Pandemic in Ibadan

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BACKGROUND AND AIM: Public facilities such as hospitals and shopping malls are a potential hotspot for transmission of infectious disease like COVID-19. Decontamination practice is therefore an essential infection prevention and control strategy used in preventing disease outbreaks. Information on knowledge, attitude, and practice of facilities workers towards decontamination are poorly investigated and documented in developing countries. This study, therefore, assessed the knowledge, determined the attitude and practice of hospital and shopping mall workers towards decontamination during the Covid-19 pandemic.

METHODS: The cross-sectional study utilized a comparative approach involving the use of Adeoyo hospital and a shopping mall in Ibadan, Nigeria. An interviewer-administered questionnaire was used to assess the knowledge, attitude, and practices of decontamination among 250 respondents. Data collected were analyzed using SPSS version 25, for mean, standard deviation, and T-test at 5% significance level.

RESULTS: Most (64%) of Adeoyo respondents and majority (89%) of Shopping mall respondents had a poor practice level towards decontamination at their workplaces, however, the majority (89.8%) and (81.1%) of the respondents in Adeoyo and shopping mall respectively had a good attitude towards decontamination. Although there was a significant association between knowledge ($p = 0.001$), practice ($p < 0.001$), and study location. A little more than half (56.1%) and some (21.2%) of respondents in Adeoyo and Shopping mall respectively had poor knowledge about decontamination. Among respondents from Adeoyo, level of education ($p = 0.006$) was significantly associated with level of practice on decontamination.

CONCLUSIONS: The study revealed that both study locations had poor decontamination practice and a large percentage had poor knowledge about decontamination, therefore Hospital and mall workers should be educated on the importance of decontamination. Necessary infrastructure should be put in place to ensure decontamination practice and ensure infection control.

KEYWORDS: Decontamination, Knowledge, attitude, practice, hospital, shopping mall

P-0645 Impact of air pollution on cardiovascular mortality during the COVID-19 pandemic in South Korea

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BACKGROUND AND AIM Multiple studies have reported the impacts of the coronavirus-2019 pandemic on cardiovascular disease (CVD) and the concentration of air pollution, respectively. Although the association between air pollution and CVD outcomes has been widely identified, the changes in the association during the pandemic period have not been fully investigated. This study aimed to examine the nationwide changes in the short-term effect of fine particulate matter (PM2.5) on CVD deaths in South Korea.

METHODS: We performed an interrupted time-series analysis to estimate temporal changes in the association between PM2.5 and CVD-related deaths (total, ischemic health disease [IHD], cerebrovascular disease [CD], and hypertension) before (Jan 01, 2016 to Feb 17, 2020) and during the pandemic (Feb 18, 2020 to Dec 31, 2020), using daily data. Relative humidity, day-of-week, seasonality, and temporal trend were controlled. We conducted a two-stage analysis to estimate the risk of air pollution on CVD deaths for each of 16 regions and then generated an overall estimate.

RESULTS: The total number of CVD mortality was 53,552. The average annual concentration of PM2.5 changed before (23.8 μg/m3) and during the pandemic (17.1 μg/m3) in South Korea. for total CVD deaths, the changes in relative risks (RRs; for 10 μg/m3 increase in PM2.5) were not pronounced during the pandemic. Whereas, for ISH and CD, the RRs increased during the pandemic: (pre-pandemic to pandemic period) 1.00 (0.99, 1.01) to 1.02 (1.00, 1.04) for IHD and 1.00 (1.00, 1.01) to 1.02 (1.00, 1.04) for CD, although the changes were not statistically significant (p-values 0.08 and 0.24).

CONCLUSIONS:We found that the risks of short-term exposure to PM2.5 on mortality for IHD and CD increased in the first pandemic year in South Korea, compared to the pre-pandemic years.

KEYWORDS: COVID-19, Pandemic, PM2.5, Cardiovascular mortality.

P-0648 Higher incidence of novel coronavirus (COVID-19) cases in areas with combined sewer systems, heavy precipitation, and high percentages of impervious surfaces

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Combined sewer systems (CSS) are water management systems that collect and transport stormwater and sewer water in the same pipes. During large storm events, stormwater runoff may exceed the capacity of the system and lead to combined sewer overflows (CSOs), where untreated sewer and stormwater are released into the environment. Previous studies identified SARS-CoV-2 in sewage, urine, feces, and municipal wastewater. As such, areas contaminated by CSOs may be a reservoir of SARS-CoV-2 and may result in illness after the ingestion and/or inhalation of contaminated splashes, droplets, or aerosols. We investigated the association between COVID-19 incidence and CSSs and whether this association differed by precipitation and percent impervious surfaces as a proxy for possible CSOs. We fitted a quasi-Poisson regression model to estimate the change in percentage of incidence rate of COVID-19 cases in counties with a CSS compared to those without, adjusting for potential confounders (i.e., state, population density, date of first documented COVID-19 case, social vulnerability, and percent vaccinated) and including interaction variables between CSS, precipitation, and impervious surfaces. Our findings suggest that heavy precipitation in combination with high percentages of imperviousness is associated with a higher incidence rate of COVID-19 cases in counties with a CSS compared to in counties without a CSS. We theorize that more COVID-19 cases may be seen in counties with a CSS, heavy precipitation, and high percentages of impervious surfaces because of the possible increase in frequency and severity of CSOs. The results suggest links between climate change, urbanization, and COVID-19.

P-0650 Using Google data and weather factors to predict COVID-19 transmission in Melbourne, Australia: A time-series predictive model

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BACKGROUND AND AIM: We aimed to assess the effect of weather variability and Google data on COVID-19 transmission and develop multivariable time series AutoRegressive Integrated Moving Average (ARIMA) models for predicting COVID-19 transmission and outbreaks in Australia.

METHODS: Data including COVID-19 case notifications, meteorological factors and Google data were collected for the period of the Delta outbreak in Melbourne, Australia from the 1st of August to 15th November 2021. Time-series cross-correlation (TSCC) was used to evaluate the temporal correlation between weather factors, Google search trends, Google Mobility data and COVID-19 transmission. Time series ARIMA models with potential predictors were used to forecast COVID-19 incidence and Effective Reproductive Number (Reff) in the Greater Melbourne region. Five models were fitted to compare and validate predictive models using three-day ahead increments to test the predictive accuracy for both COVID-19 incidence and Reff. ARIMA models were fitted and validated using 70% training (75 days) and 30% validating (32 days) from 1st August 2021 to 15th November 2021 (107 days).

RESULTS: Maximum temperature (Tmax), absolute humidity, solar exposure, and transit station mobility (TSM) were significantly positively associated with COVID-19 incidence over time. Tmax and TSM were selected at a lag of 8 and 7 days respectively to develop multivariable ARIMA models. Multivariable ARIMA models including Tmax or TSM improved the predictive accuracy of COVID-19 cases slightly.

CONCLUSIONS: ARIMA modelling was useful for predicting epidemic growth, there is also a potential application for inclusion of weather and Google data in creating effective early warning systems for future outbreaks. Our results suggest that TSM and Tmax would be useful for further exploration and developing weather-informed early warning models for future potential COVID-19 outbreaks.

KEYWORDS: COVID-19, ARIMA, forecasting, weather, internet search queries, mobility

P-0652 Health impacts of a reduced aircraft noise exposure during the Covid-19-pandemic - A natural experiment in Stockholm, Sweden

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BACKGROUND AND AIM: The lock-downs during the Covid-19-pandemic induced significant changes in travel patterns. In Stockholm, Sweden, the aircraft traffic around Bromma airport reduced by 77 percent during the first wave of the pandemic, March 1 to June 15, 2020, resulting in a sharp decline in residential exposure to noise. Based on this "natural experiment", we aimed to assess the impact of the reduced aircraft noise exposure on population well-being and health.

METHODS: In September 2020, we invited 10 000 individuals residing in the vicinity of Stockholm Bromma airport (n=7 500) and in Nacka municipality (n=2 500), serving as a reference, to a web-based questionnaire survey. The questions related to a pre- and during the pandemic situation, respectively, and concerned individual and housing factors and various disturbances, e.g., noise annoyance, sleep impairment, and stress related symptoms. Residential exposure to aircraft noise was assessed for a pre-pandemic situation in 5 dB categories ranging from ≤45 to ≥55 dB Lden. Logistic general estimating equation models were used to assess Relative Risks (RR) and 95% Confidence Intervals (95% CI).

RESULTS: In total, 3 582 individuals responded to the survey (35,8%). In the pre-pandemic situation, statistically significant associations were found between aircraft noise and all investigated disturbances. During the pandemic, the associations reduced and approached unity. The RR for high noise annoyance dropped from 7.51 (95% CI 5.18-10.90) among those exposed ≥46 dB Lden compared to the reference before the pandemic, to 2.18 (95% CI 1.24-5.9) during the pandemic. Corresponding figures for high sleep disturbance were 7.64 (95% CI 3.90-15.0) and 1.57 (95% CI 1.62-1.02), respectively. Improvements were also seen for stress symptoms.

CONCLUSIONS: The reductions in aircraft noise exposure around Stockholm Bromma airport during the Covid-19-pandemic resulted in an overall improved health in the local population.

KEYWORDS: Aircraft noise, Covid-19-pandemic, annoyance, sleep, stress

P-0653 Environmental surveillance and clinical assessment of SARS-CoV-2 epidemiology and variant prevalence in an urban area in Spain

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BACKGROUND AND AIM: Wastewater-based epidemiology (WBE) provides the means to monitor pathogens prevalence in the sewage system of a community. SARS-CoV-2, the virus responsible for the COVID-19 global pandemic, can be detected in the feces of infected individuals. Therefore, viral concentrations in wastewater can be taken as an indication of SARS-CoV-2 prevalence in the entire population. This work was aimed at the detection and sequence analysis of SARS-CoV-2 RNA in wastewater and its correlation with clinical data.

METHODS: Samples collected over a nine-month period (2020-21) at a wastewater treatment plant in Elche (Spain) were concentrated by ultrafiltration and analyzed for the presence of SARS-CoV-2 RNA by reverse transcriptase quantitative polymerase chain reaction (RT-qPCR). Sequences generated from cDNA samples with a MinION Nanopore device were compared to SARS-CoV-2 sequence databases.

RESULTS: The appearance of the first qPCR positive signals correlated with the increasing number of covid-19 cases in Elche at the onset of the second wave of COVID-19 (july 2020). Measurements of viral genomes in water samples in October-November 2020 reflected the higher number of clinical cases within that period. Nanopore sequencing assay allowed the detection of spike (S) protein mutations associated with circulating SARS-CoV-2 variants both in environmental as well as in clinical samples, reflecting the emergence of the B.1.1.7 variant in Elche in late 2020.

CONCLUSIONS: This study highligted the potential of wastewater-based epidemiology (WBE) in revealing the presence of pathogenic viruses in urban populations. By the use of the nanopore sequencing technology we were able to assess the changes in circulating SARS-CoV-2 variants in a whole population.

KEYWORDS: environmental epidemiology, SARS-CoV-2 variants, wastewater, nanopore sequencing

P-0670 COVID-19 in the Eastern Caribbean: Engaging the Root of Ill-Health and Unhappiness

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BACKGROUND: The peripheral impacts of the global COVID-19 pandemic have had enduring effects on our everyday lives. Citizens of small island Caribbean states in particular faced increased frequencies and odds of morbidity beyond SARS-COV-19 infections.
AIM: Our pilot project sought to probe health-relevant outcomes among Eastern Caribbean residents.

METHODS: We surveyed residents of St. Kitts-Nevis, ages 17 to 55 and facilitated student focus groups (SFG) in 2021 and 2022. Analyses produced descriptive methods and odds ratios.

RESULTS: Among 81 respondents, 72.8% identified as female and 82.7% had been involved in academic training within a year of completing the questionnaire. Physical activity (50.6%) and mental health (69%) were at least moderately impacted due to the atmosphere of risk and restrictions. Male participants were less likely (OR: 0.32) to have friendships greatly impacted (95CI%: 0.11 - 0.86) while female participants were more likely (OR: 1.15) to report at least moderate declines in mental health (95CI%: 3.21 - 9.16). Students and teachers had a 3.92 higher odds (95CI%: 3.92 - 13.52) of experiencing mental health challenges relative to other occupations. Persons with moderate-to-severe feelings of negative mental health had increased odds (OR: 5.70; 95%CI: 2.05 - 17.83) of a moderate-to-severe comprise of diet relative to individuals feeling little to no changes in mental well-being. Informational sources such as TV as a source of COV-19 information was linked to greater mental health deficits (OR: 3.44; 95%CI; 1.31 - 9.45). SFG participants (n=8) qualified mental health challenges during the pandemic, highlighting lack of communication and clear instructions from their institutions, insufficient feedback and guidance from teachers, absenteeism due to parent(s) serving as essential worker(s) and isolation due to quarantine and/or lockdown.

CONCLUSIONS: Results reflect both unique and relatable ways in which Caribbean folks experience and reflect on health status throughout the unprecedented COV-19 pandemic.

P-0671 Long-term exposure to ambient air pollution and COVID-19 incidence in Italy

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BACKGROUND AND AIM: The SARS-CoV-2 pandemic gave rise to a large number of epidemiological studies linking ambient air pollution (AP) to COVID-19 incidence. However, to date, the role of chronic exposure to AP in explaining COVID-19 occurrence is still not clarified.

METHODS: Within a national study (EpiCovAir) promoted by National Institute of Health (ISS) and Italian Network of Environmental Protection (SNPA), we identified all COVID-19 cases in Italy from February 2020 to June 2021. Chronic exposure to particulate matter < 10 micron (PM10), < 2.5 micron (PM2.5) and nitrogen dioxide (NO2) were assigned at municipality level (n=7800) using a national satellite-based AP exposure model (1-km2 spatial resolution) for the period 2016-2019. We applied principal component analysis (PCA) and generalized propensity score (GPS) approaches to summarize information of about 50 area-level covariates to account for major determinants of the spatial distribution of COVID-19 cases (municipality characteristics, population density, mobility, population health, socio-economic status). Finally, we applied generalized negative-binomial regression models matched on GPS, age, sex, province and month to study the association between AP and COVID-19 incidence.

RESULTS: 3,995,202 COVID-19 cases occurred in Italy in the entire period (incidence rate=67x1000). Overall, incidence rates increase by 0.6% (95% CI: 0.5%, 0.7%), 0.5% (95% CI: 0.4%, 0.6%) and 0.9% (95% CI: 0.9%, 1.0%) per 1 □g/m3 increment in PM2.5, PM10 and NO2, respectively. Associations were consistent to different sensitivity analyses, particularly for NO2. Increments were higher among elderly subjects, and during the second pandemic waves (Sept. 2020-Dec. 2020). In two-pollutant models, NO2 estimates were robust to PM adjustment, while PM showed no associations after adjustment for NO2.

CONCLUSIONS: We found evidence of association between long-term exposure to ambient AP (particularly NO2) and the occurrence of 4 million COVID-19 cases in Italy, suggesting a role of AP in increasing the incidence of COVID-19 disease.

P-0674 Long-term Air Pollution Exposure on COVID-19 Risk and Severity

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Since the emergence of the COVID-19 pandemic, long-term exposure to air pollution has emerged as a possible risk factor for increased COVID-19 disease risk, severity, and mortality.
The objective of this study was to examine the association between COVID-19 and long-term exposure to air pollution.
This retrospective cohort study included patients who had a COVID-19 test at the University of Chicago Medicine Center from March 18, 2020, to March 30, 2021. Air pollution exposure was assessed using models developed for Chicago by the MESA Air Study and data from the Environmental Protection Agency's EJSCREEN. Air pollution exposure estimates were linked to the University of Chicago Medicine patients using residential addresses. Air pollution measurements included PM2.5 (MESA Air and EPA), NO2, diesel PM, the respiratory hazard index, traffic proximity, and ozone. The outcome was COVID-19 risk and severity (ICU admission). Mixed effect analyses were performed to test whether poor air quality status was associated with COVID-19 risk and severity, controlling for demographic, smoking, and comorbidity indicators collected from the medical records.
A total of 74,004 patients (mean [SD] age 44.0 [22.51] years; 42,979 [58.09%] women; and 32,870 [49.09%] African Americans) were linked to air quality exposure based on residence and other covariates using electronic medical record data in addition to COVID-19 test results. Overall, 8,463 participants (11.4%) tested positive for COVID-19. In the mixed effect analysis, long-term PM2.5 exposure was associated with increased risk of testing positive for COVID-19 (odds ratio [OR], 1.30; 95% CI, 1.23-1.38; P <0.01) and increased severity from COVID-19 (OR= 2.28; 95% CI, 2.00-2.60; P = <0.01).
The results of this retrospective cohort study provide some evidence of the effect of long-term air pollution exposure on COVID-19 risk and severity.

P-0678 Field measurements of indoor and community air quality in rural Beijing before, during, and after the COVID-19 lockdown

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BACKGROUND AND AIM: The outbreak of the coronavirus (COVID-19) initiated a global prevention response to curb the spread of the virus, including a series of actions to reduce human mobility. Previous studies report reductions in outdoor $PM_{2.5}$ associated with COVID-19 lockdown in many countries and regions. Few studies assessed the impacts of COVID-19 on local air quality in environments with diverse socioeconomic and household energy use patterns. We evaluated whether indoor and community $PM_{2.5}$ in homes with different energy use patterns in rural Beijing, China differed before, during, and after the lockdown.

METHODS: We deployed low-cost $PM_{2.5}$ sensors (Plantower), calibrated with co-located filter-based $PM_{2.5}$, to measure indoor and community air quality in 147 homes from 30 villages in Beijing in January-April, 2022. We apply mixed-effects models to assess the impact of the COVID-19 lockdown on indoor $PM_{2.5}$ and used the random component superposition model (RCSM) to estimate the contributions of indoor and outdoor sources to indoor $PM_{2.5}$.

RESULTS: Community pollution was higher during the lockdown period (61 ± 47 μg/m³) compared with before (45 ± 35 μg/m³) and after (47 ± 37 μg/m³) the lockdown. However, we did not observe higher indoor $PM_{2.5}$ during the lockdown (during vs. before: 98 ± 86 vs. 96 ± 83 μg/m³). Indoor-generated $PM_{2.5}$ was lowest in homes using clean energy exclusively for heating and without smokers, and did not change significantly during the lockdown compared with homes using solid fuels.

CONCLUSIONS: Indoor air quality did not worsen during the COVID-19 lockdown in our rural Beijing sites, though community $PM_{2.5}$ was higher during the lockdown. Indoor-generated $PM_{2.5}$ in homes using clean energy exclusively for heating was low and stable, while decreased during the lockdown in homes using solid fuel, which may be due to less solid fuel burning for heating because outdoor temperatures warmed.

P-0680 How the COVID-19 infection and deaths are shaped by socioeconomic inequities and air pollution exposure in Mumbai, India?

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BACKGROUND: The COVID-19 pandemic caused a global health crisis and exposed the low socioeconomic groups to higher exposure and death due to the existing social inequalities. India witnessed three unprecedented waves of COVID infection and deaths. However, a systematic analysis of the impact of socioeconomic inequities and other environmental factors on COVID-19 infection and mortality are not well examined in India.
AIM:
The present study aims to understand the impact of socioeconomic inequities and air pollution on COVID-19 infection and deaths in Mumbai, India.

METHODS: Ward-level data on COVID-19 cases and deaths from 24 wards is obtained from the Municipal Corporation of Greater Mumbai. Socioeconomic data is acquired from the official Govt. of India 2011 census. Bivariate and multivariate regression is applied to examine the impact of various socioeconomic factors on COVID fatalities and infections.

RESULTS: Mumbai reported 1,032,563 positive cases with an overall mortality rate of 18.9. The maximum mortality (41.9) and recovery rate (991.4) were observed in wards B and A in south Mumbai. A significant negative correlation (r=-0.55) was observed between deaths and the total population, irrespective of gender. Education (defined by literacy rate) showed a positive association with the COVID cases for both genders, suggesting no significant disparity based on gender and education ($p<0.05$). The homeless population depicted a positive correlation with mortality rates and positive cases, indicating the role of economic inequities. The higher population density in the wards may have caused higher mortalities, as suggested by a significant positive association (r= 0.46).
CONCLUSION: Our initial analysis suggests the influence of healthcare and housing affordability on the mortality rates, whereas the total positive cases seem to be driven by the non-slum population. The effect of other socioeconomic variables and air pollution, and multivariate analysis is currently underway.

KEYWORDS: COVID-19, Socioeconomic inequity, Air Pollution, Healthcare, Mortality

P-0683 Environmental, health and economic benefits of Covid-19 lockdown in Morocco

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Several measures have been taken to mitigate the effects of the Covid-19 pandemic. In this context, almost all non-essential activities in Morocco have been halted since March 20, 2020. The main objectives of this work are firstly to study the effects of lockdown measures on air quality, by analyzing dust PM2.5, NO2 and O3. Secondly, to estimate the health and the total economic benefits caused by PM2.5 during the Covid19 scenario based on Environmental Benefits Mapping and Analysis Program (BenMAP). A review of the various health and economic studies of the impact of lockdown on air quality was conducted and taken into account. The dust PM2.5 analysis was carried out from 2016 to 2020. NO2 and O3 analysis was carried out in 2019 and 2020. This study, which is based on satellite data from TROPOMI Sentinel 5P and MERRA, has shown that Morocco has experienced an improvement in air quality during the lockdown. A significant reduction in surface dust PM2.5 and tropospheric NO2 was observed (-10%, -4%, respectively on average). The total column of ozone recorded a slight increase on average of around 1%. According to the results obtained, it is inferred that the reduction of PM2.5 concentration saved lives mainly from cardiovascular and respiratory diseases, with 291 and 137 avoided deaths respectively. According to the VSL method, the economic benefits of avoiding deaths from all causes due to a decrease in PM2.5 concentration of the order of 67 % in Morocco have been estimated at about 451 million USD. This hypothetical clean air scenario has shown us the significant health and economic benefits that could be achieved through transport, climate and environmental strategies and policies that at the same time support a robust economic recovery and reduced emissions.

KEYWORDS: Air quality, Covid-19, Morocco, health impacts, economic benefits.

P-0685 Race-ethnicity disparities in COVID-19 outcomes may be worsened by shorter- and long-term aerosol pollutants exposure

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BACKGROUND AND AIM: The importance of ultrafine particles (UFP or $PM_{0.1}$) exposure to respiratory disease has been identified. However, its effect (and that of $PM_{2.5}$) on COVID-19 outcomes remain unknown. This study aims to identify and quantify shorter- and long-term aerosol impacts on COVID-19 in context of disparate outcomes observed for minority race-ethnicity groups in New York State (NYS).

METHODS: COVID-19 outcomes included infections, hospitalizations, ICU admissions, and deaths reported by the CDC COVID-19 Case Surveillance Restricted Access Detailed Data, 2020–2022. UFP and $PM_{2.5}$ data were simulated by a global three-dimensional model of chemical transport with state-of-the-science aerosol microphysical processes extensively validated with observations. for shorter-term (0–30 lag days) UFP and $PM_{2.5}$ exposure, Distributed Lag Non-linear Model (DLNM) were used to examine the association at county-level, adjusting for meteorological factors. Long-term (average level of 2013–2020) associations with COVID-19 were assessed by Negative Binomial Mixed Models adjusting for county-level confounders. County-level confounders from the Census Bureau, Behavioral Survey, and Homeland Infrastructure Data were used.

RESULTS: Compared to White, Hispanic/Black subgroups had greater excess risk of COVID-19 infection (+25%), hospitalization (+31%), ICU admission (+60%), and death (+5.5%). Excess risk per IQR increase for long-term UFP ($PM_{2.5}$) exposure was significant for COVID-19 hospitalization: +40%; 95%-CI=20.5–63.6% (+22%;18.8–25.5%), ICU admission: +44%;39.1–49.2% (+24%;18.6–30.5%), and death: +40%;38.0–42.4% (+19%;8.2–30.7%). for short-term exposures, risks for all COVID-19 outcomes were elevated (RRs range from 1.0–4.6, all $p < 0.05$) when UFP > 2000 #·cm−3 and $PM_{2.5}$ > 6.3 μg·m−3.

CONCLUSIONS: Both shorter- and long-term exposure to aerosols increased the risk of COVID-19 infection and subsequent outcomes, with ultrafine particles (UFP) exerting larger effects than $PM_{2.5}$, and with greater likelihood. The UFP and $PM_{2.5}$-associated risks were disproportionately higher for race-ethnicity minorities (particularly Hispanic and Black) and for their economically vulnerable subgroups.

KEYWORDS: COVID-19, ultrafine aerosol, particulate matter, environmental justice, socioeconomic status

P-0688 Maximum apparent temperature lowers birth weight and increase hazards of preterm birth in a constant high ambient temperature exposed population in Piura, Peru

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BACKGROUND AND AIM: Exposure to high environmental temperature during pregnancy has been associated with lower birth weight and an increased risk of preterm birth (PTB). The province of Piura is a region with a higher environmental temperature than the rest of the country; however, it is unknown how temperature would be impacting reproductive health in populations exposed to high basal temperatures. The aim of the study is to determine the association between maximum apparent temperature (HImax) during pregnancy with birth weight and preterm birth in newborns in the province of Piura, 2011-2016.

METHOD: Semi-ecological study, where maternal-perinatal data from Santa Rosa Hospital (N=17,788); and maximum apparent temperature data were evaluated. Four exposure windows were analyzed: the entire pregnancy, and each gestational trimester, which were assigned according to date of birth and gestational age, categorized into quartiles. The association with birth weight was assessed by linear regression; and Cox regression for PTB.

RESULTS: A negative association was found between birth weight and HImax in all exposure windows, except for the first trimester, the effect being greater during the third trimester. As for preterm birth, higher HImax increased the hazard of PTB, with the highest effect seen in the P95 exposed group in every exposure window; nonetheless, the first and second trimester being the most temperature-sensitive exposure windows.

CONCLUSIONS: HImax during pregnancy is related to lower birth weight and higher PTB hazards, but with different susceptibility according to the stage of pregnancy.

KEYWORDS: Apparent Temperature, Heat Index, Birth Outcomes, Peru, Latin America

P-0689 Residential exposure to Pesticides and Cleaning Detergents with increased risk of respiratory and allergic symptoms among farmworkers in Northern Tanzania

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BACKGROUND AND AIM: It has been suggested that environmental exposures to pesticides and cleaning detergents have an increased risk of respiratory and allergic symptoms in adults. However, the evidence of residential exposure to pesticides and cleaning detergents with increased risk of respiratory and allergic symptoms among farmworkers is limited. The aim was to investigate the association of environmental exposure to pesticides and cleaning detergents with increased risk of respiratory and allergic symptoms in farmworkers.

METHODS: In this cross-sectional analysis, we included farmworkers at the ages of 18 and 48 years from Kilimanjaro and Arusha region with information on residential exposure to pesticides, cleaning detergents, cough, rhinitis, wheeze, shortness of breath, cough with phlegm and itching skin collected in 2021 (N = 389) through administered questionnaires. Logistic regression analysis was used to estimate associations between exposure and outcomes, adjusting for potential confounders.

RESULTS: Cleaning detergents was associated with an increased risk of cough among farmworkers [adjusted odds ratios (95% CI) 3.90 (1.33, 11.38)]. However, there was a reduction of risk for itching when the farmworkers use cleaning agents [adjusted odds ratios (95% CI) 0.32 (0.16, 0.67)]. We found that there were risk reduction for cough, rhinitis, wheeze, shortness of breath, cough with up phlegm, difficulty in breathing and itching skin for farmworkers who had vegetable garden at their homes [adjusted odds ratios (95% CI) 0.31 (0.18, 0.54),0.48 (0.29, 0.78), 0.14 (0.05, 0.37), 0.35 (0.13, 0.96), 0.18 (0.07, 0.44), 0.20 (0.09, 0.47), 0.49 (0.25, 0.96)].

CONCLUSIONS: The findings of this study suggest that vegetable gardens at their homes had public health concerns as it reduced the risk of respiratory and allergic symptoms among our study participants. This is an important issue for future research.

KEYWORDS: Pesticides, Cleaning detergents, Respiratory, Allergic.

P-0696 Ambient air pollution and Carotid Intima-Media Thickness: a cross-sectional analysis from the Mexican Teachers' Cohort (MTC)

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BACKGROUND AND AIM. Is well known that ambient air pollution increases the risk of cardiovascular health outcomes. Carotid Intima-Media Thickness (CIMT) is a marker of subclinical atherosclerosis and a strong predictor of both prevalent and incident cardiovascular morbidity and mortality, including coronary heart disease, myocardial infarction, and stroke. CIMT has been positively associated with air pollutants such as PM2.5 and NO2, nevertheless evidence from low- and middle-income countries is scarce. We evaluated the cross-sectional association between long-term exposure to air pollutants and mean (left and right) CIMT in a population of middle-aged women from the MTC.

METHODS: We analyzed a randomized selected clinical subsample of the MTC participants living in the Mexico City Metropolitan Area, who were measured the mean CIMT once in 2017, using a standardized protocol (n=265). Self-administered questionnaires collected information on health and sociodemographic characteristics. Ambient PM2.5 and NO2 annual averages were predicted at home and work addresses using high resolution Generalized Additive Models, which were validated using ground measurements. We fitted multiple linear regression models adjusting for potential confounders: age, diabetes, body mass index, cholesterol, triglycerides, smoking and socioeconomic status.

RESULTS: Mean CIMT among participants was 618.5 µm (±86.5 SD), while mean PM2.5 and NO2 exposure was 22.5 µg/m3 (±3.5 SD) and 22.5 ppb (±6.6 SD) respectively. After confounder adjustment, each 10-unit increment of PM2.5 and NO2 exposure was positively non-significant associated with a 12.97 µm (95% CI: -16.91, 42.86) and 12.26 µm (95% CI: -1.46, 29.97) higher CIMT, respectively. Sensitivity analyses evaluating CIMT sides shown larger effects on the left CIMT.

CONCLUSIONS: Although with limited precision, these results suggest that long-term PM2.5 and NO2 exposure is associated with subclinical atherosclerosis in an upper-middle income country women population. Small sample size may have limited the statistical power to detect the effect.

KEYWORDS: Air pollution, atherosclerosis, Carotid Intima-Media Thickness

P-0712 The association between urinary concentrations of organophosphate metabolites and asthma-related outcomes at 12-month follow-up among children from informal settlements in Western Cape, South Africa

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BACKGROUND AND AIM: There is limited evidence on the relationship between pesticide exposure and child respiratory outcomes in non-agricultural settings. This study investigated the association between organophosphate pesticide (OP) exposure and child asthma-related outcomes among children from four informal settlements.

METHODS: This study was a longitudinal study of 590 schoolchildren, with a 12-month follow-up period. A standardised questionnaire adopted from the International Study of Asthma and Allergies in Childhood (ISAAC) was administered to caregivers on child's respiratory symptoms and household characteristics. Spirometry and fractional-exhaled nitric oxide (FeNO), including a phadiatop test (atopy status) and urinary concentrations of dialkyl phosphate (DAP) metabolites diethylphosphate (DEP), dimethylthiophosphate (DMTP)] were measured at baseline and follow-up. Dimethylphosphate (DMP) was measured only at baseline.

RESULTS: The mean age of schoolchildren were 9.9 ± 0.91 years and median sum DAP was 32.9 ng/ml (18.4 – 52.9 ng/ml) at baseline. Incidence proportions of new asthma outcome cases at 12-months were 2.2 % doctor diagnosed asthma, 17.8 % asthma-symptom score ≥ 2, 14.5 % forced expiratory volume 1< lower limit of normal, and 5.9 % airway inflammation across all areas. In the linear mixed and fixed effect model, no consistent patterns of increased risk of new asthma-associated outcomes at the 12-month was found. However, there was a significant increase in airway inflammation (β:2.99 (95% CI: 0.48 - 5.50) in the 3rd DEP quintile (1.9 – 3.0 ng/mL) compared to the reference quintile (1.10 ng/ml).

CONCLUSIONS: DAP concentrations were higher than those of children in other settings. However, the study did not find consistent associations between urinary concentrations of DAP metabolites and asthma related outcomes over a 12-month follow-up period among schoolchildren. Future studies with a longer follow-up period and repeated OP pesticide biomonitoring are recommended.

KEYWORDS: Pesticides, organophosphates, asthma, children, informal settlements, dialkyl phosphates, South Africa

P-0716 Epidemiological characteristics and spatio-temporal distribution patterns of human norovirus outbreaks in China, 2012-2018

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BACKGROUND AND AIM: Human norovirus are the leading cause of acute viral gastroenteritis worldwide. In China, the occurrence of norovirus outbreaks in different regions shows significant heterogeneity, while few study has focused on the spatial epidemiological characteristics of norovirus outbreaks. Thus, the aim of this study is to clarify the epidemiological characteristics and spatial distribution patterns of norovirus outbreaks.

METHODS: In China, according to the National Notifiable Disease Reporting System (NNDRS), 964 human norovirus outbreaks involving 50,548 cases in 26 provinces reported from 2012 to 2018 were analyzed in this study.

RESULTS: The outbreaks showed typical seasonality, with more outbreaks in winter and fewer in summer, and the total number of infected cases increased over time. The most common setting of norovirus outbreaks was school especially middle schools and primary schools with major transmission route of life-contact. More outbreaks occurred in southeast coastal areas of China and showed significant spatial aggregation. The highly clustered areas of norovirus outbreaks have expanded towards northeast over time.

