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MONDAY AUGUST 26

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**Monday August 26 3:00 PM – 4:30 PM**

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Monday August 26, 9:00 AM – 10:00 AM

Keynote Lectures
Cities as unequal opportunities for good health

Ezzati M

1Imperial College London

Empirical evidence strongly points to urban residents enjoying better health than their rural counterparts, in high-income as well as low- and middle-income countries. The health advantages of urban living, however, are unevenly distributed and massive within-city inequalities exist in short distances. This talk will present data on urban advantage for a range of health outcomes, and examples of inequalities within cities from high as well as low-income settings. It will argue that to reduce urban health inequalities, we must take a broad perspective on urban environment, and to develop methods for studying how various features of cities, and their interconnections, influence the health of poorest.
Challenges and Prospects of Environmental Epidemiology in Africa

Mustapha A

1Nigerian Institute For Medical Research/Imperial College London

Keynote Lectures Monday, Beatrix theater, August 26, 2019, 9:00 AM - 10:00 AM

Urbanization and the shift to industrialized economies in Africa are leading to increased exposure to contaminants such as pesticides, heavy metals, toxic industrial chemicals and hazardous wastes released into air, water and soil. Africa has higher exposure to poor conditions related to water, sanitation, hygiene, and solid fuel use compared to most other parts of the world. Most of the populations in Africa depend on climate sensitive agricultural resources for livelihood. Hence, Africa is more vulnerable to adverse effects on public health of climate change than other regions. Despite the substantial disease burden and economic impact of environmental stressors on public health, significant environmental health data gaps exist about Africa. With half of the expected global population growth to be in Africa by 2050, increased knowledge of the nature and magnitude of environmental health risks in Africa is important to improve global public health.
Monday August 26 10:30 AM – 12:00 PM

S01: Mapping the Air Pollution Metabolome: Applications, Limitations, and the Path Forward

Metabolic perturbations following exposures to traffic-related air pollution in a panel of commuters with and without asthma

Liang D¹, Ladva C², Golan R³, Yu T¹, Walker D⁴, Sarnat S¹, Uppal K¹, Jones D¹, Russell A⁵, Sarnat J¹

¹Emory University, ²US Centers for Disease Control and Prevention, ³Ben-Gurion University of the Negev, ⁴Icahn School of Medicine at Mount Sinai, ⁵Georgia Institute of Technology

Background. Mechanisms underlying the effects of traffic-related air pollution on asthma etiology remain largely unknown, despite the abundance of observational and controlled studies reporting associations between traffic sources and asthma exacerbation and hospitalizations.

Objectives. We conducted the Atlanta Commuters Exposure (ACE-2) study: a crossover panel of commuters with and without asthma, to identify molecular pathways perturbed following traffic pollution exposures.

Methods. We measured 27 air pollutants and conducted high-resolution metabolomics profiling on blood samples from 45 commuters before and after each exposure session. We evaluated metabolite and metabolic pathway perturbations using an untargeted metabolome-wide association study framework with pathway analyses and chemical annotation.

Results. Most of the measured pollutants were elevated in highway commutes (p < 0.05). From both negative and positive ionization modes, 17,586 and 9,087 metabolic features were extracted from plasma, respectively. 494 and 220 unique features were associated with at least 3 of the 27 exposures, respectively (p<0.05), after controlling confounders and false discovery rates. Pathway analysis indicated alteration of several inflammatory and oxidative stress related metabolic pathways, including leukotriene, vitamin E, cytochrome P450, and tryptophan metabolism. We identified and annotated 45 unique metabolites enriched in these pathways, including arginine, histidine, and methionine. Most of these metabolites were not only associated with multiple pollutants, but also differentially expressed between participants with and without asthma. The analysis indicated that these metabolites collectively participated in an interrelated molecular network centering on arginine metabolism, underlying a potential etiology of traffic-related pollutants toxicity in individuals with asthma.

Conclusions. We detected numerous significant metabolic perturbations associated with in-vehicle exposures during commuting and validated metabolites that were closely linked to several inflammatory and redox pathways, elucidating the potential molecular mechanisms of traffic-related air pollution toxicity. These results support future studies of metabolic markers of traffic exposures, their corresponding molecular mechanisms, and asthma etiology.
Traffic-Related Air Pollution Exposure and Altered Fatty Acid Oxidation Among Adolescents and Young Adults – the Interplay with Obesity

Chen Z1, Newgard C2, Kim J1, Ilkayeva O1, Alderete T1, Thomas D1, Berhane K1, Breton C1, Chatzi L1, Bastain T1, Avol E1, Lurmann F4, McConnell R1, Hauser E2, Gilliland F1

1Department of Preventive Medicine, University Of Southern California, 2Duke Molecular Physiology Institute and Sarah W. Stedman Nutrition and Metabolism Center, Duke University Medical Center, 3Department of Integrative Physiology, University of Colorado at Boulder, 4Sonoma Technology, Inc.

Background/Aim: Air pollution exposure has been shown to increase the risk of obesity and metabolic dysfunction in animal models and human studies. However, the metabolic pathways altered by air pollution exposure are unclear, especially in adolescents and young adults who are at a critical period for developing cardio-metabolic diseases. The aim of this study was to examine the associations of exposures to traffic-related and regional air pollutants with indices of fatty acid and amino acid metabolism.

Methods: A total of 173 young adults (18-23 years) from eight Children’s Health Study (CHS) Southern California communities were examined from 2014-2018. Exposures to traffic-related [freeway and non-freeway nitrogen oxides (NOx)] and regional air pollutants (nitrogen dioxide, ozone and particulate matter) were estimated based on participants’ residential addresses. Serum concentrations of 64 targeted metabolites including amino acids, acylcarnitines, ketones and total non-esterified fatty acid (NEFA) were measured in fasting serum samples. Principal component analysis (PCA) of metabolites was performed to identify metabolite clusters that represent key metabolic pathways. Mixed effects models were used to analyze the associations of air pollution exposure with metabolomic principal component (PC) scores and individual metabolite concentrations adjusting for potential confounders.

Results: Higher long-term (lagged one-year average) exposure to non-freeway NOx was associated with higher concentrations of NEFA oxidation byproducts and higher NEFA-related PC score (all p’s<0.01). The effect sizes were larger among obese and Non-Hispanic White individuals (interaction p’s≤0.002). Among females, higher exposure to freeway NOx was associated with a higher NEFA-related PC score (p=0.006). Additionally, among all participants, higher exposure to freeway NOx was associated with a lower PC score for lower concentrations of short- and median-chain acylcarnitines (p=0.042).

Conclusions: Results of this study indicate that traffic-related air pollution exposure is associated with altered fatty acid metabolism, which contributes to the metabolic perturbation in obese youth.
The Maternal Serum Metabolome and Ambient Air Pollution Exposure during Pregnancy

Yan Q¹, Von Ehrenstein O, Ling C¹, Cui X¹, Walker D², Jones D³, Uppal K³, Liew Z⁴
¹Univ Calif Los Angeles, ²Icahn School of Medicine at Mount Sinai, ³Emory University, ⁴Yale University

S01: Mapping the Air Pollution Metabolome: Applications, Limitations, and the Path Forward, Room 217, Floor 2, August 26, 2019, 10:30 - 12:00

Studies have shown that maternal exposure to ambient air pollution during pregnancy can increase the risk of various adverse birth outcomes and induce neurodevelopmental disorders. Utilizing high-resolution metabolomics (HRM), we investigated perturbations of the maternal serum metabolome in response to ambient air pollution. The goal was to identify biological responses and potential mechanisms from the exposure in stored mid-pregnancy serum samples from mothers living in the Central Valley of California. We assessed ambient air pollution exposure for each subject based on their birth address. Relying on liquid chromatography-high resolution mass spectrometry, we obtained metabolic profiles in an untargeted approach for women who were either exposed to very high or low levels of traffic related air pollution according to the California Line Source dispersion model (CALINE4) and also for women who did or did not give birth to a child later diagnosed with autism. Using partial least squares discriminant analysis (PLS-DA) we selected metabolic features associated with air pollution exposure or with autism while controlling for potential confounders selected a priori. Pathway analyses were employed to identify relevant biologic pathways impacted by exposure. We will present metabolomics features and pathways from this critical pregnancy period we found to be associated with air pollution exposure and/or with autism in the offspring.
High-resolution metabolomics in human clinical studies of traffic-related pollutants  
Walker D¹, Utell M², Frampton M², Miller G³, Jones D⁴  
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.S01: Mapping the Air Pollution Metabolome: Applications, Limitations, and the Path Forward, Room 217, Floor 2, August 26, 2019, 10:30 - 12:00  

Background: Controlled exposure studies play an important role in identifying acute effects of individual pollutants and can inform underlying mechanisms, establish causality, and assist in developing rational national ambient air quality standards. In this study, we applied high-resolution metabolomics to characterize effects of exposure to traffic-related pollutants and glutathione-S-transferase mu-1 (GSTM-1) phenotype in two human exposure studies.

Methods: Plasma samples were obtained at multiple timepoints from two separate, double-blinded, randomized, crossover studies including 24 individuals (12 GSTM-1+, 12 GSTM-1 null) exposed to concentrated ultrafine particulates (UFP) or two separate doses of ozone (100 and 200 ppb). Metabolic profiling was completed using untargeted, high-resolution metabolomics, and a metabolome wide association study (MWAS) framework was used to identify metabolite changes associated with exposure and effect modification based upon GSTM-1 status.

Results: MWAS identified systemic metabolic changes associated with both exposures. UFP exposure included alterations in pathways related to fatty acid oxidation, co-factor metabolism, immune response and inflammation. Ozone exposure showed similar associations with fatty acid and inflammation pathways, in addition to changes consistent with increased oxidative stress. When stratifying by GSTM-1 status, GSTM-1 null participants showed increased levels of lipid peroxidation products and decreased antioxidant metabolites. These effects also exhibited a dose-dependent relationship with ozone exposure. Correlation of metabolites associated with each exposure and physiological measures, including blood pressure and lung capacity, provide insight into pathways underlying traffic-related pollution health effects.

Conclusions: Controlled exposure to traffic-related pollutants was associated with biological responses consistent with risk for cardiometabolic disease, and varied depending on GSTM-1 status. Continued application of metabolic profiling to controlled human exposure studies can provide important insight into the effects of individual pollutant exposures that would not be possible in observational studies.
Changes in the blood metabolome in relation to air pollution exposure: results from the EXPOsOMICS project


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...S01: Mapping the Air Pollution Metabolome: Applications, Limitations, and the Path Forward, Room 217, Floor 2, August 26, 2019, 10:30 - 12:00

Background: The peripheral blood might harbor compounds originating from air pollutants and endogenous metabolites influenced by air pollution. Within the EXPOsOMICS project untargeted metabolomics was explored as a tool to detect air pollution related changes in metabolic pathways occurring in peripheral blood.

Methods: We applied metabolomic profiling by untargeted, high resolution mass spectrometry in two panel studies (focusing on the association with short-term variation in air pollution) and two cohort studies (focusing the association with long-term variation in air pollution). All blood samples were analyzed in a single laboratory. We applied univariate mixed-effects models, corrected for multiple testing, to investigate the association between metabolomic features and air pollution. Pathway enrichment was explored with bioinformatics approach Mummichog.

Results: We identified associations between metabolomic features and estimates of both long- and short-term variation in air pollution metrics, including PM2.5, PM10, NO2, and ultrafine particles. We confirmed the identity of several associated features, including linoleate, octanoic acid, sphingosine, L-carnitine, L-Tyrosine, Phenylalanine, and caffeine. We observed enrichment of linoleate metabolism and fatty acid activation in most EXPOsOMICS studies.

Conclusions: In the EXPOsOMICS studies we observed evidence for a potential impact of both long- and short-term variation in air pollution on metabolic changes in peripheral blood. Considerable differences were observed between studies in terms of identified metabolomic features, complicating the identification of those features that are unique to air pollution. Overlap between studies in the identified enriched pathways would suggest the identified associated metabolomic features reflect similar underlying biological mechanisms.
'One Health' is an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes (WHO, 2017). Traditionally, the One Health approach originates from and is particularly relevant in the infectious disease field in relation to food safety, control of zoonoses (diseases that spread between animals and humans, and mitigating antibiotic resistance. In this context, collaboration exists between human, veterinary and environmental health specialists. In the Netherlands, emphasis on One Health types of collaborations developed after emergence of livestock associated health risks such as the largest recorded Q-fever outbreak between 2007 and 2009 and emergence of antimicrobial resistance (livestock associated MRSA and Extended Spectrum Beta Lactamase resistance). Several examples will be given of interdisciplinary collaboration in projects which aimed at establishing environmental health risks. Examples involve application of concepts on exposure assessment developed in environmental (air pollution) epidemiology, such as land use regression, to modeling infectious agent exposure, which originates from livestock farms. Other examples show that the mechanisms through which livestock associated exposures lead to health effects are diverse and go beyond the zoonosis paradigm because interactions seem to exist between particulate matter exposure from livestock farms and infectious diseases. The examples illustrate that the One Health approach is effective and can lead to major steps forward, including novel approaches, when the attitude exists to attempt to solve problems by involving experts from different disciplines. The One Health approach becomes ineffective when it is applied rigidly to classical infectious disease risks which are not necessarily zoonotic. With this in mind, the One Health approach should be seen as a plea for interdisciplinary research approaches to solve complex scientific puzzles.
Environmental water influences human health in many ways. Health benefits include the use of water for domestic purposes, food production, transport, energy production and recreation. Health risks are created by exposure to polluted water – often through the same pathways. Pressures from the environment can result in changes in the state of the water body, causing for instance chemical pollution, microbiological contamination, or the presence of disease vectors, such as insects. Water bodies used by people are often influenced by animals, increasing emissions of nutrients and potentially pathogens, or creating ideal mosquito breeding sites. The concept of One Health helps to understand water-related human health risks resulting from the interactions between environment, people and animals around water systems. Interventions in design and water management have the potential to address several health issues at the same time. Systematic and integrated planning and management of water resources from a One Health perspective can contribute to reducing or preventing negative health impacts and enhancing the health benefits.
Field evaluation of air sampling methods using a one-health approach to assess pathogen contamination in animal operation environments

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Concentrated animal feeding operations (CAFOs) have been identified as a source of antibiotic-resistant bacteria as well as other zoonotic pathogens, which have been detected within CAFO environments (e.g. barn surfaces), the ambient environment near CAFOs (e.g. air, soil, water), CAFO workers, and in community residents without direct livestock contact. Additionally, transmission between animals and humans has been documented. For this reason, it is important to measure contamination of animals, people, and the environment simultaneously (One Health design) to assess transmission dynamics of pathogens, and to develop public health interventions.

Most operations raising animals in confinement administer antibiotics for disease prevention and treatment. Waste is stored in open-air pits in the ground (anaerobic “lagoons”) and then sprayed onto crop fields as fertilizer (“sprayfields”). The use of these animal husbandry and waste management practices has raised concerns amongst CAFO workers and neighboring residents about exposure to pathogenic, antibiotic-resistant bacteria (and associated resistance genes) that may be present in animals and their waste.

To address these concerns, we have deployed personal and area air samplers inside the farm, in the surrounding CAFO environment, and within the communities using three well-established biological air sampling methodologies in a one-health approach: (1) Inhalable air samplers (Button sampler®, SKC Inc.) loaded with 25mm gelatin filters (Sartorius, Germany), (2) Sterile all-glass impingers (BioSampler®, SKC Inc) with 20 mL sterile PBS as collection media, and (3) single stage impactor (N6, Thermo Scientific, Inc) with selective media plates or MD8, (Sartorius) with gelatin filters.

Using a case study we will talk about how the choice of sampler is determined by the specific environment to be measured. Personal samplers are best to capture the individual exposures, whether worker or community member. Impinger samplers are preferred when molecular assays are needed, and impactor samplers are preferred when sampling low concentration environments.
Intensive livestock farming is associated with high exposures to dust, dander and fumes. Farmers are at high risk of developing asthma, COPD, other respiratory diseases as well as contracting diseases directly from the animals e.g. zoonotic diseases. Due to livestock farming large quantities of manure is accumulated, which is in turn is used as crop fertilizers on the surrounding land. Manure gives off fumes and gases, which affects the environment around the farm. These fumes and gases are suspected to aggravate respiratory diseases, but not necessarily cause them. Intensive use of antibiotics in the farming production influences development of resistant bacteria, which can be transferred into the surrounding environment and potentially pose serious health risks.

Despite farming being known as dusty and dirty several studies have shown that it also represents an exposure with beneficial effects on our health. It turns out that farmers have less allergy and less allergic asthma than the general population. It is still unclear what causes this beneficial effect but the theory is that the diverse microbial exposure found in the farming environment represents a positive stimulation of our immune system. It furthermore appears that an urban rural gradient of atopic disease exists and that the farming environment provides the best protection. The farming exposure being dirty yet beneficial is a conundrum we continue to investigate.
One Health studies examine the interplay between people, animals, and their shared environment in relation to health outcomes, and this nexus is particularly relevant in the context of microbial sharing. One environment that has not been extensively evaluated via a One Health lens is the healthcare setting. Hospitals and other healthcare facilities include immunocompromised patients, a group particularly susceptible to drug-resistant pathogens that may be fostered by the patient population and antimicrobial selective pressure that typifies hospital environments.

Animal-assisted interventions (AAI), or the use of companion animals as an adjunctive therapy modality, are a noteworthy example of an important One Health challenge within the hospital environment. There are substantial benefits of AAI to patients in the form of reduced anxiety and stress, reduced need for pain medications, and improved clinical outcomes. However, little is known about the potential for therapy animals to participate in pathogen transfer between patients, and whether this needs to be addressed explicitly in hospital protocols.

An additional component of AAI that has not been explored is the potential for other microorganisms, including beneficial commensals, to be transmitted between therapy animals and patients, which could then influence an individual’s microbiome. The presence of pets in the home is associated with increases in microbial diversity, and children with early-life exposure to pets, particularly dogs, are at a decreased risk of developing allergic diseases. What is unknown is whether this same phenomenon will occur for therapy animals who only have brief interactions with patients, and whether this will confer resistance to colonization of drug-resistant pathogens or other beneficial effects.

Therefore, this talk will summarize what is known about microbial transmission in hospital-based AAI programs, including findings from a pilot study involving decolonization of the therapy dog, and will postulate future directions for One Health work involving AAI.
S05: PFAS Research Reaches its Adolescence: What Have We Learned and Where Are We Going?

Perils of biomarkers of exposure vs. external exposure estimates: Lessons from the mid-Ohio Valley on potential for reverse causality and other biases

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Background:
Many cross-sectional studies have associated serum PFOA in relation to outcomes which could potentially affect serum PFOA. When available, use of model-based blood PFOA estimates may avoid this problem. We provide examples from the mid-Ohio valley of three outcomes where we believe reverse causality may be occurring: renal function, menopause, and birthweight. Both measured and model-estimated PFOA blood levels were available in a high exposed population in the mid-Ohio valley.

Methods
In cross-sectional analyses, we analyzed measured and model-estimated PFOA in relation to self-reported menopause (controlling for age) among women (n = 6,342, 40–65 years old), and in relation to kidney function (eGFR) among adults > 20 years old (n = 29,499). We also compared the association of birth weight with serum PFOA in the mothers measured early vs. late in pregnancy, hypothesizing the measurement later in pregnancy might be decreased when the fetus was larger and plasma volume greater.

Results Controlling for age, being post-menopausal and having decreased eGFR were significantly associated with higher measured PFOA (trend tests: p = 0.013, p = 0.0005, respectively), but not with modeled serum PFOA (p = 0.50, p = 0.76, respectively). Measured PFOA levels increased for the first 7 years after menopause (trend test, p < 0.0001), supporting the reverse-causality hypothesis. For birth weight, we found no association with maternal PFOA measured early in pregnancy, but an inverse association with maternal PFOA measured late in pregnancy.