CONCLUSIONS: By identifying the epidemiological characteristics and high-risk areas of norovirus outbreaks, this study provides important scientific support for the development of preventive and control measures of norovirus outbreaks, which is conducive to the administrative management of high risk settings and reduction of disease burden in susceptible areas.

KEYWORDS: norovirus outbreak; epidemiological characteristics; spatio-temporal heterogeneity; spatio-temporal aggregation

P-0718 The Risk of CVDs from Desalinated Seawater: A Nested Case-Control Study

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BACKGROUND AND AIM: Desalinated water has already been incorporated into municipal water supplies as the major source of water. The aim of this paper is to assess the association between desalinated seawater and cardiovascular diseases (CVDs).

METHODS: We conducted a nested case-control prospective study on a cohort of 7,806 subjects who live on an island of China that lacks fresh water. From this cohort, we identified 140 paired CVD cases and matched controls by sex and age during the same period. Questionnaires were used in order to investigate basic sociodemographic information and risk factors for CVDs, and urine samples were collected to measure calcium and magnesium levels. Using these data we developed and tested both univariate and multivariate logistic regression models.

RESULTS: We observed no significant differences in urinary calcium and magnesium levels between groups with and without directly desalinated seawater intake. From multivariate logistic regression, we found that obesity (OR= 5.38, 95% CI: 1.05 - 27.45), physical activity (OR= 0.35, 95% CI: 0.16 - 0.75), hypertension (OR= 3.61, 95% CI: 1.58 - 8.25), alcohol consumption (OR= 2.57, 95% CI: 1.02 - 6.47), and irritability (OR= 4.30, 95% CI: 1.93 - 9.60) were associated with an increased risk of CVD.

CONCLUSIONS: In this population, we found no association between desalinated seawater intake and CVDs; the incidence of CVDs was primarily related to lifestyle.

KEYWORDS: desalination, cardiovascular disease, incidence

P-0719 Socio-demographic heterogeneities govern the spatial dynamics of water and food-borne infections in the urban city of Ahmedabad, India

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BACKGROUND AND AIM: Urban areas of low and middle-income countries (LMICs) are conducive to inequality, environmental hazards, and infectious diseases due to a confluence of unique and complex risk factors such as in-migration and informal settlements. Therefore, this study aims to evaluate socio-demographic heterogeneities as determinants of water and food-borne infections in an urban city of Ahmedabad, India.
METHOD: Spatial disease dynamics of viral hepatitis, typhoid, and diarrhea in Ahmedabad from 2010 to 2017 were analyzed with socio-demographic risk factors of age/gender, slum population density, and illiteracy rates. Additionally, the administrative units' geographical distance was also considered, i.e., wards vicinity from the river. The association was delineated by spatial regression models of Ordinary Least Square (OLS) and Spatial Lag Regression (SLR).

RESULTS: A total of 97,171 cases from 2010 to 2017 were reported of viral hepatitis, typhoid, and diarrhea. Temporal trend analysis identified a rising trend of cases over the study period. Further, spatial autocorrelation analysis revealed a significant positive correlation with Moran's I statistics ranging from 0.09 for typhoid to 0.21 for diarrhea, i.e., a similar prevalence in nearby wards. The multivariate regression model revealed slum population density as a significant risk factor for all three diseases. Illiteracy rate and vicinity to the river also significantly contribute to the prevalence of viral hepatitis. Finally, excess risk mapping of diseases identified central and southern zones of the city, to the east of river Sabarmati as hotspots wards.

CONCLUSIONS: This study identified spatial disease dynamics of water and food-borne infections in Ahmedabad with hotspot wards that can be relevant from a public health perspective. The study recommends advocating rehabilitation, capacity building, and health system strengthening at sub-ward/ward levels through micro-planning to reduce the risk of diseases arising from spatial heterogeneities.

KEYWORDS: Viral Hepatitis, Typhoid, Diarrhea, Spatial heterogeneity, Socio-demographic risk factors

P-0720 Factors underlying urinary arsenic levels in a population residing close to a coastal heavy-industrial area in southern Taiwan

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The public in the southwestern Taiwan's Kaohsiung City expressed concern over risk of arsenic (As) to people living in six of that city's townships nearby a coastal area with heavy industry. To investigate, we first analyzed urinary total As levels in 539 subjects administered Taiwan's Nutrition and Health Survey, a nationwide survey of nutritional status 2005-2008 (NAHSIT 2005-8). We found the top three highest median urinary total As levels in residents from Penghu island (136.93 μg/L, n = 24), the upper northern region of Taiwan (78.54 μg/L, n = 69), and the southwestern region of Taiwan (71.87 μg/L, n = 36). We then measured total urinary As levels in 1,801 and 1,927 voluntary residents of the above-mentioned six townships in 2016 and 2018, respectively, and compared with those with people residing in the top three highest total As levels of NAHSIT 2005-8. Median urinary As levels were 84.6 μg/L in 2016 and 72.5 μg/L in 2018, similar to those in southwestern region of Taiwan, but far below those in Penghu island ($p < 0.05$). Finally, in 2020, we interviewed 116 healthy and voluntary residents from the same six townships and collected one-spot urine samples to analyze total inorganic-related As (TiAs), a summation of As3+, As5+, monomethylarsonic acid (MMA), and dimethylarsinic acid (DMA). Median urinary TiAs in participants consuming seafood two days before urine sampling (n=15) was 24.0 μg/L, significantly higher than those not consuming seafood then (median: 20.5 μg/L, n=101, $p=0.029$). The results remained significant after adjusting for other covariates ($p = 0.028$). These findings suggest that seafood consumption is probably the main source of urinary total As and TiAs in people residing close to that coastal heavy industrial area of southern Taiwan. A future intervention study (dietary control) could be conducted to re-confirm our findings.

P-0726 Determinants of carbon load in airway macrophages in pregnant women

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BACKGROUND AND AIM: The airway macrophages carbon loading (AMCL) has been suggested to be a biomarker of the long-term exposure to air pollution; however, to date no study has characterized AMCL for the pregnancy period. Therefore, this study aimed to assess the determinants of AMCL during pregnancy in Iran, a middle-income country.

METHODS: This study was based on a sample of 234 pregnant women with term and normal vaginal delivery who were residing in Sabzevar, Iran (2019). Image analysis was applied to calculate the carbon area (µm2) in airway macrophages as an indicator of AMCL. Measuring the AMCL was performed by two independent investigators and checked by third investigator to reduce the AMCL measurement bias. We characterized 35 potential determinants of personal exposure to air pollution for each participant, including six personal, nine indoor, and 20 home-outdoor factors. We applied Deletion/Substitution/Addition algorithm to identify the most relevant determinants that could predict AMCL levels.

RESULTS: The median (IQR) of AMCL level was 0.12 (0.30) µm2 with a successful sputum induction in 82.9% (194) of participants. Ambient residential PM2.5 levels were positively associated with higher AMCL levels. On the other hand, increased residential distance to the traffic lights, squares and ring-roads, the duration of opening window per day, and opening window during cooking were inversely associated with AMCL levels.

CONCLUSIONS: This study is the first to characterize AMCL during pregnancy. Moreover, this is one of the largest reported studies on characterization of AMCL levels. Furthermore, this is the first study to explore the personal, indoor and outdoor determinates of personal exposure to air pollution in pregnant women in an LMIC. Our findings provide novel insights on the different personal, indoor, and outdoor determinants of personal exposure to air pollution during pregnancy in a middle-income country.

KEYWORDS: Air pollution, Pregnancy, Biomarker, Lung

P-0727 Association of Traffic-Related Air Pollution with Newborn's Anthropometric Indexes at Birth

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BACKGROUND AND AIM: The evidence suggested many adverse health effects due to exposure to traffic-related air pollution (TRAP). However, the evidence on neonatal anthropometric measurements (NAPM) in low and middle-income countries is very scarce yet. Therefore, we investigate the association of prenatal exposure to indicators of traffic and ambient particulate matter (PM) with NAPM.

METHODS: This cross-sectional study was based on hospital medical records of 4053 mother-neonate pairs (2016-2018). Pwere estimated at residential addresses based on validated spatiotemporal models. Moreover, total street length in 100, 300 and 500m buffers around the home, residential distance to the ring road, major roads, heavy-traffic lights, gas station, motorway junction, bank, square, bus terminal, public parking and industrial land-use were calculated as indicators of traffic. The head circumference (HC), birth weight (BW) and birth length (BL) of neonates were collected as NAPM. Multivariate regression models were applied to evaluate the relationship between PMs and indicators of traffic with NAPM, controlled for relevant covariates.

RESULTS: The adjusted models revealed that higher exposure to PM2.5 and PM10 was significantly related with lower BW and BL. Similarity results were observed for total street length in a 100 m buffer around maternal home with BW and BL. Moreover, higher distance to heavy traffic lights was significantly associated with higher BW and BL. An IQR increase in PM10 was significantly related to lower HC (95% CI: -0.11, -0.01, P-value = 0.03). An increase in distance from residential address to heavy traffic lights, ring roads, bus terminal, and transportation land-use was associated with higher HC.

CONCLUSIONS: This is the first study on the association of prenatal exposure to ambient PMs and different indicators of traffic with NAPM. Overall, our findings suggested that higher prenatal exposure to TRAP was related with lower BW, BL and HC.

KEYWORDS: Infant, Maternal, Neonates

P-0731 Physical Activity Profiles and Uptake of Fitness Tracking Technology among Caribbean Residents

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BACKGROUND: Health is inextricably linked to, among various lifestyle factors, physical activity. However, countries in the Caribbean are understudied relative to other nations in North America, Europe and Asia regarding probes of potential associations between well-being and physical activity.
AIM: Our pilot study aimed to investigate physical activity in the Caribbean.

METHODS: We survey Caribbean ages 18 to 75 from 2016 to 2022. Analyses included descriptive statistics and logistic regression.

RESULTS: Among 272 survey respondents including a 10-member fitness tracker focus (FTF) group, approximately 53.0% reported not having diagnoses or symptoms of any illnesses. The most popular activities that persons engaged in were dancing (34.9%), football (27.6%), track and field (26.1%) and walking (38.2%). at least one hour was spent per week exercising (70.2%) and socializing (83%). The most popular recreational event types were related to carnival festivities (46.2%) and concerts (26.7%). Persons who participated in carnival were less likely to report recent maladies relative to non-participants (OR: 0.57; 95%CI: 0.35, 0.92). FTF group members report greater activity when supported by peers. FTF "revelers" (carnival participants) logged up to ten times more steps on carnival event days than non-event days. The top three barriers to being consistent in physical activity were lack of time (72.1%), lack of motivation (58.1%) and access to workout facilities (27.2%). While persons 30 and over were less likely than persons under 30 to be perceive facility access as an obstacle (OR: 0.45, 95%CI: 0.26, 0.78), persons under 30 were more likely to report insufficient time as a challenge to being more active relative to their older counterparts (OR: 1.84; 95%CI: 1.08, 3.17).

RESULTS: Findings proffer insight into the unique ways in which Caribbean peoples pursue and participate in various forms of physical activity with potential health benefits, partially mediated by peer support and fitness technology.

P-0732 NutriBodEC: A Cross-sectional Survey on Nutrition and Body Image in the Eastern Caribbean

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BACKGROUND: Body image dissatisfaction often driven by experiences as well as exposure to “unrealistic” body images through various visual media, has been linked to individual health.
AIM: Our pilot study intended to assess perceptions of body image and links to various lifestyle factors including diet.

METHODS: We surveyed 115 persons, ages 17 to 65, between 2018 and 2022 in the Eastern Caribbean country of St. Kitts and Nevis. Logistic analyses were applied.

RESULTS: Less than 20% of participants regarded their diet as "healthy". Neither food type nor portion sizes were significantly associated with weight, body types or perceptions of self. However, respondents with higher BMI (>25 kg/m2) were more likely (OR: 3.64; 95%CI: 1.63, 8.60) to eat larger portions of fish than those with lower BMI. The most desirable body types were (i) for women: hourglass (wide bust, narrow waist, with wide hips) and triangle (wide hips) and (ii) for men: inverted triangle (broad shoulders with small waist) and trapezium (broad shoulders with medium waist). Median complexions were higher ranked than extremes. While most respondents did not rate body types similar to their own as highly desirable, persons tended to rank complexion at least somewhat similar to their own more favorably. Male respondents were less likely to have negative thoughts about their appearance (OR: 0.41; 95%CI: 0.17, 0.94). Persons with BMI>25 kg/m2 were marginally more likely to be dissatisfied with taking selfies (OR: 2.84; 95%CI: 0.90, 10.91) than participants with lower BMI. Students, many of whom had to wear tailored uniforms to school, had a higher likelihood of anxiety (OR: 3.19; 95%CI: 1.10, 11.62) around their appearance relative to their non-academic counterparts.

CONCLUSIONS: Findings contribute to existing literature on perceptions of body image, while providing profiles of diet, body image satisfaction and health in an overlooked population

P-0744 Household fuel choices and the risks of cooking-related burns in Ghana

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BACKGROUND AND AIM: Cooking-related burns are a major public health concern in developing countries. Women and children are extremely vulnerable to burns at home. This study aimed to assess the determinants of household fuel choices and the risk of cooking-related burns among two riparian peri-urban communities along the Lower River Volta of Ghana.

METHODS: This cross-sectional study was conducted as part of a baseline assessment of an ongoing Invasive Aquatic Weeds Biomass Briquette Production for use as a Cooking Fuel project (AQUAWEB). The AQUAWEB is a cluster randomized control trial involving 400 households in intervention and control riparian communities (1:1) along the Lower Volta Lake in Ghana. In-person interviews guided by structured questionnaires hosted on the REDCap application served as the primary data source for the study. Chi-square tests and Logistic Regression tests were employed to analyze the data.

RESULTS: The majority of the households depended largely on charcoal (64.99%) and less on wood fuel (15.12%) and LPG (19.89%) as their primary cooking fuel. of the LPG users, 53.7% used LPG exclusively, whereas 3.3% and 43.3% used wood fuel and charcoal as secondary fuels respectively. Among charcoal users, 57% used it exclusively but 11% and 31.8% used wood fuel and LPG as their secondary fuel respectively. Among the primary users of wood fuel, 75% used it exclusively. But 23.6% and 1.3% used charcoal and LPG as their secondary fuel respectively. 68.5% of the adult population in households suffered any household air pollution cooking-related burns. Charcoal (OR=2.15, p-value = 0.004) and wood fuel (OR=1.98, p-value = 0.038) were associated with cooking-related burns.

CONCLUSIONS: Charcoal is predominantly used in riparian communities as a primary fuel. Wood fuel and LPG were also used to support the primary fuel. Charcoal and wood fuel is associated with cooking-related burns.

P-0745 Urinary pesticide residual levels and acute respiratory infections in children under five years of age: Findings from the Offinso North Farm Health Study

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BACKGROUND: Several environmental factors are associated with the risk of acute lower respiratory infections (ALRIs) and upper respiratory infections (URIs) in children under five years of age (YOA). Evidence implicating chemical pesticides remains equivocal. There are also no data on this subject in these children in Ghana. This study investigated the association between urinary pesticide residual levels and the risk of ALRIs/URIs in children under five YOA .

METHODS: The participants for this study were from the Offinso North Farm Health Study, a population-based cross-sectional study. 254 parents/guardians who had answered affirmatively to the question "Has your child ever accompanied you to the farm?" were interviewed on household socio-demographic and environmental factors, being breastfed, child education, age, gender, and respiratory infection. 150 children were randomly selected to provide the first void urine.

RESULTS: The proportion of children with ALRI was 22.1% and those with Upper Respiratory Infection (URI) were 35.8%. We observed a statistically significant exposure-response relation of p,p'-DDE (tertile) with ALRI [1.7-3.2 µg/L urine: prevalence ratio (PR)=1.22 (1.05-1.70), ≥ 3.2 µg/L urine: 1.50 (1.07-3.53) (p-for trend=0.0297)]. This observation was observed in children older than 2 YOA (p-for trend=0.0404). Delta-HCH and beta-HCH (2-levels) were significantly associated with ALRI but not URI. The risk of ALRI increased with deltamethrin levels in an exposure-response manner [2.5-9.5 µg/L urine: 2.10 (1.37-3.24), ≥ 9.5 µg/L urine: 4.38 (1.87-10.32) (p-for trend=0.0011) and this was also observed in older than 2 YOA. Similar observation was noted for URI. Bifenthrin (>0.5µg/L urine) was associated with ALRI and URI. But permethrin (≥1.2 µg/L urine) was associated with URI.

CONCLUSIONS: The present study reinforces the hypothesis that exposure to chemical pesticides is associated with respiratory infections in children under five YOA.

P-0746 Differential impact of environment on malaria due to control interventions in Uganda, 2010-2018

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BACKGROUND AND AIM: Studies have estimated the impact of environment on malaria incidence although few have explored the differential impact due to vector control interventions. We aimed to evaluate the influence of temperature, rainfall, humidity, and vegetation, in presence or absence of long-lasting insecticide treated bednets (LLIN) and indoor residual spraying (IRS).

METHODS: This study used weekly malaria cases from 2010 to 2018 from six health facility-based malaria surveillance in Uganda. Environmental variables were extracted from remote sensing sources and include enhanced vegetation index (MODIS), cumulative rainfall (ARC2), minimum and maximum temperature (ERA5), specific humidity (ERA5), averaged over different time periods (one to four months). Non-linearity of environmental variables was investigated, and general linear models based on a negative binomial distribution was used to explore the influence of ITN and LLIN on the malaria-environment relationship.

RESULTS: A total of 204,252 malaria cases were laboratory confirmed and the median (range) weekly cases was 58.0 (0-597), rainfall 18.6 mm (0-129), minimum temperature 17.6˚C (12.3-24.2), maximum temperature 26.7˚C (20.1-34.8), and humidity 0.014 kg.kg (0.006-0.018). The best fit model was with the meteorological measures averaged over 3 months. All environmental variables showed a relatively linear pattern. Both IRS and LLIN were significantly associated with risk reduction (IRR: 0.39, 95% CI: 0.36–0.42 ; IRR: 0.71, 95% CI: 0.67–0.75, respectively). Marginal effects of environmental variables showed that joint effect of IRS and LLIN reduced the weekly predicted counts of malaria by 72.5% compared to no intervention.
CONCLUSION: LLIN and IRS both reduced the influence of environmental drivers of malaria and therefore morbidity in various transmission setting in Uganda. The benefits appeared to be greatest when the two interventions are used in combination.

P-0751 Personal exposure to heat amongst older adult women in Tamil Nadu, India

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BACKGROUND AND AIM: In 2019, 127,000 deaths were attributed to heat exposure globally, with over 40% in India, where a substantial portion of the population has limited access to cooling technologies. This substantial burden is expected to worsen with climate change, but little is known about personal exposure to outdoor temperatures in India We leverage data collected as part of the Household Air Pollution Intervention Network (HAPIN) randomized controlled trial to describe personal temperature exposure of older adult women in Tamil Nadu. We compare personal exposure to ambient monitoring stations and modelled temperature products.

METHODS: As part of HAPIN, older adult women in Tamil Nadu periodically wore instrumentation for a 24-hr period to measure air pollution; these instruments also measure temperature. We analyzed temperature measurements taken between 2018 and 2021 and compared them to the nearest identified ambient monitoring stations, and to the ERA5 and GLDAS meteorological products.

RESULTS: Personal measurements were recorded from 105 different participants for a total of 1.7 million datapoints. The mean temperature recorded was 28.6 °C with a standard deviation of 3.5 °C. Differences of ≥5 °C across individuals on the same day were not uncommon, nor were intra-individual exposures that varied by several degrees within an hour -- potentially a result of elevated heat while cooking. ERA5 estimates were more positively correlated with personal exposure than with GLDAS or ambient monitors. Correlations varied by season, with best performance across all products during the monsoon season.

CONCLUSIONS: Accurate exposure assessment is important for assessing health effects of heat – a growing problem. There is substantial variability in how well public datasets correlate with personal experience, not only by product type but also location and season. It is important to quantify these differences to appropriately estimate health effects.

KEYWORDS: Heat, India, Remote Sensing, Exposure Assessment

P-0762 Health outcomes in redlined versus non-redlined neighborhoods: A systematic review and meta-analysis

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BACKGROUND AND AIM: Redlining was a racialized zoning practice in the U.S. that blocked fair access to home loans during the 1930s, and recent research is illuminating health problems in the current residents of these historically redlined areas. However, this work has not yet been holistically summarized. Here, we present the first systematic review and meta-analysis comparing health outcomes in redlined versus non-redlined neighborhoods in U.S. cities.

METHODS: We extracted relevant articles in PubMed, Web of Science, Cochrane and Science Direct databases published from January 2010 to September 2021.

RESULTS: The search revealed 12 studies on preterm births (n=3), gunshot-related injuries (n=2), cancer (n=1), asthma (n=1), self-rated health (n=1), multiple health outcomes (n = 2), heat-related outcomes (n=1) and COVID-19 incidence and mortality (n=1). A meta-analysis of three studies found the odds of having preterm birth was significantly higher (OR=1.41, 95% CI: 1.05-1.88; p=0.02) among women living in redlined areas compared to those in non-redlined areas. Review of other outcomes revealed that gunshot-related injuries, asthma, heat-related outcomes, and multiple chronic conditions were worse in redlined areas, while associations with cancer varied by cancer type. In terms of cause-specific mortality, one study revealed no link between residential redlining and infant mortality rate, while one study on COVID-19 outcomes was inconclusive.

CONCLUSIONS: Overall, this review presents evidence that living in historically redlined areas is associated with increased risk of multiple serious adverse health outcomes. Further research on mechanisms, remediation, and neighborhood-level interventions is needed to strengthen the understanding of the impacts of redlining on health.

KEYWORDS: Redlining; health inequities; structural racism; environmental justice; racial disparities; place-based disparities

P-0764 Identifying susceptibility factors for methylmercury-induced developmental neurotoxicity

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BACKGROUND AND AIM: Methylmercury (MeHg) exposures during pregnancy or childhood can cause developmental neurotoxicity (DNT), including cognitive, behavioral, and other effects. While many studies have reported on these effects, fewer have examined other factors that contribute to susceptibility to MeHg-induced DNT. The first objective of this project is to determine whether there are demographic, biological, psychosocial, societal, environmental, or other factors that may make developmentally exposed individuals more susceptible to these effects. A second objective is to develop a replicable approach for identifying susceptibility data in assessments of the health effects of chemicals.

METHODS: A systematic literature search for 2019-2021 aimed to identify all epidemiology studies that examined methylmercury exposure and DNT. Identified studies were then screened for susceptibility information at the title/abstract and full text levels by two reviewers. A search string was also developed and applied to title/abstracts to determine whether these studies could be identified without extensive screening. Susceptibility information was then summarized.

RESULTS: Data examining several potential susceptibility factors for MeHg were identified, including genetic polymorphisms, sex, maternal factors, nutritional status, and multi-chemical exposures.

CONCLUSIONS: This project identifies potential susceptibility factors associated with MeHg and DNT. The methods applied to MeHg may be adapted and utilized for identifying and interpreting the literature on susceptibility factors for adverse health effects from other chemical exposures.

KEYWORDS: methylmercury, developmental neurotoxicity, susceptibility, systematic review, environmental justice

Disclaimer: The views expressed in this abstract are those of the author and do not necessarily represent the views or the policies of the U.S. Environmental Protection Agency.

P-0769 Association between historical redlining and preterm birth in North Carolina, 2003-2015

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BACKGROUND AND AIM: Starting mid-1930s, the Home Owners' Loan Corporation (HOLC) ranked urban neighborhoods as least to most desirable in terms of perceived mortgage stability. This racist practice, redlining, likely led to disparities in proximity to environmental pollutants in these areas. Recent research suggests associations between historical redlining and adverse birth outcomes today. We investigated the association between historical redlining and preterm birth (PTB, <37 weeks gestation) in North Carolina (NC) and evaluated modification of that association by gestational parent (GP) race/ethnicity.

METHODS: We assembled a retrospective, administrative cohort of singleton births in NC from 2003-2015, linking geocoded residences at time of delivery to Mapping Inequality's HOLC polygons. Eligible births were assigned HOLC grade A (Best), B (Still desirable), C (Declining), or D (Hazardous). We estimated odds ratios (OR (95%CI)) using logistic regression adjusting for GP age at delivery and smoking during gestation, and applying generalized estimating equations to account for clustering by city.

RESULTS: Our analysis included 36,571 births within historically redlined cities in NC (Asheville, Charlotte, Durham, Greensboro, Winston-Salem). for births within the historically defined HOLC grades B, C, and D, respectively, the odds of PTB were 1.43 (95%CI: 1.10, 1.86), 1.77 (1.50, 2.09), and 2.10 (1.79, 2.48) compared to HOLC grade A. In stratified analyses, ORs were null and imprecise for all HOLC grades compared to HOLC grade A among non-Hispanic Black individuals (e.g. D vs A: 1.01 (0.60, 1.72)). ORs were positive but similarly imprecise among Hispanic and non-Hispanic white individuals with ORs that ranged from 1.61 (0.57, 4.54) to 1.70 (0.74, 3.93) and 1.20 (0.96, 1.50) to 1.27 (0.97, 1.67), respectively.

CONCLUSIONS: These preliminary results suggest that historical redlining is associated with poorer PTB outcomes decades later, providing additional evidence that historically racist practices continue to have lasting negative environmental burdens and health impacts on communities today.

P-0772 Quantifying sociodemographic inequities in exposure to point source carcinogenic industrial pollution emissions across the USA

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BACKGROUND AND AIM: Few studies have investigated how carcinogenic environmental exposures are distributed among the general population. We described recent cross-sectional relationships between carcinogenic industrial emissions and sociodemographic characteristics across the USA (US).

METHODS: We linked US Environmental Protection Agency's 2018 Toxics Release Inventory to sociodemographic characteristics in 2010 Census tracts. Using chemical abstract service registry numbers, we identified onsite emissions (e.g., air, landfill, surface) of known and probable carcinogens as classified by the International Agency for Research on Cancer. Tract characteristics included total population, median household income, Yost neighborhood deprivation index, poverty, and percentages of Black, Hispanic, and white populations. We used linear regression to investigate the relation between quintiles of emissions in each census tract and distributions of these characteristics.

RESULTS: 5,209 (7%) tracts with an estimated 23.2 million population contained 7,028 facilities emitting known (n=22) or probable (n=33) carcinogens, including 1 billion pounds of these emissions in total (median: 226; IQR 7-5970 pounds/tract). Compared to tracts without emissions (all p-values <0.01), those with the highest quintile of emissions had higher proportions of rural (44% vs. 19%) and white (71% vs. 62%) populations, lower median household income ($45,000 vs. $55,000), and a higher deprivation score (62 vs. 49). Tracts with the highest emissions had a higher proportion of population with a high school education or less (53% vs. 44%). Overall, the proportions of families below the poverty level did not differ; however, greater numbers of black and white families below poverty lived in the tracts with the highest emissions. We observed similar demographic patterns in analyses restricted to air emissions.

CONCLUSIONS: Our novel assessment demonstrates that carcinogenic emissions are not homogeneously distributed among the US population. It may be important to consider joint distributions of sociodemographic characteristics when describing environmental exposures and associated health disparities.

KEYWORDS: carcinogens, health disparities

P-0786 Quantification of green and walkable neighbourhoods across the distribution of social and material deprivation in Metro Vancouver, Canada

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BACKGROUND AND AIM: Along with other environmental exposures, both neighbourhood walkability, and greenspace exposure and access have been linked to many diverse health benefits. Previous work has examined the spatial relationship of built and natural environments according to levels of neighbourhood deprivation; however, less is known about how these relationships may vary when different greenspace metrics are used. This work examines how normalized differences vegetation index (NDVI), tree canopy cover, green land cover, and park count metrics relate to walkability, and how these neighbourhood characteristics associate with both social and material deprivation.

METHODS: Greenspace exposure was measured using NDVI, tree canopy cover, and green land cover, while park access was quantified by the number of designated public parks within 1000m and 400m network buffers for each six-digit postal-code centroid in Metro Vancouver, Canada. Local area deprivation was measured using the 2016 Material and Social Deprivation Index (MSDI). Pearson's correlation coefficients were calculated to compare these neighbourhood characteristics.

RESULTS: Walkability was positively associated with social deprivation (1000m $r = 0.48$; 400m $r = 0.48$, $p < .01$), while walkability has a weak inverse relationship with material deprivation (1000m $r = -0.21$, $p < .01$). Tree canopy was negatively related to both social (1000m $r = -0.23$, 400m $r = -0.23$, $p < .01$) and material deprivation (1000m $r = -0.24$, 400m $r = -0.23$, $p < .01$). In contrast, the relationship between park count and both deprivation measures was weak.

CONCLUSIONS: In this study, areas with greater social and material deprivation tend to have less greenspace, but not necessarily less park access. The identification of neighbourhoods with higher material deprivation, low walkability, and low greenspace, may be prioritized by urban planners and decision makers as possible locations for additional greenspace allocation.

KEYWORDS: greenspace, walkability, social deprivation, material deprivation

P-0794 Disparities in adverse birth outcomes attributable to elevated ambient air pollution in the U.S.

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BACKGROUND AND AIM: Preterm birth and low birth weight are global health challenges that increase a child's lifelong risk for chronic disease. These adverse birth outcomes (ABO) are associated with ambient air pollution with differential risks across socioeconomic groups, yet are not presently accounted for in environmental policy assessments. This study estimates annual counts of ABO associated with $PM_{2.5}$ exceeding American Thoracic Society (ATS) recommended standards and investigates relevant disparities by race and income.

METHODS: Pollution increments of annual $PM_{2.5}$ were calculated for all monitored U.S. counties by comparing 2018-2020 EPA design values to counterfactuals meeting ATS recommended levels (8 μg/m³ for annual and 25 μg/m³ for 24-hour $PM_{2.5}$). Increments were coupled with current concentration-response functions and CDC baseline incidence data to determine county-level annual numbers of ABO associated with $PM_{2.5}$ above counterfactual levels. Sub-group analyses by mother's race and source of delivery payment were conducted to determine exposure differentials.

RESULTS: Across monitored U.S. counties, approximately 7,300 (95% CI: 3,700–11,500) preterm and 5,200 (95% CI: 3,300–7,500) low weight births are associated with $PM_{2.5}$ levels above ATS recommendations. $PM_{2.5}$-related ABO rates were higher among Black vs. White mothers, driven by higher baseline incidence rates experienced by Black mothers. $PM_{2.5}$-related ABO rates were higher among Medicaid vs. non-Medicaid payees, a result of both higher $PM_{2.5}$ increments and higher baseline incidence among Medicaid payees.

CONCLUSIONS: Approximately 12,500 annual U.S. ABO can be linked to $PM_{2.5}$ above ATS recommended levels, with trends towards greater air pollution-related ABO for both Black mothers and Medicaid recipients. The magnitude of this effect, combined with lifelong health impacts attributable to these birth outcomes, provides a compelling argument that ABO should be factored into future environmental policy assessments.

KEYWORDS: birth outcomes; environmental justice; health impact assessment; particulate matter.

P-0806 Use of gradient boosting machine for exposome-wide analyses: application for pharmaceutical risk factors for amyotrophic lateral sclerosis

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BACKGROUND
Accumulating evidence suggests that human health is affected by a complex set of exposures, including to environmental toxicants, dietary constituents, psychosocial stressors, and physical factors. Capturing the complexity of the whole exposome is pivotal for advancing etiological knowledge, yet standard statistical methods, as well as recent developments for mixtures analysis, are limited to considering only a modest number of exposures and interactions while often also making the implicit assumption that the exposures are continuous. Machine learning approaches could offer benefits in these very high-dimensional settings.
METHOD
Using gradient boosted decision trees coupled with Bayesian model optimization and a nested cross-validation design, we describe an approach for outcome prediction based on a mixture of exposures, and for identification of specific culprit factors within the mixture that consistently drive the association while allowing for synergistic or antagonistic interactions between the predictors. While this flexible approach is applicable to many settings, we used it to evaluate the association between patients' history of medication use and risk of amyotrophic lateral sclerosis (ALS), as a steppingstone for integrating additional exposures and in a setting that largely avoids exposure measurement errors that further complicate many toxicant mixtures.

RESULTS: of nearly 800 binary predictors, we identified 7 medication classes that were consistently associated with ALS risk across independently trained models. Interactions between medication groups did not substantially affect the risk. Prediction accuracy was consistent, but low due to the lack of information on other etiological risk factors for ALS.
SUMMARY
The described methodology allows to predict the overall effect of a mixture and to identify specific culprit factors in very high dimensional settings and when both continuous and categorical exposures are of interest. While causal interpretation of purely predictive models should generally be avoided, the repeated sampling of the dataset has interesting causal inference implications.

P-0808 World Trade Center Exposome: A novel, data-driven approach to modeling risk and protective factors for adverse mental and physical health outcomes among WTC Responders

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BACKGROUND AND AIM: Responders involved in rescue and recovery efforts following the 9/11 World Trade Center (WTC) attacks were exposed to hazardous working conditions and toxic agents. Previous studies associating WTC exposure with adverse health outcomes focus on a small number of risk factors selected a priori. We proposed a data-driven, exposomic approach to investigate the mixture of risk and protective factors experienced by WTC responders (i.e., a 'WTC exposome') and its relation to responder health.

METHODS: We included 34,096 responders from the WTC Health Program (WTC-HP) with a physical and mental health evaluation and exposure assessment at first (post 9/11/01) visit. We used generalized weighted quantile sum (gWQS) regression to examine positive (i.e., risk) and negative (i.e., protective) associations between the "WTC Exposome" index containing 84 factors (i.e., dust and traumatic exposures, baseline health information, social support) and five WTC-related health outcomes as dichotomous (ever/never): post-traumatic stress disorder (PTSD), gastroesophageal reflux disease (GERD), respiratory problems, diabetes, and headaches. All models were adjusted for age, race, ethnicity, and gender.

RESULTS: The WTC exposome was associated with all five health outcomes (PTSD β_{risk} = 6.4, $\beta_{protective}$ = 0.1; GERD β_{risk} = 4.4, $\beta_{protective}$= 0.5; respiratory problems β_{risk} = 3.9, $\beta_{protective}$ = 0.6; diabetes β_{risk} = 1.6, $\beta_{protective}$ = 0.7; headaches β_{risk} = 5.6, $\beta_{protective}$ = 0.3; $p<0.0001$ for all models). The WTC exposomic profile (i.e., the mix of risk and protective factors) differed by health outcome. for example, working in an enclosed area contaminated with dust contributed most to PTSD risk while full-time employment post 9/11 appeared protective against PTSD.

CONCLUSIONS: Understanding WTC-related risk and protective factors enable us to better identify responders vulnerable to adverse outcomes and identify factors that may protect against the development or progression of disease. This approach has potential for future disaster response studies.

P-0815 Sex-specific associations between prenatal exposure to phthalates and neurocognitive development in Taiwanese children: Application of environmental mixture methods to small study sample

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BACKGROUND AND AIM: Few studies have examined the sex-specific effect of phthalates as a mixture by applying multiple mixture methods to a small study sample. This study, therefore, examined sex-specific associations of prenatal exposure to urinary phthalates with neurocognitive development in Taiwanese children aged two to three years old.

METHODS: The study included 127 children who were followed up at the ages two-three years in the Taiwanese Maternal and Infant Cohort Study. The Mental Development Index (MDI) and Psychomotor Development Index (MDI) were measured in children using the Bayley Scales of Infant Development-II (BSID-II). The monomethyl phthalate, monoethyl phthalate, mono-butyl phthalate (MBP), mono-benzyl phthalate, mono-2-ethylhexyl phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate, mono (2-ethyl-5-oxohexyl) phthalate (MEOHP) were measured in urine samples collected from mothers during pregnancy. Multivariable linear regression (MLR), Weighted Quantile Sum (WQS) regression, quantile g-computation (qgcom), Bayesian Kernel Machine Regression (BKMR), the Super Learner with g-computation were applied and compared to examine the sex-specific effects of the phthalate mixture on MDI and PDI.

RESULTS: The mediation MDI and PDI were 94.0 and 99.0, respectively. The spearman correlation ranged between -0.01 and 0.74. None of these methods could detect any sex-specific associations between phthalates and MDI. Results suggest that WQS and qgcomp were able to detect inverse associations between phthalates and PDI with a stronger effect in boys. BKMR and Super Learner with g-computation were unable to detect any precise associations of phthalates with PDI. However, mixture methods detected mixtures' negative directionality and linear dose-response effects on neurocognitive development. MBP, MEHP, and MEOHP dominated these associations with PDI.

CONCLUSIONS: Mixture methods outperformed MLR. However, flexible approaches like BKMR and Super Learner with g-computation may perform better with larger samples. Therefore, the study recommends using multiple mixtures methods for getting comprehensive results from mixture studies.

KEYWORDS: Mixture; Neurodevelopment; WQS; BKMR; G-computation

P-0820 Residential greenness, air pollution, and incident ischemic heart disease: A prospective cohort study in China

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BACKGROUND AND AIM: Green living environments are associated with beneficial health outcomes, whereas higher air pollution exposure might increase the risk of chronic diseases. Moreover, few studies have explored the interaction between residential greenness and air pollution on the risk of ischemic heart disease (IHD). Therefore we aimed to estimate the associations of residential greenness and air pollution with IHD and their interaction.

METHODS: We performed a prospective cohort study that included 29,141 adult participants recruited from Yinzhou District, Ningbo, China. Normalized Difference Vegetation Index (NDVI) around each participant's residence was calculated to measure residential greenness exposure. Land-use regression models were conducted to estimate long-term individual exposure to air pollutants, including nitrogen dioxide (NO2) and particulate matter with aerodynamic diameters ≤ 2.5 μm (PM2.5) and ≤10 μm (PM10). Cox proportional hazard models were used to calculate the hazard ratios (HRs) and 95% confidence intervals (95% CIs) for the association of residential greenness and air pollutants with the risk of incident IHD.

RESULTS: During 101,172.5 person-years of follow-up, 1,392 incident IHD cases were reported in the study population. Residential greenness, expressed as an interquartile range (IQR) increase in NDVI within 300m, was inversely associated with incident IHD. However, long-term air pollution exposures were associated with higher IHD incidence. Mediation analyses suggested that the beneficial effect of residential greenness on incident IHD could be partly mediated by reducing the exposure to PM2.5.

CONCLUSIONS: Higher greenness was associated with decreased risk of IHD, while air pollutants were positively associated with incident IHD. Meanwhile, residential greenness may decrease the risk of IHD by reducing PM2.5 exposure.

KEYWORDS: Residential greenness; Air pollution; Ischemic heart disease; Cohort study; Effect mediation

P-0827 Solar and Geomagnetic Activity Reduces Pulmonary Function and Enhances Particulate Pollution Effects

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BACKGROUND: Increased solar and geomagnetic activity (SGA) may alter sympathetic nervous system activity, reduce antioxidant activity, and modulate physiochemical processes that contribute to atmospheric aerosols, all which may reduce pulmonary function.
Aim: Investigate associations between forced expiratory volume at 1 second (FEV1) and forced vital capacity (FVC) with SGA, and assess whether SGA enhances adverse effects of black carbon (BC) and particulate matter ≤2.5 μm in diameter (PM2.5).

METHODS: We conducted a repeated measures analysis in 726 Normative Aging Study participants (Boston, USA) between 2000 and 2017, using interplanetary magnetic field (IMF), planetary K index (Kp), and sunspot number (SSN) as SGA measures. Linear mixed effects models were used to assess exposure moving averages up to 28 days for both SGA and pollution.

RESULTS: Increases in IMF, Kp Index and SSN from the day of the pulmonary function test averaged through day 28 of were associated with a significant decrement in FEV1 and FVC, after adjusting for potential confounders. There were greater effects for longer moving averages and enhanced effects of PM2·5 and BC on FEV1 and FVC with increased SGA. for example, for each inter-quartile increase (4.55 μg/m3) in average PM2·5 28 days before testing, low IMF (10th percentile: 3.2 nT) was associated with a -21.4 ml (95% CI:-60.8, 18.1) and -7.1 ml (95% CI:-37.7, 23·4) decrease in FVC and FEV1, respectively; high IMF (90th percentile: 9.0 nT) was associated with a -120.7 ml (95% CI:-166.5, -74.9) and -78.6 ml (95% CI: -114.3, -42·8) decrease in FVC and FEV1, respectively.

CONCLUSIONS: Increased periods of SGA may directly contribute to impaired lung function and enhance effects of PM2.5 and BC. Since exposure to solar activity is ubiquitous, stricter measures in reducing air pollution exposures are warranted, particularly in elderly populations.

KEYWORDS: Pulmonary Function, Air pollution, Solar and Geomagnetic Activity

P-0841 The urban vegetation and allergic rhinitis in Montreal, Canada

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BACKGROUND: Urban vegetation offers many benefits to population health and wellbeing. In addition to these benefits, trees also emit pollen that can cause allergies.
Objective: This study aimed to assess the association between urban vegetation and allergic rhinitis in the Montreal area.

METHODS: Data on spring symptoms (April, May, June) of allergic rhinitis were retrieved from the 2008 and 2014-2015 Quebec Population Health Surveys (EQSP) and population-weighted. 2015 Landsat-8 satellite images and LiDAR (Light Detection and ranging) point cloud were used to calculate, respectively, the Normalized Difference Vegetation Index (NDVI) and the average crown volume of trees. The values of these indices were classified into population quintiles. Associations between vegetation parameters and the prevalence of symptoms of allergic rhinitis were assessed with logistic regression models within buffer zones of 100, 250, 500, and 1000 meters around the respondent's six-digit residential postal codes, adjusting for sex, age and categories of income.

RESULTS: The combined sample of the two surveys totaled 6,901 respondents. The estimated prevalence of spring symptoms of allergic rhinitis in the population was 11.3% (CI95%: 10.4 – 12.2). The NDVI and average crown volume were not associated with symptoms of allergic rhinitis for any of the buffer zones. for a buffer zone of 250 meters, the adjusted odds ratio for an increase from the lowest to the highest NDVI value (Q1 and Q5) was 1.029 (CI95%: 0.764 – 1.385). The adjusted odds ratio for an increase from the lowest to the highest average crown volume value was 1.167 (CI95%: 0.878 - 1.552).

CONCLUSIONS: The results suggest that vegetation density does not have an impact on the prevalence of spring symptoms of allergic rhinitis in residents of the Montreal urban area. More detailed assessments on the associations with vegetation types are needed.

KEYWORDS: Urban vegetation, allergic rhinitis, Remote Sensing, NDVI

P-0843 Spatiotemporal exposure modeling of environmental circadian misalignment

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BACKGROUND AND AIM: Light exposure is the most powerful resetting signal for circadian rhythms. Environmental circadian misalignment (ECM) occurs from geographic variation in light exposure due to location within a time zone (delayed circadian phase from less morning and greater evening light exposure moving west in a time zone). The aim of this study was to develop and validate the first-ever nationwide spatiotemporal exposure model of ECM in the US.

METHODS: for all US census tracts, the ECM exposure model incorporated elevation (in meters) and the average difference (in minutes) in sunrise time and sunset time between the census tract center of population and the eastern-most time zone boundary. Higher ECM exposure values indicate higher circadian misalignment due to higher elevation (fewer obstructions/extended field of view) and larger differences in sunrise and sunset times. Spearman correlation coefficients and multivariable linear regression adjusting for age, sex, race, ethnicity, median household income, and population density were used to validate the ECM exposure model with census tract-level prevalence of obesity (2016-2019) (known outcome associated with circadian misalignment).

RESULTS: Among the 60,943 census tracts included in this study, obesity prevalence was 32.62%. ECM exposure was positively correlated with obesity prevalence, with the strongest correlation in the Eastern time zone (r_s=0.44, $p<0.01$). The highest vs. lowest ECM quintile was associated with higher obesity prevalence in the Eastern (adjusted β=6.00, 95% CI 6.68, 7.11) and Central time zones (adjusted β=2.85, 95% CI 2.62, 3.09), which are the US time zones characterized by the largest east-to-west distance (i.e., opportunity for ECM).

CONCLUSIONS: We developed and validated a US nationwide spatiotemporal ECM exposure model, which can be used for exposure assessment in epidemiologic studies to enable comprehensive characterization of geographic variation in light exposure potentially impacting circadian phase.

KEYWORDS: light exposure; circadian misalignment; exposure model

P-0846 Phenols, parabens and triclosan in maternal urine, Medellín-Colombia

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INTRODUCTION: Phenols, phthalates, parabens and triclosan are endocrine disruptors and are suspected of generating epigenetic damage during prenatal life (1). The biological matrix most used to measure them is urine (2). Objective: to quantify the concentrations of phenols, parabens and triclosan) in pregnant women in two health institutions in Medellín.

METHODS: 400 pregnant women were recruited and of these it was possible to analyze 38 pools of urine (20 punctual samples) to quantify the metabolites of phenols, parabens and triclosan, the analysis was carried out at the Norwegian Institute of Public Health (NIPH), by ultra-high resolution liquid chromatography coupled to tandem mass spectrometry (UPLC-MS-MS) (2), the analyzes were corrected by specific gravity.

RESULTS: the geometric means according to the metabolites were Bisphenol A (BPA: 1.78 ng/mL), Methyl paraben (MEPA: 88.91 ng/mL), Ethyl paraben (ETPA: 2.95 ng/mL), Propyl paraben (PRPA: 10.32 ng/mL), Oxybenzone (OXBE: 27.94 ng/mL) and Triclosan (TRCS: 36.74 ng/mL).

CONCLUSIONS: This is the first study in Colombia that quantifies concentrations of phenols, phthalates, parabens and triclosan in pregnant women from Medellin. The geometric means of the metabolites BPA and parabens are in the middle when comparing with studies, but TRCS is above other studies in the world.

KEYWORDS: phenols, parabens, triclosan, endocrine disruptors; urine

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P-0849 Personal exposure to radiofrequency electromagnetic fields in various occupations in Spain

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BACKGROUND: A Job-Exposure Matrix (JEM) for radiofrequency electromagnetic fields (RF-EMF) was previously created based on measurements collected from the literature and individualized EMF source-based information. In the context of an international study aimed at enhancing this preliminary JEM, personal measurements of occupational exposure to RF-EMF were conducted among various occupations in Spain.

METHODS: Identification and prioritization of occupations to be measured were based on the levels and prevalence of exposure to RF fields in the preliminary RF-JEM and expert judgements. A screening questionnaire developed within our project was used to identify potential participants, based on job titles, tasks, and reported sources of RF exposure. Personal full-shift measurements were conducted using 10 Narda RadMan 2XT personal measurement devices.

RESULTS: Personal full-shift measurements were collected for 285 workers of various occupations in Spain. Exposures to electric (E) and magnetic (H) fields were low (99.74% of (E-fields) measurements <1% ICNIRP standards). Results exceeded the ICNIRP limits for only 3% of the workers, though these exceedances lasted a few seconds. Overall, almost 50% of workers had values above 1% of the ICNIRP standards (exposure duration between 1 second and 27.13 minutes). Electric and magnetic fields peaks exceeding 100% of the standards were observed among 8% of the physiotherapists (N=59) and 7% of the nursing auxiliaries (N=28), with exposure durations ranging from 1 to 13 seconds (E-fields) and 2 to 36 seconds (H-fields) of exposure above the limits, respectively.

CONCLUSIONS: We performed the first phase of data collection of personal RF-EMF measurements among various occupations in Spain in the framework of an international study. The initial results in Spain showed low prevalence and low overall levels of exposure to RF fields, despite some short-term peaks. Additional measurements will be conducted in France and the Netherlands.

KEYWORDS: Radiofrequency electromagnetic fields, occupational exposure assessment, job-exposure-matrix

P-0857 Assessing environmental exposure and socioeconomic history prior to cancer diagnosis

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BACKGROUND AND AIM Exposure assessment solely based on the address at cancer diagnosis assumes fixed exposure over time, while ignoring exposures from other addresses prior to cancer diagnosis. We aim to examine excess exposure risks of non-asbestos air toxics and socioeconomic status (SES) estimated over available residential history for mesothelioma patients.

METHODS: Patients' residential histories were obtained by linking mesothelioma cases (n=1,015) diagnosed during 2011-2015 from the New York State Cancer Registry to LexisNexis administrative data and inpatient claims data. Percentile ranking of lifetime cancer risk from inhalation of non-asbestos air toxics was based on the National Air Toxic Assessment. SES was measured by Yost index, which is a percentile ranking derived from U.S. Census data. Excess exposure risk was calculated by dividing exposures at individual census tracts by the state-level average and subtracting one. We used a generalized linear regression model with the generalized estimating equation to compare the excess exposure risk in years prior to and at cancer diagnosis.

RESULTS: Approximately 43% of the study sample had a residential history prior to the cancer diagnosis for up to 30 years, and 94% up to 5 years. The excess exposure risks at the cancer-diagnosis tracts were below the state average, with means ranging from -0.22 to -0.11 for air toxics, and from -0.23 to -0.18 for SES. Excess exposure risks for both air toxics and SES tended to be higher in earlier addresses than addresses at cancer diagnosis, though the effect size was relatively small (1%-6.2%).

CONCLUSIONS:We demonstrated the feasibility of including residential history in cancer research and revealed differences between multiple approaches of estimating residence-related exposure risks over time. As the findings may be unique to the mesothelioma patients studied, future examinations using different exposure indicators and among different patient populations and other cancer types are needed.

P-0864 Influence of Environmental and Dietary Exposures on Trace Metals and Organochlorine Pollutants Accumulation Among the Residents of a Major Industrial Harbour (Fos-sur-Mer, France)

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BACKGROUND AND AIM. – We investigated whether residents who lived closer to the core of one of the largest industrial zone in Europe (Fos-sur-Mer, France) had higher serum or urine levels of trace metals (Antimony, Arsenic, Cadmium, Chromium, Cobalt, Mercury, Nickel, Lead and Vanadium) and organochlorine indicators (NDL-PCBs, DL-PCBs and PCDD/Fs) than people who lived out of the industrial core zone (Saint-Martin-de-Crau, France).

METHODS: –The INDEX cross-sectional study was conducted from September to November 2016. We collected blood samples from 138 people (80 in the exposed area and 58 in the control area), which were included using a stratified random sampling method and selected with strict criteria (e.g., 30–65 years old, living in the area for at least 3 years, not working in the industrial sector, non-smoker). Biomonitoring indicators were calculated using single-pollutant multivariate linear regression models (using substitution when censored data were under 15% and Tobit models alternatively), adjusting for personal physiological, social, dietary, housing characteristics and leisure activities. We also measured these pollutants in samples of lichens (Xanthoria parietina) and atmospheric particles (PM2.5).

RESULTS: – Living close to the core industrial zone was significantly associated with an increase in blood levels of lead (adjusted geometric mean = 17.2 [15.8-18.7] vs 15.1 [13.7–16.7] µg.g-1 creatinine, $p<0.05$). We reported that behaviours that involved environmental exposures (i.e., gardening, dietary history of consumption of vegetables, eggs, poultry, and local seafood) were significantly associated with an increase in some organochlorine and trace metals urine/serum levels amongst residents of the industrial port zone compared to the residents of the control area.

CONCLUSIONS: - These results brought interesting clues, in complement to national programs, regarding the exposure to trace metals of residents living in a major industrial european harbor.

KEYWORDS: - Industrial pollution - Biomonitoring - Heavy metals - PCBs – Dioxines - Dietary habits

P-0867 Urinary Creatinine Concentrations and Its Explanatory Variables in General Chinese Population: Implications for Creatinine Limits and Creatinine Adjustment

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BACKGROUND AND AIM Urinary creatinine (Ucr) is commonly used to determine the acceptability of spot urines and to adjust for dilution variation of spot urine specimens. However, some controversy exists over the creatinine limits (0.3–3.0 g/L) recommend by WHO. Ucr concentrations variy across individuals and are affected by numerous factors, which may complicate epidemiologic associations related to chemical-to-creatinine ratios. An improved understanding of the variation and predictors of Ucr concentrations is necessary. The study aimed to analyze the applicability of the WHO's exclusionary guidelines in the general Chinese population, and to identify Ucr related factors.

METHODS: The cross-sectional study included 21,167 participants aged 3 to 79 years from the initial cycle of the China National Human Biomonitoring Program. We used mixed linear models and restricted cubic splines (RCS) to analyze associations between explanatory variables with Ucr.

RESULTS: In general Chinese population, the geometric mean and median concentrations of Ucr were 0.90 g/L and 1.01 g/L, respectively. 9.36% samples were outside 0.3-3.0 g/L, including 7.83% below the lower limit and 1.53% above the upper limit. Middle age, male, obesity, smoking, higher frequency of red meat consumption and chronic kidney disease were significantly associated with higher concentrations of Ucr. Results of RCS showed Ucr was inversely and linearly associated with BMI, systolic blood pressure, diastolic blood pressure, triglycerides and glomerular filtration rate, and were non-linearly associated with triiodothyronine.

CONCLUSIONS:The age- and sex-specific cut off values of Ucr determining the validity of urine samples in general Chinese population were recommended. To avoid introducing bias into epidemiologic associations, potential predictors of Ucr observed in the present study should be considered when choosing correction methods.

KEYWORDS: Biomonitoring; Urine; Hydration correction; Creatinine

P-0872 Metal contaminants in river water and human urine after an episode of major pollution by mining wastes in the Kasai province of DR Congo

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BACKGROUND: In July2021, the Tshikapa river became heavily polluted by mining wastes from a diamond mine in neighboring Angola, leading to massive killing of fish, disease and even deaths among residents living along the Tshikapa and Kasai rivers. The exact nature of the pollutants was unknown.

METHODS: In a cross-sectional study, conducted in the city of Tshikapa in August 2021, we enrolled by opportunistic sampling 65 residents (11 children <16y) living alongside the polluted rivers, and 65 control residents (5 children) living alongside the Kasai river upstream from the Tshikapa-Kasai confluence. We administered a questionnaire and obtained river water and spot urine samples for measuring thiocyanate (a metabolite of cyanide) and 26 trace metals (by ICP-MS).

RESULTS: Participants from both groups consumed river water. In the area affected by the pollution, most participants had eaten dead fish. Prevalences of reported health symptoms were higher in the exposed group than among controls: skin rashes (52% vs 0%), diarrhea (40% vs 8%), abdominal pain (8% vs 3%), nausea (3% vs 0%). In polluted water, concentrations [median (range)] were only higher for nickel [(2.2(1.4–3.5)µg/L] and uranium [78(71–91)ng/L] than in non-polluted water [0.8(0.6–1.9)µg/L; 9(7–19)ng/L]. In urine, concentrations [µg/g creatinine, median(IQR)] were significantly higher in the exposed group than in controls for lithium [19.5(12.4–27.3) vs 6.9(5.9–12.1)], thallium [0.41(0.31–0.57) vs 0.19(0.16–0.39)], and uranium [0.026(0.013–0.037)] vs 0.012(0.006–0.024)]. Urinary thiocyanate concentrations did not differ.

CONCLUSION. This study after an ecological disaster in DR Congo has documented contamination of river water by nickel and uranium, and high urinary levels of some trace metals among affected riverine populations. However, the exact cause of the massive fish kill and disease among residents remains elusive. The capacity to rapidly investigate toxic pollution events must be increased in the area.

KEYWORDS: Trace Metals,mining,Water pollution,Kasai province.

P-0874 An ecological analysis of the association between industrial air pollution and asthma onset in children of Quebec, Canada

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BACKGROUND AND AIM: Asthma is the most prevalent respiratory disease in children worldwide. During the past decades, industrial emissions decreased dramatically in Canada. However, whether these decreases contributed to the decrease in asthma cases is still unclear. The aim of this study was to assess the associations between the changes in concentrations of industrial PM2.5, NO2, and SO2 emissions and the changes in asthma onset in children (<12 years) in Quebec, Canada with an ecological longitudinal design.

METHODS: Within 1310 small geographic sectors of Québec, yearly new cases of asthma in children were compiled from linked medico-administrative databases. The annual ambient concentrations of PM2.5, NO2, and SO2 related to industrial emissions from overall sectors for 2002 to 2015 were estimated by the POLAIR3D chemical transport model. Fixed-effects regression models were used to assess the associations between the time trend of industrial air pollution levels and the time trend of rates of asthma onset within the small areas, adjusting for median annual household income. Environmental tobacco smoke was additionally adjusted in sensitivity analyses.

RESULTS: The pollutant levels from industrial emissions per small area ranged from 0 to 12.91 µg/m3 for PM2.5, 0 to 28.63 ppb for NO2, and 0 to 494.34 ppb for SO2, respectively. The adjusted incidence rate ratios per 1 µg/m3 increase in PM2.5 and per 1 ppb increase in NO2 and SO2, were 1.045 (95% CI: 1.016 - 1.075), 1.045 (1.032 - 1.060), and 1.006 (1.004 - 1.07), respectively.

CONCLUSIONS: Industrial emission-related air pollutions were significantly associated with childhood asthma onset in Quebec. Since significant reductions in industrial emissions of air pollutants and asthma incidence have been observed in Quebec over the past two decades, our results suggest that the reduced industrial emissions may have contributed to the decreased asthma onset rate.

KEYWORDS: asthma, industrial emission, pollution, fixed-effects model

P-0877 Predicting Monthly Community-level Radon Concentrations with Spatiotemporal Random Forest METHOD: a Study in Northeastern and Midwestern USA

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BACKGROUND AND AIM: Exposure to radon gas is the lead cause of lung cancers in never-smokers in the USA. Studies associating radon to other health outcomes have reported conflicted results, likely due to the inaccurate exposure assessments. Most previous radon-related epidemiological studies relied on an out-of-date county-level exposure model without temporal variation, which introduced misclassifications. Tens of millions of radon measurements have been conducted in the U.S, therefore enabling us to estimate radon concentrations at higher resolutions with better accuracy.

METHODS: We obtained over four million radon measurements from Spruce Environmental Technologies, Inc, a leading radon detector manufacturer. Community-level monthly radon concentrations were predicted based on geological, architectural, meteorological, and socioeconomic factors. Our innovative spatiotemporal random forest method extended the original one by allowing the relation between radon and its predictors to vary across space and time. Specifically, we fitted an independent model for each ZCTA and month based on the nearby radon measurements that are defined by the spatiotemporal proximity. The abundance of measurements enabled us to predict concentrations in the basement and upstairs respectively.

RESULTS: In Northeastern and Midwestern U.S, the average radon concentrations are 81.8 Bq/m3 in the basement and 50.7 Bq/m3 in the upstairs. The correlation (R2) between the predicted and observed geometric mean of radon concentrations is 0.77 in the basement and 0.57 in the upstairs if there are over 10 radon measurements in the same ZCTA and month. The mean absolute error (MAE) and mean relative error (MRE) are 19.7 Bq/m3 and 14.3% without obvious spatial trends.

CONCLUSIONS: Our predicted radon concentrations are highly correlated with the observed levels, therefore can be used in epidemiological studies to reduce misclassifications. The temporal variation characterized in our model will facilitate studies regarding the acute effects of radon.

KEYWORDS:
Radon, Machine Learning, Exposure Assessment.

P-0879 A National Comparison Between Short- and Long-term Radon Measurements in the USA

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BACKGROUND AND AIM: Understanding the spatiotemporal distribution of radon is essential to assess residential radon exposure. Long-term radon measurements that last over 90 days are considered gold standard to assess residential exposure but were conducted in a limited quantity due to the long duration. Tens of millions of short-term radon measurements, which normally last 2 to 4 days, have been conducted in the past decades because radon disclosures are required during property transaction in 35 out of 48 contiguous states. However, the application of these massive short-term measurements is limited likely because of the unknown real-life uncertainty.

METHODS: We therefore collected 2,450 pairs of collocated short- and long-term measurements, evaluated the pairwise correlation between them, and investigated the factors that determine the correlation between them via stratified linear regression and bootstrapping resampling.

RESULTS: We found that the pairwise correlation between the short- and long-term radon measurements is a joint function of two factors: the temporal difference between two measurements and the measuring length of the following long-term measurements. The correlation was as high as 0.76 (0.95 Confidence Interval [CI]: 0.70 to 0.84) when the temporal difference was shorter than two weeks and the length of long-term measurement was shorter than 100 days. Meanwhile, the correlation can be as low as 0.13 (0.95 CI: 0.09 to 0.32) when the temporal difference was over two months, and the length was close to a calendar year.

CONCLUSIONS: The high correlations indicates that short-term measurements can be used as a reliable proxy to a long-term measurement under specific conditions after adjusting for inherent differences. Our conclusion will facilitate the usage of this abundant data source, which has been obtained but was underutilized, thus likely enhancing our knowledge regarding other health effects associated with radon.
KEY WORDS
Radon, Exposure Assessment, Statistics

P-0883 Case-crossover study between PM2.5 and hospital admissions for respiratory diseases in Pretoria

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BACKGROUND: Particulate matter air pollution has been associated with adverse health effects. Air pollution epidemiology traditionally focuses on the relationship between individual air pollutants and health outcomes (e.g., mortality). To account for potential co-pollutant confounding, individual pollutant associations are often estimated by adjusting or controlling for other pollutants in the mixture. The objective of the study is control for components within the mixture which are highly correlated.
METHOD: An overall study is performed where PM2.5, BC, UV-PM and trace elements were controlled for Tapp and public holidays, stratified for age and sex. A second model, where PM2.5 is also controlled, was performed.

RESULTS: In total, there were 15 155 reported hospitalisations for respiratory diseases (J00-J99) over the 34-month period. The increase in respiratory hospital admissions was significantly increased by an increase in total PM2.5 of 2.7% (95% CI: 0.6, 4.9) per 10 µg/m3 increase. respiratory hospital admissions significantly increased for Ca by 4.0 % (95% CI: 1.4% - 6.8%), Cl by 0.7 % (95% CI: 0.0% - 1.4%), Fe by 3.3 % (95% CI: 0.5% - 6.1%), K by 1.8% (95% CI: 0.2 – 3.5) and Si by 1.3 % (95% CI: 0.1% - 2.5%). When controlling for PM2.5, respiratory hospital admissions increased significantly for total Ca by 3.2 % (95% CI: 0.3, 6.1) and for the 0 – 14 age group by 5.2 % (95% CI: 1.5, 9.1). Hospital admissions was positive and significantly increased with an increase in resuspended dust matrix by 2.9 % (95% CI: 0.1% - 5.7%) and for biofuel burning by 1.6 % (95% CI: 0.1% - 3.2%) sources.

CONCLUSIONS: Controlling for a co-pollutant which is highly correlated with PM2.5 does reduce overestimation, but further studies should include deposition rates and parallel sampling analysis.

KEYWORDS: Tapp, PM2.5, sources, respiratory

P-0896 Intrauterine exposure to phthalates in pregnant women, Colombia

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INTRODUCTION: Phthalates are endocrine disruptors used in the manufacture of multiple industrial products, mainly plastics. Intrauterine life represents the main window of vulnerability and exposure to phthalates in this stage of life generates adverse fetal and postnatal effects (1). The most reliable biomarker for phthalate measurement is urine.
OBJECTIVE: To characterize the different sources of exposure to endocrine disruptors and to quantify the urinary concentration of phthalates in pregnant women.

METHODS: 400 women ≤12 weeks pregnant were included at baseline, and of these 38 pools of urine (20 spot samples) were analyzed for phthalate metabolites, analysis was performed at the Norwegian Institute of Public Health (NIPH) (2), analyzes were corrected for specific gravity and descriptive statistics are presented.

RESULTS: The geometric means of phthalate Di(2-ethylhexyl)phthalate(DEHP), Mono-n-butyl phthalate(MnBP), Mono-2-ethyl-5-hydroxyhexyl phthalate(MEHHP), and Mono-2-ethyl-5- oxohexyl phthalate(MEOHP) were 162.72 µg/L, 58.50 µg/L, 33.93 µg/L and 31.63 µg/L, respectively.

CONCLUSIONS: it is the first study that quantifies phthalate metabolites in Colombia. Concentrations of MnBP, MEHHP, and MEOHP in urine are higher than those found in pregnant women around the world.

KEYWORDS: phthalates; endocrine disruptors; urine; pregnancy
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P-0898 Occupational Exposure to Diesel Exhaust in Bus Drivers in the New York Metropolitan Area

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BACKGROUND AND AIM: Exposure to diesel exhaust (DE) has been associated with adverse respiratory health outcomes and bus drivers could be at significant risk. We leveraged exposure data collected from real-time personal monitoring and geospatial location information to identify the factors influencing DE exposure in New York bus drivers.

METHODS: DE exposure was estimated via black carbon (BC; a component of DE) measurements recorded using a micro-Aethalometer (microAeth®Model-AE51) every minute over six 24-hour periods in four bus drivers during September-October 2014. Driving routes originated from two Westchester bus depots and traversed lower Westchester. Each driver's location was continuously recorded every minute using a global positioning system (GPS) device. Information on fuel type, smoking status, worker activities, and meteorological variables were collected. Road density indices were calculated based on an 100-meter buffer. We performed multivariable-adjusted regression models to assess the factors associated with BC levels.

RESULTS: BC data were collected for a total of 2682 working minutes and 4328 non-working minutes. Overall median BC level was 578 ng/m3 (IQR: 189-1487 ng/m3) [working hours: 1166 (612-2168) ng/m3; non-working hours: 351 (132-860) ng/m3]. Multivariable-adjusted models predicted that compared to times working in office, workers were on average exposed to an additional 1403.5 ng/m3 and 2150.4 ng/m3 of BC when they were in the depot yard and driving the bus, respectively. Driving a diesel-powered vehicle was associated with 2.7-fold increase in BC levels compared to gasoline-powered. for every 10% increase in the sum of road length index, BC level increased by 19% (95%CI=15-24%). Further, for every 10% increase in average speed, BC level increased by 20% (95%CI=17-23%).

CONCLUSIONS: Driving a diesel-powered vehicle presented significantly more BC exposure comparing to gasoline-powered vehicle. Roadway density and driving speed contributed to elevated BC levels.

KEYWORDS: diesel, transportation, bus driver, occupational exposure

P-0912 Health Benefit of PM2.5 Control Legislations in Korea

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BACKGROUND AND AIM: Exposure to PM2.5 has been associated with increased mortality. The aim of the present study was to evaluate the health benefit of policies to reduce air pollution.

METHODS: We selected three air pollution control policies that were implemented between 2006 and 2018 in Seoul and Incheon, Korea. We estimated three types of impacts to evaluate the benefit of each policy. These impacts are benefit from reduced PM2.5 concentration (Impact 1), benefit from reduced magnitude of association (Impact 2) and reduced both concentration and magnitude of association (Impact 3). We conducted interrupted time series analyses to examine changes in PM2.5 concentration and magnitude of association with mortality after the implementation of the policies. We calculated the health benefit accounting for reduced daily PM2.5 concentration and its association with mortality.