Conclusions:
Our results suggest caution when judging cross-sectional associations between measured serum PFOA and outcomes which might alter serum PFOA levels. Our findings also suggested that model-estimated serum PFOA may be preferable to measured serum PFOA, contrary to the usual assumptions made in many systematic reviews.
Approaches to Integrating the Toxicology and Epidemiology Evidence on PFAS

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.S05: PFAS Research Reaches its Adolescence: What Have We Learned and Where Are We Going?, Beatrix theater, August 26, 2019, 10:30 - 12:00

Per- and polyfluoroalkyl substances (PFASs) have gained wide attention the last two decades. At present 4,600 CAS Registry Numbers are associated with PFASs that may have been on the global market (OECD 2018), while only some very few of these have been studied extensively. Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), belonging respectively to the sub groups of perfluoroalkyl carboxylic acids (PFCAs) and perfluoroalkyl sulfonic acids (PFSAs), are the best studied PFASs. Under the European REACH regulation, some PFCAs and PFSAs have been identified as substances of very high concern (SVHC), demonstrating a need for undertaking risk assessments.

The risk assessment process include several steps, including hazard assessment and identification of the critical effect. The importance of integrating data from both experimental animal studies and human epidemiological studies have been highlighted, as both types of data have specific advantages and disadvantages. However, for many PFASs the amount of data is very limited, making this impossible.

In the case of PFOS and PFOA data from both animal studies and human epidemiological studies are available for several endpoints. In this presentation, there will be a discussion on how these complementary types of data can be used in hazard assessments and how to utilize this knowledge for other PFASs where the data, in particular epidemiological data, are more limited or do not exist. However, for some endpoints such as changes in blood lipids, contradictory results have been observed between studies on experimental animals and humans. This, along with differences in exposure and toxicokinetics, needs to be considered when combining data from experimental animal studies and epidemiological studies.

Reference
PFAS Dose Response Relationships and New Research Strategies
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.05: PFAS Research Reaches its Adolescence: What Have We Learned and Where Are We Going?, Beatrix theater, August 26, 2019, 10:30 - 12:00

With so many per- and poly-fluoralkyl alkyl substances (PFAS) there is a pressing need to resolve a number of epidemiological questions – can we estimate “no-effect” levels for the well-studied compounds, how do epidemiological and toxicological no-effect levels compare, what is their relative potency, singly and in mixtures, is it better to estimate dose-response based on intake or body burden?

Serum levels of PFAS as exposure biomarkers are stable, reflect integrated exposure and measure exposure close to target organs, yet their stability reflects a disadvantage too: the long half-life reflects active reabsorption pathways. These shared pathways contribute to the strongly correlations between PFAS body burdens of different and also some outcomes of interest. Estimates of no effect levels or benchmark doses are sensitive to whether, and how to adjust for such potential confounding in mixed exposures. This is a concern in both background low level exposures and local highly contaminated communities.

A widespread source of local exposures is due to water contamination from firefighting foams containing various PFAS. For example the Ronneby community in Sweden has a population with some serum PFAS levels (PFHxS and PFOS) up to 1000 ng/ml due firefighting foam exposures, but highly correlated. The HBM4EU project across Europe is integrating studies and methods for assessing background exposure and health effects to biomarkers including PFAS. Progress has been made to assess relative potency between PFAS, and this can form the basis for a weighted index for assessing risk to complex mixtures of PFAS. Pooled studies provide more power to assess no effect levels or benchmark doses. By integrating high and low exposure studies, with many different external exposure profiles, the future is promising for more robust limit setting for both individual and mixed PFAS exposure.
Evolution of Research on Health Effects of PFAS and Current Unmet Needs to Inform Public Policy

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S05: PFAS Research Reaches its Adolescence: What Have We Learned and Where Are We Going?, Beatrix theater, August 26, 2019, 10:30 - 12:00

Research into the environmental health effects of per- and polyflouroalkyl substances (PFAS) began decades ago but was markedly influenced by the contributions of the C8 Science Panel, along with growing recognition of the scope of worldwide exposure. Over the past decade, the scope and quality of research has expanded, yet regulators have important unmet needs that the research community should address. As part of the decision-making process regarding regulation of PFAS for the State of Michigan in the US, I was invited to provide current scientific information on PFAS to help determine acceptable levels of PFAS in drinking water. These policy-driven concerns have distinctive features that can help guide us to conduct more influential research. Key issues included: (1) Specific forms of PFAS to be regulated, individual chemicals or aggregations, considering mechanisms of toxicity, persistence, and relative potency; (2) Estimation of thresholds for observable health effects based on toxicology, epidemiology, and their combination, specifically whether 70 ppt in drinking water is sufficiently protective of public health; (3) Relative importance of exposure pathways other than drinking water, including food products and dermal exposure; (4) Clinical relevance of recognized history of elevated exposure, specifically guidance to those with elevated PFAS exposure and their health care providers; (5) Methods to mitigate exposure through changes in environmental policy and removal from community and individual water supplies. As part of the contribution, an panel with expertise in epidemiology, toxicology, risk assessment, environmental chemistry, and water quality engineering was assembled to inform the State by describing the current state of knowledge. While the fundamental understanding of PFAS continues to advance, targeted approaches to make the best practical use of current knowledge and pinpointing critical gaps will benefit regulators and therefore the public and help the research community prioritize research activities.
The Symposium organised by the Policy Committee of ISEE originated following the widespread surprise and annoyance of our members from the sponsorship of the 2018 ISES-ISEE joint conference in Ottawa by ExxonMobil. ISEE did not directly accept these funds but other societies are more willing to accept them. We will argue that organizations representing health researchers should not accept support from the fossil fuel extraction companies. Banning health research funded by the tobacco industry helped bring major public health gains; we will argue that we should do the same with BigOil. We further argue that ISEE should become more vocal on this issue and promote measures such as divestment from these industries. There are three main reasons for taking this position: (i) The most important is that fossil fuel industries are major determinants of human disease and environmental deterioration; (ii) The second is that they knew! Like the tobacco industry, Big Oil knew for decades that their products could make the planet uninhabitable, and intentionally buried the evidence; (iii) The third reason is that like our stand against the tobacco industry that resulted to significant public health advances, we should take a categorical, effective and clear-cut position against the products and actions of these harmful industries. The science is more than adequate to warrant action. Unless we do this, we will not be able to effectively convince the lay public and our politicians of the urgency with which we must mobilise.

The proposed Symposium will illustrate major aspects of health consequences of fossil fuel combustion and the reactions of the industry trying to influence epidemiological research. We will discuss on the way epidemiologists should continue providing essential support to health policies avoiding corporate interests while encouraging industry and other stakeholder involvement as a part of the solution to the problem.
**The Impact of Fossil Fuel Combustion on Global Health**

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S20: A world less dependent on fossil fuels – scientific evidence and corporate influence. An ISEE Policy Committee Symposium, Room 315, Floor 3, August 26, 2019, 10:30 - 12:00

Background: While numerous studies, such as the Global Burden of Disease, have reported the health impacts of PM2.5 exposure worldwide, these have not focused on the fossil fuel contribution to those PM2.5 concentrations, or used the most recent dose-response curves.

Methods: Global PM2.5 exposure levels in 2012, with and without fossil fuels were derived from the chemical transport model GEOS-Chem. Relative risks of mortality were modeled using functions previously published in a meta-analysis of association between long-term exposure to air pollutants and mortality, incorporating nonlinearity in the concentration-response.

Results: We estimate a global total of 6.81 million premature deaths annually attributable to the fossil-fuel component of PM2.5. The greatest mortality impact is estimated over regions with substantial fossil fuel related PM2.5 concentrations, notably parts of the eastern US, Europe, China, India and Southeast Asia. Notably, the steeper slope at lower concentrations results in larger estimates than previously in Europe and North-America, and the slower drop-off in slope at higher concentrations results in larger estimates in Asia.

Conclusions: The fossil fuel industry has launched a full scale attack on the science behind limits for PM2.5 pollution to obscure its role in global health.
Health impact of China Coal Consumption Cap Project: an analysis of PM2.5 monitoring and morbidity/mortality data in typical cities in China

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S20: A world less dependent on fossil fuels – scientific evidence and corporate influence. An ISEE Policy Committee Symposium, Room 315, Floor 3, August 26, 2019, 10:30 - 12:00

Background/Aim
The China Coal Consumption Cap Project (CCCP) (2013-2020) is one of the most important actions to mitigate air pollution by controlling coal consumption in China. We aimed to take 2013 as a baseline to evaluate the effects of the CCCP and the related health impacts.

Methods
Beijing, Taiyuan, and Guangzhou were selected as typical cities in mainland China. An analysis of the PM2.5 monitoring and morbidity/mortality data was conducted to estimate the health losses caused by coal consumption. Changes in outpatient/emergency room visit, hospitalization and mortality were calculated to assess the health impact of the CCCP, in 2017 and 2020, respectively.

Results
The concentration of PM2.5 in Beijing, Taiyuan, and Guangzhou decreased from 89.50μg/m3 to 58.00μg/m3, 75.02μg/m3 to 59.00μg/m3, and 51.73μg/m3 to 35.00μg/m3, respectively in 2013-2017 (and will drop to 50.00μg/m3, 47.00μg/m3, 30.00μg/m3 in 2020 scenario respectively, numbers in the parenthesis are the 2020 value, the same applies to the following).
During this period, Ischemic Heart Disease and Chronic Obstructive Pulmonary Disease hospitalization, and non-accidental deaths in Beijing due to coal burning decreased (will decrease) by 1,990(2,461) and 995(1,205) person-times, and 1099(1,396) cases, respectively. The total number of hospitalizations, outpatients, and non-accidental deaths in Taiyuan due to coal burning decreased (will decrease) by 15,728(25,738) and 4,491(7,735) person-times, and 488(881) cases, respectively. The number of emergency patients with circulation and respiratory system diseases, and non-accidental deaths in Guangzhou caused by coal burning decreased (will decrease) by 158(203) and 277(348) person-times, and 3,159(3,908) cases, respectively.

Conclusions
There were large reductions in PM2.5 concentrations during the period of CCCP. Substantial reductions in morbidity and mortality related to control of ambient air pollution were achieved from 2013 to 2017 in China, and the health benefits will be more obvious in 2020, indicating appreciable effectiveness of controlling coal consumption and improving air quality.
The world is unequal: The energy dilemma in LMICs
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S20: A world less dependent on fossil fuels – scientific evidence and corporate influence. An ISEE Policy Committee Symposium, Room 315, Floor 3, August 26, 2019, 10:30 - 12:00

About three billion people worldwide cook on open fires or use dirty and polluting fuels. Indoor air pollution contributes to 4 million deaths every year, more than HIV/AIDS and Malaria combined, and disproportionately affects women and children. For people without access to modern energy sources cooking and lighting fuel can take up a large portion of their income, increasing poverty and limiting opportunities for development. (World Health Organization, 2014). Though the Sustainable Development Goals (SDGs) principles and the Paris Climate Agreements are relevant to all nations, the global goals do not easily translate to regional/national contexts due to different starting points, capacities, priorities, etc. Low and Middle Income Countries (LMICs) on average, exhibit lower levels of per capita resource use, energy consumption, and greenhouse gas emissions than developed countries. However, imminent industrialization and economic growth portends better potential for integrating low-carbon energy options in its energy mix compared with counterparts in the developed world. The use of kerosene as cooking and lightening fuel is dominant in several countries in sub-Saharan Africa. Some countries such as Nigeria, do not generate enough electricity to serve its population. Therefore, households often do not see cooking as a priority for electricity use compared to lighting and appliances, for which fuel substitutes are not available. Strong population growth has been said to offsets effort to increase access to modern cooking facilities, resulting in an increase in number of people cooking with biomass. LPG use is set to increase significantly, driven by rising incomes, government programs, and its ease of use. As an example, both Nigeria and Kenya have stated the intention to promote the use of LPG as substitution for biomass and kerosene. This presentation will discuss energy dilemma in LMICs and outlines ways to strengthen emerging partnerships to accelerate progress to cleaner energy.
Policies for accelerating progress towards a fossil fuel free economy and improving health

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.S20: A world less dependent on fossil fuels – scientific evidence and corporate influence. An ISEE Policy Committee Symposium, Room 315, Floor 3, August 26, 2019, 10:30 - 12:00

Under the Paris Climate Agreement countries submitted Nationally Determined Contributions of reductions in greenhouse gases emissions with the aim of keeping global mean temperature increases to less than 2°C above pre-industrial (and if possible to 1.5°C). However implementation of these commitments would result in a temperature increase of about 3.2 °C by late 21st century, emphasizing the need to increase the level of ambition. In view of the reluctance of some nations to decarbonise and the powerful lobbying activities of fossil fuel companies this is challenging. Making a positive and convincing case for rapid and transformative change towards a ‘zero-carbon’ economy based on near-term multiple benefits to health and development, in addition to the longer term benefits of reducing the risks of dangerous climate change, is therefore imperative. There are a range of credible zero-carbon renewable technologies that are becoming increasingly competitive with fossil fuel power sources. If the current externalities of fossil fuel combustion, particularly those arising from air pollution, are taken into account in economic analyses the case for action becomes highly compelling. This presentation will review evidence about the magnitude of the health co-benefits of decarbonizing the economy and discuss the potential to address industrial emissions through development of circular economy approaches which emphasize re-use, recycling, re-manufacturing and shared ownership of products. It will also outline potential policies to accelerate progress towards a fossil fuel phase out.
Association of urinary metabolites of organophosphate flame retardants with chronic kidney function markers in the US general population

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Background/Aim: Organophosphate flame retardants (OPFRs) have been widely used in building materials and consumer products as flame retardants and plasticizers. In vitro studies suggest toxic effects of OPFRs on the kidney. While human exposure to OPFRs is increasing, their potential effects in humans are not well documented. In this study, the association between OPFRs exposure and chronic kidney function markers among humans was investigated employing the data from the US National Health and Nutrition Examination Survey (NHANES) 2013-2014.

Methods: In the NHANES population, we identified 1,795 adults without current pregnancy, for whom urinary metabolites of four OPFRs, i.e., diphenyl phosphate (DPhP), bis(1,3-dichloro-2-propyl) phosphate (BDCPP), bis(2-chloroethyl) phosphate (BCEP), and dibutyl phosphate (DBuP), along with chronic kidney function markers, i.e., estimated glomerular filtration rate (eGFR) and albumin-to-creatinine ratio (ACR), were available. Their associations were tested using linear regression models. To account for urine dilution, covariate-adjusted creatinine standardization method which controls potential confounding by kidney function was employed for the chemical concentrations, in addition to conventional creatinine-adjustment.

As a sensitivity analysis, the association between quartiles of OPFR metabolites and chronic kidney disease (CKD) outcome (eGFR < 60 mL/min per 1.73 m² or ACR > 30 mg/g) was also assessed.

Results: Three OPFR metabolites were identified to be associated with reduced kidney function. Urinary BCEP level was negatively associated with eGFR, and both BDCPP and DBuP were positively associated with ACR. When urine dilution was adjusted with the covariate-adjusted standardization method, the association became more evident. Moreover, similar results were observed in the sensitivity analysis supporting the observed association between OPFRs and the kidney function markers.

Conclusions: Among general adult population with moderate sample size, several OPFRs were identified as chemical determinants of chronic kidney function. Experimental studies are warranted to understand the potential mechanisms of this observation.
Biomarker-Based Assessment of the Influence of Chemical Exposures on Chronic Kidney Disease
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OPS 01: Understudied environmental health issues, Room 412, Floor 4, August 26, 2019, 10:30 - 12:00

Background/Aim
Chronic Kidney Disease (CKD) was the 9th leading cause of death in the United States in 2015. Previous studies have identified environmental toxicants such as Per- and polyfluoroalkyl substances (PFASs) and heavy metals to be associated with CKD but focused on only a handful of chemical classes corresponding with a few biomarkers of CKD. To better understand the influence of environmental toxicants on CKD, we implemented an overarching screening approach to systematically evaluate the associations between chemical biomarkers and biomarkers of CKD as well as identify populations at risk for CKD.

Methods
We used the National Health and Nutritional Examination Survey (NHANES) of 167 chemicals and 4 biomarkers of CKD (Cystatin, Glomerular Filtration Rate (GFR), Albumin, and Creatinine) measured in 18881 participants 1999-2002. For every pairwise combination of CKD and chemical biomarkers, we conducted a series of linear regression models to determine the association of one biomarker of CKD and chemical exposure adjusted for covariates such as age, race, gender, poverty income ratio, and cotinine (biomarker of smoking).

Results
For a 1 unit increase in chemical biomarker levels, we identified Heptachlorodibenzofuran and Oxychlorodane decrease GFR by 29% and 28% respectively, and a few PFASs decreases albumin levels by 4-12%, implying an increased risk for CKD. Additionally, Non-Hispanic Blacks, Mexican Americans, & Other Hispanic Americans on average have Albumin levels that are higher compared to those of Non-Hispanic Whites by 57%, 10% and 19%, respectively, implying that they are at a higher risk for CKD.

Conclusions
Overall, we presented a framework that systematically identified populations susceptible to CKD and environmental toxicants that are either risk or protective factors for CKD. Ongoing work is understanding how these toxicants influence biological pathways associated with CKD to better elucidate the link between environmental exposures and kidney health.
Prenatal exposure to perfluoroalkyl substances and child liver injury
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OPS 01: Understudied environmental health issues, Room 412, Floor 4, August 26, 2019, 10:30 - 12:00

Background/Aim: Early-life exposure to perfluoroalkyl substances (PFAS) has been associated with hepatic steatosis and inflammation in rodents, but studies in human are scarce. We aimed to examine the associations between prenatal exposure to PFAS and child liver injury.

Methods: We relied on the Early-Life Exposome project, HELIX, a collaborative project of six European prospective birth cohorts. Concentrations of perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), perfluorohexane sulfonic acid (PFHxS) and perfluorononanoic acid (PFNA) were measured in serum samples of the HELIX mothers in the first trimester of pregnancy, and liver injury markers, including alanine aminotransferase (ALT), aspartate aminotransferase (AST) and γ-glutamyl transferase (GGT), were measured in 1129 children at ages 6-10 years. Principal component (PC) analysis was performed and the first PC score was used to represent the exposure burden of PFAS mixture (explaining 65% variance of all 4 PFAS) and liver injury (explaining 67% variance of all 3 liver markers).

Results: Median (interquartile range, IQR) PFOA, PFOS, PFHxS, and PFNA concentrations in maternal serum were 2.35 (1.98), 6.61 (5.91), 0.57 (0.59), and 0.71 (0.65) ng/ml, respectively. Each unit increase in the PFAS PC score was associated with 0.6 increased PC score of liver injury (95% CI: 0.01 – 1.11) after adjusting for covariates. The strongest associations were seen for elevated AST. Each unit increase in log2-PFHxS and log2-PFNA was associated with 0.8U/L (95% CI: 0.06 – 1.51) and 0.9U/L (95% CI: 0.01 – 1.74) increase in AST, respectively. Similar associations were observed for ALT and GGT but they were not statistically significant. Further adjustment for child exposure to PFAS did not substantially change the results, and there was no evidence of interaction with child sex and BMI.

Conclusions: Our study is one of the first human studies showing effects of developmental exposure to PFAS on subsequent markers of child liver injury.
Background. Tampons are used by up to 86% of US women and are a rarely considered potential source of pesticide and metal exposure. Tampons may be of particular concern given the likely higher absorption that occurs in the vagina. Our objective was to examine the potential associations between tampon use and metal concentrations, and biomarkers of inflammation and oxidative stress among healthy women.

Methods. We used information from Biocycle, a prospective cohort of 259 regularly menstruating women, aged 18–44, followed for two menstrual cycles. Tampon use was assessed using information from participant study diaries. Metal concentrations were measured from a blood sample collected at enrollment. Oxidative stress and inflammation biomarker concentrations were determined from blood samples collected at up to 8 clinic visits for each cycle. Linear regression models were used to estimate associations of tampon use with metal exposure, and linear mixed models to estimate associations of tampon use with inflammation and oxidative stress biomarkers at different times during the menstrual cycle.

Results. We observed non-significantly higher mean levels of mercury for tampon users compared to non-tampon users (exp(β)=1.25, 95% CI: 0.93, 1.68). We found no evidence of an association between tampon use and inflammation biomarkers. We observed consistently higher isoprostane levels, an oxidative stress biomarker, among tampon users compared to non-tampon users (e.g. exp.(β)=1.05, 95%CI: 0.96, 1.16, for the average isoprostane during the menstruating week); however, these results were not statistically significant.

Conclusions. While our results are not statistically significant, we observed suggestive associations between tampon use and elevated levels of mercury and oxidative stress biomarkers. Although our finding should be interpreted in light of our limitations, they indicate that tampons may be a source of exposure to metals and chemicals that have been largely ignored, and any related health effects are an important public health concern.
Accounting for intercourse in the relationship of ambient temperature with fecundability

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OPS 01: Understudied environmental health issues, Room 412, Floor 4, August 26, 2019, 10:30 - 12:00

Background/Aim: Although ecological studies have observed relationships between ambient temperature and fertility, it is unclear whether these observations are due to effects on physiology and/or through behavior and whether individual-level factors may bias findings. In the LIFE study, a preconception cohort of couples attempting pregnancy, we evaluated the relationship of temperature with both pregnancy and intercourse, a key behavioral mediator.

Methods: 500 couples from Michigan and Texas with geocoded addresses were followed for up to 12 months attempting pregnancy and reported start of menses, day of ovulation, pregnancy status and daily intercourse for each menstrual cycle. The Weather Research Forecasting model estimated daily temperature and humidity at participants’ residences. Temperature was modeled per 5 degrees Celsius and non-linear trends assessed using natural cubic splines. Generalized estimating equations accounted for multiple observations per participant, adjusting for relative humidity, season, study site, menstrual cycle of follow-up and maternal characteristics.

Results: Mean temperature was 8.7 (SD=9.3; Min=-6.3, Max=26.1) degrees Celsius in Michigan and 21.9 (SD=5.6; Min=9.4, Max=30.7) in Texas. No non-linear trends were observed between temperature and fecundability or intercourse. Average temperature during both the fertile window and implantation was related to menstrual-cycle probability of pregnancy in unadjusted models (RR=1.05, 95% CI=1.00-1.11 and RR=1.05, 95% CI=1.00-1.11); however, estimates were attenuated after adjustment (RR=1.01, 95% CI=0.96-1.05 and RR=1.01, 95% CI=0.95-1.07). Higher temperature was associated with a small increase in daily probability of intercourse within (RR=1.03, 95% CI=1.00-1.06) but not outside (RR=1.00, 95% CI=0.97-1.03) the fertile window. No heterogeneity was observed by study site or season.

Conclusions: In a population attempting pregnancy and exposed to moderate temperatures, temperature and fecundability were not associated after adjustment. There was a modest increase in intercourse with higher temperatures during the fertile window. Studies that observe relationships between temperature and fecundability should consider intercourse patterns as a potential mediator.
Health impact of attending school close to the abandoned copper mine of Musoshi, DR Congo

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Aim
We investigated environmental exposure to trace elements and possible health effects among pupils attending school close to the abandoned copper mine (and tailings) of Musoshi in the Haut Katanga province, a mining area of the Democratic Republic of Congo.

Methods
We conducted a cross-sectional study, in the dry season, among 203 pupils (8-12 years) attending school close to the abandoned mine and 203 control pupils from the provincial capital, Lubumbashi, using a respiratory questionnaire and spirometry. Trace metals were measured by inductively coupled plasma mass spectrometry in superficial soil (tailings, schoolyards, classrooms), in aerial dust samples, and in spot urine (24 exposed, 27 controls).

Results
Metal soil concentrations were lower near the mine than in the control location, but tailing soil had a potential of hydrogen of 3.7. Cobalt concentration in aerial dust in schoolyards was higher (452µg/g) in Musoshi than Lubumbashi (59µg/g). Children of Musoshi also tended to have lower urinary creatinine-corrected metal concentrations, except for Li and Sn. Compared to Lubumbashi, pupils from Musoshi reported more cough (Odds ratio (OR) 1.7 (1.10–2.64), itchy nose (OR 1.63 (1.02–2.58), epistaxis (OR 2.62 (167–4.11), eye symptoms (OR 33.58 (10.35–108.92), but spirometric indices did not differ.

Conclusion
Pupils attending school close to the abandoned copper mine reported more nasal, respiratory and eye symptoms, probably because of their exposure to acid dust.
OPS 10: Wildfires

Mortality in US In-Center Hemodialysis Patients Following Exposure to Wildfire Smoke PM2.5

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Background/Aim: Wildfire size and frequency have increased dramatically across the US, and end-stage renal disease (ESRD) patients are potentially susceptible to this growing environmental stressor. Our aim was to assess the effect of exposure to wildfire smoke fine particulate matter (smoke-PM2.5) on mortality among US ESRD patients who receive in-center hemodialysis (HD).

Methods: A retrospective time-series analysis of the association between daily exposure to smoke-PM2.5 and daily mortality was conducted for the period 2008-2012 in the 627 US counties within 200km of a major wildfire origin point. We assessed immediate and lagged effects and estimated rate ratios (RR) per 10 μg/m3 increase in smoke-PM2.5. Using the United States Renal Data System, we identified 48,454 ESRD patients who 1) had Medicare as primary payer, 2) survived first 3 months of dialysis initiation, and 3) visited dialysis clinics within study counties before death. County-level daily wildfire-originated smoke-PM2.5 was estimated with Community Multiscale Air Quality model. We considered all-cause and cause-specific (cardiac, vascular, infection, and other) deaths.

Results: For all-cause mortality, the RR of immediate effect was 1.04 (95%CI: 1.01-1.07), and RRs of lagged effect over 1-, 7-, 14-, and 30-day prior death were 1.05 (95%CI: 1.01-1.08), 1.07 (95%CI: 1.03-1.11), 1.06 (95%CI: 1.01-1.10), and 1.07 (95%CI: 1.01-1.12), respectively. Null-effects were estimated for cardiac-, vascular-, and infection-related deaths. The immediate effect of RR 1.08 (95%CI: 1.04-1.12) was estimated for deaths due to other causes.

Conclusions: Wildfire smoke exposure was positively associated with all-cause mortality among HD patients. This study highlights an elevated risk for this population and the need for research to understand the differences observed for cause-specific mortality, and to potentially develop and implement interventions to manage smoke-PM2.5 exposure. This abstract does not represent EPA policy.
Background: The effect of acute exposure to extreme heat episodes and other extreme weather events on adverse birth outcomes is not well understood. Understanding these relationships is becoming an important priority, especially as these environmental conditions are expected to increase in the context of climate change. We examined the association between many definitions of extreme heat episodes and preterm birth in a large, population-based cohort in California. We also investigated the potential interaction with wildfire smoke events.

Methods: We created a population-based cohort comprised of 2,030,407 mothers who had singleton live births in California, from May through September, 2005-2013. Daily temperature data was used to create 12 definitions of extreme heat episodes of varying threshold temperatures and frequencies and assigned to residential zip codes. We estimated risk of preterm (<37 gestational weeks) delivery among mothers who experienced a heatwave during their last week of gestation using Cox proportional hazard regression models, adjusting for seasonality and socioeconomic factors. The interaction between extreme heat episodes and wildfire smoke was additionally assessed.

Results: Approximately 8% of the cohort experienced a preterm delivery. The risk of preterm birth was consistently higher among mothers who experienced an extreme heat episode during their last week of gestation. Hazard ratios ranged from 1.01 (95% CI: 1.00, 1.02) to 1.11 (95% CI: 1.05, 1.18).

Conclusions: Results from this study suggest acute exposure to high ambient temperatures during the gestational period may trigger an earlier delivery. Extreme heat episode warnings targeted toward pregnant women may be beneficial in improving birth outcomes.
Characterizing Impacts of Wildfire Smoke Exposure on Medication Fills and Outpatient Visits for Asthma during the 2015 Wildfire Season in the Western United States

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OPS 10: Wildfires, Room 210, Floor 2, August 26, 2019, 10:30 - 12:00

Background/Aim
Smoke from wildfires impacted several states in the western United States (U.S.) during the summer months of 2015. Our objective was to evaluate associations between smoke-related fine particulate matter (smoke PM2.5) concentrations and adverse health outcomes for asthma, specifically medication fills and outpatient visits, using spatio-temporal exposure models and epidemiological regression techniques.

Methods
Our assessment examined employer-based health insurance claims for asthma from the Truven-IBM health insurance claims database for a period between June 1st and September 30th, 2015, covering 11 states in the western U.S. We linked approximately 450,000 asthma medication fills and 85,000 outpatient visit records with smoke concentrations estimated from a geographically weighted ridge regression (GWR) model. The GWR model blends information from PM2.5 monitors, a chemical-weather model, and satellite data products to estimate PM2.5 concentrations in the smoke-affected area. A conditional quasi-Poisson regression with month/day/place strata in combination with a distributed lag non-linear model, was used to measure the overall cumulative effect of smoke concentrations. This regression framework explored how the associations were distributed over a 7-day lag period and included predictors, such as cross-basis terms for daily measures of ozone, relative humidity, and temperature.

Results
The estimated (95% Confidence Interval) risk ratios (RRs) associated with a 10 µg/m3 increase in smoke PM2.5 exposure for asthma medication refills and outpatient visits were 1.072 (1.052 – 1.093) and 1.109 (1.065 – 1.153), respectively. RRs estimated on the day of smoke exposure were the highest, but delayed effects of smoke on these health outcomes were statistically significant and persisted until 5 days following the smoke exposure.

Conclusions
Asthma medication refills and outpatient visits are significantly associated with smoke PM2.5. A comprehensive strategy to mitigate adverse health impacts associated with wildfire disasters necessitates a thorough understanding of population-level exposures and health impacts associated with smoke PM2.5 concentrations.
Out-of-Hospital Cardiac Arrests and Fine Particulate Matter (PM2.5) during 2015-2017 California Wildfires
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Background: The burden of California wildfires is increasing, yet cardiovascular health impacts of wildfire smoke are not well understood.

Methods: We examined the relationship of wildfire smoke exposures and cardiac arrest occurring outside a hospital setting using categorical estimates of wildfire-related PM2.5 (light, medium, heavy smoke) derived from satellite-imagery in the National Oceanic Atmospheric Association’s Hazard Mapping System Smoke Product. Surveillance data of EMS-attended out-of-hospital cardiac arrests (OHCA) in adults (≥ 35 years of age) was provided by the Cardiac Arrest Registry to Enhance Survival for 14 California counties during wildfire months, May – October, 2015-2017. We applied conditional logistic regression incorporating a spline for heat index in a case crossover design (matching smoke exposures with OHCA cases and 4 referent day controls from 1, 2, 3, and 4 weeks prior to case date). We modeled exposures for lags 0-3, stratified by gender, age (35-64 and ≥ 65), and SES (percent living below poverty).

Results: We observed positive relationships between heavy smoke levels (>22 µg/m3) and OHCA, consistent across lags 0-3, while light and medium smoke often had negative associations. These relationships were more pronounced in the lower SES group, which experienced impacts across all exposure levels, while the higher SES group tended to have elevated ORs only with heavy smoke, and even showed deficits with light and medium smoke.

Conclusion: This study of cardiac arrest occurring outside a hospital setting may capture associations not represented in previous studies based on health care utilization. Consistent with many environmental exposures, the lower SES population appeared to be more vulnerable to the effects of wildfire smoke. Further investigation can help explain the differences in effects by SES and gender, and inform interventions most relevant to vulnerable populations during wildfire events.

This abstract does not necessarily reflect USEPA policy.
Wildfire smoke may interfere with the use of black carbon as an indicator of traffic exposure

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OPS 10: Wildfires, Room 210, Floor 2, August 26, 2019, 10:30 - 12:00

Background
Black carbon (BC) has been used to characterize traffic-related air pollution (TRAP) exposure. However, BC has multiple sources, including wildfire smoke (WS). We examined the potential for WS to bias exposure assessments of BC during wildfire events impacting Denver, Colorado.

Methods
Weekly integrated filter-based BC samples were collected during spring and summer of 2018. For each filter we calculated a time-weighted average concentration and assessed the length of major roads in a 300-m buffer around the sample location as a comparative measure of TRAP. A filter was considered impacted by WS if the closest network monitor recorded a weekly mean concentration at least one standard deviation (SD) above the 10-year monthly mean for that monitor and if a smoke plume was present within 50 km. We used the Kruskal-Wallis test and Spearman-Rank correlation to compare BC concentrations across roadway-length quartiles.

Results
We collected n=552 filters from >50 locations across the region, 29% of which were smoke-impacted. The mean (SD) BC concentration was 1.5 (0.8) μg/m³. Mean BC concentrations were 38% higher for smoke-impacted filters (2.1 μg/m³) than non-impacted filters (1.3 μg/m³, p<0.001). Similarly, the median absolute deviation for smoke-impacted filters (0.5 μg/m³) was higher than for non-impacted filters (0.3 μg/m³), suggesting increased variability in concentrations during wildfire events. For each roadway-length quartile, mean concentrations for smoke-impacted filters were significantly higher than for non-impacted filters: Q1: 2.0 vs. 1.2; Q2: 1.8 vs 1.2; Q3: 2.0 vs 1.3; and Q4: 2.6 vs 1.5 μg/m³ (all p-values<0.001). Spearman-Rank correlations between BC concentration and roadway-length quartile were similar for smoke-impacted filters (r=0.23) and non-impacted filters (r=0.15).

Conclusions
Exposure assessments relying on BC as a proxy for TRAP exposures may be biased by wildfire events. Future work will identify the extent to which this bias may affect studies of traffic-related air pollution.
Development of Land-Use Regression Models for Particulate Matter due to residential wood burning in Temuco, Chile

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Land use regression models have been widely employed in environmental epidemiology to predict spatiotemporal variation of air pollution. The spatial variability of fine particulate (PM2.5) due to wood-burning has not been studied in Chile. In this study, we used data from a sampling campaign to develop a Land-Use Regression (LUR) model in a city heavily impacted by wood-burning: Temuco, Chile.

Models were built based on a field campaign similar following the ESCAPE protocol. The campaign included sampling at 40 fixed sites in parallel with sampling at a central site located at a government monitoring station to control for background levels. Sites tried to maximize the spatial distribution of likely predictors such as number of residential dwellings, number of wood-stoves, PM2.5 concentrations and traffic impact. Two-weeks PM2.5 samples were collected at each site and repeated in 4 sessions covering a whole year. Samples were analyzed for mass and the wood-burning tracers levoglucosan and soluble potassium. To predict the spatio-temporal PM2.5 concentrations and wood tracers, land use regression models were built using average concentrations from the air pollutant campaign as response variable, and potential spatial and temporal predictors including meteorological variables, pollutants concentrations from the air quality network, traffic, urban green areas, land use, among other.

The results show that the LUR model was capable of explaining 0.94 of the variation in PM2.5. The population density, houses with coal stoves density, household density and length of local road were positively correlated with PM2.5 concentrations, whereas the no residential areas, density of woodstoves, traffic, electric stoves, elevation, temperature, and precipitation were negatively correlated with PM2.5.

This work is the first LUR study in a city heavily impacted by residential air pollution in Chile. The performance of the model was higher than wood burning LUR models reported previously.
Background/Aim: Few studies have investigated congenital anomalies in relation to municipal waste incinerators (MWIs) and results are inconclusive. The study aim was to conduct a national investigation into the risk of congenital anomalies in babies born to mothers living within 10 km of an MWI associated with: i) modelled concentrations of PM10 as a proxy for MWI emissions more generally and; ii) proximity of residential postcode to nearest MWI, in areas in England and Scotland that are covered by a congenital anomaly register.

Methods: Retrospective population-based cohort study within 10 km of 10 MWIs in England and Scotland operating between 2003 and 2010. Exposure was proximity to MWI and log of daily mean modelled ground-level particulate matter ≤10 µm diameter (PM10) concentrations.

Results: Analysis included 219,486 births, stillbirths and terminations of pregnancy for fetal anomaly of which 5,154 were cases of congenital anomalies. We found no increased risk of congenital anomalies in relation to modelled PM10 emissions, but small excess risks associated with congenital heart disease and genital anomalies and proximity to MWIs

Conclusions: The findings in proximity to MWI might reflect residual confounding, however, a true, causal effect cannot be excluded even in the absence of associations with modelled PM10 emissions and further monitoring of exposures near MWIs is warranted.
Associations of prenatal urinary phthalates, gestational weight gain, and postpartum weight retention among pregnant women from Mexico City
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OPS 15: Chemicals and pregnancy, Room 114, Floor 1, August 26, 2019, 10:30 - 12:00

Background
Weight gain during pregnancy contributes to obesity among women. Although diet and physical activity are contributors, environmental factors also play a role. Phthalates are ubiquitous environmental contaminants that have endocrine-disrupting capabilities and may interfere with energy balance and metabolism to influence weight. There has been little research on the impact of phthalates on long-term postpartum weight gain and retention. Thus, we utilized data from Programming Research in Obesity, Growth, Environment, and Social Stressors (PROGRESS) birth cohort to examine relations of phthalates exposure during pregnancy with gestational weight gain (GWG), postpartum weight retention (PWR), and long-term weight changes.

Methods
From 2007 to 2011, 948 pregnant women were recruited during the second trimester (baseline). Spot urine samples from the second and third trimesters were analyzed for 15 phthalate metabolites. Maternal anthropometric measurements and covariate data were collected at the second and third trimester as well as over seven additional visits through 72 months postpartum. Linear mixed models were used to estimate the relations of gestational phthalates exposure with GWG, PWR, and long-term weight differences.

Results
None of the measured phthalate metabolite concentrations were associated with GWG between the second and third trimester. Individual urinary phthalate metabolite concentrations and molar sums of DEHP, DEHTP, DOP, and DiBP were associated with greater GWR between the third trimester and one year postpartum. mCPP, a metabolite of DOP and non-specific metabolite of several other phthalates, was additionally associated with higher maternal body mass index (BMI, kg/m2) from 12 through 72 months postpartum (0.28 kg/m2 difference per interquartile range, p=0.02).

Conclusions
Prenatal exposure to several phthalates was associated with greater GWR, which may contribute to the development of obesity and other adverse metabolic health outcomes in women. Further studies are needed to explore long-term consequences and to develop interventions to reduce environmental contaminant exposures during pregnancy.
Per- and polyfluoroalkyl substances in early pregnancy and risk for preeclampsia

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OPS 15: Chemicals and pregnancy, Room 114, Floor 1, August 26, 2019, 10:30 - 12:00

BACKGROUND
Preeclampsia affects 3-7 percent of all pregnant women and is one of the most common causes of perinatal and maternal morbidity/mortality. Preeclampsia has been called "the disease of theories" because so much is unknown. One risk factor that has been suggested is exposure to endocrine disrupting environmental pollutants such as per- and polyfluoroalkyl substances (PFAS). Pregnant women absorb PFAS by ingestion, inhalation and dermal exposure. The present study aims to investigate the hypothesized association between serum concentrations of PFAS in early pregnancy and the risk of developing preeclampsia.

METHODS
The study was a case-control study including 296 women from the most southern county in Sweden (Skåne) who were diagnosed with severe preeclampsia (cases) and 580 health pregnant controls. Maternal serum samples were obtained from a biobank, which included samples collected in early pregnancy (around 12-14 weeks) in connection with screening for infections and German measles (rubella). Serum concentrations of perfluorohexane sulfonate (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA) and perfluorooctane sulfonate (PFOS) were analyzed at the laboratory of Occupational and Environmental Medicine in Lund, Sweden, using liquid chromatography-tandem-mass-spectrometry (LC/MS/MS).