RESULTS: We observed a decrease of PM2.5 concentrations after interventions in Seoul and Incheon. The effect of policy on associations between PM2.5 and mortality were different from intervention to intervention, but the magnitude of association in Seoul continued to decline. The numbers of prevented deaths in Seoul in one year after the implementation of each policy were 252 (95% CI: 221, 293), 365 (95% CI: 24, 432) and 120 (95% CI: 0, 262), respectively. In Incheon, the numbers of prevented deaths were 68 (95% CI: 0, 197), 167 (95% CI: 0, 184) and 149 (95% CI: 0, 298), respectively.

CONCLUSIONS: The present results suggests that air pollution control policies in Seoul and Incheon were effective in terms of preventing mortality.

KEYWORDS: mortality, health impact assessment, policy, particulate matter, attributable deaths

P-0913 Association of sound pressure levels and frequency components of road traffic noise with prevalent depression in Taichung, Taiwan

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The World Health Organization has reported that the prevalence of mental illness is 4% in the global population. Epidemiological studies have reported a relationship between road traffic noise exposure and depression, but the association between noise frequency components and depression remains unclear. This cross-sectional study investigated the associations between road traffic noise exposure and its frequency components with prevalent depression. A total of 3,200 residents living in Taichung who participated in the Taiwan Biobank between 2010 and 2017, were included as study participants. We used land-use regression models to evaluate individual annual average values of A-weighted equivalent sound level over 24 h (Leq,24h) and particulate matter with an aerodynamic diameter less than 2.5 μm (PM2.5) using the geographic information system. Multiple logistic regression was applied to estimate the odds ratios (ORs) for depression after adjusting for potential risk factors and PM2.5. An interquartile range increase in Leq,24h at full frequency (4.7 dBA), 1000 Hz (5.2 dB), and 2000 Hz (4.8 dB) was significantly associated with an elevated risk for depression with ORs of 1.62 (95% confidence interval [CI]: 1.03, 2.55), 1.58 (95% CI: 1.05, 2.37), and 1.58 (95% CI:1.03, 2.43), respectively, by controlling for PM2.5. The high-exposure group (≥ the median of noise levels) at full frequency, 500 Hz, and 2000 Hz had an increased risk for depression with ORs of 1.87 (95% CI: 1.03, 3.39), 1.94 (95% CI: 1.03, 3.65), and 1.86 (95% CI: 1.03, 3.37), respectively, compared with the low-exposure group (< the median of noise levels) after adjustment for PM2.5. Road traffic noise exposure may be associated with an increased prevalence of depression, particularly at 500 to 2000 Hz.

P-0917 Multiple xenoestrogen air pollutants and breast cancer risk: statistical approaches to investigate the combined exposures effect

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BACKGROUND AND AIM: Despite that the population is exposed to a mixture of multiple air pollutants, the joint effect of these pollutants on breast cancer (BC) has never been investigated. We applied two new statistical approaches to assess the complex effect of exposure to a mixture of four xenoestrogen air pollutants (Benzo-[a]-pyrene (BaP), cadmium, dioxins, Polychlorinated Biphenyl 153(PCB153)) on the risk of BC.

METHODS: The study was conducted on 5,222 cases and 5,222 matched controls nested within the French national E3N cohort. Annual estimates of exposures to pollutants at participants' addresses for each year from recruitment 1990 through 2011, were assessed using a chemistry transport model. Mean annual concentrations for each pollutant was then estimated from inclusion in the study to the index date. We fitted the bayesian kernel machine regression (BKMR) and the weighted quantile sum (WQS) regression models to estimate the risk of BC associated with the joint effect of co-exposure of four xenoestrogens air pollutants.

RESULTS: In BKMR, despite the no statistically significant association, there was an increasing trend between the joint effect and the risk of BC, when fixing other chemicals at their median concentrations. BaP, cadmium and PCB153 showed positive trends in the multi-pollutant mixture, while dioxin showed a modest inverse trend. In WQS, there was a borderline positive association between the WQS index of the joint effect and the risk of BC (odds ratio (OR)=1.06, 95% confidence intervals (CI):0.99-1.10). By menopausal status, there was a differential joint effect, with a significant positive association observed only in women who underwent menopausal transition (OR=1.09, 95% CI:1.02-1.14)

CONCLUSIONS: Overall, although no clear association was observed with BKMR model, there was a tendency of an increased risk of BC associated with co-exposure to long-term xenoestrogens air pollutants using both approaches. Further studies are needed to confirm these findings.

P-0921 Estimating attributable deaths from short-term pollution effects: Differential air pollution impact on cause-specific mortality

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BACKGROUND AND AIM: Health impact assessment (HIA) is a common policy tool that quantifies health burden from air pollution under different policy scenarios. Most HIAs consider all-natural-cause deaths from single-pollutant models, leaving uncertainty about varying impacts on cause-specific mortality from multiple air pollutants.

METHODS: Daily city-wide average air pollution concentrations were collected from the Environmental Protection Agency's Air Quality System and mortality records (2005-2019) from New York City (NYC) Vital Statistics. Total cumulative pollution attributable fractions (AFs) and annual average attributable counts (ACs) of mortality were estimated from single- and co-pollutant quasi-Poisson distributed lag time-series models at one lag day. Three mortality outcomes were evaluated: all-natural-cause, cardiovascular (CVD), and respiratory. Full year and seasonal models, adjusting for temperature and seasonal trends, were fit for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone, fine particulate matter ($PM_{2.5}$), and carbon monoxide (CO).

RESULTS: Across all pollutants, outcomes, and seasons, single-pollutant models showed positive associations, although cold-season models generally had lower AFs and larger confidence bands. for all-natural-cause mortality, NO_2 AF from the full-year, single-pollutant model was 1.4% (95% CI: 0.6%, 2.3%) representing the largest pollution AC, about 660 deaths annually, which did not change when additional pollutants were added to the model. CVD full-year model of $PM_{2.5}$ was robust to addition of NO_2, contributing about 250 deaths annually: 1.2% AF (0.5%, 1.9%). for respiratory mortality, warm-season NO_2 AF was 4% (-0.4%, 7.9%) and robust in co-pollutant models with $PM_{2.5}$ and NO_2, but not ozone. Warm-season ozone AF was 8.1% (2.9%, 13%), representing about 125 respiratory deaths annually.

CONCLUSIONS: Concentration-response functions used to quantify health burden based on air pollution attributable all-natural-cause deaths must consider short-term NO_2 associations in NYC. Cause-specific associations differ from those for all-natural-cause deaths, with $PM_{2.5}$ more important for CVD deaths and ozone for respiratory deaths.

KEYWORDS: Air pollution, Mortality

P-0922 Chronic exposure to ambient air pollution and the risk of non-alcoholic fatty liver disease: A cross-sectional study in Asia

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BACKGROUND AND AIM: Information on the relation between air pollution and non-alcoholic fatty liver disease (NAFLD) is scarce. We conducted a population-based cross-sectional study to evaluate the relationship between air pollution and NAFLD.

METHODS: We recruited 329,048 adults (mean age: 41.0 years) without other liver disease (hepatitis and cirrhosis) or excessive alcohol consumption in Taiwan and Hong Kong from 2001 to 2018. The levels of PM2.5 were estimated using a satellite-based spatio-temporal model, and the concentrations of NO2 and O3 were measured using a space–time regression model. NAFLD was determined using the hepatic steatosis index (HSI) or the fatty liver index (FLI). NAFLD-related advanced fibrosis was determined using fibrosis-4 (FIB-4) or the BARD score. A logistic regression model was used for data analysis.

RESULTS: We found positive relationships between PM2.5 and the odds of NAFLD and NAFLD-related advanced fibrosis, with a 10% (95% confidence interval [CI]: 9%–11%) increase in the prevalence of NAFLD and an 8% (95% CI: 7%–9%) increase in the prevalence of advanced fibrosis for every standard deviation (SD, 7.5 μg/m3) increase in PM2.5 exposure. Similarly, every SD (18.9 μg/m3) increase in NO2 concentration was associated with 8% (95% CI: 7%–9%) and 7% (95% CI: 6%–8%) increases in the prevalence of NAFLD and NAFLD-related advanced fibrosis, respectively. In addition, every SD (9.9 μg/m3) increase in O3 concentration was associated with 12% (95% CI: 11%–13%) and 11% (95% CI: 9%–12%) decreases in the prevalence of NAFLD and advanced fibrosis, respectively.

CONCLUSIONS: Long-term exposure to PM2.5 and NO2 is associated with higher odds of NAFLD and NAFLD-related fibrosis. Our findings indicate that reducing PM2.5 and NO2 concentrations may be an important strategy for preventing NAFLD. Further investigations on O3 are warranted.

KEYWORDS: PM2.5; NO2; ozone; non-alcoholic fatty liver disease; advanced fibrosis

P-0933 Interdisciplinary Community-based Participatory Health Research across a Major Industrial Harbour (Fos-sur-Mer, France)

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BACKGROUND AND AIM. – We conducted a community-based participatory environmental health study in three towns: two in the heart of Marseille's (France) industrial zone (Fos-sur-Mer and Port-Saint-Louis-du-Rhône) and one on the periphery located about 30 km away (Saint-Martin-de-Crau).

METHODS: – We first conducted a cross-sectional survey of a random sample of residents in each of the three towns. We asked study participants to self-report a wide variety of health issues (Port-Saint-Louis: n = 272, Fos-sur-Mer: n = 543, Saint-Martin-de-Crau: n = 439). We then conducted focus groups with residents and other stakeholders to share preliminary data in order to propose areas of reflection and collaboratively produce contextually-situated knowledge of their health and environment. We directly standardized the prevalences (by age and gender) to the French metropolitan population to make our results more comparable.

RESULTS: – Study participants who lived closer to the core industrial zone (residents of Fos-sur-Mer and Port-Saint-Louis-du-Rhone) had significant higher prevalences of eye irritation, nose and throat problems, chronic skin problems and headaches than people who lived further away (residents of Saint-Martin-de-Crau). Residents also offered diverse qualitative insights about their environment and health experiences, strengthening an understanding of their own empirical observations which helps to produce knowledge about health in an industrial context. The results of the workshops show an important benefit from the co-production of local knowledge.

CONCLUSIONS: – We encourage future researchers to do in-depth, community-based research to comprehensively describe the health of residents in other heavily polluted zones, product local knowledge and to help identify policy solutions, engender trust among the local people, and identify opportunities for intervention.

KEYWORDS: - Community-based participatory research
Environmental health - Health disparities - Industrial pollution

P-0934 Association between polycyclic aromatic hydrocarbon exposure and esophageal cancer risk in typical areas of China

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BACKGROUND: Studies of people show that individuals exposed by breathing, skin contact, or diet for long periods to polycyclic aromatic hydrocarbon (PAHs) can develop cancer, such as lung, skin, and bladder cancer. However, their effects on esophageal cancer have not been well examined.
AIM: This study is to compare the concentration of PAHs metabolite(OH-PAHs) in the urine of patients in the early stages of esophageal cancer and healthy people, and to evaluate the association between PAHs exposure and esophageal cancer risk.

METHODS: The 211 urine samples were collected from 105 esophageal cancer patients in the early stages and 106 healthy people in three high Incidence districts of esophageal cancer from November 2019 to June 2020. The 10 OH-PAHs (including 1-NAP, 2-NAP, 2-FLU,3-FLU,9-FLU,1-PHE,2-PHE, 3-PHE, 4-PHE,1-PYR) were analyzed with isotope dilution gas chromatography/tandem mass spectrometry (GC-MS/MS) based on CDC method.

RESULTS: The 10 OH-PAHs detection rate were relatively high more than 90%. 1-NAP and 2-NAP were the most abundant contributor to the total concentration of OH-PAHs.The mass concentration of OH-PAHs in the urine of healthy people was in the range of 1.5-44.6 μg/g, the median concentration of ∑OH-PAHs was 6.1 μg/g and the geometric mean concentration was 6.8 μg/g. ∑OH-PAHs concentration in the urine of esophageal cancer patients in the early stages was in the range of 3.6-104.2 μg/g, the median concentration of ∑OH-PAHs was 9.8 μg/g and the geometric mean concentration was 10.2 μg/g.

CONCLUSIONS: The results showed ∑OH-PAHs concentrations in urine from esophageal cancer patients in the early stages were higher than healthy people. The different habits and way of life, such as smoking and fried food, were increasing the PAHs exposure causing esophageal cancer risk.

KEYWORDS: polycyclic aromatic hydrocarbon, urine, esophageal cancer risk, typical areas

P-0938 Cluster analysis of premature deaths attributable to PM2.5 in aging population, South Korea

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BACKGROUND AND AIM: Health impact analysis for PM2.5 can display spatial heterogeneity of premature deaths attributable to PM2.5 and stands out as one of the best effective tools to present scientific evidence to guide policy actions. Subsequent spatial cluster analysis allows us to detect the areas with large burden and guide intervention programs to target such areas. We aimed to estimate the number of attributable deaths associated with PM2.5 exposure and identify the clustered areas with large attributable deaths compared to other areas in Korean aging population.

METHODS: We computed district-specific attributable deaths for lung cancer, chronic obstructive pneumonia disease, ischemic heart disease, and stroke each year for 2016 – 2019 using district averages of PM2.5 obtained from a previously-validated prediction model, district-level population aged 65 years and over, provincial-level mortality rate, and relative risks of cause-specific deaths for PM2.5. Then, we aggregated to total attributable deaths including all four causes in each of the 250 districts over four years. Finally, we applied spatial scan statistic with optimal size of elliptic shape window and identified the most significant cluster of high premature deaths.

RESULTS: Over four years, the total number of deaths attributable to PM2.5 was 49,449 out of 35,368,100 old adults in South Korea. The premature deaths attributable to PM2.5 were higher in the Northwest and Southeastern districts where population is relatively old. The cluster analysis showed the Southeastern districts as the significantly high mortality burden cluster attributed to PM2.5.

CONCLUSIONS: This study suggests that the cluster analysis can increase the benefit of the health impact analysis.

KEYWORDS: health impact assessments, cluster analysis, ambient air pollution, premature death

P-0939 NATURGREEN: Health impact assessment of greening Denver through native plants

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BACKGROUND: Cities often use exotic plants (e.g., turf grass and non-native trees) to expand green space to reduce micro-heat islands or promote physical activity. Native plants, however, may require less water, be more drought-tolerant, and have co-benefits for local biodiversity (e.g., pollinators). Epidemiologic studies suggest urban green space can improve human health and prevent premature mortality, but the benefits associated with this specific type of vegetation has received little attention.
AIM: We aim to estimate premature deaths that would be prevented by the implementation of native-plants policy scenarios in the City of Denver, Colorado, USA.

METHODS: To develop realistic native-plants policy scenarios, we conducted interviews with local stakeholders engaged in green-space advocacy, research, and policy in Denver. We build four scenarios: 1) greening a 20% of all city census-block groups to the greenness level of native plants, 2) adding 200-foot native-plants buffers around riparian areas, 3) constructing additional large water retention ponds landscaped with native plants, and 4) greening parking lots. We measured existing green space with satellite imagery and linked with census and land-use data. Using a health-impact assessment approach, we estimated premature mortality averted under each scenario.

RESULTS: In the most ambitious scenario, we estimated that 45 (95% confidence interval (CI): 42, 49) annual premature deaths would be prevented by greening 20% of all city census block groups with native plants. We estimated that greening 20% of parking-lot surface with native plants would prevent 8 annual deaths (95% CI: 7, 9), adding the native buffers around riparian areas would prevent 8 annual deaths (95% CI: 6, 9), and adding the planned native-landscaped stormwater retention ponds would prevent 1 annual death (95% CI: 1, 1).

CONCLUSIONS: Using native plants to increase green spaces has the potential to prevent substantial premature deaths in the City of Denver.

P-0941 Health risk assessment of PM2.5 and PM2.5-bound trace elements in Pretoria, South Africa

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BACKGROUND: The objective of the present study was to assess the human health risks associated with fine particulate matter (<PM2.5) and trace elemental constituents in Pretoria, South Africa.
METHOD: Outdoor ambient PM2.5 was sampled at the School of Health Systems and Public Health from 18 April 2017 to 28 February 2020. The health risk assessment method followed the USA Environmental Protection Agency's (US EPA) health risk assessment method. Reference doses for PM2.5 were taken from the World Health Organization (WHO) guidelines and the South African National Ambient Air Quality Standards (NAAQS).

RESULTS: The average yearly concentration for PM2.5 was 23.2 µg/m3 (N = 350) for the 34-month sampling campaign. This is above the yearly WHO guidelines (5 µg/m3) and the South African NAAQS (20 µg/m3). The monthly PM2.5 concentration is seasonal as is the concomitant Health Quotient (HQ). The calculated HQ for Adults, Children and Infants was above 1 when utilising both the WHO guidelines and the SA standard for ambient PM2.5. Children and Infants were three times higher at risk than adults throughout the year for summer and in winter for K and Si. Particle-bound Ni presented a cancer risk (CR) throughout the year.

CONCLUSIONS: It can be concluded that PM2.5 poses health risks in central Pretoria.

KEYWORDS: Air pollution, PM2.5, Seasons, Health Risk Assessment, South Africa, Trace elements

P-0943 Effects of hourly levels of ambient air pollution and the emergency department visits for asthma in Taiwan

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BACKGROUND AND AIM: Daily exposure to O_3, NO_2, and $PM_{2.5}$ is associated with asthma attacks. However, peak exposure (hourly) of such air pollution exacerbating asthma symptoms remains unknown.

METHODS: Daily emergency department visits (EDVs) of asthma from the National Health Insurance Research Database and hourly concentrations of O_3, $PM_{2.5}$, and NO_2 recorded at fixed-site monitoring stations in Taiwan from 2006 to 2016 were used. Excess risks (ERs) of asthma EDVs (ICD-10-CM: J45) at 0–2 lag days associated with daily maximum rolling 1-, 3-, 8-, and 24-hour concentrations of air pollutants were evaluated using the quasi-Poisson generalized additive models (GAMs). Models were stratified by warm and cold season and adjusted for townships, days of the week, and the smoothing splines as the year, temperature, and relative humidity at the same hours.

RESULTS: A total of 369,256 asthma EDVs in 50 townships of Taiwan from 2006 to 2016 were observed. The cold period (110 ± 125) had a higher average count of daily asthma EDV than the warm period (70 ± 90). Among air pollutants, there were positive associations between concentrations of all hourly pollutants and asthma EDVs, even in 1-hour exposure. Every a 10-unit increase in 1-hour exposure to $PM_{2.5}$ in warm (lag2) and O_3 in cold (lag2) increases the risks of daily asthma EDVs by 1.74% (95% CI, 1.43–2.04%) and 1.13% (95% CI, 0.83–1.44%), respectively. Exposure to 1-hour NO_2- in warm had the most significant effect (ER = 2.91%, 95% CI: 2.36–3.46%) on daily asthma EDVs. Then, all pollutants indicated that the 24-hour exposure was much more severe than 1-hour.

CONCLUSIONS: Short-term (1-hour) exposure to air pollutants is significantly associated with daily asthma EDVs. Hourly standard of air quality is suggested.

KEYWORDS: Asthma; emergency department visits; hourly air pollution; stratified analysis; sensitivity analysis

P-0946 The effectiveness of a text messaging intervention trial to reduce mercury contaminants and conserve healthy fish consumption in reproductive age Chicago Asian women

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BACKGROUND AND AIM: Hg exposure during pregnancy can impact cognition, memory, attention, language, fine motor skills, and visual spatial skills in offspring. There is a high prevalence of elevated mercury (Hg) levels among Asian communities, attributable to frequent fish consumption. A controlled, cluster-randomized, 6-month intervention trial was conducted to decrease consumption of fish with moderate to high mercury levels and/or very frequent fish consumption and to reduce hair Hg levels.

METHODS: Reproductive age Asian women were recruited with the help of community organizations serving the Chinese, Vietnamese, and Korean communities in Chicago. The control group (n = 131) received general nutrition text messages, while the intervention group (n = 154) received text messages on risks and benefits of fish consumption, with advice tailored to the Chicago Asian communities based on a prior community assessment. Outcomes were hair Hg measurements and rates of fish consumption. Non-parametric tests compared treatment groups at baseline and six months and the effect of the intervention on outcomes was tested using longitudinal linear models with random effects for cluster.

RESULTS: Geometric mean hair mercury decreased 16% in the intervention group and increased 2% in the control group (p=0.04, Figure). In Chinese women, hair Hg decreased 9% in intervention and control groups, while in Korean women hair Hg decreased 27% in the intervention and increased 10% in the control group (p=0.04). The rate of ingestion of moderate and high mercury fish (g/day) decreased 50% in the intervention and 35% in the control group (p = 0.15).

CONCLUSIONS: Our findings suggest that in reproductive age Asian American women, a text messaging intervention providing information on healthy fish consumption and health risks of contaminated fish consumption decreased hair mercury levels, but efficacy differed by Asian ethnicity.

P-0952 The Association of Air Pollution and Serum Biomarker Abnormalities in Individuals with Hemodialysis-Dependent Kidney Failure

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BACKGROUND AND AIM: Ambient PM2.5 is a ubiquitous air pollutant with established adverse health consequences. While postulated to promote a systemic inflammatory response, few studies have demonstrated changes in serum biomarkers related to PM2.5 exposure. To examine associations between short-term PM2.5 exposure and commonly measured biomarkers known to be affected by inflammation among patients receiving maintenance in-center hemodialysis.

METHODS: We conducted a retrospective open cohort study from 1/1/2008 to 12/31/2014 among 173,697 cohort patients identified from the USA Renal Data System and linked at the patient level to laboratory data from a large dialysis organization. Daily ambient PM2.5 was estimated on a 1 km grid for the entire contiguous US and assigned to cohort patients based on the ZIP code of their dialysis clinics. Serum albumin, serum ferritin, transferrin saturation (TSAT), and serum hemoglobin were ascertained from the dialysis provider organization database. Mixed-effect models were used to assess the changes in biomarker concentrations associated with PM2.5 exposure.

RESULTS: Among study cohort, 50.3% patients were older than 65 years at the initiation of hemodialysis, 44% were female, and 62.8% were of white race. Overall, the daily ZIP-level ambient PM2.5 averages were 8.4 to 8.5 µg/m3, and the inter-quartile ranges (IQRs) were 5.9 to 6.0 µg/m3 for dates when biomarkers were measured. A 10 µg/m3 increase in same-day ambient PM2.5 exposure was associated with higher relative risks of low albumin (RR: 1.01, 95% CI: 1.01, 1.02) and low hemoglobin (RR: 1.02, 95%CI: 1.01, 1.03). Associations of same-day ambient PM2.5 exposure and high ferritin and low TSAT did not reach statistical significance.

CONCLUSIONS: Short-term PM2.5 exposure was associated with low serum hemoglobin and albumin. The findings among patients receiving in-center hemodialysis lend support for the potential of inflammation-driven changes after PM2.5 exposure.

KEYWORDS: Biomarker, air pollution, vulnerable population, dialysis patients

P-0953 Diesel exhaust particles affected heart rate variability but not endothelial function – results from a controlled chamber study

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BACKGROUND: Adverse cardiovascular effects have been associated with exposure to both diesel exhaust and road traffic noise. Effects of these highly correlated exposures are hard to disentangle in epidemiological studies, but effects on intermediary outcomes and mechanisms can be studied experimentally. Heart rate variability (HRV) and peripheral arterial tonometry (PAT), a measure of endothelial function, are noninvasive methods to study mechanisms related to the autonomic nervous system associated with cardiovascular risk. The aim of this study was to evaluate the impact of diesel exhaust particles and traffic noise on HRV and PAT, and possible synergistic effect of combined exposure.

METHODS: Eighteen healthy adults were in a controlled chamber exposed to four exposure scenarios in a randomized cross-over fashion. Each scenario consisted of either filtered (clean) air or diesel engine exhaust (PM concentrations around 300 µg/m3), and low (46 dB(A)) or high (75 dB(A)) traffic noise for three hours at rest. ECG was recorded for 10-minute periods before and during each scenario, and frequency-domain heart rate variability (HRV) computed. Endothelial function and arterial stiffness were assessed after each exposure using EndoPAT 2000.

RESULTS: Compared to the control scenario, HRV in the high frequency band decreased during exposure to diesel exhaust, both alone and combined with noise, but not during exposure to noise only. The differences were stronger in women. There were no synergistic effects of combined exposure, no significant differences between exposure scenarios for other HRV indices, and no effect on endothelial function or arterial stiffness after exposure.

CONCLUSION: Three-hour exposure to diesel exhaust, but not noise, was associated with decreased HRV in the high frequency band. This indicates activation of irritant receptor-mediated autonomic reflexes, and increased cardiovascular risk during chronic diesel exposure.

KEYWORDS: Diesel, PM1, noise, heart rate variability, endothelial function, cardiovascular

P-0954 Placental Cellular Composition and Umbilical Cord Metal Concentrations: A Descriptive Molecular Epidemiology Study Leveraging DNA Methylation

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BACKGROUND AND AIM: During pregnancy, potentially toxic metals and metalloids can cross the placenta with varying degrees of efficiency. We hypothesized metal toxicokinetics may be regulated by placental cellular composition. Until recently, disentangling complex placental tissue at the population level has been challenging. Here, we leveraged DNA methylation profiles to characterize major placental cell types and described relationships with umbilical cord metal concentrations in an extremely preterm birth cohort.

METHODS: Among 145 infants born before 28 weeks' gestation enrolled in the US-based ELGAN cohort (2002-2004), we quantified concentrations of 7 non-essential metals/metalloids in cord tissue, representing passage through the placental barrier. Placental DNA methylation profiles were measured by the Illumina EPIC BeadChip and deconvoluted using a novel reference-based approach (planet) to estimate proportions of six constituent cell types. To satisfy the sum-to-one constraint of proportions, we transformed the data into pivot coordinates (a special case of isometric log-ratios) before fitting linear regression models with cord tissue metal concentrations.

RESULTS: Arsenic, lead, strontium, and barium were detected in all umbilical cord tissue samples; cadmium and mercury were detected in 97.9% and antimony in 93.7%. The most relatively abundant cell type in placental tissue was syncytiotrophoblast (31.7%), followed by nucleated red blood (27.3%), endothelial (19.4%), Hofbauer (9.6%), stromal (8.8%), and trophoblast cells (3.2%). As syncytiotrophoblasts increase, arsenic levels in cord tissue decrease (Coefficient = -0.6 ng per 1-percentage point, p-value = 0.03) whereas as Hofbauer cells increase, cadmium levels increase (Coefficient = 0.3 ng per 1-percentage point, p-value = 0.03). Null associations were observed for the other metals/metalloids.

CONCLUSIONS: The findings suggest the cellular composition of the placenta may influence the transport of environmental metals to the fetus. Future studies examining prenatal environmental exposures should consider methylation-based deconvolution as a powerful tool for investigating placental biology.

P-0965 Impact of urban exposures during pregnancy on placental small non-coding RNAs

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BACKGROUND AND AIM: Epidemiological studies show that urban exposures (e.g., air pollution, built and natural environment, and noise) during pregnancy could adversely influence the developing foetus. Although the underlying mechanisms are unclear, recent findings suggest that placental transcriptome can be a proxy of placental function during pregnancy and a plausible mediator of the association between intrauterine environmental exposures and foetal growth and development, and childhood and adult health trajectories. In particular, there is an increasing interest in small non-coding(nc)RNAs, including microRNAs (miRNAs), which are regulatory RNAs critical for placenta function and foetal development. Our main aim is to assess the association of several urban exposures during pregnancy with placental small ncRNA profiles in the Barcelona Life Study cohort (BiSC).

METHODS: BiSC is a population-based birth cohort of 1,086 mother-child pairs from the Barcelona metropolitan area (2018 onwards). We will characterize exposure to air pollution, noise, green space, and built environment as indicators of the urban exposome. Placental RNA was obtained from 450 placental foetal villi biopsies. Small ncRNA profiles were measured by RNA-sequencing (library insert of 17-52 nucleotides length, 50 nucleotides sequencing length, and 5M reads/sample). Quality control, processing of RNA-sequencing data, and small ncRNAs annotation and quantification will be done with the SeqCluster/SeqBuster bioinformatic tool.

RESULTS: A pilot study of 8 samples identified a total of 550 small ncRNAs, 44% being miRNAs. MiRNAs of the placental specific C19MC cluster were found among the most abundant. In the ISEE Conference we will present the placental small ncRNA profiles and their association with urban-related exposures.

CONCLUSIONS: Studying the impact of pregnancy exposures on the foetus and its biological intermediates is crucial to prevent their harmful effects and to develop biomarkers that allow early monitoring and treatment.

KEYWORDS: transcriptomics, microRNAs, small non-coding RNAs, placenta, urban exposures, air pollution, built environment, noise

P-0968 Epigenome-Wide Association of Neonatal Methylation and Prenatal PM2.5 Exposure Suggests Timing-Specific Effects

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BACKGROUND AND AIM: Exposure to particulate matter with an aerodynamic diameter smaller than 2.5 microns (PM2.5) can affect birth outcomes through physiological pathways such as inflammation. One potential way PM2.5 affects physiology could be through altering DNA methylation (DNAm). Considering that exposures during specific windows of gestation may have unique effects on DNAm, we hypothesized a timing-specific association between PM2.5 exposure during pregnancy and DNAm in the neonatal epithelial-cell epigenome.

METHODS: After collecting salivary samples from a cohort of 91 neonates, DNAm was assessed using the MethylationEPIC array (EPIC) which covers over 850,000 CpG methylation sites (850K) on the epigenome. Daily ambient PM2.5 concentrations were estimated based on the mother's address of primary residence during pregnancy. PM2.5 was then averaged over the first two trimesters, separately and combined, and tested for association with DNAm through an epigenome-wide association (EWA) analysis. for each EWA, FDR-corrected $p < 0.05$ constituted a significant finding, and every CpG site with uncorrected $p < 0.0001$ was selected to undergo pathway and network analysis to identify molecular functions enriched by them.

RESULTS: Our analysis showed that cg18705808 was associated with the combined average of PM2.5. Pathway and network analysis revealed little similarity between the first two trimesters. Previous studies reported that TMEM184A, the gene regulated by cg18705808, has a putative role in inflammatory pathways.

CONCLUSIONS: The differences in pathway and network analyses could potentially indicate trimester-specific effects of PM2.5 on DNAm. Further analysis with greater temporal resolution would be valuable to fully characterize the effect of PM2.5 on DNAm and child development.

P-0972 Exposure to Metals and the microRNA Profile of Participants in the Normative Aging Study

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BACKGROUND AND AIM: Metals have previously been associated with adverse effects in multiple organ systems. However, the molecular mechanisms by which they cause these effects are not fully elucidated. MicroRNAs are short non-coding RNA sequences that play an important role in the regulation of gene expression and may be a mechanism by which metals influence health.

METHODS: The study population consisted of496 persons (with 694 samples) enrolled in the Normative Aging Study (NAS). This cohort began recruiting male veteran who lived in the New England area in 1963 and has followed up with them every three to five years ever since. Our study period includes visits from 1999 to 2014. Extracellular microRNAs were sequenced from participants' plasma, and toenail samples were used to measure levels of metals, namely: arsenic (As), cadmium (Cd), lead (Pb), manganese (Mn), and mercury (Hg). We used canonical correlation analysis (CCA) to find whether metal levels correspond with microRNA levels. We further assessed the relationship between metals and microRNA using Bayesian kernel machine regression (BKMR).

RESULTS: Our preliminary CCA results showed very strong correlations between the first five canonical variables of the metals and those of the microRNA, with correlation values of 0.937, 0.923, 0.903, 0.894, 0.886, respectively. However, only the correlation between the first canonical variables was statistically significant. Pb and Cd showed the strongest association with the first canonical variable of the metals dataset. The strongest associations between the first canonical variable in the microRNA set were with the following microRNAs: miR-182-5p, miR-183-5p, miR-516b-5p, and miR-26a-5p.

CONCLUSIONS: There was a strong correlation between the first canonical variables of the metals and the microRNA, indicating a potential association between them. Future analyses will use BKMR to assess the joint effect of metals on the microRNA profile.

KEYWORDS: Metals, microRNA, Epigenetics, Mixtures Analysis

P-0975 Exposure to persistent organic pollutants and biomarkers of oxidative stress - A scoping review

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BACKGROUND AND AIM: Oxidative stress is a known mediator in pathways related to environmental exposures and numerous diseases. However, epidemiological studies investigating the association of persistent organic pollutants (POPs) and oxidative stress are limited and revealed inconsistent results. This scoping review evaluates the effect of POPs, including per- and polyfluoroalkyl substances (PFAS), polychlorinated biphenyls (PCBs), organochlorine pesticides, and polybrominated diphenyl ethers (PBDEs), on oxidative stress biomarkers in epidemiological studies.

METHODS: A search was conducted in PubMed and Embase through September 7, 2021, to identify all published studies related to POPs and oxidative stress. Search results were uploaded into Covidence systematic review management tool for de-duplication and for double independent abstract and full-text screening. We included human observational studies reporting at least one exposure and oxidative stress biomarker of interest for data extraction. The Office of Health Assessment and Translation risk of bias assessment tool was implemented for quality assessment.