RESULTS
The median serum concentration of all four PFAS was significantly higher among the cases as compared to the controls (18-26%; p-values<0.05). When the PFAS substances was categorized into quartiles, the women in the highest quartiles had significantly increased risks of developing preeclampsia as compared with women in the lowest category for PFOA (OR=1.96), PFNA (OR=1.83), and PFHxS (OR=2.18), respectively, whereas for PFOS there was a non-significant increase (OR=1.22). Adjusting for potential confounders did increase these estimates somewhat.

CONCLUSIONS
In the present study among women from the general population we did observe significant associations between maternal levels in early pregnancy of PFOA, PFNA and PFHxS, respectively, and the risk for developing preeclampsia.
Associations between urinary parabens exposure in early to mid-pregnancy and gestational diabetes mellitus

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OPS 15: Chemicals and pregnancy, Room 114, Floor 1, August 26, 2019, 10:30 - 12:00

Background/Aim: Certain endocrine disruptors have been linked to glucose homeostasis among pregnant women, but data on parabens in relation to gestational diabetes (GDM) are limited. We investigated the associations of urinary parabens 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 111 GDM cases diagnosed at gestational weeks (GW) 24-28 and 222 non-GDM controls, matched on age, GW at urine collection, and race/ethnicity (Asian/non-Asian, given high proportion of Asian cases). Urinary concentrations of butylparaben (BuP), ethylparaben (EtP), methyl paraben (MeP), and propylparaben (PrP) were assessed at GW 10-13 and 16-19, with cumulative concentrations estimated by area-under-the-curve. Conditional logistic regression examined the associations of parabens with GDM risk, after adjusting for pre-pregnancy body mass index, urinary creatinine levels, and race/ethnicity (White/Black/Hispanic/Asian).

Results: The detection rates for urinary parabens were 32% (BuP), 47% (EtP), 97% (MeP), and 94% (PrP). In the overall sample, PrP in the second versus lowest tertile at GW 10-13 was associated with GDM with a marginal significance (adjusted odds ratio 1.84; 95% CI 0.98-3.47), whereas no associations were observed for other parabens at either gestational period. When stratified by race/ethnicity, the association of PrP in the second versus lowest tertile with GDM was only significant among Asians [GW 10-13: 2.93 (1.06-8.08), P-for-interaction=0.29; GW 16-19: 3.18 (1.10-9.21); P-for-interaction=0.20]. Significant effect modification by race/ethnicity was observed for the cumulative concentrations of EtP (P-for-interaction=0.005), with a 2.66-fold (1.01-7.04) increased risk of GDM among Asians and 67% (0.33; 0.13-0.84) decreased risk among non-Asians, comparing women with detected versus non-detected levels.

Conclusions: Urinary PrP exhibited a non-linear association with GDM risk among Asians. Opposing associations were observed between detected urinary EtP and GDM risk among Asians (positive) and non-Asians (inverse). Further investigations are needed to understand these racial/ethnic differences.
Parameters of ovarian reserve in relation to urinary concentrations of parabens


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OPS 15: Chemicals and pregnancy, Room 114, Floor 1, August 26, 2019, 10:30 - 12:00

Background/Aim:
Parabens are commonly used as antimicrobial preservatives in cosmetics, pharmaceuticals, food and beverage processing. Widespread human exposure to parabens has been recently documented, and some parabens have demonstrated adverse effects on female reproduction in animal studies. Despite the widespread usage of parabens in personal care products little is known about their effect on female fertility. The aim of this study was to evaluate the association between environmental exposure to parabens and parameters of ovarian reserve.

Methods:
Urine samples collected from 511 female who attended the infertility clinic for diagnostic purposes were analyzed for five parabens concentrations using a validated gas chromatography ion-tag mass spectrometry method. Parameters of ovarian reserve were: follicle-stimulating hormone (FSH), antral follicle count (AFC), estradiol (E2) and anti-Müllerian hormone (AMH) levels.

Results:
In multivariate linear regression models adjusted for age, smoking and BMI only propyl paraben (PP) decrease antral follicle count (p=0.04), estradiol level (p=0.04) and increase the FSH concentration (p=0.028). Methyl (MP), ethyl (EP), butyl (BP) and isobutyl (iBuP) parabens were not associated any with parameters of ovarian reserve.
These findings suggest that exposure to PP may adversely affect ovarian reserve, one of the predictor of female fertility among women attending a fertility clinic.

Conclusions:
PP may be associated with diminished ovarian reserve. As this is one of the first study on this topic, so the observation of the relationship between parabens and ovarian reserve warrants further investigation.
No association between perfluorinated compounds and preeclampsia in the highly exposed population of Ronneby, Sweden

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OPS 15: Chemicals and pregnancy, Room 114, Floor 1, August 26, 2019, 10:30 - 12:00

Background: Previous studies examining associations between poly- and perfluorinated alkyl substances (PFAS) and preeclampsia have shown inconsistent results. In 2013, high levels of perfluorooctane sulfonate (PFOS), perfluorohexane sulfonate (PFHxS) and perfluorooctanoic acid (PFOA) were detected in the municipal drinking water in Ronneby, Blekinge county, Sweden. The contamination had likely been ongoing for 30 years. This study aimed to investigate the association between residential exposure to PFAS and preeclampsia.

Methods: All singleton births occurring during 1993 to 2013 in Blekinge, together with information on maternal diagnoses, were retrieved from the Medical Birth Register (n=30916). Information on residential exposure was retrieved from the Total Population Register. The three years before pregnancy was defined as the exposure-window of interest and women were categorized as exposed (residential address in Ronneby receiving contaminated water, n=1542), unexposed (residential address in Ronneby receiving uncontaminated water, n=4996) or controls (residential address outside Ronneby in Blekinge, n=24378). We used multilevel logistic regression to estimate associations between preeclampsia, including gestational hypertension, and residential PFAS exposure while adjusting for confounding by maternal body mass index, age, smoking status, birth country, education level and parity.

Results: We did not find an increased odds ratio of preeclampsia in women who had been resident in the area receiving contaminated water, neither compared to the control group (adjusted OR: 0.839, 95% CI: 0.640-1.101) nor compared to the population living in the unexposed area (adjusted OR: 0.939, 95% CI: 0.696-1.267).

Conclusions: We did not find any evidence of an association between residential exposure to PFAS and preeclampsia.
OPS 25: Drinking water contamination and adult health
Assessment of drinking water safety in the Netherlands using nationwide exposure and mortality data

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OPS 25: Drinking water contamination and adult health, Room 411, Floor 4, August 26, 2019, 10:30 - 12:00

Background
Drinking water in the Netherlands is generally accepted as safe. Although risk assessments for constituents point to large margins of safety between concentrations and health-based guideline values, public concern about health risks of long-term intake still exist. We explored associations between drinking water quality and causes-of-death using national databases.

Methods
The cohort consisted of 6,998,623 persons who were at least 30 years old on January 1 2008 and lived at least five years on the same address. We evaluated mortality due to a natural cause, cardiovascular diseases, coronary heart disease, lung cancer or colon cancer. Home addresses in 1800 drinking water provision areas were linked to 233 production stations. The REWAB database with drinking water quality for parameters mentioned in the EU Drinking Water Directive was used to assess the average concentration of arsenic, nitrate, hardness, calcium and magnesium over 2000-2010 at the production stations. We applied age stratified Cox proportional hazards models with province as random effect. We adjusted for sex, marital status, country of origin, household income, socio-economic status, PM10 and NO2.

Results
453,035 persons died during the five year follow up period of a natural cause. For mortality due to cardiovascular diseases, a 100 mg/l increase in calcium was associated with a HR of 1.08 (95% CI: 1.03, 1.13) and an increase of 2.5 mmol/l of water hardness with a HR of 1.06 (95% CI: 1.01, 1.10). Magnesium was associated with a reduced risk for mortality due to coronary heart diseases: HR of 0.95 (95% CI: 0.90, 0.99) per 10 mg/l increase. For other combinations studied, no statistical significant associations were identified.

Conclusions
The observed inverse relation for magnesium is in line with the literature. The results for calcium and hardness will be discussed in the light of the literature and of potential sources of bias.
Arsenic and disinfection by-products (DBPs) in drinking water in Canada: a population-based study to explore any association with relevant cancers.

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OPS 25: Drinking water contamination and adult health, Room 411, Floor 4, August 26, 2019, 10:30 - 12:00

Introduction: People are exposed to Arsenic and DBPs (Trihalomethanes (THMs) and Haloacetic acids (HAAs)) by drinking contaminated water. Arsenic is a naturally occurring element and known as a strong carcinogen. DBPs are formed by chlorination of water containing organic substances and considered possible human carcinogen. Water quality reports demonstrate the presence of high level of arsenic and DBPs in some areas of Newfoundland and Labrador (NL). However, there is no population level data on any association between the exposure to arsenic and DBPs and related cancer.

Aim: To explore any association between Arsenic and DBPs present in drinking water and relevant cancers at the community level.

Methods: High and low risk communities were identified based on water quality reports of provincial surveys. Cancer data were extracted from the NL Cancer Registry for cases diagnosed between 2007-2016. Certain disease information such as histology and topography and demographic information like sex, year of birth and residence at time of diagnosis were extracted. An ecological analysis was then conducted comparing cancer incidence rates between high risk and low risk communities.

Results: Relative risk (RR) of arsenic induced cancers (a combination of renal cell, squamous cell of lung, skin, basal cell and Merkel cell of skin, adenocarcinoma of colon and bile ducts, hepatocellular and angiosarcoma of liver, cholangiocarcinoma, transitional cell carcinoma of urinary bladder) was 3.8 (95% CI, 1.09, 1.58). For DBPs, RR of THMs and HAAs induced cancer (a combination of urothelial cell carcinoma of urinary bladder, adenocarcinoma of rectum, colon and esophagus, malignant mesothelioma of lungs, and acute and chronic myeloid leukemia) was 2.1 (95% CI 0.67, 0.82).

Discussion: Population level data showed that arsenic in drinking water was significantly associated in cancer incidences. However, despite the high relative risks, DBPs were not significantly associated with relevant cancer.
Long-term exposure to widespread drinking water chemicals, blood inflammation markers and colorectal cancer

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OPS 25: Drinking water contamination and adult health, Room 411, Floor 4, August 26, 2019, 10:30 - 12:00

Background/aim: Trihalomethanes (THMs) and nitrate are prevalent chemical contaminants in drinking water that have been associated with colorectal cancer but mechanisms of action are not well understood. We aim to identify immune system markers in the pathway between exposure to THMs and nitrate in drinking water and colorectal cancer risk.

Methods: A subset of 198 colorectal cancer cases and 205 controls part of the multicase-control study MCC-Spain were included (enrolment 2007-2013). Average concentration of THMs (chloroform, bromodichloromethane, dibromochloromethane, bromoform) and nitrate was estimated based on the residence since age 18 until 2 years before the interview (“long term”) and for the last year before the interview (“short term”), as well as concentrations in drinking water through routine monitoring records. Exposure through ingestion was estimated based on type of water consumed. We measured a panel of immune markers including IL-1rA, IL-8, IL-17E, IP-10, EGF, VEGF, MDC, MPO, G-CSF, eotaxin, and periostin through Luminex and C-reactive protein (CRP) through ELISA. We used linear regression to estimate the association between inflammation markers and 10μg/l increase in exposure among controls, and logistic regression to estimate the association between the inflammation markers and colorectal cancer adjusting for covariates (age, sex, study area, education, smoking, body mass index) and plate.

Results: Long-term exposure to drinking water contaminants was not associated with inflammation markers. Short-term THM levels were positively associated with IL-8, IL-17E and EGF (q-value 0.014, 0.023, 0.008, respectively). Ingested brominated and total THMs were positively associated with these same inflammation markers. No associations were identified for nitrate. VEGF and IL-1ra were positively associated with colorectal cancer (OR=1.38, 1.10-1.75; and 1.37, 1.05-1.81, respectively) while CRP was negatively associated (OR=0.82, 0.77-0.88).

Conclusions. We did not identify inflammation markers in the pathway between THM/nitrate exposure and colorectal cancer.
Ulcerative colitis, Crohn’s disease and other inflammatory bowel disease in a population with high exposure to per- and polyfluoroalkyl substances through drinking water


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OPS 25: Drinking water contamination and adult health, Room 411, Floor 4, August 26, 2019, 10:30 - 12:00

Background: Per- and polyfluoroalkyl substances (PFAS) can act as surfactants and have been suggested to be capable of affecting gut mucosa integrity, a possible pathogenesis of ulcerative colitis (UC), Crohn’s Disease (CD) and other inflammatory bowel disease (IBD). So far, only perfluorooctanoic acid (PFOA) has been shown a potential positive association with UC.

Objectives: To investigate the associations of PFAS and diagnosed UC, CD and other IBD in Ronneby cohort, a population with high PFAS exposure through drinking water, using registry data.

Methods: All people that ever resided in Ronneby municipality at least one year between 1980 and 2013 were included. Crude exposure (never/ever) and time-varied exposure (never/early/mid/late) were assessed based on yearly residence address and waterworks supply data. Early period (1985-1994) were assumed the lowest exposure, and late period (2005-2013) were assumed highest exposure. Diagnosed IBD cases were retrieved from Swedish National Patient register and cause-of-death register. Cox proportional hazards model was used to estimate the hazard ratios (HRs) for diagnosed IBD, in men and women separately.

Results: No higher HRs for any kind of IBD were found for cohort subjects ever exposed compared to never exposed, in men or women. No trend of increasing HRs were found across the time-varied exposure, either. Only a slightly higher HR for CD was found for women with early period exposure compared to never exposure (HR = 1.76, p=0.073), and a slightly higher HR for other IBD for men with early exposure (HR=1.51, p=0.083). These higher HRs for early period exposure were not followed by higher HRs for mid (1995-2004) and late period exposure.

Conclusions: The lack of an overall effect together with the lack of a dose response across time-varied exposure (representing increasing exposure levels) in the present study did not support that PFAS exposure is a risk factor for IBD.
Half-lives of PFOA, PFPeS, PFHxS, PFHpS and PFOS after end of exposure to contaminated drinking water

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OPS 25: Drinking water contamination and adult health, Room 411, Floor 4, August 26, 2019, 10:30 - 12:00

Background/Aim: Per- and polyfluoroalkyl substances (PFAS) comprise a group of many different substance that been produced and widely used. They have been reported in humans and wildlife. The purpose of this observational study was to estimate the elimination half-life PFAS from human serum after end of exposure to contaminated drinking water.

Method: Municipal drinking water contaminated with PFAS had been distributed to one third of households in Ronneby, Sweden. The source was firefighting foam used in a nearby airfield since the mid-1980s. Clean water was provided from December 16, 2013. Up to ten blood samples were collected between June 2014 and May 2019 from 108 participants with a large age span (4-84 years) and balanced gender (53% female). Several PFAS were analyzed. In the present study, we reported the dominant ones: perfluorooctanoic acid (PFOA), perfluoropentane sulfonate (PFPeS), perfluorohexane sulfonate (PFHxS), perfluoroheptane sulfonate (PFHpS) and linear perfluorooctane sulfonate (PFOS).

Results: Median initial serum concentrations were: PFOA 16 ng/ml (range 2-78), PFPeS 5.9 ng/ml (range 1-49), PFHxS 257 ng/ml (range 15-1304), PFHpS 12 ng/ml (1-70) and PFOS 169 ng/ml (12-682). The observed data are consistent with a first-order elimination model. The mean estimated half-lives were 3.0 years (95% CI 2.8-3.2) for PFOA, 1.0 years (95% CI 0.9-1) for PFPeS, 4.7 years (95% CI 4.3-5.2) for PFHxS, 4.7 years (95% CI 4.3-5.3) for PFHpS and 2.9 years (95% CI 2.7-3.1) for PFOS. There was a marked age and BMI effect on half-life with more rapid elimination in younger ages and lower BMI for all PFAS studied.

Conclusion: These are the first half-life data on elimination of new PFAS compounds in a community and they are marked variation with carbon chain length.
Chronic Kidney Disease of undetermined cause (CKDu), an emerging disease in developing nations: a Malawian geographical study with focus on potable water sources

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OPS 25: Drinking water contamination and adult health, Room 411, Floor 4, August 26, 2019, 10:30 - 12:00

Background: There is increasing recognition of epidemics of primarily tubular-interstitial chronic kidney disease (CKD) clustering amongst working-age populations in agricultural communities in low-and-middle-income countries. These conditions have been termed CKD of undetermined cause (CKDu) due to unidentified underlying aetiology. Hypothesised causes include heat stress and heavy metal exposure through potable water. Our aim was to investigate CKDu presence in Malawi, and identify potential risk factors including nephrotoxic heavy metals in potable drinking water.

Methods: Blood and urine samples (n=770) taken from an urban and rural study site (January-August 2018) were used to estimate kidney function across the sample population. We applied linear and logistic regression models with postulated risk factors including age, sex, education, residence, vegetarianism, and body mass index to estimate risk of low glomerular filtration rate (eGFR) (<90 ml/min/1.73m²).

We collected potable water samples which were tested for trace metals by Nottingham University. We analysed the spatial distribution of trace metals across the study area using inverse distance weighting with standardised z-scores.

Results: Mean eGFR was 117.1±15.83ml/min/1.73m². Prevalence of low eGFR was 5% (95%CI = 3.0, 6.2), and did not vary substantially between sites. Factors associated with low eGFR included low income (<10,000 Malawian Kwacha) [OR (95%CI) = 0.16 (0.02, 1.07)]; and age [4.87 (0.39, 6.00)] per 10-year increase. Mean trace metal concentrations did not exceed permissible limits. However, some sites contained nephrotoxic metal concentrations which neared limits, including Cadmium (2.66µg/L, World Health Organisation limit 3.00µg/L).

Conclusions: Reduced kidney function in the absence of known risk factors (eGFR <90 ml/min/1.73m²) was observed across our study area, however little difference in risk between sites was observed. No known nephrotoxic trace metals exceeded permissible limits, however, analyses of heavy metals concentrations in bio samples will be conducted to rule these out as risk factors for reduced kidney function in Malawi.
OPS 45: Cardiometabolic effects of air pollution
Fine Particulate Matter Exposure and Childhood Lipid Levels in the PROGRESS Cohort

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OPS 45: Cardiometabolic effects of air pollution, Room 117, Floor 1, August 26, 2019, 10:30 - 12:00

Background: Studies have identified associations between air pollution and lipid levels in adults, suggesting a mechanism by which air pollution contributes to cardiovascular disease (CVD). However, little is known about the association between early life air pollution exposure and lipid levels in children. Given that elevated lipid levels may track from childhood to adulthood, research in children may provide insight into the early origins of CVD.

Methods: Participants included 465 mother-child pairs from a prospective birth cohort in Mexico City. Daily \(PM_{2.5}\) predictions were estimated using a 1km satellite-based exposure model and averaged over trimesters, entire pregnancy, and the first year of life. We assessed associations with several lipid measures at 48 months of age, including HDL, LDL, total cholesterol and triglycerides. Linear regression models were used to estimate change in lipid levels with each \(\mu g/m^3\) increase in \(PM_{2.5}\) for each of the different time periods. Quantile regression was additionally used to assess if the \(PM_{2.5}\) effect varied for individuals with low vs high lipid concentrations. Models were adjusted for maternal education, pre-pregnancy BMI, child’s age at study visit, child sex, and season of conception.

Results: \(PM_{2.5}\) exposure during the third trimester was associated with increases in childhood LDL levels (\(\beta=1.23, 95\%CI: 0.60, 1.85\)), in models adjusted for exposures in the first and second trimesters. There was additionally an increasing trend in the effect estimate across higher quantiles of LDL concentrations during the third trimester (\(\beta=0.57, 95\%CI: 0.03, 1.47\) for the 30th percentile of LDL concentrations and \(\beta=2.99, 95\%CI: 1.56, 3.83\) for the 90th percentile).

Conclusions: \(PM_{2.5}\) exposure in late pregnancy may be a critical window for elevated LDL cholesterol in children. Effects were strongest among children with the highest LDL levels which may represent a sensitive subpopulation. Future analyses will use distributed lag models to further define time-specific effects.
Association between Ambient Air Pollution and Subclinical Atherosclerosis: Insight from a Chinese Imaging Cohort Study

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OPS 45: Cardiometabolic effects of air pollution, Room 117, Floor 1, August 26, 2019, 10:30 - 12:00

Background: Exposure to ambient air pollution is associated with cardiovascular risk, potentially via atherosclerosis promotion. The disease mechanism underlying these associations remains uncertain. We aim to investigate the relationship between air pollution and subclinical atherosclerosis, with insight into coronary plaque phenotypes.

Methods: Exposure to air pollutants including fine particulate matter (PM2.5), nitrogen dioxide (NO2), and ozone (O3) were estimated from the Land Use Regression/Kriging models for the years between 2014 and 2016. Coronary plaque morphology, plaque vulnerability, and arterial stenosis were characterized by computed tomography angiography for 2350 atherosclerotic patients in a Chinese cohort. Multiple linear regression models were used to assess the association of each environmental exposure with plaque phenotypes and coronary stenosis, controlling for potential confounders. Logistic regression model was used to estimate associations with plaque vulnerability.

Results: The studied cohort was 60±10 years old. In fully adjusted models, PM2.5 and NO2 concentrations were associated with 5.0% (95%CI, 0.3-9.9%, per 25 µg/m3 PM2.5) and 12.0% (95%CI, 2.5-22.5% per 25 µg/m3 NO2) larger volumes of soft plaque (non-calcified), respectively. Likewise, O3 concentration was associated with 12.2% (95%CI, 2.2-23.2%, per 10 µg/m3 O3) larger volumes of calcified plaque and 12.8% (95%CI, 0.9-26.2%) greater arterial narrowing. Furthermore, higher risks of presence of vulnerable plaque were associated with increasing exposures to PM2.5 and NO2, characterized by napkin ring sign (odds ratio: 1.41 [95%CI: 1.11-1.81] for PM2.5 and 1.78 [95%CI: 1.20-2.63] for NO2) and positive remodeling index (ORs: 1.1 [95%CI: 1.01-1.21] for PM2.5 and 1.20 [95%CI: 1.02-1.42] for NO2), respectively.

Conclusion: Long-term exposures to air pollution were associated with greater degrees of plaque volumes and arterial stenosis, and higher risk of plaque vulnerability that is prone to rupturing and erosion. This finding provides support for the pathophysiologic role of coronary atherosclerosis in mediating the effect of air pollution exposure on cardiovascular disease.
Background: Air pollution is a leading preventable risk factor for cardiovascular diseases. Previous studies mostly relied on outdoor concentrations at residence, which might not represent personal exposure.

Aim: To evaluate the association between the estimated long-term personal exposure to PM2.5 and black carbon (BC) and intermediate cardiovascular markers in peri-urban South India.

Methods: We analyzed the third wave of the APCAPCS cohort (2010-2012), which recruited participants from 28 villages. We used predicted personal exposure to PM2.5 and BC derived from 610 participant-days of 24h average gravimetric PM2.5 and BC measurements and predictors related to usual time-activity.

Outcomes included carotid intima-media thickness (CIMT), carotid-femoral pulse wave velocity (cfPWV) and augmentation index (Alx). We fit linear mixed models, adjusting for potential confounders and accounting for the clustered structure of the data.

Results: Of the 3017 participants (mean age 38 years), 1453 (48%) were females. The average PM2.5 exposure was 51 µg/m3 (range 13-85) for males, and 61 µg/m3 (range 40-120) for females, while the average BC was 4 µg/m3 (range 3-7) for males and 8 µg/m3 (range 3-22) for females. A 1-ln (µg/m3) increase of PM2.5 was positively associated with CIMT (0.125 mm, 95% CI 0.067, 0.183), cfPWV (0.308 m/s, 95% CI 0.005, 0.611) and Alx (3.5%, 95% CI 1.0, 6.0) among males. Both PM2.5 and BC were positively associated with Alx among females (3.7%, 95% CI 1.4, 6.0, per 1-ln [µg/m3] PM2.5; 1.7%, 95% CI 0.5, 2.8, per 1-ln [µg/m3] BC). Results were robust to several sensitivity analyses, but the effect of PM2.5 on cfPWV for males was attenuated after adjusting for blood pressure.

Conclusions: We provide new evidence on the effect of personal exposure to particulate matter and cardiovascular risk at high exposures levels and in a setting where personal exposure is not correlated with outdoor concentration at residence.
Acute effects of personal exposure to fine particulate matter on blood pressure: results from the AIRLESS Study

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Background and Aim

Evidence on the relationship between exposure to fine particulate matter (PM2.5) and blood pressure (BP) is inconsistent. We aimed to examine the acute effects of personal exposure to PM2.5 on BP in populations.

Methods

During Nov-Dec 2016 (winter) and May-Jun 2017 (summer), 251 participants aged 40-70 years living in an urban (N=123) or a rural (N=128) site of Beijing were enrolled into a panel study (AIRLESS). Personal exposures to PM2.5 were measured for 7 consecutive days in each season with a personal air monitor (PAM). The PAM measurements have been validated by comparison against stationary reference monitors. Twelve seated BP measurements were taken across 4 visits at the clinics for each participant (2 visits to the clinics at Day 3 and 7 per the week-long campaign). The association between PM2.5 and BP was examined with a linear mixed-effects model adjusting for demographic, socioeconomic status (SES) and lifestyle parameters, temperature and relative humidity.

Results

The weekly mean concentrations (standard deviation [SD]) of personal exposure to PM2.5 during winter and summer campaign were 33.8(18.9) and 28.7(9.9) μg/m3 in participants of the urban site and 64.1(35.4) and 34.3(12.3) μg/m3 of the rural site, respectively. Preliminary analyses indicate that increased personal exposure to PM2.5 (per interquartile range [IQR] increase: 26.1-29.1 μg/m3) during the prior 1-3 days was significantly associated with elevated systolic BP ranging from 1.0 (95% Confidence Interval: 0.3-1.6) to 1.4 mmHg (0.8-1.9), after adjusting for covariates (all p<0.001). Similar results were found for diastolic BP. However, the association between PM2.5 and BP was no longer statistically significant after further adjustment for personal measurements of temperature and relative humidity.

Conclusions

Personal PM2.5 exposures may exert small adverse effects on BP, but this positive association was attenuated by adjustments of the current temperature and relative humidity.
Low-level air pollution and incidence of acute coronary events: pooled analysis of 6 European cohorts in the ELAPSE project

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OPS 45: Cardiometabolic effects of air pollution, Room 117, Floor 1, August 26, 2019, 10:30 - 12:00

Background/Aim
Long-term exposure to outdoor air pollution increases the risk for acute coronary events but the evidence for concentrations below current EU, EPA and WHO Limit Values or Guidelines remains unclear. Within the multicentre Effects of Low-Level Air Pollution: A Study in Europe (ELAPSE) study, we aim to fill this gap focusing on the shape of the concentration-response function particularly in the low range.

Methods
We pooled data of 137,194 participants from six cohorts from Sweden, Denmark, the Netherlands, and Germany and harmonized individual and area-level variables between cohorts. Annual average air pollution concentration of fine particulate matter (PM2.5), nitrogen dioxide (NO2), ozone (O3) and black carbon (BC) was centrally modelled for Europe for 2010 by hybrid land use regression models (100 m resolution). We used stratified Cox proportional hazard models with increasing covariate adjustment to investigate the association between residential long-term air pollution and coronary events incidence. We applied several methods to assess sensitivity to the method accounting for cohort heterogeneity, including indicators, frailty and mixed models. We assessed the shape of the concentration-response function with subset and threshold analyses, and the application of splines and S-shaped functions. We also investigated multi-pollutant models.

Results
We observed 10,050 incident coronary events with an average follow-up of 16 years. A 10 µg/m3 increase in NO2 was associated with an HR of 1.04 (95% CI: 1.01, 1.07), whereas PM2.5 or BC estimates were not statistically significantly elevated. O3 indicated no positive association with coronary events. Associations for NO2 remained significant when excluding participants with residential concentrations above the European annual mean limit of 40 µg/m3 (HR = 1.03; 95% CI: 1.00, 1.07). No thresholds were identified and concentration-response analyses indicated no deviation from linearity.

Conclusions
Long-term NO2 exposure was associated with incidence of acute coronary events, even at low levels.
Does type 2 diabetes mediate the effects of traffic-related air pollution (NOx) on cognitive decline?

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OPS 45: Cardiometabolic effects of air pollution, Room 117, Floor 1, August 26, 2019, 10:30 - 12:00

Background: Type 2 diabetes mellitus (T2DM) is among the fastest growing chronic disease pandemics globally. Evidence has accumulated that people with T2DM, compared to those without, are at an increased risk of cognitive impairment. Shared pathways between T2DM and cognitive decline have been suggested. Air pollution has been associated with both conditions.

Objective: To examine whether the association between air pollution and the risk of dementia/CIND is mediated by T2DM.

Methods: In a 10-year longitudinal, community-based study of elderly Latinos (n=1564), staff repeatedly assessed cognitive function. We generated local traffic-related air pollution (TRAP) estimates (NOx) at study participants’ residential addresses during the year of enrollment, using a CALINE4 dispersion model. We used Cox proportional hazards modeling to assess the relationship between NOx and dementia/cognitive impairment, non-dementia (CIND), and mediation methods to separate the estimated direct effect and indirect effect operating through T2DM.

Results: Higher levels of NOx were associated with T2DM (per IQR (2.31 ppb), OR=1.18, 95% CI=1.04, 1.31), and T2DM was related to incident dementia/CIND (HR=2.02, 95% CI=1.46, 2.80). NOx was also associated with faster time to dementia/CIND (total effect (TE): HR=1.20, 95% CI=1.01, 1.41). The estimated direct effect of NOx on time to dementia/CIND was 1.15 (95% CI=0.96, 1.36) and estimated indirect effect mediated through T2DM was 1.04 (95% CI=1.01, 1.09). Meaning, 22% of the estimated TE of NOx on time to dementia/CIND was mediated through T2DM.

Conclusions: We found higher exposure to local TRAP to be associated with higher incidence of cognitive impairment. Moreover, we estimated that 22% of the effect of TRAP on dementia/CIND was mediated through T2DM, suggesting a strong indirect pathway through metabolic dysfunction between toxic air pollution-related exposures and cognitive function.
OPS 57: Black carbon exposure and health effects
Ambient air pollution, PM components and mortality in a Danish cohort
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OPS 57: Black carbon exposure and health effects, Room 110, Floor 1, August 26, 2019, 10:30 - 12:00

Background/Aim
Air pollution, including particulate matter (PM) increases mortality. It is debated which components of the complex air pollution is responsible for the higher mortality, which is of vast importance for prevention strategies. The aim of this study was to address the relation between long-term exposure to air pollutants, including PM components, after intensive adjustment for confounders (including noise) in relation to mortality.

Methods
In a cohort of 49,564 Danes, we investigated the association between mortality (all natural, cardiovascular, respiratory) and NO2, O3, PM2.5, PM10 and PM components including black carbon (BC), organic carbon (OC), sea salt, and secondary organic and inorganic aerosols. Residential address history from 1979 was combined with air pollution concentrations from a validated Danish air pollution dispersion modelling system, AirGIS, and data on traffic noise, lifestyle and socio-demography.

Results
During a mean follow-up of 18.1 years, 10,193 deaths occurred. Median concentrations at the residential addresses of participants were 24.0, 18.0, 25.1, 0.92, and 55.4 µg/m3 for NO2, PM2.5, PM10, BC and O3, respectively. We found higher HRs for all natural cause and CVD mortality in association with NO2, PM2.5, and PM10 and lower HRs in association with O3. We found no clear association with respiratory disease mortality. The PM components BC, OC and secondary organic aerosols seemed particularly important for mortality whereas no association was observed for sea salt.

Conclusions
The results of these analyses confirmed the importance of air pollution for mortality and pointed out specific air pollution components as particularly important.
Particulate air pollution and blood glucose levels and diabetic status in peri-urban India
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Background: Limited evidence exists on the effect of particulate air pollution on blood glucose levels. We evaluated the associations of residential and personal fine particulate matter (PM2.5) and black carbon (BC) with blood glucose and diabetic status in residents of 28 peri-urban villages in South India.

Methods: We used cross-sectional data from 5,065 adults (≥18 years, 54% men) of the Andhra Pradesh Children and Parents Study. Fasting plasma glucose was measured in 2010-2012 and prevalent prediabetes and diabetes were defined following the American Diabetes Association criteria. We estimated annual residential exposure to PM2.5 and BC levels using land-use regression models and long-term personal exposure to PM2.5 and BC using prediction models. We used linear and logistic nested mixed-effect models to assess the association between exposure metrics and health outcomes. For personal exposures, we stratified analyses by sex.

Results: 16% of participants had prediabetes and 5% had diabetes. Residential PM2.5 and BC averages (SD) were 33(3) µg/m³ and 2.5(2.6) µg/m³, respectively; personal exposures to PM2.5 and BC were 55(12) µg/m³ and 5.8(2.5) µg/m³, respectively. Within-village PM2.5 and BC were not associated with blood glucose levels. Personal PM2.5 (20 µg/m³ increase) and BC (1 µg/m³ increase) were negatively associated with blood glucose levels in women (PM2.5: -1.93, 95%CI: -3.12, -0.73; BC: -0.63, 95%CI: -0.90, -0.37). In men, associations were negative for personal PM2.5 (-1.99, 95%CI: -3.56, -0.39) and positive for personal BC (0.49, 95%CI: -0.44, 1.43). We observed no evidence of associations between any exposure metrics and prevalence of prediabetes/diabetes.

Conclusions: Our results do not provide evidence that residential exposure to PM2.5 and BC is associated with blood glucose or prevalence of prediabetes/diabetes in this population. Associations with personal exposure may have been affected by unmeasured confounding, highlighting a challenge in using personal exposure estimates in air pollution epidemiology.
The Relationship Between Indoor Levels of Black Carbon and Blood Pressure

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OPS 57: Black carbon exposure and health effects, Room 110, Floor 1, August 26, 2019, 10:30 - 12:00

Background: Particulate matter less than 2.5 μm in diameter (PM2.5) is a multi-component air pollutant and a major environmental contributor to cardiovascular disease (CVD). The specific components of PM2.5 responsible for CVD are under investigated. Black carbon (BC) comprises a significant portion of PM2.5 and is thought to be an important contributor to CVD through its impact on blood pressure. The effect of indoor BC exposure on blood pressure (BP) is less clear with few studies conducted in U.S. general population cohorts. Our objective was to explore the relationship between various lag times of BC exposure in the home on BP.

Methods: Acute exposure (1 hour – 5 days) to BC was measured in 76 homes of individuals aged 10-71 in New Orleans, Louisiana. Continuous 5-day samples were obtained in the home using a microaethalometer (AethLabs MicroAeth AE51). Blood pressure was measured on day 5 using the Omron HEM 907XL sphygmomanometer (Omron Healthcare Inc). The average of three BP measurements taken 1 minute apart was used in all analyses.

Results: Black carbon exposure averaged 0.60 (± 0.81) μg/m³ over the 5-day sampling period and daily averages ranged from 0.48 - 0.78 μg/m³. At all lag times, increasing BC was associated with increased systolic blood pressure. The BC level 0-72 hours prior to the measured BP showed the strongest effect. In adjusted models, a 1-μg/m³ increase in BC was associated with a 7.09 mmHg (p=0.03) increase in systolic blood pressure. The relationship was stronger in those reporting doctor diagnosed hypertension (β = 6.7 vs β = 1.7). Black carbon level was not associated with diastolic blood pressure.

Conclusion: Indoor exposure to BC is positively associated with increasing systolic blood pressure with the most relevant exposure window being 0-72 hours prior to BP measurement. Those with hypertension may be a more susceptible subpopulation.
Effect modification of the association of indoor black carbon exposures and oxidative stress in patients with COPD

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Background/Aim: Traffic-related particles have been associated with oxidative stress; however, there are limited studies examining susceptible subgroups in populations with respiratory disease. In this study, we assessed effect modification by comorbidity (self-reported diabetes and heart disease) on the associations between indoor black carbon (BC) and oxidative stress biomarkers in chronic obstructive pulmonary disease (COPD) patients.

Methods: We recruited 134 participants with COPD (former smokers, no indoor combustion sources) who ran a micro-environmental sampler in their home for 1 week up to 4 times a year followed by urine collection (377 samples). Indoor BC concentrations were estimated by optical measurement at 880 nm wavelength, and moving averages were calculated up to one week before urine collection. Urine samples were analyzed for 8-OHdG and malondialdehyde (MDA). We fit mixed effects models with a random intercept for each participant and adjusted for age, race, season, time of urine collection, BMI, creatinine, diabetes, heart disease, recent cold, statin use, ambient temperature, and relative humidity in the full population. We assessed the effects of black carbon on oxidative stress in each diabetes and heart disease subgroup using multiplicative interaction terms.

Results: In the full population, indoor BC was positively associated with 8-OHdG and MDA. For each IQR increase in mean one-week BC exposures, there were significantly greater effects on MDA in participants with diabetes (26.9%; 95%CI: 10.2, 46.1) compared to those without (4.2%; 95%CI: -3.6,12.7), p-for-interaction = 0.03. Although there were no statistically significant differences in effects between participants with and without heart disease, levels of MDA were elevated in participants with heart disease. There was no evidence of susceptible subgroups for associations with 8-OHdG.

Conclusions: Our results suggest that among COPD patients, those with diabetes may be more susceptible to effects of BC on lipid peroxidation.
The effect of complex traffic-related mixtures on blood pressure: interaction between particles and gases in a trial of vehicle filtration

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Introduction: We have previously found that in-vehicle particle filtration lowers blood pressure relative to no filtration in healthy subjects during a scripted commute. Since traffic-related air pollution is a mixture of particles and gases, we now assessed the interaction between particle count and gas exposure on blood pressure in the commute study.

Methods: 16 young healthy participants took three 2-hr drives in heavy Seattle traffic, in a crossover design, double-blinded, randomized to order, and several weeks apart. On two “unfiltered” days, on-road air was entrained into the vehicle cabin through sham filters. On one “filtered” day, the vehicle was equipped with particle and carbon filters. Blood pressure was measured during exposure using a finger pulse-waveform device. In-vehicle particulate matter (particle count, black carbon) and gases (oxides of nitrogen, CO2, and ozone) were measured continuously during the drive.

Results: Filtration substantially reduced particle exposure (85% lower particle count—PNC—on filtered days), but not measured gases. Discretized average first-hour PNC (cutoff: 10000 particles/cm3) was significantly associated with 1-hr diastolic blood pressure: 7.0 mmHg higher (95%CI: 1.6, 12.5) for high vs low exposure, essentially mirroring previous filtration effects. PNC effect on diastolic blood pressure was stronger when NO2 was lower (<20 ppb): 15 mmHg (CI 7.1, 25.1) for high vs low PNC compared to 1.5 mmHg when NO2 was higher (CI -5.4, 8.2) (interaction p=0.017). Results were similar for systolic blood pressure.

Conclusion: In summary, urban traffic pollutant inhalation causes an acute increase in blood pressure that can be reduced with effective air filtration, and may be modified by exposure to gaseous co-pollutants represented by NO2.
Aim: To evaluate association between personal level exposure to black carbon and 24-hour ambulatory blood pressure (BP) in healthy adults living in a heavily polluted urban region.

Methods: In Beijing AIRCHD study (Air Pollution and Cardiovascular Dysfunctions in Healthy Adults Living in Beijing), 73 healthy adults (mean age of 23.3 ± 5.4 years) were recruited and followed-up with 4 repeated study visits in 2014-2016. At each clinical visit, participants were fitted with a portable Holter recording 24-hour ambulatory BP, and concurrent concentrations of personal five-minute black carbon were determined using a micro-Aethalometer instrument. Linear mixed-effects models with random intercepts were applied to assess the impacts of black carbon on BP.