RESULTS: Thirteen epidemiological studies met inclusion criteria – 7 for organochlorine pesticides, 5 for PFAS, 3 for PCBs, and 1 for PBDEs. Ten studies have overall low risk of bias. We found consistent positive associations of organochlorine pesticides and PFAS with several oxidative stress biomarkers, eg, of organochlorine pesticides with protein carbonyls, nitric oxide, and malondialdehyde, and of PFAS with 8-hydroxyguanosine and malondialdehyde. Additionally, we found consistent negative associations of organochlorine pesticides with several antioxidants, such as with acetylcholine esterase and paraoxonase-1, but associations of organochlorine pesticides, PCBs, and superoxide dismutase were inconsistent.

CONCLUSIONS: This is the first review of association of POPs and oxidative stress biomarkers in humans. Lack of prospective studies and some inconsistent results pose challenges to draw causal inference. Further evidence is needed to better elucidate the relationship of POPs and oxidative stress.

KEYWORDS: persistent organic pollutants, oxidative stress, biomarkers, review

P-0979 Use of high-resolution metabolomics to assess the biological perturbations associated with maternal exposure to Bisphenol A and Bisphenol F among pregnant African American women

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BACKGROUND: Human and animal exposure to bisphenol A (BPA) is strongly associated with adverse developmental and reproductive effects. The molecular mechanisms by which BPA exposure exerts its effects are not well-understood, even less known about its analogues bisphenol F (BPF). To address these knowledge gaps, we conducted an untargeted metabolome-wide association study (MWAS) to identify metabolic perturbations associated with BPA/BPF exposures in a pregnant African American cohort.

METHODS: From a subset (N=230) of study participants enrolled in the Atlanta African American Maternal-Child cohort, we collected both urine samples, for targeted exposure assessment of BPA and BPF, and serum samples, for high-resolution metabolomics (HRM) profiling, during early pregnancy (8-14 weeks' gestation). Using an established untargeted HRM workflow consisting of MWAS modeling, pathway enrichment analysis, and chemical annotation and confirmation, we investigated the potential metabolic pathways and features associated with BPA/BPF exposures.

RESULTS: The geometric mean creatinine-adjusted concentrations of urinary BPA and BPF were 0.85±2.58 and 0.70±4.71 μg/g creatinine, respectively. After false positive discovery rate correction at 20 % level, 264 and 733 unique metabolic features were significantly associated with urinary BPA and BPF concentrations, representing 10 and 12 metabolic pathways, respectively. Three metabolic pathways, including steroid hormones biosynthesis, lysine and lipoate metabolism, were significantly associated with both BPA and BPF exposure. We confirmed the chemical identity of 16 of the metabolites significantly associated with BPA or BPF exposure with Level One evidence using reference standard.

CONCLUSIONS: Our findings support that exposure to BPA and BPF in pregnant women is associated with the perturbation of aromatic amino acid metabolism, xenobiotics metabolism, steroid biosynthesis, and other amino acid metabolism closely linked to stress responses, inflammation, neural development, reproduction, and weight regulation.

KEYWORDS: Bisphenol A, Bisphenol F, Urinary bisphenol metabolites, High-resolution metabolomics, Metabolic perturbations

P-0982 Short-term PM2.5 exposure and executive function: association and neurophysiological mechanisms

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INTRODUCTION: Although converging evidence has shown that exposure to PM2.5 caused adverse effects on brain structure and cognitive function, the association between the short-term exposure to PM2.5 and cognition dysfunction remain underexplored, especially possible neurophysiological mechanisms.

METHODS: We conducted a longitudinal observational study with four repeated measurement sessions among 90 young adults from September 2020 to June 2021. During each measurement session, we measured participants' personal level air pollution exposure for one week with portable monitors, followed by executive function assessment and electrophysiological signals recordings at the assessment center. Standard Stroop color-word test was used accompanied with electrophysiological recordings to assess performance on executive function.

RESULTS: Adjusted mixed-effect models demonstrated that elevated PM2.5 exposure three days prior to cognitive assessment (lag 3) was associated with (1) declined performance in both congruent and incongruent tasks in Stroop tests, (2) reduced lower alpha event-related desynchronization (ERD) during 500-1000 ms after stimuli, both indicating impaired executive control. No associations were found between short-term PM2.5 exposure and aperiodic exponents both in tonic and phasic state, residual periodic alpha oscillation in tonic state.

CONCLUSIONS: Our results provided evidence that short-term PM2.5 exposure was associated with brain executive dysfunction. Reduced alpha ERD was likely to be the underlying pathway through which PM2.5 induced adverse effects on neuron activities during cognitive tasks. This study implies that transcranial electric stimulation and transcranial magnetic stimulation could be applied to access cortical neuron excitability to compensate for the cognitive impairment caused by PM2.5 exposure.

P-0983 Persistent organic pollutant exposure contributes to Black/White differences in leukocyte telomere length: Evidence from NHANES 1999-2002

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BACKGROUND AND AIM: Despite racial disparities in diseases of aging and premature mortality, non-Hispanic Black Americans tend to have longer leukocyte telomere length (LTL), a biomarker of cellular aging, than non-Hispanic White Americans. Previous findings suggest that exposures to certain persistent organic pollutants (POPs) are both racially-patterned and associated with longer LTL. We examine whether Black/White differences in LTL are explained by differences in exposure to 15 POPs by estimating the indirect effect (IE) of race on LTL that is mediated through polychlorinated biphenyls (PCBs), furans, and dioxins, as well as their mixtures.

METHODS: Our study includes 1,251 adults from the 1999-2000 and 2001–2002 cycles of the National Health and Nutrition Examination Survey (NHANES). We characterized single-pollutant mediation effects by constructing survey-weighted linear regression models and implemented various approaches to quantify a global mediation effect of POPs, including unpenalized linear regression, ridge regression, and three summary exposure scores (derived from principal components analysis [PCA], principal direction of mediation, and the Toxic Equivalency Quotient [TEQ] score) using survey weights when possible.

RESULTS: We found support for the hypothesis that exposure to PCBs partially mediates Black/While differences in LTL. In single-pollutant models, there were significant IEs of race on LTL through PCBs 118, 138, 153, 170, 180, and 187 (percent mediated ranging 18.4-43.4%) after correction for multiple testing. Ridge regression and models examining summative exposure scores with linear combinations derived from PCA and TEQ scores showed significant IE when incorporating survey weights (percent mediated 26.0-34.8%), which also supports our hypothesis based on the IE attributable to exposure mixtures.

CONCLUSIONS: Exposures to individual POPs and their mixtures, which may arise from residential and occupational segregation, may help explain why Black Americans have longer LTL than their White counterparts, challenging genetic explanations for counterintuitive race differences in cellular aging.

KEYWORDS: telomeres, mediation, disparities, persistent organic pollutants

P-0984 Effects of prenatal exposure to air pollution on placental molecular hallmarks and black carbon load

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BACKGROUND AND AIM: There is a rising social concern regarding the effects of air pollution on fetal development, as increasing epidemiological evidence shows an association with several adverse birth outcomes. However, the specific mechanisms that drive these outcomes are still not comprehensively elucidated. To better understand the pathophysiology of prenatal exposure to air pollution through the placenta is precisely one of the aims of the Barcelona Life Study Cohort (BiSC).

METHODS: BiSC is a birth cohort of 1086 mother-child pairs residing in the Barcelona metropolitan area (Spain) that includes a comprehensive follow-up, both environmental (personal exposure to noise and air pollution) and clinical (3rd trimester comprehensive sonography and reproductive outcomes). Further post-natal follow-up is focused on neurocognitive development and includes a Bayley's test (BSID-III) at 6 months.
A specific work package in BiSC is focused on how the placenta responds to prenatal exposure to air pollution, as an intermediate organ between the environment and its effects on early-life development. Specific sections include:
1. To precisely evaluate the personal exposure to air pollution during pregnancy and quantify the translocation of air pollution particles (black carbon) to placental tissue through advanced microscopy.
2. To evaluate placental function measuring maternal-fetal circulation through Doppler sonography, as well as molecular biomarkers (telomere length and mitochondrial DNA content through qPCR) to define both the degree of tissue aging and metabolic capacity.

RESULTS: Black carbon particle detection, telomere length and mitochondrial DNA content measures are currently being performed in placental samples from the BiSC cohort. Dose response associations between air pollution exposure, placental carbon load and markers of placental function (maternal-fetal circulation, placental telomere length and mitochondrial DNA content) will be investigated.

CONCLUSIONS: This study will help to understand underlying mechanisms of air pollution effects on early life.

KEYWORDS: Air pollution, DOHaD, placental function, fetal development

P-0990 Phthalates and Adipokines in Midlife Women: A Cross-sectional Study in the Study of Women's Health Across the Nation (SWAN)

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BACKGROUND AND AIM: Phthalates are associated with obesity and its metabolic complications, but the mechanisms are not well-understood. We examined if phthalate exposure was associated with adverse adipokine profiles, a potential mechanism of metabolic disturbance.

METHODS: In 1250 midlife women in the Study of Women's Health Across the Nation (SWAN), we measured 11 phthalate metabolites in spot urine samples and leptin and high-molecular-weight (HMW) adiponectin in fasting blood samples from 2002/2003. We used linear regression to examine the association between each hydration-adjusted metabolite and log-transformed leptin, HMW adiponectin, and the leptin:HMW adiponectin ratio, adjusting for demographic, lifestyle, and menopause-related factors. Additionally, we used Bayesian kernel machine regression (BKMR) to examine the joint associations between the phthalate metabolite mixture and adipokines.

RESULTS: In single-pollutant models adjusted for all covariates except body mass index (BMI), most phthalate metabolites were positively associated with leptin. Mono(2-ethylhexyl) phthalate (MEHP) was positively associated with HMW adiponectin and inversely associated with the leptin:HMW adiponectin ratio. Adjustment for BMI attenuated all associations with leptin, but MEHP remained robustly associated with higher HMW adiponectin and a lower leptin:HMW adiponectin ratio. Compared to the 1st quartile, the 2nd to 4th quartiles of MEHP were associated with -16.9% (95% confidence interval (CI): -29.1, -2.6), -24.0% (-35.2, -10.8), and -17.7% (-30.2, -3.1) lower leptin:HMW adiponectin ratio. BKMR revealed a statistically significant, positive association between the phthalate metabolite mixture and HMW adiponectin and identified MEHP as the most important metabolite.

CONCLUSIONS: Phthalates were not associated with leptin concentrations independent of BMI. MEHP was associated with higher HMW adiponectin and a lower leptin:HMW adiponectin ratio, suggesting a more beneficial adipokine profile. The apparent difference between these findings and phthalates' associations with metabolic diseases calls for further investigations on phthalates' potential metabolism-disrupting mechanisms.

KEYWORDS: phthalates, obesity, adipokines

P-0992 Periconceptional and Prenatal Metals Exposure and Extracellular Vesicle miRNA in Breast Milk: A Pilot Study

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BACKGROUND AND AIM: Breast milk is a rich source of extracellular vesicle (EV) miRNA, which are hypothesized to contribute to maternal-offspring communication during the postnatal period and child development. Impacts of environmental contaminants on EV miRNA in breast milk are largely unknown. Our pilot study examined the relationships of metal exposures during the periconceptional and prenatal periods with breast milk-derived EV miRNA.

METHODS: EV miRNA were extracted from breast milk samples collected approximately 6 weeks postpartum from participants (N=54) in the New Hampshire Birth Cohort Study. 799 miRNA were profiled using the NanoString nCounter platform; 200 miRNA were widely detectable and retained for downstream analyses. Exposure to five metals (arsenic, manganese, mercury, lead, and selenium) during the periconceptional and prenatal periods was measured in maternal toenail clippings collected at two time points. Metal-miRNA associations were evaluated using covariate-adjusted robust linear regression models.

RESULTS: In this preliminary analysis, we found 12 miRNA to be inversely associated with As exposure in the periconceptional period and 42 miRNA to be inversely associated with As exposure in the prenatal period. Four miRNA were inversely associated with As exposure at both time points (miR-106b-5p, miR-152-3p, miR-429, miR-1234-3p). Associations for other metals showed potential trends which motivate further investigation in a larger study.

CONCLUSIONS: In a pilot study of participants in northern New England, we identified four miRNA that were inversely associated with both periconceptional and prenatal As exposure and an additional set of miRNA that were inversely associated with As exposure in a time-dependent manner. In future studies, we plan to expand the number of participants with these measures to investigate multiple metal exposures simultaneously using environmental mixture modeling approaches, examine possible downstream consequences for children's health, and conduct validation studies in other cohorts.

KEYWORDS: Metals, EV miRNA, Breast Milk, Periconceptional, Prenatal

P-1004 Hair cortisol as a biomarker of chronic stress: influence of school context and bullying

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BACKGROUND: Bullying has been identified as the most common form of aggression and the main source of stress during childhood and adolescence. The study aimed to analyze the effects of school context and bullying (victim, bully and bully/victim roles) as chronic stressors, using hair cortisol as a biomarker. Moreover, executive function was examined for its relationship with cortisol as well as its influence on bullying and academic skills.
METHOD: The study included 659 eleven-year-old preadolescents from the INMA cohorts of Gipuzkoa and Sabadell. Bullying (Olweus Bully Victim Questionnaire) and variables related to the school context were used as stressors: perception of the school environment (Kidscreen-27 questionnaire), problems with peers (SDQ: strength and difficulties questionnaire) and academic skills (ad hoc questionnaire). Hair samples were used to measure cortisol levels. Additionally, executive function was evaluated using the Cups Task neuropsychological test. To test our hypothesis, structural equation modeling was conducted.

RESULTS: In this study, it was found that being a bully/victim in bullying situations is associated with higher hair cortisol concentrations (b=0.075; p=0.056). Additionally, higher hair cortisol concentrations were associated with worse executive functions across all models (victims: b=0.113; p=0.004; bullies: b=0.112; p=0.004; bullies/victims: b=0.112; p=0.004). Finally, having a poorer relationship with peers, a poorer perception of a school environment or lower academic skills did not affect hair cortisol levels (p>0.05).

CONCLUSIONS: The present study examines the relationship between school context in general and bullying in particular with hair cortisol concentrations as an indicator of chronic stress for the first time. Despite concluding that the role of bully/victim appears to be related to hair cortisol concentrations, more research is needed to study this relationship.

P-1006 The Association between Exposure to Metals and Phthalates during Pregnancy and Children's DSM-oriented Problems at Age Four Years

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BACKGROUND AND AIM: About 10%–20% of children and adolescents suffer from mental problems worldwide, and it may increase the global burden of disease. Neurotoxic metals are associated with inflammation or cytotoxicity in the brain. Prenatal phthalates (PAEs) exposure is associated with cognitive function deficits. However, the effect of co-exposure to metals, PAEs, and the association with child behaviors are less well studied. We aimed to investigate prenatal co-exposure to metals and PAEs and the consequent behavioral outcomes in early childhood.

METHODS: Participants from the central, southern, and eastern areas of the Taiwan Maternal and Infant Cohort Study were followed up during 2015–2017. We quantified the maternal urinary concentration of metals and metabolites of PAEs as prenatal exposure. Child mental disorders at age four years were according to caregiver-reported scales of the Child Behavior Checklist to define DSM (The Diagnostic and Statistical Manual of Mental Disorders)-oriented problems. Finally, there were 408 children included in further statistical analysis.

RESULTS: Maternal urinary copper was significantly associated with depressive (OR=2.30), attention-deficit/hyperactive (OR=2.31), and oppositional defiant (OR=1.98) in children. Increased concentration of cadmium and lead was significantly associated with attention-deficit/hyperactive (OR=2.55), and oppositional defiant (OR=1.70) problems, respectively. Maternal urinary concentration of mono-isobutyl phthalate was also significantly associated with depressive problems (OR=1.72) in children. In the further analysis that considering prenatal co-exposure to metals and PAEs, co-exposure to these materials was significantly associated with autism spectrum problems in children (OR=5.15).

CONCLUSIONS: We observed that prenatal exposure to copper, cadmium, lead, and dibutyl phthalate was associated with some DSM-oriented problems in children at age four. Also, prenatal co-exposure to metals and PAEs may play a certain role in children's mental health. Reduction of exposure to metals and PAEs in pregnancy is suggested to prevent increased mental problems in childhood.

KEYWORDS: birth cohort, metal, phthalate, mental disorder

P-1007 Pesticide exposure and development in children living in low- and middle-income countries: a systematic review

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BACKGROUND AND AIM
Pesticides are widely used in residential and agricultural settings in low- and middle-income countries (LMICs). Evidence from high-income settings shows that pesticide exposure in pregnancy and childhood is associated with poor child development. Our aim was to systematically review evidence on the associations between pesticides and development in children <18 years in LMICs.

METHODS: We searched 10 electronic databases through November 2021 with no language restriction. We included prospective cohort and cross-sectional studies investigating associations between self-reported or measured pesticide exposure in children and development. Two independent researchers screened studies and extracted data. Results were summarised narratively.

RESULTS: of 3372 records retrieved, 31 articles from 12 countries met the inclusion criteria. All articles assessed associations cross-sectionally; sample sizes ranged from 35 to 1762 (n=9083 total participants). Twenty-one articles assessed urine or blood biomarkers, five assessed self-reported exposure, and five used community of residence as a proxy for exposure. Two articles assessed organochlorines, 26 organophosphates, 11 carbamates, and eight pyrethroids.
In the three articles assessing children <2 years, pesticides were negatively associated with motor and social development (n=2), but not with language or adaptive development (n=2). In the 12 articles assessing pre-schoolers (2-5 years), pesticides were negatively associated with motor (n=4), language (n=3), and social (n=3) development, and with attention, memory, and processing speed (n=2). Two studies found no associations between organophosphates and these outcomes. In the 21 articles assessing school-aged children (6-18 years), pesticides were negatively associated with motor development (n=4), memory (n=6), attention (n=4), processing speed (n=4), and IQ (n=2). Five studies found no associations between pesticides and these outcomes.

CONCLUSIONS: Pesticides may be associated with deficits in multiple child development domains. However, evidence in LMICs remains inconclusive due to the small number of studies and variable methodologies used.

KEYWORDS: pesticides, child development, developing countries

P-1009 Associations of gestational phenol exposure with cognition in 7.5-month-old infants

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BACKGROUND AND AIM: Triclosan and benzophenone-3 are ubiquitous phenolic endocrine disrupting chemicals. Similar chemicals are associated with adverse neurodevelopmental outcomes, but little is known about the effects of triclosan and benzophenone-3 on neurodevelopment. We investigated associations of gestational triclosan or benzophenone-3 exposure with infant cognitive outcomes.

METHODS: A visual recognition memory task assessed 312 7.5-month-old infants (151 males; 161 females) from a prospective birth cohort study. Triclosan and benzophenone-3 concentrations were quantified in maternal urines pooled from five timepoints across pregnancy. Infrared eye-tracking recorded infants' looking as they observed identical black-and-white photographs of human faces side-by-side (familiarization) and then the familiar next to a novel face (test trials). All infants saw the same face pairs. However, half the infants saw one set of faces as familiar (stimulus set 1), and half saw the other set as familiar (stimulus set 2). Multivariable generalized linear models (adjusted for income, parity, gestational age, testing age, child sex, stimulus set) assessed associations of triclosan or benzophenone-3 with time to familiarization (time to accrue 20s of looking during familiarization; attention measure), average run duration (time looking at stimuli before looking away; information-processing speed measure), and novelty preference (proportion of time looking at novel faces; recognition-memory measure).

RESULTS: Mothers were mostly white and college-educated with household income >$50,000/yr. Urinary concentrations (mean ± SD μg/L) of triclosan (68.8 ± 43.5) and benzophenone-3 (339.2 ± 638.5) were higher than those in reproductive-age females in the general U.S. population. Sex- and set-specific estimates demonstrated associations only in males who saw set 2: triclosan with longer time to familiarization (β=0.076; 95%CI: 0.04,0.112; p<0.0001) and benzophenone-3 with longer run duration (β=0.001; 95%CI: -0.0001,0.002; p=0.067).

CONCLUSIONS: In male infants, gestational exposure to triclosan and benzophenone-3 may be associated with poorer attention and slower information processing, respectively. (ES007326;ES022848;RD83543401;OD023272)

KEYWORDS: phenols, infant cognition, neurodevelopment

P-1011 The effect of Bisphenol A exposure on Attention Deficit Hyperactivity Disorder

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BACKGROUND The effect of Bisphenol A (BPA) on attention deficit/hyperactivity disorder (ADHD) is not fully understood. This study investigated the associations (i) between postnatal BPA exposure and ADHD in children; and (ii) between BPA and IgE levels for the possible disease pathogenesis.

METHOD A total of 453 children from Childhood Environment and Allergic Diseases Study cohort with urine samples were recruited in Taiwan. Urinary BPA glucoronide (BPAG) levels were measured by UPLC-MS/MS. The associations between BPAG levels and IgE levels and the risk of ADHD were evaluated by multivariate linear regression and logistic regression.

RESULT The geometric mean (SD) of BPAG concentrations was 8.84(±2.57) ng/ml at age 6. Urinary BPAG levels were positively associated with the risk of ADHD at age 6 (β=3.21 KU/l per ln-unit increase BPAG level; 95% CI, 0.99- 10.51 KU/l), after adjusting for potential confounders . There was no significant gender difference. The BPAG levels were positively associated with IgE levels at age 6 (β=64.85 KU/l per ln-unit increase BPAG level; 95% CI, 14.59- 115.11 KU/l).

CONCLUSION BPA exposures were positively associated with the risk of ADHD in children. The BPAG levels were positively associated with IgE levels.

KEYWORDS:： Behaviour, Children, BPA.

P-1019 Early-life critical windows of metal exposure associated with internalizing symptoms in young adolescents

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Introduction and Aim: Internalizing disorders, such as anxiety and depression, affect 10 – 20% of children and increase the risk for later-life psychopathology. The neural circuitry subserving internalizing phenotypes begins developing in utero and is vulnerable to early-life environmental exposures. Although early-life exposure to metals can adversely impact children's neurodevelopment and have lifelong impacts on mental health, little is known about critical windows to metal exposures and adolescent internalizing disorders. In this study, we hypothesized that early-life exposure to a mixture of metals is associated with increased internalizing problems in early adolescence.

METHODS: Among 431 (8-12 years; 216 females) pre-adolescents enrolled in the Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) longitudinal birth cohort study in Mexico City, we estimated weekly concentrations of 15 metals in naturally shed deciduous teeth using laser ablation-inductively coupled plasma-mass spectrometry (i.e., Ba, Bi, Cd, Co, Cr, Cu, Li, Mg, Mn, Mo, Ni, Pb, Sn, Sr, and Zn) from the 14th gestation week through one year of age). Internalizing problems were assessed using the Behavior Assessment System for Children, 2nd edition (BASC-2). We used lagged weighted quantile sum (lWQS) regression to estimate a time-varying mixture effect of multiple metals on internalizing problems. Models were adjusted for age and sex.

RESULTS: A higher metal mixture index in the 22nd-43rd postnatal weeks was associated with increased internalizing problems (maximum $\beta = 0.37$ [95% CI 0.06, 0.69]), driven mainly by Mg, As, Sn, and Bi.

CONCLUSIONS: This study supports the hypothesis that mixed metal exposure during specific critical windows in early life may associate with mental health disorders in childhood and adolescence. Our lWQS modeling approach and results may inform the role of exposure timing in driving neurodevelopmental outcomes, thereby pointing to future optimal, efficient, and properly timed public health interventions.

P-1022 Associations of Prenatal Metal Exposure and Non-nutritive Suck Among Infants from the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) Birth Cohort Study

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BACKGROUND AND AIM: Infant non-nutritive sucking (NNS) has been used as an early marker of neonatal brain function. Although there is an established relationship between metal exposure and brain development, the association between prenatal metal exposure and NNS has yet to be explored. To have a better understanding of the relationship, in this study, we explored associations between maternal urinary metal concentrations and NNS measurements among 116 infants from the Puerto Rico PROTECT birth cohort.

METHODS: We measured urinary concentrations for seven metals collected between 16-20 weeks and 24-28 weeks gestation. Linear mixed effects models (LMEs) were used to regress NNS on metals, adjusting for specific gravity, maternal age, birth weight, and fetal sex. Fetal sex effects were estimated using interaction terms between metal exposure variables and fetal sex indicators.

RESULTS: We observed significant positive associations between mercury and manganese with NNS duration (mercury: Δ= 1.08, 95% CI: 0.42, 1.74; manganese: Δ= 0.67, 95% CI: 0.15, 1.20) and NNS cycles/min (mercury: Δ= 1.85, 95% CI: 0.58, 3.11; manganese: (Δ= 1.37, 95% CI: 0.40, 2.34). Furthermore, the association between NNS cycles/burst and manganese (Δ= 4.44, 95% CI: 1.40, 7.47) were in the opposite direction from its association with zinc (Δ= -9.30, 95% CI: -14.71, -3.89), as well as with copper (Δ= -6.58, 95% CI: -12.06, -1.10). We also observed differences in metal-NNS associations by fetal sex.

CONCLUSIONS: We observed significant associations between prenatal metal exposure and child neurodevelopment, using NNS measurements, among infants from the ongoing Puerto Rico PROTECT cohort. We believe this study will inform future efforts aimed at reducing health risks related to early life metal exposures, such as developing early identification of metal-induced adverse outcomes in child neurodevelopment.

KEYWORDS: Exposure, Child Neurodevelopment, Pregnancy, Metals, Puerto Rico

P-1029 Early-life exposure to a mixture of phthalates and phenols and child social behavior in a new type of mother-child cohort relying on within-subject pools of repeated urine biospecimens

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BACKGROUND AND AIM: Previous cohorts characterized exposure to phenols and phthalates using few spot urine samples, incurring in exposure misclassification. Early infancy exposure remains understudied. We relied on a cohort with improved exposure assessment to examine associations of phthalates and phenols with child autistic traits.

METHODS: This analysis included 406 mother-child pairs from the French SEPAGES cohort. 25 phenols/phthalate metabolites were measured in within-subject pools of repeated urine samples collected at second and third pregnancy trimesters (median= 21 samples/trimester), and at 2 and 12 months of age (median= 7 samples/period). Autistic traits were parent-reported at 3 years using the Social Responsiveness Scale (SRS). Adjusted differences in SRS raw scores were estimated per doubling in each biomarker concentration using linear regression. A literature review was performed to prioritize the measured phthalates/phenols based on their likelihood to affect social behavior. The mixture effect was estimated for the prioritized compounds (bisphenol A, triclosan, DEHP, MEP, MnBP and MBzP) using Bayesian Weighted Quantile Sum (BWQS) regression.

RESULTS: Most associations were observed in the 12-months exposure window. Among the prioritized compounds, triclosan (β= 0.79; 95%CI: 0.01, 1.56) and MEP (β= 0.92; 95%CI: -0.11, 1.95) were associated with worse total SRS scores, while MnBP and ∑DEHP were associated with worse social awareness (β= 0.25; 95%CI: 0.01, 0.50), and social communication (β= 0.43; 95%CI: -0.02, 0.88) scores, respectively. The mixture of prioritized compounds was associated with worse total SRS scores (Beta1= 1.40; 95%CrI: -0.22, 2.99), driven by the social awareness (Beta1= 0.36; 95%CrI: 0.03, 0.70) and social communication (Beta1= 0.87; 95%CrI: 0.31, 1.51) subscales.

CONCLUSIONS: The literature search allowed to prioritize the compounds with a higher weight of evidence. Our results suggest that early infancy is a critical window for the effects of phenols and phthalates on child social development.

KEYWORDS: phthalates, bisphenol, neurodevelopment, social behavior, autism

P-1034 Associations between phthalates and sleep quality in pregnant women with repeated assessment of exposure

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BACKGROUND AND AIM: Phthalates are associated with sleep disorders in midlife women. However, this relationship among pregnant women remains unknown. This study investigated associations of repeated measures of urinary phthalates in early and late pregnancy with sleep quality in pregnant women.

METHODS: This study analyzed eight urinary phthalates in pregnant women from the Korean Children's Environmental Health Study (n = 2,324). Multiple informant models were fit using generalized estimating equations to examine the association between phthalate metabolites measured in early and late pregnancy and sleep quality. Summary measures of phthalate mixtures, including the phthalates from plastic sources (∑Plastic), anti-androgenic phthalates (∑AA), di-(2-ethyhexyl) phthalate (∑DEHP), and all phthalate metabolites measured (∑All), were calculated from urinary phthalate metabolites. The sleep quality was assessed by the Pittsburgh Sleep Quality Index (PSQI) global and subscale scores.

RESULTS: Compared to the lowest quartile, ∑Plastic (adjusted odds ratio [OR] = 1.36; 95% confidence interval [CI]: 1.02, 1.81), ∑AA (OR = 1.60; 95% CI: 1.20, 2.12), ∑DEHP (OR = 1.37; 95% CI: 1.03, 1.82), and ∑All (OR = 1.66; 95% CI: 1.25, 2.20) in the highest quartile were significantly associated with increased odds of low sleep efficiency (85% or less). The highest quartile of ∑All had 1.40 times (95% CI: 1.02, 1.94) the odds of short sleep duration (7 hour or less). In linear models, there was a trend with any of the summary phthalate measures and sleep efficiency: each log-unit increase in concentration was associated with 1.20 to 1.24 times the odds of low sleep efficiency. Summary phthalate measures showed a nonlinear association with sleep efficiency and sleep duration (p for nonlinearity < 0.05) in the restricted cubic spline regression.

CONCLUSIONS: Our findings suggest that phthalate exposure is associated with poor sleep quality in pregnant women.

KEYWORDS: Phthalates, Pittsburgh Sleep Quality Index, sleep efficiency, pregnant women

P-1038 Wildfire Smoke and Symptoms Affecting Mental Health among Adults in Oregon

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BACKGROUND AND AIM: The impact on mental health status of experiencing a wildfire is believed to be substantial; however, few data are available to describe symptoms affecting mental health among people affected by wildfires. We assessed associations between exposure to wildfire smoke and self-reported symptoms affecting mental health among adults living in Oregon, a geographic area of the USA regularly affected by wildfires.

METHODS: We analyzed data from 5,807 adults in Oregon who responded to the 2018 Behavioral Risk Factor Surveillance System's depression and anxiety module. We linked by interview date and county of residence each adult's responses about the symptoms affecting their mental health status with smoke plume density, a proxy for wildfires and wildfire smoke exposure. Associations between days in the past year with light, medium, and heavy smoke plume densities and symptoms affecting mental health during the two weeks before the interview date were estimated using predicted marginal probabilities from logistic regression models.

RESULTS: In the year before completing the interview, 100% of respondents experienced ≥14 days of medium or heavy smoke plumes, with an average exposure duration of 32 days. Nearly 10% reported being unable to stop or control their worrying more than half the time over the past two weeks. Medium or heavy smoke for 42–74 days in the past year, compared to ≤27 days in the past year, was associated with a 30% higher prevalence of being unable to stop or control worrying more than half the time during the past two weeks (prevalence ratio: 1.30, 95% confidence interval: 1.03, 1.65).

CONCLUSIONS: Among adults in Oregon, selected symptoms affecting mental health were associated with extended durations of medium and heavy smoke. These findings highlight the burden of symptoms affecting mental health among adults living in communities affected by wildfires and wildfire smoke.

P-1050 Effect of Cadmium on the Association between Blood Pressures and Telomere Length: A Population-based Cross-sectional Study in Japan

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BACKGROUND AND AIM: Telomeres (TL) are repeated oligomers in the end of chromosome. TL shortening is associated with many pathophysiological outcomes, later in life such as cardiometabolic diseases and malignancy. However, not much is known regarding the role of heavy metals in TL shortening in association with increased blood pressure (BP). The objective of this study is to determine whether the association between high BP and TL shortening could be modified by the environmental cadmium (Cd) exposure.

METHODS: This study was a community-based cross-sectional study with 1047 individuals of age more than 19 years of 2019 Iwaki Health Promotion Project, Japan. A questionnaire survey, blood pressure measurement and blood sampling were performed by the trained research teams. Spot urine sample was also collected, and urinary Cd concentrations was measured, while Leucocyte TL was assessed by G-tail telomere hybridization protection assay. Regarding the statistical analysis, first, descriptive analysis was done using means, frequency, and percentage. Later, multivariate linear regression analysis was performed to evaluate the associations between urinary Cd concentration, BP/hypertension, and TL in relevance.

RESULTS: In high Cd concentration group, systolic blood pressure (SBP), diastolic blood pressure (DBP) and pulse pressure were significantly higher while TL was significantly shorter. By stratified multivariate regression models, telomere G-tail shortening was significantly associated with higher SBP (beta= -27.31; 95% CI: -50.71, -3.91, p=0.022) and DBP (beta= -49.33; 95% CI: -87.25, -11.42, p=0.011), only in high Cd concentration group. Similarly, TL was shorter among the hypertensive individuals (beta= -978.79; 95% CI: -1920.09, -37.51, p=0.042).

CONCLUSIONS: This study firstly identified that the negative associations of BP and TL were observed only in high Cd concentration group. These findings indicate that the associations of BP and TL could be mediated by environment Cd exposure.