Results: The mean concentration of personal black carbon over 24-hour was 2.62±2.57 µg/m3. Significant increases in systolic BP of 0.85 mm Hg (95% Confidence Interval (CI): 0.48, 1.21) to 0.57 mm Hg (95% CI: 0.15, 0.99), diastolic BP of 0.64 mm Hg (95% CI: 0.33, 0.96) to 0.39 mm Hg (95% CI: 0.02, 0.76) and mean arterial pressure of 0.72 mm Hg (95% CI: 0.41, 1.02) to 0.46 mm Hg (95% CI: 0.09, 0.82) were associated with interquartile range increases in moving average concentrations of black carbon at prior 30 minutes to 5 hours. The results were stable with adjustment for heart rate as a time varying covariate for systolic BP and diastolic BP. In addition, associations were stronger in participants with higher levels of high-sensitivity C-reactive protein, malondialdehyde and 8-hydroxy-2'-deoxyguanosine.

Conclusions: Acute exposure to black carbon at personal level was associated with significantly increased blood pressure in healthy adults living in high pollution area. Systemic inflammation and oxidative stress may modify the adverse vascular effects attributable to air pollution.
PDS 68: Outdoor air pollution, mortality and morbidity

Associations of short-to-long-term air pollution exposure with mortality in seven major cities of Korea, 2007-2016

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Background/Aim: Exposure to air pollution affects health on both short- and long-term time scale. In this study, we aimed to estimate the effect of short-to-long-term air pollution exposure on mortality in Korean adults and to compare the air pollution-mortality associations by age groups.

Methods: From 2007-2015 KNHANES-linked mortality data which are followed through December 2016, we used 17,262 participants aged over 30 and resided in 7 major cities of Korea. The district level short-to-long term (1day, 1week, 1month, 6months, 1year, and 3years moving averages) concentrations of PM10, NO2, and SO2 were assigned to individuals based on residential address. A cox-proportional hazard regression model was used to estimate the effects of time-dependent exposure of air pollutants on all-cause mortality. We stratified the analyses by age groups.

Results: During 91,169 person-years, 619 deaths were identified. We could not find statistically significant association between short-to-long-term exposure to air pollutants and mortality, although exposure–mortality associations were of larger magnitude for longer exposure periods of NO2 [e.g., HR 1.22 (95% CI: 0.79, 1.88) and HR 1.58 (95% CI: 0.98, 2.57) per 10ppb increase in 1month and 1year exposure, respectively] and shorter exposure period of PM10 [e.g., HR 1.01 (95% CI: 0.65, 1.55) and HR 0.90 (95% CI: 0.52, 1.60) per 10μg/m3 increase in 1month and 1year exposure, respectively]. Age-stratified analyses showed inconsistent results by air pollutants and exposure periods.

Conclusions: We did not find a significant association between air pollution and mortality in this study. The low statistical power caused by the small number of deaths may be one of the possible reasons for our results. Nonetheless, given that the KNHANES-linked mortality data is a representative cohort of Korean with various variables including dietary factors, it is expected to be useful in assessing long-term exposure effects of environmental factors in the near future.
Short-term Exposure of Fine Particle Chemical Constituents Associated with Cause-specific Cardio- and Cerebrovascular Hospitalizations in Beijing, China

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background: Given a growing understanding that fine particles (PM2.5) pose a threat to human cardiovascular health, identifying specific health relevant chemical components of PM2.5 has become a priority in environmental health research.

Methods: Using Poisson generalized additive models, we assessed short-term associations between daily cause-specific cardio- and cerebrovascular hospitalization admissions and daily concentrations of PM2.5, for both total mass and ten types of its chemical constituents. We also used stratified analysis to observe seasonal patterns of the pollutants’ associations with selected outcomes. Associations were estimated per interquartile range (IQR) change for each pollutant with percent increase in selected outcomes.

Results: PM2.5 total mass, carbonaceous constituents, and salt ions were negative associated with cardio- and cerebrovascular hospitalizations. An IQR increase in same day PM2.5 mass, organic and element carbon, ammonium, chloride, nitrate, and sulfate ion were associated with a 4.31% (95% CI: 2.93, 5.70%), 2.69% (95% CI: 1.56, 3.83%), 2.73% (95% CI: 1.50, 3.99%), 4.42% (95% CI: 3.00, 5.86%), 1.81% (95% CI: 0.74, 2.89%), 2.82% (95% CI: 1.75, 3.90%) and 3.58% (95% CI: 2.20, 4.96%) increase in total cardio- and cerebrovascular admissions, respectively. In the season-stratified analysis, the association of the above pollutants with cerebrovascular hospitalizations appeared to be stronger in warm seasons than in cold seasons. Non-significant associations were observed for crustal elements (calcium, magnesium, sodium and potassium).

Conclusions: Our findings add evidence that link carbonaceous constituents and salt ions with cardio- and cerebrovascular hospitalizations, and suggest that these constituents are more harmful for cerebrovascular health in cold seasons.
Evaluation of health impact of PM10 forecasting & warning system in Seoul, Korea: Focusing on the change of dose-response function

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background/Aim
PM10 forecasting and warning (PM F&W) aims to protect the health of citizens from PM10 by providing information for taking precautionary actions. In Seoul, Korea, the PM F&W has been implemented since 2005. However, effects of the policy have not been evaluated. Unlike other command-and-control policies, effectiveness of the policy may significantly depend on the compliance of population. In 2013, as WHO classified the outdoor air pollution as Group 1 carcinogen, public interest for PM grew sharply in Korea. In the present study, we aimed to estimate whether the PM F&W was effective in reducing mortality attributable to PM10 in Seoul, Korea and whether the announcement of WHO has changed the effects of PM F&W.

Methods
The effects of PM F&W were evaluated by comparing dose-response functions between PM10 and non-accidental mortality. Since the policy calls on people to take precautionary actions only after the threshold value that triggers warning protocol, the effects are expected to be observed only after the threshold value while below it remains unchanged. Under the hypothesis, we divided the study period into three separate periods and compared the dose-response function: Period 1, before the policy implementation (2001–2005); Period 2, after the implementation (2005–2013); Period 3, After the announcement of WHO (2013–2016).

Results
The dose-response function did not show a significant difference between Period 1 and Period 2, which represents the early PM F&W might not had been effective. After the announcement of WHO, however, attenuation in PM10 effects was observed around middle-high concentration of PM10, and 1,208 estimated deaths were benefited from it.

Conclusion
Our results suggest mere implementation of PM F&W may not be enough to achieve its intended goal. Other strategies to raise public perception to a risk factor or active risk communication might be helpful.
The impact of low concentrations of PM air pollution on mortality in the Canadian Community Health Survey-Mortality Cohort

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background: Large cohort studies of environmental exposures are often limited by availability of information on covariates such as smoking behaviours, alcohol consumption, and body mass index that may confound relationships with mortality. The Canadian Community Health Survey-Mortality cohort includes 4,452,700 person-years of observation making it one of the largest to include individual-level behavioural risk factor measures in addition to socio-economic covariates. The purpose of this study was to use this rich dataset of individuals exposed to generally low levels of air pollution to provide insight into the shape of the concentration-response curve for mortality at low levels of fine particles (PM₂.₅).

Methods: Respondents to the Canadian Community Health Survey from 2000 to 2012 were linked by postal code history from 1981 to 2016 to high resolution PM2.5 exposure estimates, and mortality incidence to 2016. Cox proportional hazard models were used to estimate the relationship between non-accidental mortality and ambient exposure to PM₂.₅ (measured as a three-year average with a one-year lag) adjusted for socio-economic, behavioural, and time-varying ecological covariates.

Results: Average annual ambient PM₂.₅ exposures were low (i.e. 5.9 µg/m³, s.d. 2.0) and were associated with a hazard ratio of 1.11 (95% CI 1.04-1.18) per 10 µg/m³ increase in exposure. Behavioural covariates that were associated with mortality, and typically not found in census-based cohorts, did not confound the relationship. We estimated a supra-linear concentration-response curve extending to concentrations below 2 µg/m³ using a shape constrained health impact function. Hazard ratios for PM₂.₅ and mortality were attenuated when gaseous pollutants were included in models.

Conclusions: We found an increased risk for non-accidental mortality at low levels of ambient PM₂.₅, supported by a supra-linear concentration-response curve using an extended and improved Canadian Community Health Survey-Mortality cohort. Adjusting for behavioural covariates did not substantially impact hazard ratios.
Assessing the short-term effect of PM2.5 on cardiovascular hospitalizations in the Medicaid population: a case-crossover study

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background: Many studies have demonstrated an association between short-term exposure to fine particulate matter (PM2.5) and cardiovascular disease (CVD). We conducted a national epidemiologic analysis using US-wide Medicaid data to estimate the association between short-term PM2.5 and CVD hospitalizations for the years 2010 and 2011 among low-income and disabled Americans.

Methods: We applied a time-stratified case-crossover design to estimate the association between short-term PM2.5 (measured as the average of PM2.5 on the day of the event and the preceding day), and the rate of CVD hospitalizations. We also compared the association between PM2.5 and CVD in the Medicaid population with the association in the Medicare (national program that provides health insurance to all US citizens over 65 years of age) population for the same years.

Results: We observed 691,714 CVD admissions among Medicaid beneficiaries. We observed an increase of 1.4% (95% CI: 0.8, 2.0%) in total CVD hospitalizations for each increase of 10 μg/m3 in PM2.5. The estimated association between PM2.5 and CVD hospitalizations for the US Medicaid population over 65 years of age was 2.2% (95% CI: 1.1, 3.3%) The corresponding estimated association in the US Medicare population was 1.0% (95% CI: 0.7, 1.3%). These associations were robust in sensitivity analyses.

Conclusions: Our analyses showed an increased rate of CVD hospitalizations associated with short-term PM2.5 exposure in the Medicaid population. This association in the US Medicaid population older than 65 years old was greater than the association in the US Medicare population, albeit the confidence intervals of the two estimates were overlapping. This finding indicates increased vulnerability among the low-income and disabled elderly.
Benefits of Air Pollution Control on Life Expectancy in Mexico City 1990 to 2015

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background: Over the past few decades, there have been substantial improvements in ambient air quality in Mexico City and in population survival. We examined the relationship between improved air pollution (PM2·5 and O3) and life expectancy for 16 boroughs within Mexico City during this period.

Methods: We obtained data on life expectancy, demographic characteristics, socioeconomic position, cause-specific death rates, and air pollution (PM2·5 and O3) in Mexico City for census years from 1990 to 2015. We used regression models to estimate the association of reduced PM2·5 and O3 with changes in life expectancy controlling for indicators of socioeconomic position, demographic characteristics, proxy indicators for smoking, and death rates from reference causes.

Results: Each decrease of 10 μg/m3 in annual mean PM2·5 was associated with an increase in life expectancy of 0.89±0.38 years (p = 0.028). Independently, each decrease of 10 ppb in season average maximum O3 was associated with an increase of 0.24±0.08 years (p = 0.004). There was no difference in the estimated benefits of reduced PM2·5 between men and women, but men showed an almost three times larger association with O3. In net, improvements in air quality in Mexico City over the last 25 years have yielded an estimated 1.3 years longer-life expectancy attributable to PM2·5 improvements, and an additional 1.9 years life-expectancy increase attributable to O3 improvements.

Conclusions: Improved air quality in Mexico City was associated with increased life expectancy. The progress in reducing air pollution levels in Mexico City over the last 25 years is a major public health achievement. Nevertheless, air quality levels remain above WHO guidelines, and further improvements in life expectancy would be expected with continued actions to further clean up the air of this mega-city.

Funding: Fondo Ambiental Público from the Secretaría del Medio Ambiente of the Government of Mexico City.
Acute effects of ambient particulate matter on daily emergency and outpatient visits for respiratory diseases among children aged 0-5 years in Beijing, China


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Background: Ambient particulate matter (PM) has been associated with respiratory diseases; however, few studies exist examining the impacts of PM on children who are particularly susceptible.

Methods: Electronic records of daily emergency and outpatient visits for respiratory diseases among children aged 0-5 years from 1 January to 31 December 2016 were collected from Beijing Children’s Hospital in Beijing, China. Daily concentrations of PM with aerodynamic diameter ≤ 2.5 μm (PM2.5) and ≤ 10 μm (PM10), and meteorology data at the same period were collected from Beijing Municipal Environmental Monitoring Center and a fixed monitoring site at Tsinghua University, respectively. Generalized Additive Models with a Poisson regression was used to estimate the associations between ambient PM and emergency and outpatient visits for respiratory diseases. Analyses were further performed for infants (<1 year) and children aged 1-5 years.

Results: A total of 224,584 cases of respiratory diseases (35,930 infants and 188,654 children aged 1-5 years) were recorded. The daily mean levels of PM2.5 and PM10 were 71.14 μg/m³ and 103.01 μg/m³. We observed increases in emergency and outpatient visits of 0.18% (95% Confidence Interval (CI): -0.06%, 0.42%) and 0.28% (95%CI: 0.06%, 0.50%), in associations with a 10 μg/m³ increase in PM2.5 and PM10 at prior 1 day (lag1), respectively. Statistically significant cumulative effects of PM2.5 and PM10 (P<0.05) were observed among infants, with the largest effect estimates at lag03 (0.54%, 95%CI: 0.13%, 0.95%) and lag01 (0.42%, 95%CI: 0.16%, 0.68%), respectively, whereas no significant effects were observed among children aged 1-5 years.

Conclusions: Our findings show the significant acute effects on daily emergency and outpatient visits for respiratory diseases of ambient PM among children and suggest the need for implementation of rigorous air quality policies to protect children’s health.
Prenatal air pollution and early childhood asthma

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Background: Prior studies suggest that prenatal air pollution may perturb normal fetal lung development and contribute to risk of child asthma, but few have had opportunity to investigate developmental windows of susceptibility or have been limited in exposure assessment or covariate adjustment.

Methods: Our study population included participants in two pregnancy cohorts within the ECHO-PATHWAYS consortium, CANDLE (births in 2007-2011) in Memphis, TN and TIDES (births in 2011-2013) in Seattle, WA; San Francisco, CA; and Minneapolis, MN, who had term births (37+ weeks). Child asthma was defined based on parent-report of ever asthma. Exposure to ambient fine particulate matter (PM2.5) during prenatal phases of fetal lung development was estimated using a spatiotemporal model. We used Poisson regression and adjusted for city, child sex, year and season of birth, maternal race, education, asthma, age at delivery, prior live births, pre-pregnancy body mass index, prenatal smoking, child’s postnatal secondhand smoke exposure, pets in the child’s home, and neighborhood-level socioeconomic status.

Results: Children (n=1334) were on average 4.3 years old (standard deviation [SD] 0.5), 49% male, and 11.6% had ever asthma; 46% of mothers were black and 54% had a college/technical school degree. City-specific mean PM2.5 exposures averaged across the prenatal period ranged from 5.2 µg/m3 (SD 0.9) to 10.6 µg/m3 (SD 1.0). A 2 µg/m3 higher PM2.5 exposure during the saccular phase (week 24 to week 36 of pregnancy) was associated with 28% higher risk of asthma (95% confidence interval [CI]: 1.00, 1.64; p=0.055). This effect was larger in boys than in girls, though interaction was not statistically significant. Higher average exposure across all of pregnancy was not associated with asthma (risk ratio 1.06, 95% CI: 0.84, 1.35).

Conclusions: Preliminary results suggest that the later phases of prenatal lung development may be particularly sensitive to the developmental toxicity of PM2.5.
Background: Asthma is one of the most common diseases in children. Although some risk factors are known, the role of air pollution and the interplay between known risk factors and air pollution on asthma is unclear.

Aim: To explore a combination of environmental, social and genetic determinants of onset asthma in all Danish children.

Methods: We used a register-based matched case-control design. Cases comprised children diagnosed with asthma or having a minimum of two prescriptions of asthma medicine (n=122,842) from their 1st to their 15th birthday during the time period 1997-2011. For each case, we selected 25 controls at random (n=3,069,943) having no asthma diagnosis and matched on sex and birthday. Chemistry-transport modeled average concentrations of O3, NO2, PM2.5, PM10, NOx, SO2, SO4, NO3, NH4, EC, OC, and seasalt during the last 3, 6 and 12 months prior to diagnosis was linked to the children’s residential addresses in a 1 km x 1 km grid resolution. We estimated hazard ratios with 95% confidence intervals for asthma by conditional logistic regression analyses adjusting for age, calendar year, sex, parental asthma, socio-economic status, region, and smoking.

Results: Parental asthma and smoking during pregnancy were positively associated with new-onset asthma. For air pollutants, exposure to NOx, NO2, SO2, EC and OC were positively associated with asthma, and both children having parents with asthma and children below 6 years that had been exposed to smoking during pregnancy were more susceptible to air pollution. In contrast, O3, PM10, seasalt, NO3, and NH4 were inversely associated with asthma. The results remained robust when adjusting for covariates and air pollutants in two-pollutant models.

Conclusions: This study confirms that genetics, socio-economic status, and smoking are essential risk factors for asthma. Moreover, children exposed to high levels of transport-related air pollutants were more likely to develop new-onset asthma.
Low-level ambient air pollution exposure and risk of lung cancer – a pooled analysis of 7 European cohorts

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background/Aim
Ambient air pollution has been associated with lung cancer but the shape of the exposure-response function - especially at lower exposure levels - is not well described. The aim of this study was to address the relationship between long-term low-level air pollution exposure and lung cancer incidence.

Methods
The “Effects of low level air pollution: A study in Europe” (ELAPSE) collaboration pools 7 cohorts from across Europe. We developed hybrid models combining monitoring and land use data, satellite observations, and dispersion model estimates for nitrogen dioxide (NO2), fine particulate matter (PM2.5), black carbon (BC), and ozone (O3) to assign exposure to participants’ residential addresses. We analyzed the pooled data by stratified Cox proportional hazards models adjusting for potential confounders. We developed linear and natural cubic spline models, analyses based on subsets and thresholds across the exposure distribution, and multi-pollutant models to disentangle potential inter-dependencies between pollutants.

Results
A total of 307,550 persons were included in the analyses. During a mean follow-up of 18.1 years, 3,956 incident lung cancer cases occurred. Median (5–95%) exposure levels of NO2, PM2.5, BC and O3 (warm season) were 24.2 µg/m3 (12.8–39.5), 15.4 µg/m3 (8.7–19.4), 1.6 10-5/m3 (0.7–2.1), and 86.6 µg/m3 (70.4–92.9), respectively. We observed a higher risk for lung cancer with higher exposure to PM2.5 (HR 1.13, 95% 1.05-1.23 per 5 µg/m3) after adjustment for covariates. The association was similar across subsets of exposure-levels with no sign of a threshold below which no association was evident. The effect estimate was also robust to the inclusion of co-occurring pollutants. We did not find significantly positive associations between NO2, BC or O3 and lung cancer incidence.

Conclusions
Our results indicate that long-term ambient PM2.5 exposure may contribute to lung cancer incidence even at concentrations lower than current EU limit values and WHO Air Quality Guidelines.
Environmental influences and predictors of children’s respiratory health in the Imperial Valley, California

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background: Particulate matter (PM) in the form of wind-blown dust is emerging as an increasingly prevalent exposure of health concern. In southern California, wind-blown PM is increasing due to drought, changing weather patterns and the shrinking of the Salton Sea, a 350mi2 land-locked “sea” situated near the rural border region known as the Imperial Valley. A regional water transfer agreement has accelerated the Sea’s drying, exposing large swaths of the lakebed and leaving behind highly emissive, contaminant-laden salt flats.

Methods: To begin to assess the impacts of PM on children’s respiratory health this rural environmental justice community, we administered a health survey to parents of elementary school children (n=357). We estimated children’s exposure to PM10 and PM2.5 using data collected from a community-owned PM sensor network, locally maintained and operated by Comite Civico del Valle.

Results: Individual exposure estimates for children, based on the year prior to baseline survey, were on average 11.19μg/m³ (SD: 3.17) for PM2.5 and 48.76μg/m³ (SD: 8.58) for PM10, comparable to estimates based on federally regulated air monitors. In preliminary models, adjusted for age, sex, parent education and language of survey, a 10μg/m³ increase in PM2.5 exposure was associated with an increased risk of asthma diagnosis (RR: 2.0, 95% CI: 1.0, 4.1, P=0.049). Additional factors that were associated with asthma diagnosis at baseline were having an asthmatic mother (OR: 3.7, 95% CI: 1.8-7.7), pneumonia (OR: 8.1, 95% CI: 2.4-27.4) or bronchitis (OR: 3.8, 95% CI: 1.7-8.2) prior to age 2, private insurance (OR: 2.3, 95% CI: 1.1, 4.9) and household income >$50,000 (OR: 3.0, 95% CI: 1.3, 7.0).

Conclusions: These results suggest that PM2.5 air pollution, among other factors, may impact children’s risk of developing asthma in this rural border region. Future work aims to identify modifiable risk factors to facilitate earlier intervention to improve health.
Association between particulate matter and cause-specific mortality in five Italian Regions: results of the BEEP project

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background/Aim
Air pollution has been linked to all-cause and cause-specific mortality in many epidemiological studies. However, the evidence has been mostly focused on the urban areas. The improvement of satellite data allow to estimate this association also in non-urban areas. Our aim is to evaluate the short-term effects of PM10 and PM2.5 on cause-specific mortality in five Italian Regions during 2006-2015 in the BEEP project.

Methods
We estimated daily PM concentrations at the municipality level using satellite data and spatiotemporal predictors. We collected daily counts of cause-specific mortality for each municipality in five Italian Regions: Apulia, Emilia Romagna, Latium, Piedmont and Sicily. We considered all cause, cardiovascular and respiratory mortality. We ran municipality-specific time-series models and we meta-analyzed individual effects to obtain pooled estimates for each outcome considered. Analyses for PM10 were conducted on 2006-2015, while for PM2.5 on 2013-2015 based on the goodness of our exposure models. Finally, we tested for effect modification by sex, age and degree of urbanization of the municipality.

Results
We collected data for 2,247,987 all-causes deaths, among which 902,436 and 161,060 were attributable to cardiovascular and respiratory causes. We observed average values equals to 23.0 (standard deviation=12.8) and 16.8 (11) μg/m3 for PM10 and PM2.5, respectively. Each 10 μg/m3 increases in lagged PM10 and PM2.5 (0-5 days) were associated with a percent increased risk for all-cause mortality (IR%) equals to 1.21% (95% confidence intervals: 0.73, 1.69) and 0.58% (0.14, 1.01), respectively. Similar results were obtained for cardiovascular and respiratory. No effect modification for sex and degree of urbanization were observed with similar effects in rural and suburban areas, while higher effects were displayed in elderly.

Conclusions
Short-term exposure to PM is harmful for human health and the effects are not limited to urban areas but include the all population living in a country.

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Background
Environmental factors, including deprivation, account for 23% of global deaths. Deprivation is believed to magnify differences in the exposure levels (exposure differential), and in the population’s susceptibility to develop health outcomes given a exposure (susceptibility differential). We aimed to examine exposure and susceptibility differentials to various environmental exposures, such as PM2.5 and NO2, across England (2000-2015).

Methods
Population-weighted mean concentrations of the studied exposures were assigned to 2011 Lower Super Output Area, LSOA (1,000-3,000 population) and each LSOA was classified in deciles of Index of Multiple Deprivation (IMD), 2015. To assess the exposure differential component, exposure gradients across IMD deciles were investigated. To evaluate the differential susceptibility component, we used sex- and age-specific all-cause mortality. Age-standardized death rates were investigated by exposure levels across IMD deciles. Finally, we regressed mortality rates to exposure levels adjusting for main confounders and stratifying by deprivation decile.

Results
Mean concentration of PM2.5 and NO2 were 14.01µg/m³ and 29.13µg/m³, respectively. Preliminary results show a positive gradient of concentration by IMD decile, suggesting an exposure differential by deprivation. Between 2000 and 2015, there were an average of 488,511 deaths per annum. Of these, ~11% and ~8% occurred in the top most and least deprived IMD deciles, respectively. After fitting basic regression models, our preliminary results show no difference in the effect of PM2.5 and NO2 on all-cause mortality risk by deprivation decile. More sophisticated statistical approaches are currently being explored in order to account for spatial dependency and other confounders that could be creating noise in our data.

Conclusion
This national study provides up to date evidence on the exposure differential by area deprivation in relation to environmental exposures (e.g. PM2.5 and NO2) across England. It also explores the role of deprivation in the mortality effects of these environmental exposures.
The impact of air pollutants on ambulance dispatches: A systematic review and meta-analysis of acute effects

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Background/Aim: A number of systematic reviews have investigated the short-term exposure to air pollutants, mostly focusing on hospital morbidity and mortality data. Previously, no reviews have focused solely on ambulance dispatch data. This study conducted a systematic review and meta-analysis whether the increment of pollutant and ambulance dispatches.

Methods: Publications up to December 2018 were identified using three main search categories covering: ambulance services including dispatches; air pollutants; and health. Inclusion and exclusion criteria were clarified to gain eligible studies. A meta-analysis was conducted to investigate the association between ambulance dispatches and exposure to pollutants: particulate matter less than 2.5 and 10 µm (PM2.5, PM10) per 10 µg/m3; carbon monoxide (CO) per 1 ppm; and per 10 ppb increment of sulphur dioxide (SO2), nitrogen dioxide (NO2), and ozone (O3), based on sources of ambulance data using random and fixed effects. A pooled relative risk (RR) with 95% confidence intervals (CI) were calculated to report estimates.

Results: From 283 studies initially identified, 251 were excluded and the remaining were 32 studies. Results found 10 studies were based solely on ambulance dispatch data, 14 were also informed by paramedic assessments on scene and eight by physician diagnosis at the hospital. For dispatches with paramedic assessments, three pooled RRs were statistically significant with cardiac arrest dispatches: CO, 1.45 (95%CI: 1.01-2.10); O3, 1.05 (95%CI: 1.01-1.10) and PM2.5, 1.07 (95%CI: 1.04-1.10). For dispatches with physician diagnoses, only total dispatches were statistically significant with PM2.5, 1.01 (95%CI: 1.01-1.02).

Conclusions: Air pollution was significantly associated with an increase in ambulance dispatches for cardiac arrest and total dispatches. As all the significant associations between dispatches and air pollution showed a positive correlation, ambulance services should plan for increases in certain dispatch categories during pollution events and efforts to improve air quality should lead to decreases in ambulance dispatches.
Background: Aging is a complex phenomenon and the concise definition of an aging phenotype is a major problem. Environmental exposures – ambient air pollution and noise, and neighborhood socio-economic status (nSES) – have been associated with different aging outcomes, but the link to a combination of different aging phenotypes has not been investigated yet.

Objective: We explored the associations of long-term environmental exposures with the selected aging phenotypes in elderly women.

Methods: Data from the ongoing Study on the influence of Air pollution on Lung function, Inflammation and Aging (SALIA) in elderly women (N=834, age 66-79) was used to identify the following aging phenotypes: (1) successful (reference), (2) physical (chronic cardiorespiratory disease, diabetes mellitus or cancer), (3) cognitive (depression or cognitive impairment), and (4) excessive aging (physical and cognitive). Air pollution concentrations at home addresses were estimated for baseline (1985-1994) and follow-up (2007-2010) using ESCAPE land-use regression models and extrapolation procedures. We also estimated noise exposure as weighted 24h-mean at facade points and nSES as income rate in the postcode. We ran multinomial adjusted logistic regression models.

Results: Baseline concentrations of NO2 and NOx were significantly associated with all three aging phenotypes: an interquartile range increase in NOx (23.6 µg/m3) was associated with increased odds ratios (OR) of excessive aging [OR: 2.33, 95% confidence interval (CI): 1.27;4.28], cognitive aging [2.51, 95%CI: 1.27;4.94] and physical aging [2.03, 95%CI: 1.08;3.82] compared to successful agers. Similarly, NO2 and NOx concentrations at follow-up were positively associated with cognitive aging (OR: 1.76, [95%CI: 1.00;3.10] and 1.92 [95%CI: 1.10;3.35], respectively). These associations were stronger in non-smokers. We found no associations of PM fractions, noise, and nSES with the aging phenotypes.

Conclusions: Long-term exposure to NO2 and NOx is associated with different aging phenotypes. Reductions in NOx and NO2 can have a beneficial effect on healthy aging.
Climate Penalty: Climate-driven increases in ozone and PM2.5 levels and mortality

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background: While an extensive body of literature finds that short- and long-term changes in temperature, fine particle levels and ozone levels adversely affect human health, there is limited evidence predicting the relationship between climate, air pollutants levels and human health.

Methods: We first explored how ozone levels and PM2.5 levels responded to the changing temperature, and then conducted the survival analyses to examine the direct effect of temperature on mortality, as well as the indirect effect of temperature on mortality through PM2.5 and ozone, among the Medicare population in the Southeastern USA.

Results: 1°C increase in summer temperature corresponds to 1.05 µg/m\textsuperscript{3} increase in PM2.5 concentration, and 2.90 ppb increase in ozone concentration. Climate-driven increases in ozone and PM2.5 levels, referred to as the “climate penalty”, has the potential to further increase the mortality. The Cox models adjusting for PM2.5 and ozone show that per 1°C increase in summer mean temperature was directly associated with 2.23% increase in mortality, and indirectly associated with 3.23% and 1.02% increases in mortality that were contributed by ozone and PM2.5, respectively.

Conclusions: Climate change could have greater impacts on health outcomes through its effect on air pollutants levels. The implication is that reducing the air pollution levels can lower the adverse health effects of global warming.
Long term air pollution and prevalent chronic kidney disease - a cross-sectional study of the Heinz Nixdorf Recall cohort

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background/Aim
Few studies have examined whether an association exists between long-term exposure to air pollution (AP) and chronic kidney disease (CKD), which is defined by morphological and functional damage to the kidney. CKD is a common disease worldwide that increases a person's risk for cardiovascular disease and places a high cost burden on health systems.

Methods
Data from the Heinz Nixdorf Recall study at baseline examination (2000-2003) were used in this analysis. Long-term exposure at participants’ addresses to total and source-specific particulate matter (PM; diameter ≤10, 2.5 μm), particle number (PNam; accumulation mode), and nitrogen dioxide (NO₂) was assessed at baseline using the EURopean Air pollution Dispersion (EURAD) chemistry transport model, which estimates daily exposures on a 1 km² grid. We evaluated the association between 3-year mean exposure to AP and prevalence of CKD at baseline using linear regression models and adjusting for baseline demographic and lifestyle variables. Prevalence of CKD was defined as an estimated glomerular filtration rate < 60 mg/mL/1.73m², calculated with the Modification of Diet in Renal Disease study equation (MDRD).

Results
Overall, 4,234 participants (49.7% men) with a mean age of 59.6 (±7.8) years and a mean BMI of 27.9 (±4.6) kg/m² were included in this analysis. Prevalence of CKD at baseline was 8.9% (n=375). Interquartile range increases in long-term AP exposure showed weak, positive associations with CKD prevalence for NO₂ (OR: 1.11 [95% CI: 0.96, 1.28] per 5.1 μg/m³) and for traffic-specific PNam exposure (OR 1.09 [95% CI: 0.93, 1.27] per 135 particles/mL). Associations for all other pollutants were null.

Conclusions
Our results indicate that long-term exposure to higher levels of traffic-related air pollution may be positively associated with CKD, suggesting further longitudinal studies on traffic-related AP exposure as a risk factor for CKD is warranted.
Low-level air pollution and natural cause mortality in Europe: meta-analysis of 5 European large administrative cohorts in the ELAPSE project

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background: Long-term exposure to air pollution has been related to natural mortality. However, results vary across studies because of heterogeneities in exposure assessment and data analysis, while there is still uncertainty on the shape of the association at low concentrations. The multicentre Effects of Low-Level Air Pollution: A Study in Europe (ELAPSE) study has been designed to address these limitations. Data from multiple European cohorts were collected and standardized protocols for exposure assessment and statistical analysis were applied, with focus on the exposure-response functions at low concentrations.

Methods: We collected data from seven large administrative cohorts: Norway, UK, Denmark, the Netherlands, Belgium, Switzerland and Italy. Annual average concentrations of PM2.5, NO2, BC and O3 were centrally modelled for Europe by hybrid land use regression at 100-m spatial resolution. Within each cohort we applied Cox proportional hazard models with adjustment for area- and individual-level confounders. We evaluated associations in single and two-pollutant models. Flexible approaches were used to capture non-linearity in the air pollution-mortality association. Finally, cohort-specific results were pooled into a random-effects meta-analysis.

Results: So far, we analysed data on 25,818,935 subjects from five cohorts (220 million person-years) and observed 3,026,307 deaths from natural causes. We found significant associations with NO2, PM2.5 and BC, with pooled hazard ratios (HRs) 1.041 (95% CI: 1.011, 1.072), 1.053 (1.004, 1.104) and 1.041 (1.012, 1.070) per increments of 10 ug/m3, 5 ug/m3 and 0.5 10-5/m, respectively. Estimates of NO2 and BC decreased slightly upon adjustment for other pollutants, while PM2.5 was no longer significantly associated with mortality in two-pollutant models. In subset analysis we found associations at concentrations below WHO Air Quality Guidelines. Finally, there were no positive associations between ozone and mortality.

Conclusions: Long-term exposure to air pollutants was associated with natural mortality in five large European cohorts, even at low concentrations.
The long-term effects of outdoor air pollution on child, adolescent and adult lung function – a systematic review

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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Background/Aim: Cross-sectional studies have indicated that short term exposure to outdoor air pollution is associated with adverse effects on lung function in children and adults. The most recent literature review of this research was conducted by Gotschi et al in 2007. Since then, the results of larger longitudinal studies have been published. We aimed to systematically synthesise the evidence exploring the long-term effects of outdoor air pollution exposure on lung function of children, adolescents and adults.

Methods: Systematic search of electronic databases: PubMed, EMBASE using the search terms for exposure (e.g. “air pollut*”, “particulate matter”, “PM10”, “PM2.5”, “ozone”, “nitrogen dioxide”, “sulphur dioxide”, “carbon monoxide”) and outcomes (e.g. “lung function”, “pulmonary function”, “FEV*”, “FVC”, “MEF”, “PEF”). We included cohort (prospective and retrospective), and case-control studies where coefficient/percent change and 95% confidence intervals were reported. Quality of studies was assessed using the Newcastle-Ottawa scale for cohort and case-control studies and funnel plots were used to identify potential publication bias. Registered on PROSPERO CRD2017082231.

Results: Database searching returned 5344 titles, of which 33 were included. Studies were divided into (1) prenatal exposure and lung function of young children; (2) children, (3) adults and (4) older adults, across a range of geographic settings. Subjects were healthy or with respiratory conditions. Overall, long term exposure to higher levels of nitrogen dioxide, particulate matter and ozone was associated with some lower lung function parameters in young children, children and adolescents; and declines in some adults’ and older adults’ lung function parameters. Levels of associations varied depending on the levels of exposures of different pollutants in different areas. The quality of included research was fair to very good.

Conclusion: Overall there is strengthening evidence that long term exposure to air pollution, particularly related to traffic, is associated with deficiencies in lung function across all age groups.
Acute effects of air pollution on all-cause mortality: a natural experiment from haze control measures in Chiang Mai Province, Thailand
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PDS 68: Outdoor air pollution, mortality and morbidity, Exhibition Hall (PDS), Ground floor, August 26, 2019, 10:30 - 12:00

Haze episodes causing by forest fire and agriculture waste burning during dry season have been widespread in Chiang Mai Province for more than a decade. The local governmental agencies have been proactive in taking comprehensive measures to control the haze and its impacts on health of the population since early 2008. This study assessed acute effects of ambient air pollutants on all-cause mortality before and after the haze control interventions.

We obtained daily mortality counts and data on mass concentrations of particulate matter (PM)<10 micron in aerodynamic diameter (PM10), gaseous pollutants, and meteorology in Chiang Mai Province between Jan 2002 and Dec 2016. We analyzed the data using case-crossover design adjusting humidity, day-of-week and seasons for each three periods: Jan 2002-Dec 2007 (Period 1, before intervention), Jan 2008 to 2011 (Period 2, after intervention), Jan 2012 to Dec 2016 (Period 3, after intervention).

Air pollution concentrations decreased over the study period. We found an increased risk of all-cause mortality for one IQR increase in PM10 of lag0 and mean of lag0-1; and O3 for lag0, lag1, and mean of lag0-1 before the intervention (Period 1), but no significant effects after the intervention (Period 2 and Period 3). In Period 1, the effects of PM10 and O3 are stronger for age 65 and older than those of all ages. In Period 3, we found significant effects of NO2 for lag0, lag1, and lag2 and O3 for lag2 for age 65 and older, but after the intervention no significant effects were observed for PM10 and gaseous pollutants for all ages.

The findings suggest a reduction in risk of acute effects of all-cause mortality for PM10 and O3 after haze control measures are in force in Chiang-Mai Province.
PDS 73: Neurological effects

Radiofrequency electromagnetic fields exposure, screen time, brain morphology, and attention problems in school-age children


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Purpose: To investigate the association between radiofrequency electromagnetic fields (RF-EMF) exposure, screen time, and brain morphology in school-age children and to assess whether brain morphology mediates an association between RF-EMF exposure with screen time and behaviour problems.

Methods: Cross-sectional study in children aged 9-12 years from the Generation R Study, a population-based birth cohort in Rotterdam, The Netherlands (n=2,592). Information on mobile and cordless phone calls, mobile phone uses other than calling, use of tablet and laptop, console/computer gaming, and television was reported by the parents. Residential RF-EMF exposure from mobile phone base stations was estimated using a 3D geospatial radio wave propagation model. An integrated model to estimate RF-EMF dose (J/kg/day) to the brain was calculated using all collected information. Information on brain volumes and cortical thickness was extracted from magnetic resonance imaging scans. Parental-reported behaviour problems were assessed using the Child Behavior Checklist.

Results: RF-EMF dose to the brain was not related to brain morphology alterations. However, other mobile phone uses was associated with a smaller parietal cortex [β -33.4 (95%CI -55.2; -11.6) per each increase in 1 minute]. Higher television use was associated with smaller total brain volume [β -105.0 mm3 (95%CI -159.7; -50.2) per each increase in 1 minute], and with higher attention problems [β 0.0018 (95%CI 0.0001; 0.0036) and ADHD symptoms [0.0023 (95% CI 0.0007; 0.0039) per each increase in 1 minute]. The observed smaller total brain volume partially mediated the association between television use and attention problems. None of the exposure variables was associated with cortical thickness.

Conclusion: RF-EMF dose to the brain was not associated with brain morphology alterations. Longer use of screen devices, in particular television use, was associated with smaller brain volume, and smaller brain volume partially mediated the association between higher television use and higher attention problems.
Does exposure to fine particulate matter modify the association of low neighborhood socioeconomic position with cognitive decline and dementia?

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Background/Aims. Adverse cognitive effects of social exposures such as neighborhood socioeconomic position (NSEP) may be exacerbated by environmental exposures, including air pollution. Mexican-Americans are differentially exposed to both low NSEP and high exposure to fine particulate matter (PM2.5) compared to white non-Hispanic Americans.