KEYWORDS: Blood Pressure; Hypertension; Telomere; Cadmium; Japan

P-1054 The Effects of Minimally Processed and Ultra-Processed Food Intake on Cardiovascular Health based on the Korea National Health and Nutrition Examination Survey (KNHANES), 2013-2015

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Cardiovascular disease (CVD) is the leading cause of death worldwide. CVD risk factors are usually chronic, and a diet and lifestyle can be important determinants of cardiovascular health (CVH). Recently, the importance of dietary patterns rather than single nutrients has been emphasized for CVH. Consumption of processed food is increasing due to socio-economic changes in Korea. Although harmful substances may be added or created during the processing and packaging of foods, few studies evaluated the CVH effects of processed foods in Koreans. This study investigated the effect of minimally processed food (MPF) and ultra-processed food (UPF) intake on CVH. We used the data of 6,945 adults from the Korea National Health and Nutrition Examination Survey 2013–2015. Based on the CVH metrics (Life's simple 7), the CVH indicator was estimated as the sum (0–12) of the six (blood pressure, fasting plasma glucose, total cholesterol, body mass index, smoking status, physical activity) scores, and categorized as Inadequate (0–4), Average (5–8), and Optimum (9–12). MPF and UPF intake were estimated as the distribution of total energy intake using NOVA food classification. The mean (standard deviation) of MPF and UPF intake was 61.28(0.28) and 20.27(0.24) %kcal/day, respectively. After adjusting for all covariates, we found significant positive associations between MPF intake and CVH ($p<0.001$), while associations between UPF intake and CVH were significantly negative ($p<0.001$). Comparing the highest quartiles with the lowest of MPF intake, the adjusted odds ratio (OR) (95% Confidence interval) for Inadequate (compared with Optimum) was 0.36 (0.22–0.58), while UPF intake, adjusted OR was 2.63 (1.52–4.55). This study suggests that processed food intake was significantly associated with CVH in Korean adults. Public health policies are needed to promote choosing less processed foods to prevent CVD.

KEYWORDS: Cardiovascular Health, Minimally Processed Food, Ultra-Processed Food, Dietary, NOVA food classification

P-1055 Association of perfluoroalkyl substances (PFAS) with lipid trajectories in midlife women: the Study of Women's Health Across the Nation

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BACKGROUND AND AIM: Despite lipid-lowering effects of perfluoroalkyl substances (PFAS) observed in rodent models, PFAS have been associated with unfavorable blood lipid profiles in human populations. However, evidence from longitudinal studies in the general population is limited. We examined the association of serum concentrations of PFAS with longitudinal trajectories of blood lipids in the Study of Women's Health Across the Nation.

METHODS: We included 1143 women aged 45-56 years in 1999-2000. Concentrations of PFAS including linear and branched perfluorooctane sulfonic acid (n-PFOS and Sm-PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorohexane sulfonic acid (PFHxS) were measured in serum collected at baseline. Total, low-density lipoprotein (LDL), and high-density lipoprotein (HDL) cholesterol, and triglycerides were measured in blood annually or biannually during follow-up through 2016. Using latent class growth models (LCGMs), trajectories of each lipid were estimated based on the population data. The associations between PFAS and lipid trajectory classes were evaluated by multinomial log-linear models with latent class membership as outcomes and log-transformed PFAS as exposure.

RESULTS: Three distinct lipid trajectories (low, medium, and high trajectories) were identified. After adjustment for covariates, n-PFOS and Sm-PFOS were positively associated with higher LDL cholesterol [ORs (95% CI) for high vs. low trajectory per doubling of each PFAS: 1.28 (1.04, 1.56) and 1.24 (1.04, 1.48), respectively]. N-PFOS, n-PFOA, PFNA, and PFHxS were inversely associated with higher triglycerides [ORs (95% CIs) for high vs. low trajectory per doubling of each PFAS: 0.72 (0.55, 0.94), 0.65 (0.50, 0.84), 0.78 (0.62, 1.00), and 0.76 (0.62, 0.93), respectively]. The associations of PFAS with total or HDL cholesterol were insignificant.

CONCLUSIONS: Higher serum concentrations of selected PFAS were associated with a higher trajectory of LDL cholesterol and a lower trajectory of triglycerides. Further studies on the underlying mechanisms of the findings are warranted.

KEYWORDS: PFAS, dyslipidemia, midlife women

P-1056 Frequent Cannabis Smoking and Association with Prediabetes and Diabetes in Early Adulthood

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BACKGROUND: Cannabis use in young adulthood has been linked with increased risk of prediabetes later in life. However, many previous studies have only used fasting blood samples to determine risk for type 2 diabetes (T2D), which may not detect early changes in glucose homeostasis. The objective of this study was to determine the association between cannabis use and risk for prediabetes and T2D in young adults using several measures of glucose homeostasis, including an oral glucose tolerance test (OGTT).

METHODS: The Meta-CHEM study is a subset (N=84) of overweight and obese young adults aged 22–25 years from the Children's Health Study (CHS). Participants underwent a single clinical visit which included a 2-hour OGTT and questionnaire about cannabis smoking habits in the past year. Participants were classified as non-smokers, light cannabis smokers (smoke <once a week), and heavy cannabis smokers (smoke >once a week). Those smoking more than one cigarette in the past week were excluded from the study. Participants were classified as having prediabetes or T2D if they had a HbA1c >5.6%, fasting glucose >99 mg/dL, and/or 2-hour OGTT glucose >139 mg/dL. Logistic regression was used to assess the associations between cannabis smoking habits and metabolic outcomes after adjusting for age, sex, education, body mass index, Hispanic ethnicity, physical activity, and alcohol consumption.

RESULTS: 52 (62%) participants were non-diabetic, 28 (33%) had pre-diabetes, and 4 (0.05%) had T2D. 25 (30%) participants were nonsmokers, 47 (56%) were light cannabis smokers, and 12 (14%) were heavy cannabis smokers. The odds of having prediabetes or T2D was 7.3 times higher among heavy smokers (95% CI: 0.94, 7.7), and 1.5 times higher among light smokers (CI: 0.43, 6.0) than nonsmokers (P-value for trend = 0.03).

CONCLUSIONS: Cannabis use in overweight and obese young adults was significantly associated with risk of having prediabetes or T2D.

P-1062 Seasonal variations of hospitalizations for chronic rhinosinusitis by different endotypes

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BACKGROUND AND AIM: chronic rhinosinusitis (CRS) affects ~12% of the population and costs ~$30 billion each year in the US. A recent study reported winter and spring exacerbations of sinonasal symptoms among CRS patients; however, little is known about seasonal exacerbations by endotypes. This study aims to investigate seasonal variations of CRS hospitalizations among different inflammatory endotypes.

METHODS: CRS patients with different endotypes were identified in Mount Sinai electronic health records using a multi-layer CRS phenotyping algorithm integrating features such as encounter frequencies, surgeries, provider specialties and biomarkers, which was previously evaluated with high prediction performance (PPV=0.91). The patients with hospitalizations from 2003-2019 were included while patients with comorbidities of asthma or allergic rhinitis were excluded. Quasi-Poisson regression models were used to evaluate the associations between seasons and daily counts of CRS hospitalizations, adjusting for long-term temporal trend, day-of-the-week, daily temperature and PM2.5.

RESULTS: The counts of CRS hospitalizations were 32,194 in spring, 31,993 in summer, 32,077 in fall, and 30,584 in winter. for all CRS patients, no significant differences by season were detected. Among patients with nasal polyps (1615/7604), the highest risk of hospitalization was seen in spring (RR: 1.11; 95% CI: 1.06-1.17), followed by fall (RR: 1.06; 95% CI: 1.01-1.12), compared to winter. Similar patterns were observed in patients with blood eosinophil count > 300 cells/mcL (596/7604): increased risks of hospitalization were observed in spring (RR: 1.10; 95% CI: 1.04-1.16) and fall (RR: 1.08; 95% CI: 1.01, 1.14). In contrast, no differences by season were found for CRS patients without nasal polyps or with low eosinophil count.

CONCLUSIONS: Elevated risks of hospitalizations in spring and fall were only observed in CRS patients with endotypes related to eosinophilic type 2 inflammation. The high recurrence and refractory nature of these endotypes might be attributable to seasonal environmental factors.

KEYWORDS: rhinosinusitis, seasonal exacerbations

P-1066 Long-term air pollution, cardiometabolic multimorbidity, and genetic susceptibility: a prospective study in UK biobank cohort

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BACKGROUND AND AIM: Air pollution has been associated with individual cardiometabolic diseases (CMDs) including type II diabetes (T2D), ischemic heart disease (IHD), and stroke. However, little is known about their relationship with the risk of cardiometabolic multimorbidity (CMM) with at least two of the CMDs. Therefore, we aimed to explore whether the long-term exposure to PM2.5, PM10, PM2.5–10, NO2, and NOx were associated with the progression of CMM.

METHODS: We used data from 415,855 adults of UK Biobank that were free of any of the three CMDs at baseline enrollment with a median follow-up of 8.93 years. The Land Use Regression model was used to estimate the annual average ambient concentrations of PM2.5, PM10, PM2.5–10, NO2, and NOx. We employed a multi-state model to assess associations of five pollutants with different transitions of the CMM trajectory.

RESULTS: A total of 33,375 participants developed one CMD, 3,257 of which subsequently developed another one or two. We found that PM2.5, PM10, NO2, and NOx levels were associated with the transition from healthy to having the first cardiometabolic disease (FCMD), and then to CMM with relatively higher risks. for instance, per 5-μg/m¬3 increasing in PM2.5 levels, the FCMD risk increased 27% (95% CI: 1.20-1.34) and the subsequent CMM risk raised to 41% (95% CI: 1.18-1.68). Robust associations of a weighted air pollution index with the CMM trajectory were also observed. Participants with IHD first were more likely to develop CMM than those with T2D or stroke. Additionally, the observed relationship between air pollution and CMM could be enhanced by the genetic susceptibility of CMDs.

CONCLUSIONS: Air pollution is not only associated with the individual CMDs but also could expedite the progression of CMM, which could be modified by genetic predisposition.

KEYWORDS: air pollution, PM2.5, cardiometabolic multimorbidity, multi-state model, genetic susceptibility

P-1069 Lung Cancer Mortality Risks of Long-term Exposure to Particulate Matter in South Korean Adults Including and Excluding Lung Cancer Patients

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BACKGROUND AND AIM: Lung cancer is a major burden of disease worldwide. Many epidemiological studies suggested particulate matter(PM) as a prominent risk factor of lung cancer mortality. The risk also could differ depending on the cancer status related to susceptibility, but few studies focused on this difference. This study aims to compare the associations of PM2.5 and lung cancer mortality by including and excluding lung cancer patients in the Seoul Metropolitan Areas using a population-based nationwide cohort.

METHODS: From the National Health Insurance Services-National Sample cohort for 2002-2015, we selected the study population who carried out national screening during 2005-2007, aged over 30, were non-severely disabled, and had full address information every year. for our comparison, we created two sub-populations excluding and including those who had been diagnosed with lung cancer until the baseline in 2007. Lung cancer deaths were identified for 2007-2015, while individual-level long-term exposures to PM2.5 were assessed as 5-year average concentrations estimated from a previously-validated prediction model. We performed time-dependent Cox proportional hazards model to estimate hazard ratios (HRs) and 95% confidence intervals (95% CIs) per 10ug/m3 increase in PM2.5 adjusting for individual characteristics.

RESULTS: of 87,608 and 86,739 people including and excluding 867 lung cancer patients, 367 (0.42%) and 53 (0.06%) people died with lung cancer, respectively. Although all effect estimates were statistically non-significant, both groups showed positive effect estimates with similar magnitudes. (HR=1.60 [95% CI=0.24-10.76] and 1.55 [0.73-3.26] for the populations excluding and including lung cancer patients, respectively).

CONCLUSIONS: Our finding of positive risk estimates, although non-significant, between two populations including and excluding lung cancer patients suggest a possibility of consistent risks of dying with lung cancer attributed to PM2.5 regardless of susceptibility derived by cancer status. Further studies need to confirm our findings using extended populations.

KEYWORD
Particulate matter; Lung cancer; Mortality; Cohort

P-1073 Prenatal Maternal and Paternal Household Pesticide Exposure and Childhood Acute Lymphoblastic Leukemia (ALL): Does Exposure Comparison Modeling Influence Risk Estimates?

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BACKGROUND AND AIM: Household pesticide exposure is associated with increased risk of childhood acute lymphoblastic leukemia (ALL). We sought to investigate whether ALL risk estimates for pest-specific use categories (PSUC) change when using an analysis method (AM) versus a design method (DM) of multiple-PSUC confounding adjustment.

METHODS: Cases (N=1810) ages ≤15 were identified through Children's Cancer Group institutions between 1989-1993 and age-/sex-matched to community controls (N=1951). Household pesticide use during pregnancy (including the month prior) was collected via telephone interview. We used unconditional logistic regression to estimate ALL odds ratios (OR) for parental (mother/father/both) exposure to ten household PSUC (ant-cockroach-fly-bees, moths, spiders-mites, rodents, fleas-ticks, termites, slugs-snails, weeds, plants, or commercial exterminator). for AM, we assessed risk by including all PSUC covariates. for DM, each PSUC was assessed as a contrast with a zero-use comparison group (all ten-categories=zero) in adjusted models. All models were adjusted for known ALL risk factors which remained significant in final models (income, maternal age, and prenatal-vitamin use).

RESULTS: Pesticide use during pregnancy was prevalent (54% reported exposure to 2+ PSUC). PSUC bivariate correlations were all less than 0.25. Using AM, elevated ORAM (range: 1.41-1.55) were observed in three maternal and one paternal PSUC ($p<0.05$). All ORs increased when using DM (mother's range: 22.84%-62.50%; father's range: 22.34-60.50%). Risks were highest for termite (ORDM=3.98, 95% CI: 1.24-12.75, mothers) and spider-mite pesticides (ORDM=2.72, 95% CI: 1.29-5.75, fathers).

CONCLUSIONS: ALL risk estimates for exposure to ten pesticide use categories increased among both mothers and fathers when restricting exposure contrasts to a zero-use comparison group. These results are consistent with other studies reporting highest risks for termite pesticide exposure. This may reflect either a true risk difference or other characteristics among zero-use households which reduce risk. Investigation of potential mediation among pesticide classes appears warranted.

KEYWORDS: Acute Lymphoblastic Leukemia; childhood; pesticides; prenatal; case-control

P-1076 Dietary intakes of dioxins and polychlorinated biphenyls (PCBs) and breast cancer risk in 9 European countries

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BACKGROUND AND AIM: Dioxins and polychlorinated biphenyls (PCBs) are known to be mobile and highly persistent in the environment leading to a ubiquitous pollution. These chemicals are carcinogenic. Due to bioaccumulation along the food chain, the main route of exposure in general population is through diet. However, evidence in general population is lacking. The aim of the present study was 1) to estimate dietary intakes for 17 dioxins and 35 PCBs in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort 2) to investigate the association with breast cancer risk

METHODS: EPIC is a prospective cohort that has enrolled 520,000 adults recruited across 10 European countries. Dietary and lifestyle data have been collected at baseline through validated questionnaires. Dietary intake for 17 dioxins and 35 polychlorobiphenyls were assessed through a combination of EPIC food consumption data and food contaminant levels from the European Food Safety Authority monitoring programs. Association between intakes of dioxins and PCBs and breast cancer risk were estimated using multivariate Cox regression. Analyses included 318,607 women with 13,241 incident breast cancers (median follow-up: 14.9 years).
RESULTS
Exposure to dioxins, Dioxin-Like-PCBs (DL-PCBs), and Non-Dioxin-Like-PCBs (NDL-PCBs) estimated from reported dietary intakes were not associated with breast cancer incidence, with the following hazard ratios (HRs) and 95% confidence intervals for an increment of 1 SD: HRdioxins = 1.00 (0.98 to 1.02), HRDL-PCB = 1.01 (0.98 to 1.03), and HRNDL-PCB = 1.01 (0.99 to 1.03), respectively. Results remained unchanged when analyzing intakes as quintile groups, as well as when analyses were run separately per country, or separating breast cancer cases based on estrogen receptor status

CONCLUSIONS: This large European prospective study does not support the hypothesis of an association between dietary intake of dioxins and PCBs and breast cancer risk.

KEYWORDS: Breast cancer, dioxins, PCBs

P-1077 Dietary intakes of Dioxins and polychlorobiphenyls (PCBs) and mortality: EPIC cohort study in 9 European countries

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BACKGROUND AND AIM: Dioxins and polychlorinated biphenyls (PCBs) are persistent organic pollutants which are carcinogenic. The main route of exposure in general population is through diet. Cohort studies have reported inconsistent associations between these chemicals and mortality. The aim of the present study was 1) to estimate dietary intakes for 17 dioxins and 35 PCBs in the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort 2) to investigate the impact on mortality.

METHODS: EPIC is a prospective cohort that has enrolled 520,000 adults recruited across 10 European countries. Dietary intake of dioxins and PCBs was assessed combining EPIC food consumption data with European food contamination data provided by the European Food Safety Authority. Association between intakes of dioxins and PCBs and breast cancer risk and mortality were estimated using multivariate Cox regression. Analyses included 451,390 adults with 46,627 deaths (median follow-up: 17.4 years).
RESULTS
A U-shaped non-linear association with all-cause mortality for dietary intake of dioxins (Pnon-linearity<0.0001), DL-PCB (Pnon-linearity=0.0001), and NDL-PCBs (Pnon-linearity<0.01) was observed. for example, the hazard ratios (95%Confidance interval) for all-cause mortality obtained with the spline model was equal to 1.03 (1.02-1.05) for low intake of dioxins (7 pg TEQ/day), 0.93 (0.90-0.96) for moderate intake (25pg TEQ/day), while for high intake of dioxins (55pg TEQ /day) it was 1.03 (0.97-1.09). There was no association between intakes of dioxins and cancer mortality, but a U-shaped association was observed for intake of DL-PCBs and intake of NDL-PCBs and cancer mortality. Intakes of dioxins, DL-PCBs and NDL-PCBs was not associated with cardiovascular mortality.

CONCLUSIONS: This large European prospective study does support the hypothesis of a non-linear association between dietary intake of dioxins and PCBs and mortality which might be explained by endocrine disrupting properties

KEYWORDS: mortality, dioxins, PCBs

P-1079 Long-term atmospheric exposure to PM2.5 and PM10 and breast cancer risk in a case-control study nested in the French E3N cohort from 1990 to 2011

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BACKGROUND AND AIM: Breast cancer is one of the most prevalent cancers in women and its incidence increased in France during the past thirty years. Known risk factors include ageing, genetic, reproductive, anthropometric, and lifestyle factors. Since they fail to totally explain the observed risk increase, it has been hypothesized that some of this increase could be related to environmental exposure to endocrine disrupting chemicals. Among those, particulate matters (PM) have been pointed out by epidemiological studies due to their potential endocrine disrupting and carcinogen properties We aimed to estimate the association between PM2.5 and PM10 exposure and the risk of breast cancer among women in a case-control study nested in the French E3N cohort.

METHODS: Our study focused on 5222 invasive breast cancer cases diagnosed between 1990 and 2010 and 5222 randomly selected controls matched to cases. Assessment of PM2.5 and PM10 exposures were estimated by land use regression (LUR) models and assigned to the geocoded residential postal codes of participants for each year from recruitment 1990 through 2011. We estimated odds ratios (OR) and 95% confidence intervals (CI) for breast cancer using conditional adjusted logistic regression models.

RESULTS: We found a positive association between breast cancer risk and PM2.5 (OR=1.15, 95%CI: 1.00-1.31, per 10µg/m3) and PM10 (OR=1.07, 95% CI: 0.99-1.15). These results were confirmed estimating PM2.5 and PM10 exposure with a chemistry transport model (CHIMERE).

CONCLUSIONS: We found suggestive evidence of an association between air pollution exposure and incidence of breast cancer risk in French woman

KEYWORDS: Particulate matters, breast cancer, air pollution, risk factor, land use regression models

P-1081 Is Cadmium Exposure associated with Thyroid Cancer? A National Health and Nutrition Examination Survey Analysis

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INTRODUCTION
The increasing thyroid cancer incidence in the past few decades might be partially explained by the changing prevalence of environmental exposures, including to the heavy metal cadmium. Although cadmium is known to accumulate in the thyroid gland and has been labeled a carcinogen, an association between cadmium exposure and thyroid cancer has not been demonstrated to date. To assess this potential effect of cadmium exposure, this study investigated the association between blood cadmium levels and thyroglobulin antibodies (TgAb) as previous studies showed that positive TgAb predicts the presence of thyroid cancer in patients with thyroid nodules.

METHODS: Using the 2007-2012 National Health and Nutrition Examination Survey (NHANES), participants of 20 years and older without thyroid disease/ cancer with reported blood cadmium and thyroid function levels were included (n=7,383). TgAb and cadmium were log-adjusted. Models with cadmium as a log-adjusted continuous variable and divided into quartiles of exposure, adjusted for age groups, sex, race, BMI groups, alcohol, smoking, and iodine status were assessed using complex survey design.

RESULTS: The geometric mean of cadmium across all participants was 0.348 ng/mL (standard error (SE): 0.005). After adjustment, there was no significant association between continuous cadmium levels and TgAb (β=0.057, 95% confidence interval (CI): -0.004; 0.119. Models with cadmium divided into quartiles showed that though quartile 2 and 3 were associated with increased TgAb, this association was only significant for quartile 4 (β=0.193, 95% CI: 0.069; 0.317), versus quartile 1.

DISCUSSION
High levels of cadmium were positively associated with TgAb levels indicating that cadmium exposure needs to be further explored as a potential risk factor for thyroid cancer, especially given the widespread use and exposure of the general population to cadmium. This includes in-depth studies into the potential carcinogenic mechanism of cadmium on the thyroid gland.

P-1085 Household Cooking Fuel and Gallbladder Cancer Risk: A Multi-Centre Case Control Study in India

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BACKGROUND-AIM: Evidence from India, a country with certain unique cancer patterns (e.g., high incidence of gallbladder cancers (GBC)) and distinct risk exposures such as 'biomass burning' for cooking, may offer insights into the role of indoor air pollution in cancer etiology. We evaluated the association between household cooking fuel and GBC risk in a case-control study conducted among long-term residents (i.e., at least 10-years) of North-East and East Indian regions of Assam and Bihar, with high-risk for GBC and intense 'biomass burning'. We explored if these associations were accounted-for by healthy diet, fire-vents and 'daily exposure duration'.

METHODS: We recruited men and women aged 30-69 years from hospitals between 2019 and 2021, with newly diagnosed, biopsy-confirmed GBC (N=214) and unrelated controls frequency-matched by age, sex and region (N=166). Information about cooking fuel, lifestyle, personal and family history, socio-demographics and physical measurements was collected. We tested associations using multivariable logistic regression analyses adjusted-for confounders.

RESULTS: All participants (73.4% women) were categorised based on lifetime use and duration of predominant cooking fuel. Group-1: LPG for ≥20 years (13.5%); Group-2: LPG for 1-19 years with no concurrent biomass (15.6%); Group-3: LPG 1-19 years with concurrent biomass (12.9%); and Group-4: Biomass for ≥20 years (57.9%). Compared to group-1, GBC risk was higher in group-3 [OR=2.69, 95%CI (1.07-6.72)] and group-4 [OR=2.44, 95%CI (1.07-5.56)] but not in group-2 (p-trend=0.020). The associations strengthened in women-only analysis; and attenuated with high daily consumption of fruits-vegetables, but did not alter with fire-vents or 'daily exposure duration'.

CONCLUSIONS: With cautious interpretation for residual confounding, sample-size limitations and possible errors in exposure, the findings identify 'biomass burning' as a modifiable risk factor for GBC in high-risk regions. It further highlights 'clean fuel replacement' can mitigate the risk; and a healthy diet can partially reduce the risk.

KEYWORDS: Gallbladder cancer, biomass, India

P-1086 Lifetime Chronic Arsenic Exposure and Gallbladder Cancer Risk: Evidence from Endemic Regions of India

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BACKGROUND-AIM: Evidence for the associations of varying levels of arsenic in drinking water and digestive tract cancers is limited. Data from endemic regions of India, with high incidence of a rare digestive tract cancer-gallbladder cancer (GBC)- may explain the role of chronic arsenic exposure in cancer etiology. We evaluated the associations between arsenic levels in groundwater and GBC risk in a case-control study conducted among residents of Assam and Bihar (2019-2021), the two most arsenic-impacted states of India next to West Bengal.

METHODS: We recruited men and women aged 30-69 years from hospitals (73.4% women), with newly diagnosed, biopsy-confirmed GBC (N=214) and unrelated controls frequency-matched by age, sex and region (N=166). Information about lifetime residential history, lifestyle, personal and family history, socio-demographics and physical measurements was collected. Average-weighted lifetime arsenic concentration (AwLAC) was estimated extrapolating district-level groundwater monitoring data (2017-2018) and lifetime residential history. Accounting for confounders, tertiles of AwLAC (ug/L) was modelled in multivariable logistic regression analysis (Range: Zero-448.39; median (IQR): T1-0.45(0.0-1.19); T2-3.75(2.83-7.38); T3-17.6(12.34-20.54)).

RESULTS: A higher proportion of participants in the highest tertile of AwLAC compared to the lowest tertile consumed tube-well water for drinking (67.7 vs. 27.9%) with purification (45.2 vs. 25.5%) and reported unsatisfactory water-quality (49.2 vs. 25.0%). These participants in the highest and in middle tertiles of AwLAC were associated with an increased risk of GBC versus the lowest tertile with OR (95%CI) of 2.43(1.30-4.54) and 2.00(1.05-3.79) respectively (p-trend=0.007). The associations remained consistent with 'average-maximum arsenic concentration (any-time)' as exposure variable and in a sub-set with block-level AwLAC estimations.

CONCLUSIONS: Despite limitations of one-time arsenic levels, sample-size and potential residual confounding, the findings indicate chronic arsenic exposure, including low-levels, is a risk factor for GBC. Tackling 'arsenic pollution' may help reduce the burden of GBC and other health outcomes.

KEYWORDS: Gallbladder cancer, arsenic, India

P-1092 The relation between air pollution and multiple sclerosis hospital admission in Kerman, Iran using generalized additive models

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BACKGROUND AND AIM: Air pollution may affect the nervous system and act as an environmental risk factor in increasing multiple sclerosis (MS) incidence and attacks. The aim of this study was to investigate the possible relation between air pollution and MS in Kerman, Iran.

METHODS: This was an ecological study. Data on ambient air pollutants and meteorological variables were inquired from the Kerman Environmental Protection Agency and the Kerman Meteorology Organization, respectively. MS attack incidence data were obtained from Kerman's Shafa hospital MS Registry. Generalized Additive Models with lags were used for estimating Relative Risks.

RESULTS: During 2008 - 2020, 4913 attacks occurred among MS patients in Kerman which 3739 were female. The strongest relation between CO with MS attacks was seen in the under 30 year's group in lag 0 (RR = 1.6544), for O3 in the over 50 year's group in lag 5 (RR =1.0181), for SO2 in lag 5 (RR =1.0237), for NO2 in females in lag 0 (RR =1.0126), for PM10 in the over 50 year's group lag 3 (RR =0.9828) and for PM2.5 in lag 5 (RR = 0.9832).

CONCLUSIONS: Ambient CO,O3, NO2 and SO2 might be important risk factors for MS attacks in Kerman.

KEYWORDS: Air pollution, Multiple sclerosis, Environmental factors, Epidemiology, Kerman

P-1093 Association of copper exposure with prevalence of chronic kidney disease among a Chinese elderly population

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BACKGROUND AND AIM: Metal exposures are suspected to associate with the risk of chronic kidney disease (CKD). Copper (Cu) is an essential yet toxic trace element in humans. Epidemiological evidence on the association of Cu exposure with CKD remains inconsistent. We aim to investigate the association of blood Cu and its co-exposure to other metals with CKD.

METHODS: A cross-sectional study was conducted among 3,286 Chinese elderly adults in Zhejiang, China. The whole blood levels of Cu as well as other 10 metals were measured by inductively coupled plasma mass spectrometry (ICP-MS). CKD events were defined as the presence of albuminuria or <60 mL/min/1.73m2 estimated glomerular filtration rate (eGFR). Multivariable logistic regression and linear regression models were applied to assess the single-metal association of Cu with kidney function. The Bayesian kernel machine regression (BKMR) was used to estimate associations of the metal mixture with CKD.

RESULTS: In the logistic models, we observed a positive dose-dependent association of blood Cu with CKD prevalence after adjusting for multiple covariates. Positive linear dose-response associations with blood Cu were also found for CKD and negative for eGFR. The positive association between blood Cu and CKD risk also observed in BKMR model and stronger at lower level of manganese (Mn).

CONCLUSIONS: The whole blood level of Cu was remarkably associated with the prevalence of CKD and showed positive dose-response relationships in the elderly Chinese population. The toxicity of Cu on kidney function could be antagonized by the exposure of Mn. These findings have provided new clues of the potential roles of Cu in kidney health, and the needs to develop not only recommended intake but also safe limits for Cu.

KEYWORDS: copper, chronic kidney disease, whole blood, BKMR analysis, manganese.

P-1102 The synergistic effects of Particle Radioactivity (Gross Beta Activity) and PM2.5 on Cardiovascular Diseases Mortality

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BACKGROUND: Although the effects of fine particulate matter (particulate matter ≤2.5 μm aerodynamic diameter; $PM_{2.5}$) on cardiovascular diseases (CVD) morbidity and mortality are well established, little is known about CVD health effects of particle radioactivity (PR). In addition, there are still questions about which of the $PM_{2.5}$ physical, chemical, or biological properties are mostly responsible for its toxicity.

METHODS: We investigated the association between PR, measured as gross β-activity from highly resolved spatiotemporal predictions, and mortality for CVD, myocardial infarction, stroke, and all-cause non-accidental mortality in Massachusetts (2001-2015). Within both difference-in-difference (DID) approach and generalized linear mixed-effect model frameworks, we fit gross β-activity-alone, PM2.5 alone, gross β-activity&$PM_{2.5}$ models and examined the interaction between $PM_{2.5}$ and gross β-activity.

RESULTS: We found significant associations between gross β-activity/$PM_{2.5}$ and each mortality cause. Using the DID approach and adjusting for $PM_{2.5}$, we found the highest associations with MI (RR=1.16, 95% CI: 1.08, 1.24) and stroke (RR=1.11, 95% CI: 1.04, 1.18) for an IQR increase (0.055 mBq/m3) in gross β-activity. We found a significant positive interaction between $PM_{2.5}$ and gross β-activity, with higher associations between $PM_{2.5}$ and mortality at a higher level of gross β-activity. We also observed that the associations varied across age groups. The results were comparable between the two statistical methods with and without adjusting for $PM_{2.5}$.

CONCLUSIONS: This is the first study that, using highly spatiotemporal predictions of gross β-activity, provides evidence that PR increases CVD mortality and enhances $PM_{2.5}$ CVD mortality. Therefore, PR can be an important property of $PM_{2.5}$ that must be further investigated. Addressing this important question can lead to cost-effective air quality regulations.

KEYWORDS: cardiovascular disease; death; particle radioactivity; death

P-1105 Serum levels of per- and polyfluoroalkyl substances (PFAS) and aggressive prostate cancer risk in the Prostate, Lung, Colorectal and Ovarian Cancer Screening Trial

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BACKGROUND AND AIM: Per- and polyfluoroalkyl substances (PFAS) are group of chemicals commonly used in producing non-stick cookware, textiles, and firefighting foams. Exposure to PFAS is widespread in the U.S., with detectable serum levels in 98% of U.S. adults. Epidemiologic studies have suggested positive associations between PFAS and prostate cancer incidence and mortality, but the evidence is limited. We aimed to evaluate the association between pre-diagnostic serum concentrations of PFAS and aggressive prostate cancer risk in a large prospective study.

METHODS: We conducted a nested case-control study within the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial, which enrolled participants from 1993-2001 from 10 U.S. centers. Cases (N=750) included men diagnosed with aggressive prostate cancer (Stage III/IV or Gleason score≥8) at least 1 year after the blood collection. Male controls (N=750) were individually matched to cases based on age, race/ethnicity, study center, year of blood collection, and vial type. Pre-diagnostic serum concentrations of eight PFAS, including perfluorooctanoic acid (PFOA), perfluorooctane sulfonic acid (PFOS), and perfluorohexane sulfonic acid (PFHxS), were measured. Conditional logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (95% CIs) for the association between PFAS and prostate cancer risk.

RESULTS: Preliminary analyses showed null associations between serum PFAS concentrations and the risk of aggressive prostate cancer (e.g., PFOS: ORcontinuous = 0.93, 95% CI: 0.83-1.05). However, differences were observed by calendar year of blood draw, with later years (1998-2004) suggesting a positive association for some PFAS, such as PFHxS (ORcontinuous = 1.12, 95% CI: 1.01-1.46) and PFOS (ORcontinuous = 1.20, 95%CI: 0.97-1.49).

CONCLUSIONS: This large prospective study did not provide evidence for an association between serum concentrations of individual PFAS and aggressive prostate cancer risk; however, an association among men with blood draws during later years, where measured serum PFAS concentrations were higher, cannot be ruled out.

P-1110 Occupational Hazards among Health Workers in Hospitals of Mukalla City, Yemen

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BACKGROUND: Occupational health is a neglected public health issue among healthcare workers in developing countries like Yemen and they may expose them to various forms of hazards, which have had negative consequences on their wellbeing and performance at work.
Objective: The study aims at exploring the forms of occupational health hazards prevalence and methods to mitigate these hazards among Health Care Workers (HCW) in governmental hospitals in Mukalla city.

METHODS: It is a cross-sectional study conducted among health workers in the main hospitals in Mukalla city in Hadhramout province in eastern Yemen. The sample size is calculated statistically as 366 workers from different categories including doctors, nurses and lab technicians. A sample of 391 workers were selected randomly who were distributed to be representative and proportional to the size of each professional category.

RESULTS: The prevalence of biological hazards among the healthcare workers accounted for 298 (76%) whereas the non-biological hazards accounted for 306 (78%). The most prevalent biological hazards are needle prick injury (80%) followed by exposure to contact with contaminated material (75%), while the most frequent non-biological hazards are back pain (79%) followed by extra-time work (72%). In logistic regression age, gender and duration of work and professional category have significant association with exposure of health workers to biological hazards while only gender is the only variable associated with non-biological hazards.

CONCLUSIONS: There is a high prevalence of occupational hazards (biological and non-biological) among health workers in hospitals of Mukalla city. A prevention and infection control and patient safety programs are highly recommended in Mukalla hospitals to save health workers and patients.

P-1122 The impact of farm animal exposures on Campylobacter jejuni antibody levels in rural agricultural communities of Iowa, USA

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BACKGROUND AND AIM: Campylobacter infections transmitted primarily through improperly cooked meat are the leading bacterial cause of diarrhea worldwide. How exposures to farm animals and animal waste (e.g., through occupational contact or residential proximity to animal feeding operations [AFOs]) contribute to infections has been relatively understudied.

METHODS: We measured antibodies against Campylobacter jejuni using an enzyme-linked immunosorbent assay in participants from Iowa in the Biomarkers of Exposure and Effect in Agriculture study (n=304 farmers; n=146 non-farming controls from similar communities). Participants self-reported occupational animal contact within the past year. We used a statewide database of permitted AFOs that included animal counts standardized by animal size and manure production to characterize the intensity of AFO exposure within 5km of participants' residences. We performed linear regressions of log-transformed optical density units (ODs) for immunoglobulin (Ig) A, G, and M antibody levels in relation to occupational animal and low/high AFO exposures, using non-farming controls with low AFO exposure (n=96) as the referent group. We adjusted for age, season, and other potential confounders. We further examined antibody levels by occupational contact with specific animal types.

RESULTS: Occupational animal contact was associated with elevated IgA and IgG OD levels in those with low AFO exposure (geometric mean ratio [95% confidence interval]; IgA:1.34[1.07-1.67]; IgG:1.34[1.13-1.57]) as well as those with high AFO exposure (IgA:1.48[1.12-1.95]; IgG:1.34[1.09-1.65]). Antibody levels were higher in farmers raising poultry (IgA:2.20[1.03-4.71]; IgG:2.11[1.35-3.32]), swine (IgA:1.52[1.04-2.22]; IgG:1.50[1.17-1.94]), and dairy cattle (IgG:1.65[1.18-2.31]), particularly for IgG levels in those who reported spending time in poultry (2.29[1.25-4.19]) or swine (1.63[1.25-2.12]) confinements within the past month. We found no significant relationships between occupational animal contact and IgM or AFO exposure alone and any antibody levels.

CONCLUSIONS: Occupational animal contact may be a stronger determinant of C. jejuni exposure than residential proximity to AFOs in agricultural communities.

KEYWORDS: Campylobacter, animal exposures

P-1125 Health Risk Assessment for Pest Control Workers Using Biocidal Products after COVID-19 Outbreak: A Comparison of EU and US

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After the COVID-19 outbreak, the workloads of disinfection have remarkably increased. As disinfectants are harmful to human, health risk assessment of disinfection workers is needed to ensure their safety. However, the acceptable operator exposure level (AOEL) for most disinfectants are not established. Moreover, the method of calculating the AOEL varies across the countries. This study aims to identify the health risks of disinfection workers based on two different risk assessment methods of EU and US after the COVID-19 outbreak.

We surveyed 533 disinfection workers to identify exposure patterns of disinfectants. The inhalation and dermal exposure were calculated based on different work types. The AOEL was calculated and compared using the EU and US methods. The health risks of workers are determined by hazard index based on whether the exposure exceeds AOEL.

Workers used 53 chemicals from 175 biocidal products, and only 34 chemicals (65%) had AOEL. 17 Chemicals with absorption factors for each route or AOEL were selected for risk assessment. When compared the estimated AOEL was calusing EU and US methods, only 2 (4%) were the same. The result of health risk assessment showed 10 (19%) were exceed 1 (acceptable level) using EU method, while 9 (17%) were exceed 1 using US method.

This study performed the health risk assessment of disinfection workers based on EU and US methods after the COVID-19 outbreak. Only 65% had an AOEL, and health risks of workers were differd according to risk calculation methods of EU and US. Given the increasing use of biocides after the COVID-19 outbreak, AOEL need to be established for health risk assessment of workers.

Biocides, Risk assessment, Reference dose, AOEL, COVID-19, pest control worker

This study was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2021R1F1A1063967).

P-1126 The Effectiveness of Occupational Health and Safety Management System (OHSMS) Application in the R.O.K. Navy and Improvement Plan

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The Republic of Korea Navy is applying OHSMS (Occupational Health and Safety Management System) to 3 type of units(repair, engineer, ammunition) for workplace safety. Several studies have argued that implementing OHSMS in the workplace is problematic and that measures are needed to improve its effectiveness. Moreover, since OHSMS focuses on corporate safety, it should be adequately reviewed when applied to the military, but studies have not been conducted yet. This study aims to confirm the effectiveness of the Navy's OHSMS and to identify improvement measures.

We surveyed 599 members of the units to determine the impact of OHSMS on unit safety conditions (systems, management, activities). for engineer and ammunition units, the safety conditions were compared according to whether they were OHSMS certified. In the repair units without the OHSMS non-certified comparator, the safety conditions according to the OHSMS application period were compared. To confirm the improvement plan of OHSMS, we surveyed 29 Naval OHSMS experts and analyzed IPA (Importance-performance Analysis) and AHP (Analytic Hierarchy Process).

There was no statistical difference in the level of safety conditions according to whether OHSMS was applied and the operating period, so the effectiveness of OHSMS could not be confirmed. The Navy's OHSMS needed gradual improvement due to its low overall performance. In particular, there was an urgent need for improvement in 1.organizational roles, responsibilities, 2.consultation and participation of members, 3.support, and 4.capabilities. Among them, consultation and participation of members was rated the most as a result of importance weight analysis through AHP.

In this study, the effectiveness of the Navy's OHSMS has not been confirmed, and consultation and participation of members was a vital improvement factor. This can be used as basic data for the practical application of OHSMS in the Navy in the future.

KEYWORDS: OHSMS, Military Health and safety, Navy, IPA, AHP

P-1133 Occupational injuries and extreme heat: An analysis from the hot desert climate of Kuwait

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BACKGROUND–Temperatures in the harsh summer times of Kuwait commonly exceed 40°C during the day. Since 2015, a ministerial law banned employees from working under the sun (11am to 4pm) from June 1st to August 31st of every year. The vast majority of the affected employees are migrant workers in outdoor jobs such as construction and hospitality.
AIM–We assessed the risk of occupational injuries associated with outdoor extreme hot temperatures during the summertime ban period in Kuwait.
METHODS–We collected daily occupational injuries that are reported to the Ministry of Health's Occupational Health Department for five years from 2015 to 2019. We examined counts of occupational injuries during the same summertime ban period from June 1st to August 31st in each of the five years. We fitted generalized additive models with a quasipoisson distribution in a time series design. A 7-day moving average of daily mean temperature was modelled with penalized splines adjusted for relative humidity, time trend and day of the week.
RESULTS–During the June-August summertime ban, the daily average temperature was 39.4°C(±1.8°C). There were 7.2, 7.6 and 9.4 reported injuries per day in the summer months of June, July and August, respectively. The exposure-response relationship was S-shaped with a decrease in risk at very extreme hot temperatures. Compared to the 10th percentile of summer temperatures in Kuwait (37.4°C), the average day with a temperature of 39.4°C increases the risk of injury by 1.38-fold (95% confidence intervals: 1.30-1.46). Similarly, temperatures of 40°C and 41°C were associated with relative risks of 1.41 (1.33-1.49) and 1.34 (1.21-1.49), respectively. The risks leveled off at 42°C (relative risk 1.21; 0.93-1.57).
CONCLUSIONS–We found substantial increases in occupational injury risk from extremely hot temperatures despite the summertime ban in Kuwait. Calendar-based rather than heat- or risk-based regulation may be inadequate to provide occupational protections for migrant workers.

P-1134 Evaluation of lung inflammation from daily exposures to fine and ultrafine particulate matter in a trade school

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BACKGROUND - Daily short-term exposure to ambient fine particles ($PM_{2.5}$; < 2.5 µm) in the general environment has been related to acute respiratory effects such as respiratory symptoms and inflammation, emergency room visits for respiratory conditions and mortality. Although exposure is higher in trade/occupational settings, acute respiratory effects of daily exposures remain unexplored.
OBJECTIVE - To evaluate the association between daily exposures to fine particles ($PM_{2.5}$) and Ultrafine Particles (UFP; < 0.1 µm), and fractional exhaled nitric oxide (FeNO), a relevant indicator of lung inflammation, in two trade settings from a construction school.
METHOD - A repeated-measure panel study was carried out on students performing welding and bricklaying activities (n=30). $PM_{2.5}$ and UFP concentrations were measured daily (area measurements with direct-reading instruments) and fractional exhaled FeNO were measured two times per day, pre-work and post-work, for 5 consecutive days. Mixed GLM models were used to assess associations.

RESULTS: - Daily geometric mean exposure to $PM_{2.5}$ from welding and bricklaying activities were respectively 183 µg/m³ (σg=3.5) and 90.8 µg/m³ (σg=1.6). Daily geometric mean UFP concentrations for these activities were 106,000 (σg=1.6) particles/cm³ and 4,400 (σg=1.7) particles/cm³. Combining bricklaying and welding activities, for a 10,000 particles/cm³ increase in UFP, there was a 0.2 ppb (95%CI: 0.05-0.3) increase in FeNO inter-day. There was also a tendency for a small increase in FeNO (0.2 ppb; 95%CI: -0.06 - 0.5) per 100 µg/m³ of $PM_{2.5}$. Further analyses will be performed with additional participants and stratified by occupational trade.
CONCLUSION - Bricklaying and welding activities expose workers daily to $PM_{2.5}$ and UFP that may contribute to recurrent pulmonary inflammation and impair respiratory health.

KEYWORDS: particulate matter, occupational exposures, short-term exposure, pulmonary inflammation.

P-1136 Association between night shift work and different categories of non-occupational physical activity in the Shahedieh cohort study

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INTRODUCTION
Shift-work has been associated with physical and mental health problems. This study aimed to explore the association between shift-work and different non-occupational physical activities in Iranian adults enrolled in the Shahedieh cohort study (SCS).

METHODS: The participants were men enrolled in the SCS (2014-2017). Different categories of non-occupational physical activity were quantified by the International Physical Activity Questionnaires and presented (as continuous by the metabolic equivalent of task [MET]), and dichotomous for defining sedentary/non-sedentary behavior based on MET). Shift-work status was asked through a face-to-face interview. The odds of having a sedentary behavior associated with shift-work, and the association between shift-working and daily MET of each category of activity were modeled using adjusted logistic regression and multiple linear regression (presented as odds ratio [OR] and beta respectively, with 95% confidence intervals [CI]). Results are based on the models adjusted for hypothesized confounders.

RESULTS: of 5132 men, 13.3% were shift-worker (more educated, and younger than non-shift-workers). Shift-workers had 20% lower odds of sedentary behavior compared to non-shift-workers (OR = 0.80; 95% CI: 0.60-0.98). Shift-working was associated with higher daily MET related to time spent on driving (ß=0.88; 95%CI: 0.75: 1.02), walking (ß=0.45; 95%CI: 0.33: 0.56), and light manual handling (ß=0.06; 95%CI: 0.01: 0.10), but the negative association with heavy sports activities (ß=-0.01; 95%CI: -0.03:-0.00), time spent on house cleaning (ß=-0.03; 95%CI: -0.06:-0.01), watching television (ß=-0.11; 95%CI: -0.20:-0.02), and working with a computer (ß=-0.13; 95%CI: -0.21:-0.06).
CONCLUSION: Shift-workers spent more energy on non-occupational activities than non-shift-workers, especially on outdoor activities. It implies the importance of considering shift-working as a possible effect modifier in the studies with hypotheses related to exposures linked to residing in outdoor environments such as the use of greenspace and ambient air pollution.

KEYWORDS: Shift-Work, Physical Activity, Occupational Health

P-1138 Occupational heat exposure and prostate cancer risk: a pooled analysis of case-control studies

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BACKGROUND AND AIM: Heat exposures occur frequently in many indoor and outdoor occupations. In our previous work, we observed some evidence for a positive association of occupational heat exposure and breast cancer risk. Here we seek to examine potential associations with prostate cancer risk in a large multi-country study.

METHODS: We performed a pooled analysis of data from 3,175 histologically confirmed prostate cancer cases and 3,529 frequency-matched controls from studies in three different countries, Spain, France, and Canada. The Finnish job exposure matrix, FINJEM, was used to apply estimates of occupational heat exposure to the lifetime occupational history of participants. Three main exposure indices were used: ever vs. never exposed, lifetime cumulative exposure (heat stress years) and duration of exposure (years) with a lag period of 5 years. We estimated odds ratios (ORs) and 95% confidence intervals (CIs), using conditional logistic regression models stratified by 5-year age groups and study and adjusted for potential confounders.

RESULTS: A total of 32% of cases and 33% of controls were classified as being ever occupationally exposed to heat. Highest heat exposed occupations included ore and metal furnace operators, firefighters, and bakers. We found no evidence for an association of ever occupational heat exposure and prostate cancer risk (OR 0.92; 95% CI 0.83, 1.03). There were also no associations observed in the highest categories of lifetime cumulative exposure or duration, and there was no evidence for a trend. Results did not change when stratifying by Gleason scores. When analysing the Spanish case-control study separately using a Spanish job exposure matrix developed for local working conditions, some odds ratios were elevated, though results were imprecise.

CONCLUSIONS: Findings from this pooled study have provided no strong evidence for an association between occupational heat exposure and prostate cancer risk.

KEYWORDS: prostate cancer, occupational exposures, heat, pooled analysis

P-1141 Oxidative stress in workers in indoor and outdoor environments

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BACKGROUND AND AIM: Occupational exposure to particles can raises important health issues for exposed workers. High concentrations of these particles can be found in a variety of occupational and environmental contexts, depending on the type of scenario, whether indoors or outdoors working environments. The aim of this study was to investigate the role that indoor and outdoor environments play in altering oxidative stress levels in workers in relation to the exposure to particles.

METHODS: 162 subjects were recruited; 62 were subjects working in indoor environments (13 employed in the handling of waste, 49 not exposed to this task), 100 subjects working in outdoor environments (65 employed in sweeping of the streets, 35 not exposed to this task). Oxidative stress was assessed by analysing 15-F2t-isoprostane concentrations in urine samples of all the recruited subjects. In addition, a questionnaire was administered to each to obtain information among which gender, age, BMI, smoking habits. Statistical analyses were done using SPSS and 15-F2t-Isoprostane concentrations were compared each other using the Kruskal-Wallis test.

RESULTS: The analyses showed a higher level of 15-F2t-Isoprostane in workers working in indoor environment when compared to workers working in outdoor environments ($P<0.01$). Furthermore, the employed in the handling of waste in indoors show the highest level of 15-F2t-isoprostane ($P<0.05$) while, subjects not exposed to this task in indoors, place themselves at intermediate 15-F2t-isoprostane levels.

CONCLUSIONS: This study shows that higher levels of oxidative stress were found in both exposed and unexposed workers in indoor environments. Analysing the responses to the questionnaire, we also controlled tobacco smoke exposure because it may have a role in the redox imbalance recorded in workers.
These results hypothesise that particle dilution in outdoor environments may be directly associated with lower levels of oxidative stress in the workers.

KEYWORDS: occupational exposure, environmental exposure, particle emissions.

P-1152 Contribution of Occupational Risk Factors to Lifespan Inequalities across Socio-Occupational Groups in France

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BACKGROUND AND AIM: Occupational risk factors can mediate the effect of socioeconomic status on mortality; however, the reduction in social disparities in mortality that could be achieved by modifying employment and working conditions has been under-studied. Our aim was to quantify the role of occupational risk factors (lack of job control, job insecurity, and unemployment; and in men only: occupational physical activity (OPA)) in producing socio-occupational inequalities in lifespan among the French population.

METHODS: We reviewed the literature on 75 occupational risk factors and selected four of them with a robust all-cause mortality effect size. We used the Health and Career Path survey (SIP-2006) to estimate differential exposures in each French socio-occupational group (SOG) by sex. Then, using the life tables published by The French Institute of Statistics and Economic Studies and developing a method based on population attributable fractions, we estimated loss in life expectancy attributed to workplace exposures by SOG and sex.

RESULTS: Based on life expectancy estimated at age 35 and depending on SOG, from one to three years of life lost for men, and from 0.6 to two years for women are attributed to a combination of high OPA, low job control, job insecurity, and unemployment compared to those who had low OPA, high job control, no concerns about job loss and were employed. The difference in life expectancy at age 35 between senior executives and manual workers would have been reduced from 6.3 to 4.4 years for men and from 3.2 to 2.2 years for women if socio-occupational exposures had been set at the theoretical minimum level for the four risk factors.

CONCLUSIONS: Our results, although based on a limited number of workplace factors due to large data gaps, show that improving employment and working conditions would substantially lessen social inequalities in life expectancies.

P-1153 Agricultural pesticide exposure assessment in Latin America and the Caribbean. A review study

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The region of the Americas shows heterogeneous agricultural labor scenarios. The measurement of pesticide exposure is a challenge and a necessary requirement for prevention. A systematic review of the scientific literature was carried out to identify the methodologies to assess exposure to agricultural pesticides in Latin America and the Caribbean (LAC).

PubMed, Scielo and Lilacs were searched (January 2010 and April 2021). Keywords selected: "pesticides", "occupational exposure", "farmers", "pesticide exposure" and "Latin America". Eighty-two publications from 11 countries were retained for analysis. The exposure assessment methods (EAMs) were analyzed, categorized into direct and indirect, analyzing the productive context of the study, according to whether it belonged to the formal or informal economy.

Most of the articles analyzed came from Brazil (41%) and Colombia (23%); cross-sectional designs predominated (64%). The term "exposure" appears as a scattered concept in the literature; 67% of the studies evaluated exposure to pesticides in informal agricultural contexts where family work was identified, in contrast to formal productive environments where it was not reported. The types of EAMs used were: a) indirect methods (58%): surveys, index construction, and measurement of environmental parameters (water and soil); b) direct methods (15%): biomarkers in blood, urine and other human matrices; c) combination of both methods (27%). Significant differences were identified between the EAMs used (direct/indirect) according to the context (formal/informal) of study (p= 0.016). The use of indirect EAM was more frequent in productive contexts of the informal economy.

Pesticide exposure assessment in LAC is heterogeneous and implemented through methods that are difficult to identify and classify. In the informal economy, family work prevails and there is less knowledge about pesticide exposure. Knowledge about these processes is necessary to reduce risks and vulnerabilities.

Pesticides - exposure - assessment methods - agriculture

P-1161 Physically strenuous work in a hot climate and reduced kidney function in the sugarcane industry

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BACKGROUND AND AIM: Sugarcane workers are reportedly at increased risk of chronic kidney disease of non-traditional causes (CKDnt). Most prior studies have focused on a limited number of jobs, yet suspected risk factors of hot climatic conditions and strenuous work are common across jobs in the industry. We examined whether reduced kidney function was associated with working in hot climatic conditions and strenuous work in an industry-wide program.

METHODS: Data from a surveillance program at a Nicaraguan sugarcane planation 2015-2020 involved random collection of blood, allowing estimation of glomerular filtration rate (eGFR), for all employees. Any eGFR <=60 mL/min/1.73m2 was classified as low. Jobs were classified by whether outside and whether physical labor. Analyses restricted to males <50 years old who were non-supervisors. Multivariable models were used to estimate adjusted odds ratios (aORs) and 95% confidence intervals (CIs) comparing odds of low eGFR for working outside with inside, either adjusted for or stratified by age. Among outside workers, odds of low eGFR for each laborer job was compared with non-laborers. Models also adjusted for repeated measures and harvest period.

RESULTS: Analyses included 2,884 employees with 6,144 eGFR measures. There was no difference in odds of low eGFR between working outside or inside. Among those outdoors, laborers had increased odds of low eGFR compared with non-laborers (OR=3.58, (95% CI 1.85-6.94)). The association was most pronounced among those <=30 years old (OR=11.89 (95% CI 1.68-84.03)). Jobs of seed loader, seeder/reseeder, and weeder had >=6-fold increased odds of low eGFR relative to outdoor non-laborers (p<0.001).

CONCLUSIONS: Physically strenuous jobs in combination with working outside in a hot climate was consistently associated with reduced kidney function, with strongest influence in younger workers. Our results suggest more research should evaluate younger workers in physically demanding jobs to help identify prevention strategies.

KEYWORDS: CKDnt, heat, work

P-1174 Assessment of Portuguese firefighters' lifestyle: results from an online survey

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Firefighters are an occupational group exposed to multiple agents, such as heat, fatigue, noise and chemical substances. Exposure to these agents can have a severe impact on their health. In addition, lifestyle behaviors may also affect their health and well-being. As such, the aim of this study was to assess health-related lifestyle behaviors in Portuguese firefighters.

Data was obtained via an online survey using an adapted version of the FANTASTIC Lifestyle Assessment Inventory that included questions on relationships with family and friends, physical activity, nutrition, tobacco and alcohol consumption, sleep and stress, career and shifts. The access link to the survey was disseminated through collaboration with the National School of Firefighters. Data was collected between April 24th and May 27th 2021.

From the 861 participating firefighters, the majority were men and had less than 40 years old. Around half were married and were firefighters for more than ten years. The majority referred to have people to talk about important things and to give and receive affection. Regarding physical activity the majority did not practice physical activity in the professional context. Only a quarter reported to have healthy eating habits and the majority reported the consumption of high-calorie foods and to be exceeding their ideal weight. More than a third reported smoking and around 16% reported driving motor vehicles after consuming alcohol. Around 40% reported to consume more than 3 caffeine drinks per day. Around a tenth reported to almost never have good quality sleep and only around 78% reported to have difficulties sleeping. About 43% didn't have capacity to manage stress in their day to day life and about 57% were not able to relax in their free time. Around 40% reported not being happy with their work and a third reported to do periodic medical exams.

P-1177 Impact of the COVID-19 pandemic on a pilot sample of women enrolled in the SEMILLA birth cohort study

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BACKGROUND AND AIM
Project SEMILLA, a community-engaged epidemiological cohort study, assesses environmental, occupational, and social factors among pregnant women in a major flower-growing region of Ecuador and the impact of these factors on child growth and development. The COVID-19 pandemic has presented an unprecedented challenge to the implementation of the SEMILLA study. This paper presents the results of a pilot qualitative study with SEMILLA participants examining the impact of the pandemic on their lives.

METHODS: SEMILLA follows pregnant women and their infants up to 18 months of age. Methods include obtaining prenatal urine samples, maternal and neonatal blood samples to assess thyroid hormone levels, and data on working conditions, environmental exposures (home/work), stress, social support, maternal health, socioeconomic factors, and infant neurodevelopment, growth and nutritional status. During the initial months of the pandemic, SEMILLA researchers observed important impacts of the pandemic in the study region and with enrolled participants. In April 2020, we conducted phone interviews with currently enrolled participants (n=11), to assess the experiences of the participants during this time. Semi-structured questions addressed concerns and worries as well as changes in activities (work/home) due to the pandemic.

RESULTS: Emergent themes from qualitative analysis include economic insecurity and job loss, food insecurity and food access issues, strained relationships at home including interpersonal violence, responsibilities at home including additional burdens for participants regarding schooling of other children. Fear and worry about being infected, about having a healthy pregnancy and a healthy delivery and baby, and fear of family members being infected prevailed.
CONCLUSION: Findings from this pilot study helped shape protocol changes and revisions to capture the new reality for women participating in SEMILLA during the pandemic; changes which are critical for understanding the impact of the COVID-19 pandemic on the lives of pregnant women and their families in the region.

P-1178 The environmental risk factors of birth defects in Iraq

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BACKGROUND AND AIM: Ever since the war started in 2003, Iraqi doctors have reported an increase in the birth of children with congenital anomalies. According to them, the rise in incidence has been attributed to war-related heavy metal pollution e.g. from depleted uranium and white phosphorus. As the war impeded quality research, the current post-conflict situation has allowed renewed space for quality research. The aim of the study is to assess to what extent exposure to environmental pollution might be associated with the incidence of congenital anomalies in Iraq.

METHODS: We conducted a case-control study in Fallujah, a heavily bombarded city, comparing 50 parents of children with birth defects and 50 parents of children without birth defects. We used a questionnaire to comprehensively document environmental exposure and history of residence of each couple. Further, we complemented the interviews with biomonitoring through hair analysis of parents on heavy metals using ICP-MS. In addition, we took soil samples of the city of Fallujah using grid sampling and compared this to a control city in northern Iraq which has been less bombarded. We used Stata to statistically assess the differences in case and control groups regarding exposure and heavy metal concentrations, correcting for confounders like age and socio-economic status.

RESULTS: Comprehensive data analysis will take place in the summer 2022. Our preliminary results already point to a striking discrepancy between the occupation of the fathers of children children with congenital anomalies and the fathers of the control group. The fathers of the birth defects are more often construction workers, working on houses often damaged or levelled by war.

CONCLUSIONS: Having a child with a congenital anomaly in Iraq might be associated with paternal environmental exposure, possibly through epigenetic pathways.

KEYWORDS: Congenital anomalies, Military pollution, Teratogenicity, Epigenetics, Exposome

P-1179 Associations between traffic-related air pollutants and preterm birth in a North Carolina birth cohort, 2003-2015

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BACKGROUND AND AIM: Preterm birth (PTB; <37 weeks completed gestation) is associated with exposure to fine particles and ozone, but less is known about associations with nitrogen dioxide (NO_2) and other traffic-related air pollutants, such as benzene, toluene, ethylbenzene, and xylene (BTEX). We estimated the associations between PTB and NO_2, with and without adjustment for BTEX.

METHODS: We examined the associations between PTB and gestational exposure to NO_2 in a North Carolina singleton birth cohort (N=1,367,507) from 2003-2015. Daily 8-hour max NO_2 concentrations from a hybrid-model with a spatial resolution of 1km² were aggregated to census tracts and linked to residential address at delivery, then averaged across each week of pregnancy. We obtained annual average ambient concentrations for BTEX for census tracts from the 2011 National Air Toxics Assessment. Modified Poisson regression models with robust errors were used to estimate risk differences (RD(95% CIs)) per 10-ppb increase in NO_2, adjusted for gestational parent marital status, race/ethnicity, age at delivery, Medicaid status, month of conception, and BTEX.

RESULTS: The median (IQR) NO_2 across each day of pregnancy was 15.0(10.2) ppb and 1.6(1.1) ppb for BTEX. The associations between NO_2 and PTB were of similar magnitude across each week of gestation. RDs with and without adjustment for BTEX varied. RDs per 10-ppb increase NO_2 exposure during each week of gestation ranged from -7(95% CI: -14,1) in weeks 17 and 23 to 0(-6,5) in week 36 per 10,000 births, respectively. Adjusting for BTEX, RDs ranged from 19(13,25) in week 36 to 36(27,44) in week 24 per 10,000 births, respectively.

CONCLUSIONS: While the association between NO_2 exposure and PTB were generally null across each week of gestation, when adjusting for BTEX, we observed a consistent pattern of increased risk of PTB with NO_2 exposure.

KEYWORDS: air pollution, preterm birth, nitrogen dioxide, reproductive outcomes

P-1181 Associations between Repeated Measures of Urinary Phthalate Metabolites with Hormones and Timing of Natural Menopause: The Study of Women's Health Across the Nation

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BACKGROUND AND AIM: Studies on phthalate metabolites and sex hormones during the menopausal transition are limited and have yielded conflicting results. We aimed to examine the associations of phthalate metabolites with hormones including estradiol, testosterone, follicle-stimulating hormone (FSH), sex hormone-binding globulin (SHBG), anti-Müllerian hormone (AMH), and the timing of natural menopause.

METHODS: We examined 1,189 midlife women from the Study of Women's Health Across the Nation aged 45-56 years in 1999-2000 who had complete information on phthalate metabolites and hormones while not receiving hormone therapy. Urinary concentrations of 12 phthalate metabolites were repeatedly measured in 1999-2000 and 2002-2003. Hormones were measured at the same time points. Linear mixed-effect models were used to calculate percent differences (%D) and 95% confidence intervals (CIs) in serum concentrations of estradiol, testosterone, FSH, SHBG, and AMH per doubling in urinary phthalate metabolites. Cox proportional hazards models were used to calculate hazard ratios (HRs) and 95% CIs of natural menopause per doubling increase in urinary phthalate metabolites.

RESULTS: We observed significant associations of phthalate metabolites with lower testosterone concentrations: mono (7-carboxy-2-methyloctyl) phthalate (MCOP) (%D: -2.08%, 95% CI: -3.66, -0.47), and mono-n-butyl phthalate (MnBP) (%D: -1.99%, 95% CI: -3.82, -0.13), after adjusting for multiple comparisons with false discovery rates < 5%. Lower AMH concentrations were also found with higher MECPP (%D: -14.26%, 95% CI: -24.10, -3.14), MEHHP (%D: -15.58%, 95% CI: -24.59, -5.50), and MEOHP (%D: -13.50%, 95% CI: -22.93, -2.90). No associations were observed for other hormones or timing of natural menopause.

CONCLUSIONS: These results suggest that exposure to phthalates may affect circulating levels of testosterone in midlife women. Exposure to phthalates may also dimmish the ovarian reserve. Given the endocrine-disrupting role of phthalates, future studies are warranted to evaluate their impact on health outcomes among midlife women.

KEYWORDS: Phthalates; endocrine-disrupting chemicals; hormones; midlife women; menopause

P-1185 Urinary concentrations of non-persistent endocrine disrupting chemicals and fecundability in a preconception cohort study

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BACKGROUND AND AIM: Non-persistent endocrine-disrupting chemicals (EDCs) are found in consumer products including personal care products, plastics, and cleaning supplies. EDCs can affect hormonal pathways involved in reproduction. We examined prospectively the association between urinary concentrations of select non-persistent EDCs and fecundability, the per cycle probability of conception.

METHODS: We used data from PRESTO and Snart Foraeldre.dk, web-based preconception cohort studies that recruited female participants who were aged 21-45 years, residents of North America or Denmark, and trying to conceive without fertility treatment (2013-2019). Participants completed a baseline questionnaire and follow-up questionnaires every 8 weeks for up to 12 months. A subset of 207 participants residing in Boston, Massachusetts (n=119), Detroit, Michigan (n=18), or Aalborg, Denmark (n=70) provided urine samples during in-person clinic visits. We measured concentrations of 7 phenols, 4 parabens, triclocarban, 15 phthalate metabolites and 2 phthalate alternative metabolites using on-line solid-phase extraction-high-performance liquid chromatography-isotope dilution-tandem mass spectrometry. We used proportional probabilities models to estimate fecundability ratios (FR) and 95% confidence intervals (CI), adjusting for potential confounders.

RESULTS: Concentrations of some non-persistent EDCs were associated with reduced fecundability. The adjusted FR for the highest vs. lowest quartile of benzophenone-3 was 0.53 (95% CI: 0.28-0.99), with evidence of a monotonic association. Bisphenol S and 2,5'-dichlorophenol, and ethyl paraben concentrations were also associated with reduced fecundability. Among phthalate metabolites, mono-ethyl phthalate (highest vs. lowest quartile: FR=0.71, 95% CI: 0.45-1.12), monocarboxyoctyl phthalate (highest vs. lowest quartile: FR=0.71, 95% CI: 0.44-1.14), and the non-phthalate plasticizer cyclohexane-1,2-dicarboxylic acid monohydroxy isononyl ester (≥0.6 µg/g creatinine vs. <limit of detection: FR=0.59, 95% CI: 0.37-0.95) were associated with reduced fecundability.

CONCLUSIONS: Biomarkers of some non-persistent EDCs were associated with reduced fecundability. Future analysis of additional urine specimens in these cohorts will enable examination of chemical mixtures on fecundability.

KEYWORDS: endocrine-disrupting chemicals, fecundability, fertility, phenols, phthalates

P-1188 Association between maternal $PM_{2.5}$ exposure and gestational diabetes mellitus in Tokyo, Japan

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INTRODUCTION
Recent epidemiological findings suggested that $PM_{2.5}$ exposure is a risk factor for diabetes, and the association between $PM_{2.5}$ and glycaemia and insulin resistance provided the biological mechanistic support. Based on these, a hypothesis has been proposed that maternal exposure to $PM_{2.5}$ contributes to the development of gestational diabetes mellitus (GDM). However, the association between $PM_{2.5}$ and GDM was controversial, and there was limited evidence regarding exposure to specific components of $PM_{2.5}$. In this study, we examined the association between the $PM_{2.5}$-GDM association in the Asian population.

METHODS: From 2013 to 2015, we had permission to the Japan Society of Obstetrics and Gynaecology, and obtained the data on all mothers who delivered births after 22 gestational weeks at 39 cooperating hospitals in 23 Tokyo wards from the Japan Perinatal Registry Network database. We collected fine particle on a filter each day at one fixed monitoring site, and analysed carbon and ion components of $PM_{2.5}$. The average concentrations of $PM_{2.5}$ and its components over the 3-month before pregnancy, the first trimester (0-13 gestational weeks) and the second trimester (14-27 weeks) were calculated, and assigned to each mother. We applied a multi-level logistic regression analysis.

RESULTS: of the 83,319 mothers (mean age at delivery = 33.7 years), the proportion of GDM was 4.8%. The median concentration of total $PM_{2.5}$ over the first trimester was 16.1 (interquartile range (IQR) = 3.6) $\mu g/m^3$. When we simultaneously included three exposure windows of total $PM_{2.5}$, only exposure over the first trimester was associated with GDM (odds ratio per IQR = 1.09, 95%CI = 1.02-1.16). for specific components, we observed the association between exposure to carbon constituents over the first trimester and GDM.
CONCLUSION: Our findings provided the additional evidence for the association between maternal exposure to $PM_{2.5}$ and GDM.

KEYWORDS: fine particle, chemical element, GDM,

P-1196 Exposure to ambient sulfur dioxide during gestation and risk of preterm birth among people in North Carolina, 2003-2014

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BACKGROUND AND AIM: Coal-fired power plants are major contributors of ambient sulfur dioxide (SO2) air pollution. Epidemiological literature suggests an adverse association between SO2 exposure during gestation and preterm birth (PTB; <37 weeks completed gestation). PTB is strongly associated with infant mortality and increased risk for later life morbidities. We investigated associations between SO2 and PTB in North Carolina and evaluated whether the associations were modified by race/ethnicity.

METHODS: We assembled a retrospective, administrative cohort of singleton births in North Carolina from 2003-2014. We used USEPA CMAQ data to assign SO2 gestational exposures to eligible births for the entire pregnancy and trimesters. We used multivariable generalized linear regression to estimate risk differences (RD (95%CI)) per 1-ppb increase in SO2, adjusted for gestational parent education, marital status, and season of conception. Multi-pollutant models were additionally adjusted for criteria air co-pollutants (CO, O3, PM2.5, NO2).

RESULTS: The median SO2 across exposure windows was ~3.5 (IQR: 4) ppb. The overall baseline risk for PTB was 8800 per 100,000 live births. When stratified by race/ethnicity, the baseline risk for PTB was 12200, 7900, and 7100 per 100,000 live births among non-Hispanic Black, non-Hispanic white, and Hispanic births, respectively. Regardless of exposure window, SO2 was adversely associated with PTB with the strongest associations observed for the entire pregnancy period. RDs per 1-ppb increase in SO2 averaged across the entire pregnancy were 133.5 (95%CI: 117.0, 149.9) and 195.7 (171.6, 219.7) per 100,000 live births for single- and multi-pollutant models, respectively. for multi-pollutant models, we observed similar RDs for non-Hispanic Blacks (239.4 (200.7, 278.2)) and non-Hispanic whites (211.5 (182.4, 240.7)) with smaller RDs for Hispanics (119.8 (80.7, 158.9)).

CONCLUSIONS: Across exposure windows, the results for our adjusted single- and multi-pollutant models showed adverse associations between SO2 and PTB, with some evidence of effect measure modification by race/ethnicity.

KEYWORD: PTB

P-1197 Ambient temperature and preterm birth risk in New York City: A time-series analysis

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BACKGROUND AND AIM: Recent studies suggest an association between daily variation in ambient temperature during pregnancy and preterm birth (PTB). Our objective is to examine the short-term effects of heat and cold on PTB risk from 2008 to 2016 in New York City (NYC).

METHODS: We applied quasi-Poisson regression with distributed lag nonlinear models to estimate the cumulative relative risk (CRR) of daily counts of spontaneous PTB (<37 weeks gestation) and outdoor temperature, and to estimate the fraction of PTBs attributable to temperature, by season, using NYC Vital Statistics birth records and National Weather Service daily temperature data at LaGuardia airport. Models were adjusted for within-season trends and daily number of pregnant people at risk for preterm delivery. Heat and cold were defined as the 95th versus 50th percentile of maximum temperature during the warm season and 5th versus 50th percentile of minimum temperature during the cold season, respectively. Maternal race/ethnicity was assessed for effect modification.

RESULTS: Our analysis consisted of 38,593 spontaneous PTBs. Heat was not associated with PTB during the warm season [CRR: 0.98 (95% CI: 0.92, 1.05)]. There was a nonlinear association between cold and PTB. During the cold season, the CRR was 1.08 (0.99, 1.17) for cold up to three days before delivery (lag 0-3). The estimated fraction of PTBs attributable to cold was 9.3% (-0.6%, 17.4%), which corresponded to 81 (-2, 154) cold-attributable PTBs over the 9-year study period. Among non-Hispanic Blacks, the CRR was 1.20 (1.04, 1.39) for cold over lag 0-3 days, and an estimated 23.2% (10.3%, 34.3%) of non-Hispanic Black PTBs, equivalent to 69 (29, 105) PTBs, were attributable to cold.

CONCLUSIONS: Heat had no measurable impact. Cold potentially increased risk of PTB. Our finding for the impact of cold on non-Hispanic Black PTBs warrants additional research.

KEYWORDS:
Preterm birth
Temperature

P-1199 The association of congenital heart defects with prenatal exposure to air pollutants: An umbrella review

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BACKGROUND AND AIM: for idiopathic congenital heart defects (CHD), air pollution during fetal development is a potential risk factor. However, findings of previous epidemiological studies and consequently of systematic reviews, have been mixed. We aimed to synthesize and evaluate the extant evidence on associations between gestational exposure to air pollutants and CHD subtypes, using a systematic review of reviews approach ("umbrella review").

METHODS: We systematically searched PubMed, Embase, and Epistemonikos for published and unpublished systematic reviews. The search was supplemented by the use of internet search engines and hand-searching of reference lists. The Risk of Bias in Systematic Reviews ("ROBIS") tool was used to evaluate included systematic reviews.

RESULTS: We identified ten systematic reviews, including eight meta-analyses. Moderately strong evidence for an increased risk of coarctation of the aorta following prenatal exposure to NO2 was provided by five reviews, which reported statistically homogeneous pooled odds ratios of 1.10 to 1.20 (95% confidence interval range: 0.99 to 1.41). Also, there was limited evidence for positive associations between SO2 and coarctation of the aorta, PM10 and atrial septal defects, NO2 and pulmonary artery and valve anomalies, and for both, PM2.5 and NO2 and Tetralogy of Fallot. Findings for other pollutant-CHD associations were inconsistent. Based on the ROBIS tool, a high or unclear risk of bias rating was assigned to eight out of ten reviews.

CONCLUSIONS: Beyond the increased risk of coarctation of the aorta following exposure to NO2, a clear pollutant-outcome pattern was not identified. These incoherent findings may partly be explained by differences in methods used across the reviews (e.g., inclusion criteria) as well as between individual studies (e.g., exposure and outcome assessment methods). Further establishment of and adherence to systematic review methods for environmental exposures and children's health may improve the validity and consistency of future systematic review findings.

P-1201 Metabolome-wide association study of prenatal exposure to air pollution and adverse birth outcomes in the Atlanta African American Maternal-Child cohort

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BACKGROUND: African Americans (AA) are disproportionately exposed to high air pollution and elevated risks of adverse birth outcomes, while the underlying mechanisms are still largely unknown. We aimed to address the knowledge gaps by investigating the associations between air pollution exposures, perturbations in maternal metabolome, and preterm (PTB) and early term birth (ETB).

METHODS: In 288 participants from the Atlanta AA Maternal-Child cohort we performed metabolomic profiling using high-resolution mass spectrometry with liquid chromatography in early gestation serum samples. Using spatiotemporally-resolved machine learning models, we estimated individual residential exposures to nitrogen dioxide, fine particulate matters, and ozone during the first trimester and one-year before conception. Using the meet-in-the-middle approach, we investigated whether the maternal metabolic perturbations associated with air pollution are also associated with PTB and/or ETB.

RESULTS: After quality control, 13,980 and 11,106 metabolic features were extracted from HILIC and C18 chromatography columns, respectively. In the HILIC column, 95 and 190 metabolic features were associated with at least one air pollutant (false positive discovery corrected $q<0.2$) during the first trimester and one-year before conception, respectively, while 3 and 4 features were associated with PTB and ETB. From C18, 243 and 48 features were associated with first trimester and one-year before conception exposures, while 5 and 1 were associated with PTB and ETB, respectively. Perturbations in purine metabolism were associated with both air pollution and PTB in pathway enrichment analysis. Using chemical annotation, we confirmed inosine and inosinic acid, which were enriched in purine metabolism and involved in DNA damage and repair.

CONCLUSIONS: The findings suggested a potentially critical role of purine metabolism in connecting air pollution exposures and PTB, which may support future development of sensitive biomarker and targeted interventions to reduce adverse birth outcomes induced by air pollution exposures.

KEYWORDS: Air pollution, preterm birth, metabolomics, meet-in-the-middle, molecular mechanisms

P-1203 Cadmium may affect testosterone levels as a hormone-like disruptor in adult males

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BACKGROUND AND AIM: Sex hormones play an important role in human health, and sex hormone disorders can cause a series of relevant consequences. Cadmium is ubiquitous in the environment, while little is known on the relationship between cadmium exposure and sex hormones in adult males. The purpose of this study is to explore the potential association between cadmium exposure and serum testosterone as well as serum testosterone to serum estradiol ratio (T/E_2) among Chinese adult males.

METHODS: Adult male aged ≥18 years old who participated in China National Human Biomonitoring program from 2017 to 2018 were surveyed. Blood cadmium, urine cadmium and urine cadmium adjusted with creatinine were measured, serum testosterone and serum estradiol were measured, and T/E_2 was calculated. Multiple linear regression models were used to analyze association of cadmium exposure with serum testosterone and T/E_2 in adult males.

RESULTS: Among Chinese adult males ≥ 18 years old, the weighted geometric means (95% CI) of blood cadmium, urine cadmium and urine cadmium adjusted with creatinine levels were 1.23 (1.12, 1.35) μg/L, 0.63 (0.56, 0.71) μg/L and 0.53 (0.47, 0.59) μg/g, respectively. The geometric means (95% CI) of serum testosterone and T/E_2 were 18.56 (17.92, 19.22) nmol/L and 143.86 (137.24, 150.80). After adjusting for all covariates, tertiles of cadmium exposure were positively associated with log-transformed serum testosterone (lgT) (all Ptrend < 0.05). Moreover, tertiles of cadmium exposure were positively associated with log-transformed serum testosterone to serum estradiol ratio [$lg(T/E_2)$] (all Ptrend < 0.05).

CONCLUSIONS: In Chinese adult males, cadmium exposure may affect serum testosterone and T/E_2 as a hormone-like disruptor.

KEYWORDS: testosterone, testosterone to estradiol ratio, China National Human Biomonitoring, cadmium.

P-1211 Urinary biomarkers of inorganic arsenic exposure, inorganic arsenic metabolism, and birth weight in Tacna, Peru, 2019

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BACKGROUND AND AIM: Arsenic exposure during pregnancy has been related to adverse birth outcomes such as low birthweight. The province of Tacna is located in southern Peru. It is characterized by elevated arsenic levels in drinking water, nonetheless, its mean birth weight is greater than the country's average. Thus the aim of this study was to evaluate the effect of urinary arsenic species on birth weight in Tacna pregnant women in 2019.

METHODS: 160 pregnant women ≤24 weeks were recruited from different health centers of Tacna, and followed up to delivery. First morning voids of urine were sampled in the second and third trimester; they were encouraged to avoid consuming seafood at least three days before sampling. Arsenic species (AsIII, AsV, MMA, DMA and arsenobetaine) were analyzed by ICP-MS. Birth outcomes data was obtained from the clinical records of Hospital Hipólito Unanue. Inorganic arsenic exposure was measured as the sum of inorganic and methylated species in urine, adjusted for arsenobetaine. Inter-individual differences in arsenic toxicokinetics were measured using the principal components of the relative concentrations of inorganic, methylated, and dimethylated arsenic in urine. We considered inorganic arsenic exposure, and arsenic toxicokinetics, individually and with an interaction term as predictors of birth weight.

RESULTS: Mean birth weight was 3618.71g, while mean tAs, iAs, MMA and DMA were 41.62, 3.52, 2.49, and 35.61µg/L, respectively. The estimate of the beta coefficient for the association of arsenic with birth weight was 0.21 (95%CI -2.31;2.74) for inorganic arsenic, while for arsenic toxicokinetics it was11.88 (95%CI -22.35;46.12), and for the interaction between them was 0.33 (95%CI -0.83;1.49).

CONCLUSIONS: In this population, we did not find evidence that arsenic exposure affected birth weight. This null association could be due to study limitations as sample size or factors not measured.

KEYWORDS: Arsenic, Birth weight, Peru, Latin America

P-1215 Residential greenspace and birth outcomes in the Chemicals in Our Bodies cohort, San Francisco, California

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BACKGROUND AND AIM: Evidence from prior studies is inconclusive regarding the association between residential proximity to greenspace and birth outcomes. Psychosocial stress increases the risk of adverse birth outcomes and may modify associations with greenspace. We evaluated the effects of residential greenspace on gestational age and fetal growth and whether they differed with experiences of psychosocial stressors.

METHODS: Chemicals in Our Bodies is a demographically diverse prospective cohort of pregnant people in San Francisco, California (N = 815). Three measures of greenspace were constructed using the birth parent's residential address and secondary data: normalized difference vegetation index (NDVI) and percent green or blue space within 500m, and Euclidean distance to the nearest park. We used linear regression to estimate the association between quartiles of greenspace measures, completed gestational week and birthweight for gestational age z-scores (BWz), adjusting for parental age, education, smoking, parity, food insecurity, race/ethnicity, nativity, traffic within 500m, and noise. We stratified by perceived stress and depression.

RESULTS: Comparing quartile 1 vs. 4, NDVI and percent green and blue space were not strongly associated with differences in mean completed weeks of gestation (β=-0.05 [95% confidence interval -0.57, 0.48] and 0.09 [-0.39, 0.57]) or mean BWz (β=-0.07 [-0.35, 0.21] and -0.11 [-0.36, 0.14]). Low NDVI (quartile 1 vs. 4), low percent green and blue space (quartile 1 vs. 4), and high distance to nearest park (quartile 4 vs. 1) were weakly associated with reductions in gestational age among parents reporting high levels of stress or depression (β=-0.73 [-2.83, 1.36], -1.31 [-3.47, 0.85], and -0.47 [-1.92, 0.99] weeks). Associations were slightly stronger when we considered 1km buffer distances, but still not statistically significant.

CONCLUSIONS: We did not find strong evidence that residential greenspace is associated with reductions in gestational age or birthweight in this study population.

KEYWORDS: nature, urban, perinatal

P-1217 Maternal Vitamin D levels modify the association between pre-pregnancy Triclosan exposure and neonatal anogenital distance

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BACKGROUND AND AIM: Triclosan (TCS) is widely used as an antibacterial agent in consumer products and is suspected of having endocrine-disrupting properties, limited epidemiological studies examined the developmental effects of TCS exposure before pregnancy. Meanwhile, Vitamin D deficiency is a global health issue and the consequences of vitamin D deficiency during pregnancy cannot be underestimated. We investigated association between maternal TCS exposure and anogenital distance (AGD) and other genital measurements in infants at birth after considering maternal vitamin D status.

METHODS: Participating 258 women were recruited from Shanghai Birth Cohort between 2012 and 2013. TCS concentration was quantified from maternal urine samples collected before pregnancy. Vitamin D was measured by maternal plasma during early pregnancy. A standardized measure of AGD was obtained in infants at birth. Anogenital index (AGI) was defined as AGD divided by weight (kg) at examination. Effect modification by Vitamin D was estimated.

RESULTS: We found no significant associations between maternal TCS and AGD in male or female infants. However, after stratified by maternal plasma vitamin D status (deficiency (<20ng/ml) versus insufficiency or sufficient (≥20 ng/mL)), per unit increase in maternal lg concentration of TCS, AGI increased on average by 0.23 in male infants (95% confidence interval (CI): 0.02, 0.45) when maternal VD concentration was lower than 20 ng/mL. No significant association was observed between maternal TCS and AGD in male infants when VD concentration is higher than 20 ng/mL. Furthermore, no significant association of maternal TCS with AGD or AGI was found in female infants.

CONCLUSIONS: These data support the hypothesis that maternal TCS exposure at environmental levels can adversely affect male reproductive development especially when maternal Vitamin D status is deficiency. Further prospective cohort studies with longitudinal measures are warranted to confirm these findings.

KEYWORDS: triclosan, Vitamin D, anogenital distance, anogenital index, birth cohort

P-1219 Proximity to restorative environment: Perception vs. Reality

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Proximity to restorative environment is known to be associated with health outcomes. for couples who are trying to conceive, neighborhood environment may affect reproductive function. This study assessed the association of duration of infertility with self-perceived and actual restorative environment, respectively. We analyzed the data of 500 participants of PRegnancy and UrbaN Environment (PRUNE) study, which is an ongoing mobile-based prospective cohort study of infertile couples. We assessed the perceived proximity to park and blue space (river, lake, stream, etc.) and actual environment of home address (NDVI within 500m and distance to blue space). Most of participants were women (64.9%) and 37 years and beyond (50.8%). Duration of infertility was ≥ 2 years in 167 (40.3%). Mean distance to blue space was shorter when the participants reported proximity of blue space, while mean NDVI was not different according to the perceived proximity. When adjusting for age and body mass index, perceived proximity to blue space was associated with lower risk of infertility for ≥ 2 years (relative risk = 0.78, 95% confidence interval: 0.62, 0.97). Associations of infertility for ≥ 2 years with perceived proximity to park, NDVI, and actual distance to blue space were close to null. In a sample of infertility couples living in urban area, we observed a positive association between perceived proximity to blue space and duration of infertility which was not replicated for actual distance. To optimize reproductive health, interventions to improve perceived environment would be necessary.

P-1227 Health risk assessment of phthalates exposure through lipid peroxidation in children with asthma

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BACKGROUND: Global prevalence of asthma in children has dramatically increased in the past decades. Recent studies revealed that Taiwanese children are still exposed to considerable amounts of phthalates after the 2011 incident of phthalates-tainted food products. Up-to-date findings indicated that phthalates may increase malondialdehyde (MDA), a lipid peroxidation marker, in asthma patients. The role of phthalates in the increased occurrence of childhood asthma through lipid peroxidation remains unclear. We want to assess the association between phthalates exposure and MDA in children with asthma.

METHODS: We recruited 125 children with clinically-diagnosed asthma and around 98 controls from Taipei Hospital since January 2019. Participants provided urine specimen and questionnaire. Eleven phthalate metabolites and MDA were analyzed by liquid chromatography tandem-mass spectrometry (LC-MS/MS) and ELISA, respectively. Pearson correlation and related statistical method were used to analyze the relationship of urinary phthalate metabolites or MDA in asthma children.

RESULTS: BMI in asthma children was significantly higher than that in control (p=0.005) whereas no similar phenomena was observed for other demographic factors. Mother ever had cigarette smoking in pregnancy and current burn incense at home in the case group were marginally significantly higher than those in control. Meanwhile, the median levels of urinary MEHP (72.18 v.s 68.81 ng/mL), MiNP (28.75 v.s 23.51 ng/mL), and MDA (6.87 v.s. 5.86) in asthma children were higher than those in control, though failed to reach statistical significance. Age was positively correlated with urinary MDA (r=0.159, p=0.018) and MEP (r=0.13, p=0.058). Urinary MEP was highly correlated with the other phthalate metabolites which indicated a common exposure source.
CONCLUSION: Certain phthalates may increase lipid peroxidation markers in asthma children.

KEYWORDS: Phthalate metabolites; lipid peroxidation; asthma.

P-1232 Psychosocial stress exposure and lung function in childhood: effect modification by child sex

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BACKGROUND: Psychosocial stress is linked with adverse childhood respiratory outcomes, but the influence of exposure timing and sex differences has not been completely elucidated.
Aim: Examine the association between prenatal and concurrent maternal stress and lung function in children and explore sex differences.

METHODS: Analyses included 283 mother-child pairs from the Programming Research in Obesity, Growth, Environment and Social Stressors cohort in Mexico City. Lung function was tested at ages 8-11 years and age, height and sex adjusted z-scores were estimated for FEV1, FVC, FEF25-75% and FEV1/FVC. Psychosocial stress during pregnancy and concurrent to the lung function was assessed using the Crisis in Family Systems Revised questionnaire. Exposure to stress during both periods was categorized as low prenatal-low current, low prenatal-high current, high prenatal-low current and high prenatal-high current. Effect modification by sex was examined with interaction terms and in stratified analyses. Models were adjusted for maternal age and education at enrollment and concurrent report of a smoker in the home.

RESULTS: We found no associations between stress and lung function in our main models. There was a significant interaction between stress and sex in relation to FEV1 and FVC z-scores. In stratified models, low prenatal-high current stress was associated with lower percent predicted FEV1 in males (β: -0.509, 95%CI [-0.94, -0.08]) but not in females (β: 0.11, 95%CI [-0.35, 0.56]) when compared to low prenatal-low current stress. Low prenatal-high current stress was associated was associated with lower percent predicted FVC in males (β: -0.56, 95%CI [-0.96, -0.16]) but not in females (β: 0.31, 95%CI [-0.16, 0.78]) when compared to low prenatal-low current stress.

CONCLUSIONS: Time varying associations between stress children's lung function are sex-dependent and greater in males. Results highlight the importance of considering the emotional environment and the susceptibility by sex.

KEYWORDS: stress, respiratory, children's health

P-1234 Incident COPD and Its Disparities Associated with Low-concentration Air Pollution in American Older Adults: A National Cohort Analysis

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BACKGROUND: Risk of air pollution-related Chronic Obstructive Pulmonary Disease (COPD) and corresponding disparities associated with air pollutant exposures are less clear at concentrations below current National Ambient Air Quality Standards (NAAQS).

METHODS: We constructed a national U.S. population-based cohort of those aged ≥65 from the Medicare Chronic Conditions Warehouse (2000-2016), combined with high-resolution population-weighted air pollution datasets, to investigate the association of long-term exposure to low-level air pollution and incident COPD. We defined four distinct low-exposure sub-cohorts comprised of individuals who were always exposed to low-levels of: (1) PM2.5 (annual mean ≤12-μg/m³), (2) NO2 (annual mean ≤53-ppb), (3) O3 (warm-season mean ≤50-ppb), and (4) low levels of all three air pollutants. We further tested effect modification by individual- and community-level characteristics.

RESULTS: of the 18.8 million individuals, 64.2% (12.1-million), 99.3% (18.7-million), 75.4% (14.2-million), and 54.1% (10.2-million) were always exposed to low-level annual PM2.5, NO2, O3, and all three air pollutants, respectively. Among the single-pollutant low-exposure cohorts, a 5-μg/m³ increase in PM2.5, 5-ppb increase in NO2, and 5-ppb increase in warm-season O3 were associated with an increase in COPD rate ranging between 9-12%, 1-2%, and 11-12%. Associations with each individual pollutant were also significant in the cohort exposed to low-levels of all three pollutants. There was evidence of linearity in concentration-response relationships for NO2 and O3 at levels below the current NAAQS. for PM2.5, there was a sharp increase in risks at levels above 10-μg/m³. Further, individuals in communities with lower household incomes, lower educational attainment, and lower numbers of active doctors experienced higher risk.

CONCLUSIONS: Our study suggests exposures to low-level PM2.5, NO2, and warm-season O3 were associated with incident COPD. Subgroup differences suggest individual and contextual factors contributed to COPD disparities under effects of air pollutant exposures.

KEYWORDS: Chronic obstructive pulmonary disease (COPD), air pollution, low concentration, disparities

P-1241 Associations between exposure to ambient fine particulate matter (PM2.5) and prevalence of chronic respiratory disease in Senegalese adults: Results from the demographic health survey (DHS) 2011

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BACKGROUND AND AIM: The prevalence of chronic respiratory conditions such as asthma and chronic bronchitis has been increasing in Africa over the past decade. Recent studies show that exposure to air pollution is associated with increased risk of chronic respiratory diseases. However, very few studies have been conducted in sub-Saharan Africa using estimated measurements of particulate matter (<2.5 um; PM2.5). The aim of our study is to investigate the association between PM2.5 exposure and prevalence of asthma/chronic bronchitis in Senegal.

METHODS: This study used data from the Demographic and Health Survey (DHS 2011 collected from October 2010 to April 2011 throughout Senegal. Using their geographic location of survey clusters, we linked data for 19,843 Senegalese adults to remotely sensed and gridded annual concentrations of PM2.5. We estimated covariate-adjusted associations of PM2.5 with prevalence of self-reported asthma/chronic bronchitis using logistic regressions while accounting for survey weights and clustering. We also evaluated potential effect modification by gender.

RESULTS: The prevalence of asthma/chronic bronchitis was 2.99%.The adjusted association between PM2.5 and asthma/chronic bronchitis prevalence was 1.03 (95%CI: 0.99 – 1.06). The association between PM2.5 and asthma/chronic bronchitis significantly differed by gender (p=0.008) with stronger associations in males (prevalence odds ratio [pOR] = 1.09; 95%CI: 1.03-1.15), compared to females (pOR = 1.01; 95%CI: 0.97 – 1.05).

CONCLUSIONS: Our results suggest that increasing levels of ambient exposure to PM2.5 puts individuals at a higher risk for chronic respiratory diseases, especially men even when taking possible indoor exposures to air pollutants into account. These findings have significant policy implications and should be built upon in future research using more refined measures of PM and prospective designs.

KEYWORDS: Air pollution, PM2.5, Asthma, Chronic bronchitis, Chronic respiratory diseases, Senegal, Sub-Saharan Africa

P-1243 Effects of smoking cessation on respiratory health and related chronic diseases

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OBJECTIVE: This study aims to understand the effects of smoking cessation on respiratory symptoms and chronic diseases.

METHODS: From 2015 to 2018, 1583 male residents aged 18-70 from 7 counties of Huaihe River Basin were selected as participants. Logistic regression model was used to analyze the effects of smoking or smoking cessation on respiratory symptoms and chronic diseases.

RESULTS: The smoking rate was 49.3%, and the smoking cessation rate was 26.3%. The prevalence rates of respiratory symptoms and chronic diseases was various 3.3% to 20.0%. Compared with current smokers, never smokers had a lower risk of cough, chronic cough, expectoration, chronic expectoration, wheezing, shortness of breath, and bronchial asthma/chronic bronchitis (OR=0.25~0.62), and smokers who quit smoking had a lower risk of cough (OR=0.63), but a higher risk of shortness of breath, hypertension, coronary heart disease/stroke, and diabetes than current smokers (OR= 1.44~2.40). Smokers who quit smoking due to illness had a higher risk of wheezing, shortness of breath, bronchial asthma/chronic bronchitis, coronary heart disease/stroke, and chronic gastritis/gastrointestinal ulcer (OR=1.85~2.62), while smokers who quit smoking for other reasons had lower risks of cough (OR=0.52), chronic cough (OR=0.20) and expectoration (OR=0.53), but higher risks of hypertension (OR=1.54) and coronary heart disease/stroke (OR=2.20) than current smokers. All the above were statistically significant (P<0.05).

CONCLUSIONS: Smoking cessation without illness could reduce the risk of respiratory symptoms and chronic diseases in rural male of Huaihe River Basin. Therefore, effective strategies are needed to encourage current smokers to quit.

KEYWORDS: Huaihe River Basin; smoking cessation , rural male; respiratory symptoms; chronic diseases

P-1244 Environmental impact of microbes on Awba dam: it's effect on ecotourism

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BACKGROUND AND AIM: Recreational use of water is often given inadequate consideration and care. This is of particular concern as the recreational use of water is becoming popular in Nigeria. Many of these are increasingly contaminated by domestic sewage and industrial effluents. This study is therefore relevant in assessing the environmental impact of microbes on ecotourism in Awba dam.

METHODS: A total of nine water (n=9) and soil (n= 9) samples were collected at entry, middle and the end of the Awba dam for heavy metal analysis and microbial assay. Total aerobic plate count, Isolation and characterization of strains was
done using standard methods. The presumptive E. coli isolates were subjected to agglutination tests with specific E. coli O157:H7 . for the antibiotic sensitivity test, the Bauer-Kirby disc diffusion
method was used to test the sensitivity of the isolates. Statistical analysis of ANOVA was used and Duncan multiple range test was used to separate the means.

RESULTS: All the values obtained for the total aerobic count and total coliform count for soil and water were higher than EPA recommended value for recreational waters. for the antibiotic Sensitivity Profile, isolates from Awba dam showed the highest sensitivity (16.17mm) to ciprofloxacin while lowest was with Augmentine (8.25mm). Generally, E.coliO157:H7
isolates were highly sensitive to Oflatoxin and Ciproflaxin(93.3%) while the isolate was completely resistant to Ampicilin and Cefuroxime.

CONCLUSIONS: The presence of E.coliO157:H7 in the dam
can make the dam unfit for recreational activities and also for the community household chores, if not well treated. The University management should device means of controlling
waste water that enters into the dam by providing alternate channels of discharge to reduce the growth and spread of the microbes in the dam.

KEYWORDS: Total Coliform Count, Heavy Metals, Physico-Chemical Parameters, Ecotourism, E. coli O157:H7, Microbe

P-1251 Nitrate Ingestion from Drinking Water and Ovarian Cancer Risk in the Agricultural Health Study

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BACKGROUND AND AIM: N-nitroso compounds (NOCs) formed endogenously after nitrate/nitrite ingestion cause ovarian cancer in animals. Few epidemiologic studies have evaluated the association of drinking water nitrate with ovarian cancer risk, and the only previous investigation observed increased risks with higher intake.

METHODS: We evaluated nitrate exposure from drinking water and ovarian cancer risk in the Agricultural Health Study, a cohort of pesticide applicators and their spouses in Iowa and North Carolina. for the enrollment water source (1993-1997; N=29,408), we computed average nitrate concentrations for women on public water supplies (20% of participants) from historical monitoring data and estimated nitrate concentrations in private wells (76%) using random forest models; 4% used other water sources and were excluded. We used Cox regression models adjusted for age, body mass index, smoking status, and menopausal status to estimate hazard ratios (HR) and 95% confidence intervals (CI) for nitrate quartiles and the 90th percentile. Among those with dietary data (collected at first follow-up; N=13,465), we calculated HRs for < and ≥ median nitrate concentration (1.47 mg/L), stratified by median dietary intakes of vitamin C (145.1 mg/day), as higher intake decreases endogenous NOC formation.

RESULTS: We identified 122 ovarian cancer cases through 2018 (Iowa) and 2014 (North Carolina). Risk was elevated (HR=1.67, CI:0.82–3.37, P-trend=0.19) for women in the 90th percentile (≥6.81 mg/L NO3-N) versus the lowest quartile (≤0.75 mg/L). The association with higher average nitrate exposure (> median) was stronger among women with low vitamin C intake (HR<median=2.20, CI:0.77-6.27) versus those with high vitamin C intake (HR>median=1.14, CI:0.58-2.25), although the interaction was not significant (P-interaction=0.28).

CONCLUSIONS: Although we cannot rule out the possibility our findings are due to chance, they suggest that higher average nitrate levels in drinking water may increase ovarian cancer risk and that vitamin C intake may modify this relationship.

KEYWORDS: nitrate, ovarian cancer

P-1258 Environmental influences and prediction of *Escherichia coli* concentration in freshwater recreational beaches in Southern Ontario

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BACKGROUND AND AIM: The concentration of *Escherichia coli* is used in Canada as an indicator of fecal pollution in freshwater recreational beaches, and is associated with recreational water illness among beachgoers. This study examines the environmental predictors of *E. coli* in Toronto and Niagara Region beaches to inform beach monitoring programs and reduce beachgoer illness risks.

METHODS: Our first objective used advanced analytical methods to examine region-specific environmental predictors of *E. coli* at 18 beaches in Toronto and Niagara Region. Mixed-effects models investigated regional differences, while the application of path analysis identified intervariable relationships and pathways associated with *E. coli* in Niagara Region. Our second objective involves the development of region-specific predictive models using a novel Bayesian Network approach to provide real-time assessments of beach water E. coli concentrations in our study regions.

RESULTS: *E. coli* observations were collected from 2007-2019 for Toronto and 2011-2019 for Niagara Region. In the mixed-effects analysis, substantial clustering of *E. coli* values at the beach level was observed in Toronto, while minimal clustering was seen in Niagara, suggesting an important beach-specific effect in Toronto beaches. Air temperature and turbidity were positively associated with *E. coli* in all models in both regions. In the path analysis, we found that water turbidity was an important mediator for the indirect effect of environmental variables overall and in beach-specific models. Results from these analyses informed the development of region-specific Bayesian Network predictive models, which are currently being tested and finalized.

CONCLUSIONS: Poor beach water quality could result in an increased risk of recreational water illness among the beachgoers. The development of accurate predictive models will guide beach managers in decision-making and risk communication to reduce recreational water illness risks among beachgoers.

KEYWORDS: *E. coli*, water quality, recreational water illness

ISEE 2022
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