Methods. The Sacramento Area Latino Study on Aging (SALSA, N=1,789) is a cohort of Mexican Americans aged 60-100 who completed a modified Mini-Mental State Exam (3MS) every two years from 1998 to 2008. 3MS scores were standardized to the baseline mean and standard deviation. Satellite-based annual average particulate matter (PM2.5) estimates at a 1 km2 resolution were assigned to participants’ baseline residential addresses. Baseline NSEP was estimated by a composite of six census (year 2000) tract measures. Joint latent class mixed models were applied to estimate effects of NSEP and PM2.5 exposure (and their interaction) on 3MS decline and dementia, adjusting for competing risk of death, baseline age, gender, rural/urban residence, occupation, schooling, diabetes, baseline BMI, and being foreign born.

Results. Mean PM2.5 at baseline was 11.15 µg/m3 (SD=1.10). The joint latent class mixed model showed neither higher NSEP (difference per SD in NSEP=0.36(0.27)) nor higher PM2.5 exposure (difference per 1 ug/m3=0.002 (0.06)) predicted cognitive decline. Neither NSEP or PM2.5 were associated with dementia incidence during the 10 year follow-up (HRNSEP =0.98(0.10-9.7)); HRPM2.5 =0.98(0.80-1.20)). With higher PM2.5 exposure, the association of NSEP with decline and dementia tended to be more adverse, but these interactions were estimated imprecisely (p=0.25 and 0.95, respectively).

Conclusions. In this cohort of Mexican-Americans, we found little evidence for an effect of NSEP and PM2.5 on dementia incidence, but suggestive though imprecise evidence indicated of interactive effects on cognitive decline.
Air pollution exposure and cognitive and academic performance in children

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"Background/Aim": Air pollution could affect cognition due to its suspected role in oxidative stress, neuroinflammation, and brain functional and structural changes. Children are a population at risk since childhood is a crucial period of brain development. This study aims to explore the associations between air pollution and cognitive performance in children.

"Methods": Data from the UK Millennium Cohort Study was used. Concentrations representative of the 12-months prior to cognitive test performed at 7 years of age were calculated for each participant living in London. Exposures of NO₂, NOx, PM₂.₅, PM₁₀, PMcoarse, O₃, and the PM exhaust and non-exhaust fractions were computed for each participant address (postcode centroid) from concentrations estimated at 20×20m resolution from dispersion models in London. Cognitive performance evaluation included the British Ability Scale test assessing word reading and pattern construction and the National Foundation for Educational Research test assessing progress in maths (n=442). Academic performance scores available from the linked Education Administrative datasets were also collected (N= 152). Multiple linear regression analysis evaluated the associations between air pollution and children cognitive and academic performance. Models were adjusted with age, gender, parent education level, ethnicity, birth weight, birth gestational age and maternal age at delivery.

"Results": Air pollution exposure was not associated with word reading, progress in maths scores, or academic performance. However, higher NO₂ concentrations were associated with lower pattern construction scores (β= -.155 points, 95%CI -0.295, -0.016 per each increase of 1 µg/m³). Oppositely, higher O₃ concentrations were associated with higher pattern construction scores (β= 0.353 points, 95%CI 0.116, 0.59 per each increase of 1 µg/m³).

"Conclusions": NO₂ exposures were associated with worse visuoconstruction abilities, whilst better results were associated with O₃. Further analysis will consider other exposure time windows, further adjustments for potential confounding variables and extend the analysis to the full UK cohort.

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Background/Aim: Hearing loss is a major public health concern globally. Perfluoroalkyl substances (PFAS) are hypothesized to impact neurobehavioral functions, yet few previous studies explored the role of PFAS on auditory disturbances and hearing impairment (HI). Our goal was to investigate the associations of serum PFAS concentrations with low/mid- and high-frequency HI among adults and adolescents using nationally representative data in the United States.

Methods: The 2003-2012 National Health and Nutrition Examination Survey (NHANES) data were used, with 1669 adults 20-85 years of age and 1176 adolescents 12-19 years of age having complete information on audiometry, serum PFAS measurements, and covariates. Low/mid-frequency HI was defined by pure-tone average (PTA) of thresholds across 0.5-1-2 kHz >25 dB hearing level (HL); high-frequency HI defined by PTA across 3-4-6-8 kHz >25 dB HL, in the worse ear. Logistic regression models were performed with consideration of complex survey design characteristics and adjustment for confounders including age, age squared, sex, race/ethnicity, education level, poverty-income ratio, body mass index, as well as exposures to occupational, recreational and firearm noise. PFAS data were fit as log-transformed serum concentrations, >90th percentile of the PFAS distributions, and quartiles of concentrations. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated.

Results: The associations between PFAS exposures and HI were non-monotonic. Compared to those with concentrations≤90th percentile, adults with perfluorohexane sulfonic acid (PFHxS) and perfluorononanoic acid (PFNA) >90th percentile had adjusted ORs of 3.10 (95% CI: 1.42-6.74) and 1.84 (95% CI: 1.16-2.93) in low-frequency HI, respectively. No significant associations were detected for other PFAS homologues among adults and with any PFAS among adolescents.

Conclusions: PFHxS and PFNA serum concentrations above certain levels might result in an increased risk of hearing loss. Future research with longitudinal study designs needs to be conducted to confirm our findings.
Periconceptional and prenatal exposure to metal mixtures in relation to behavioral development at three years of age in the New Hampshire Birth Cohort Study

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PDS 73: Neurological effects, Johan Friso Foyer, Floor 1, August 26, 2019, 10:30 - 12:00

Background: Behavioral effects of early life exposure to several neurotoxic metals are incompletely understood.

Methods: We investigated periconceptional and prenatal exposure to metals, metalloids, and other trace elements in relation to child behavior in the New Hampshire Birth Cohort Study, an ongoing prospective rural birth cohort study enrolling pregnant women with private wells for household water. Toxic (Pb, Hg, As) and essential (Mn, Zn, Se) trace elements were measured in maternal toenails at approximately 24-28 weeks gestation and 6 weeks postpartum and in placenta. Parents completed the Behavior Assessment System for Children, 2nd ed. (BASC-2) and the Social Responsiveness Scale, 2nd ed. (SRS-2) to assess neurobehavioral development at three years. In preliminary analyses, we used Bayesian Kernel Machine Regression (BKMR) to investigate associations between the BASC-2 Behavioral Symptoms Index (BSI; median: 280) and SRS-2 Total Score (median: 23) with ln-transformed trace elements concentrations adjusting for potential confounders (SRS-2: n=487; BASC-2: n=417). Higher scores on these assessments indicate more maladaptive behaviors.

Results: The trace elements were detected with high frequency (% detect: median = 0.95; range = 0.66-1.00). Using BKMR with hierarchical variable selection, maternal gestational toenail concentrations (Posterior Inclusion Probability (PIP): 56%) were more strongly associated with SRS-2 Total Scores than placental (PIP: 42%) or maternal postpartum toenail (PIP: 29%) concentrations. Mn (PIP: 65%) was the most strongly associated trace element measured during pregnancy, and the inverse relation with Total Scores appeared linear. Generalized Linear Models also identified an inverse association between ln-transformed maternal gestational toenail Mn and Total Scores ($\beta$: -1.71; 95% CI: -2.99,-0.43). Further, ln-transformed maternal gestational Mn concentrations were inversely related to BSI scores, albeit imprecisely ($\beta$: -2.83; 95% CI: -6.51,0.85).

Conclusions: Our preliminary results suggest a potential protective role of periconceptional Mn exposures against adverse early childhood behavior, including abnormal social and communicative behavioral skills.
How transport modes, the built and natural environment, and activities are associated with mood: A GPS smartphone app study

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Background/Aim: Active travel has been shown to have mental health benefits compared to motorized travel modes. Most studies on this topic rely on retrospective surveys that have high recall bias, particularly with a transient state such as mood. Furthermore, most studies are limited to a single time-point measurement of mood, making it impossible to study within-person variation. We address this shortcoming by employing the Experience Sampling Method and a smartphone app to study mood after each transport trip over 1 week for each participant. Our goal is to explore how mood during travel is related to transport mode, activities, and the built and natural environments.

Methods: We tracked travel patterns of 225 participants in three urban areas (Southwest Virginia, Washington, D.C., and Minneapolis, MN, USA) during 7-14 days per participant (n = 4,605 total trips). After each trip, participants reported their mood and trip characteristics. We employed multi-level regression analyses to assess the variations of mood based on transport mode (i.e., active vs. motorized), trip purpose (i.e., recreational vs. utilitarian), and the natural and built environment (i.e., walk score, density, green and blue space).

Results: Compared to car drivers, active travelers had higher mood, for example, cyclists (B=0.30; p<.05) and pedestrians (B=0.20; p<.05). Compared to commute trips, running errands resulted in lower mood (B=-0.38, p<.01). Individuals who talked with others during the trip had higher mood than those who did not (B=0.26; p<.01). Mood was lower when individuals travelled to more walkable places (B=-0.01; p<.01), but higher when individuals travelled through natural environments (B=0.002; p<.05).

Conclusions: Our study takes a more rigorous approach to understanding how mood relates with transport and environmental variables. Our work demonstrates how information on mood could be used to promote sustainable transportation (e.g., walking, bicycling) and how practitioners can design urban spaces that enhance mental well-being.
Prenatal and postnatal exposure to mobile phone use associated with behavior problems in children

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Background: Concern has been raised regarding the possible effects of mobile phone use on children’s health. The World Health Organization has emphasized the need for research into the possible effects of radiofrequency electromagnetic field (RF-EMF) in children. We examined the association between prenatal and postnatal exposure to mobile phones and behavioral problems in children.

Method: Study subjects were 763 mother-child pairs from a prospective birth cohort, Mothers and Children’s Health (MOCEH) study. Mother’s mobile phone call frequency and duration were assessed at early pregnancy (≤20 weeks), 36 and 60 months of children’s age via questionnaire. Children’s neurodevelopment was assessed using the Korea-Child Behavior Checklist (K-CBCL) of Infant Development-Revised at 4, 5 and 6 years of age. The K-CBCL is consisted of total behavior problems, internalizing and externalizing problem. Logistic regression analysis was applied to groups classified by trajectory analysis showing neurodevelopmental patterns over time. Models were adjusted for residential area, child’s gender, maternal age at child birth, household income, alcohol intake and urinary cotinine level at 5 years of age.

Results: There was a significantly increased risk of having a high externalizing problem score from 4 to 6 years of age, in relation to an increasing maximum of mother’s mobile phone call duration at 36 and 60 months of age after adjusted several confounding factors (p-trend = 0.02). There was no association between mother’s mobile phone use during pregnancy and children’s behavior problem.

Conclusions: We found association between postnatal exposure to mobile phone use and child’s behavior problems.

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Outdoor artificial light at night exposure during pregnancy and child cognitive and psychomotor development.

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Background/Aim: Exposure to artificial light at night (ALAN) has been related with a higher exposure to blue light spectrum that has been shown to suppress melatonin. We assessed whether residential outdoor ALAN exposure during pregnancy was associated with child cognitive and psychomotor development at 4 years of age.

Methods: We used data of 477 children from Sabadell, Spain, as part of the INMA Project. Outdoor ALAN was estimated using images from the International Space Station of 2013. Exposure to remotely sensed upward visual light and to blue light spectrum for whole pregnancy period was calculated. Child cognitive and psychomotor development was assessed at 4 years of age by psychologists using the McCarthy Scales of Children’s Abilities. Linear regression models were adjusted for various socio-economic and lifestyle characteristics. Multiple imputation and inverse probability weighting were applied to correct for potential attrition bias.

Results: Exposure to visual light of outdoor ALAN and in the blue light spectrum during pregnancy was not associated with child general cognition and global motor (e.g. 2.30 points of general cognition [95%CI: -0.67;5.92] for higher vs. lowest tertile of visual light and 1.06 points of general cognition [95%CI: -2.03;4.14] for highest vs. lowest tertile of blue light spectrum). However, exposure to outdoor ALAN in the blue light spectrum was associated with better child fine motors skills (3.93 points [95%IC:0.66;7.22] for higher vs. lowest tertile of blue light spectrum).

Conclusions: Evidence on the effect of residential outdoor ALAN in the visual light or in the blue light spectrum exposure during pregnancy and cognitive and psychomotor development in children at 4 years old was not consistent. However, we found modest evidence between residential outdoor ALAN in the blue light spectrum exposure and child fine motor skills.
This study examined the effects of both mental health and socioeconomic status (SES) as susceptibility factors for the influences of prenatal environmental exposures on neurodevelopment.

Methods: Children aged 2 to 5 years (488 with ASD and 329 controls) were enrolled between 2003 and 2012 into the CHARGE (Childhood Autism Risks from Genetics and the Environment) population-based, case-control investigation. Children’s diagnoses were confirmed using standardized assessments. Neighborhood level factors were obtained from the California Communities Environmental Health Screening Tool (CalEnviroScreen), which ranks census tracts based on environmental exposures, socioeconomic factors, and prevalence of certain health conditions. Principal component (PC) analysis was used to visualize the data, and derive composite variables. Odd ratios (OR’s) for financial hardship, maternal mood disorders and PC’s were calculated with multivariate logistic regression models.

Results: The air quality PC included measures of diesel particulate matter (PM), traffic density, toxic releases and PM2.5, and was significantly associated with ASD risk in unadjusted and adjusted logistic regression, with increased odds of ASD among children whose mothers reported financial hardship (OR = 1.5; 95% CI [1.1, 1.9]). Worsening air quality was associated with increased risk of ASD (OR = 1.1; 95% CI [1.01, 1.3]). Children whose mothers reported mood disorders exhibited higher risk of ASD (OR = 1.9; 95% CI [1.5, 2.3]). There was also evidence of increasing risk with worsening air quality (OR = 1.2; 95% CI [1.05, 1.3]) when controlling for maternal mental health. We found increasing odds ratios at increasing levels of air quality when adjusting for maternal mood disorders, and significant persistent risk when adjusting for financial hardship.

Conclusions: Findings are consistent with studies linking prenatal exposures to air-pollutants, and SES with ASD. There is a critical need for action to reduce air pollution, with a focus on those communities with greatest exposures and socioeconomic vulnerabilities.
Background/Aim: Phthalate exposures may adversely affect child behavior via hormonal disruption. Because few studies have examined the impact of both gestational and childhood phthalate exposure on behavior, we estimated these associations.

Methods: Using data from 228 mother-child pairs in the HOME Study (Cincinnati, Ohio), we quantified concentrations of 11 phthalate metabolites in urine samples collected twice during pregnancy and 6 times during childhood (ages 1-8 years). We assessed children’s behaviors at age 8-years via parent report using the Behavior Assessment System for Children-2; higher scores indicate more problem behaviors. We first estimated associations between urinary phthalate metabolite concentrations at each visit and behavior, testing for differences in associations across visits using multiple informant models. Then, we estimated associations of average creatinine-standardized phthalate metabolite concentrations during pregnancy and childhood separately with behavior using linear regression. Finally, we quantified the cumulative association between childhood phthalate metabolite concentrations and behavior using weighted quantile sum regression. We adjusted for demographic, perinatal, and child factors.

Results: Phthalate-behavior associations did not differ across visits; thus we report associations using average pregnancy or childhood phthalate metabolite concentrations. Gestational mono(3-carboxypropyl) phthalate and monobenzyl phthalate (MBzP) concentrations were positively associated with internalizing and externalizing problems scores, respectively. Childhood sum of di(2-ethylhexyl) phthalate metabolites ($\Sigma$DEHP), MBzP, and mono-n-butyl phthalate (MnBP) concentrations were positively associated with externalizing scores. For example, each 1-standard deviation increase in childhood MBzP was associated with a 1.8-point increase in externalizing scores (95%CI=0.6, 3.1). Childhood $\Sigma$DEHP, MBzP, MnBP, and monocarboxynonyl phthalate were both individually and cumulatively associated with higher behavioral symptom index scores (weighted phthalate index $\beta$=1.1, 95%CI=0.1, 2.0).

Conclusions: In this cohort, urinary concentrations of several phthalate metabolites during pregnancy or childhood were individually or cumulatively associated with higher behavior problem scores. We did not identify specific periods of heightened susceptibility during pregnancy or childhood.
Residential environment is associated with anxiety and depression in a cohort of ageing men

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Background/aim: The residential environment, including the physical and social environment, affect old adult’s health and mental health, especially depression and anxiety. The world’s population is ageing rapidly with an expected increase from 900 million people over the age of 60 in 2016 to 2 billion people over the age of 60 in 2050. Among those over 60 years at the moment 20% of older adults suffer from a mental or neurological disorder. We aim to investigate the impact of attachment to the residential environment on depression and anxiety in older men, taking into account socio-demographic factors. Methods: A community sample of men (n=1437) was prospectively studied in a cohort study design. Multilevel models were used to examine the associations between place attachment and changes in symptoms of depression, anxiety, and hostility over the survey years. Results: The results show that relocating contributes to increased symptoms levels of depression and anxiety. In longitudinal analyses, staying in the same residential environment remained a significant factor for positive mental health. Conclusion: Additional to objective characteristics of places, attachments to places and to the residential environment is important in old age.
Effect of highway commuting on physiological stress: a randomized, cross-over intervention study
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Background: Physiological stress is an organism's response to a stressor such as an environmental exposure. This study aims at investigating associations between traffic-related air pollution (TRAP) exposure in highway commuting and stress indicated by serum cortisol levels.

Methods: Study design: a randomized double-blind controlled exposure crossover trial. Each of the sixteen eligible subjects enrolled into the study completed three two-hour commutes between 9am and 11am by car on a major highway between 2014 and 2016 in Seattle. During one commute, an in-vehicle HEPA filter was operated, while the filter was not operating during the other two commutes. The order of the three trips was randomized and double-blind. Each commute was separated by at least three weeks. During the commute, in-vehicle ultrafine particles (UFP), PM2.5, black carbon (BC), particle-bound PAH, CO2, CO, NO2 and NOx concentrations were monitored. Serum cortisol was measured three times at each commute – before the commute at 8am, after the commute at 4pm, and 24-hours after the commute at 9am the next day.

Results: Mean age of the 16 subjects was 29.7 (± 2.0); 9 were male and 7 were female, and 12 were Caucasian and 4 were Asian. On average, the HEPA filter removed 88.5% of BC, 88.8% of UFP and 88.4% of PM2.5 in the vehicle, but was less effective in removing NOx. After controlling for the diurnal pattern of serum cortisol, without filtration, subjects had on average 3.86ng/ml (-13.48, 21.194) higher cortisol 5 hours after the commute than with filtration. At 24 hours, without filtration, subjects had 4.81ng/ml (-12.53, 22.15) higher cortisol levels than with filtration.

Conclusion: While there was a suggestion that in-vehicle TRAP exposure resulted in increased serum cortisol in healthy adults, the study was likely underpowered to detect a statistically significant difference.
Air pollution exposure during fetal life and childhood, and brain morphological alterations in school-age children

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PDS 73: Neurological effects, Johan Friso Foyer, Floor 1, August 26, 2019, 10:30 - 12:00

Background. Studies investigating the relationship between exposure to air pollution and brain development using magnetic resonance images are emerging. However, most studies have focused only on prenatal exposures and have included a limited selection of pollutants. Here, we aim to expand the current knowledge by assessing the relationship between exposure during fetal life and childhood to a wide selection of air pollutants and brain morphological alterations in a large population of school-age children.

Methods. We used data from 3,133 children from a birth cohort from Rotterdam, The Netherlands (enrollment: 2002-2006). Concentrations of nitrogen oxides, particles of various sizes, and composition of fine particles were estimated at each home address that the participants have resided in during fetal life and childhood. Structural images were obtained when the participants were 9-12 years old. We assessed the relationships between air pollution exposure and global metrics of brain volume, area and thickness, as well as surface-based morphometric data, adjusting for child and parental socioeconomic, and life-style characteristics.

Results. We found strong positive associations between fetal life and childhood exposures to various air pollutants and cortical and sub cortical brain volumes (e.g. an increase in volume of putamen of 773.4 mm\textsuperscript{3} [95% CI: 293.2 to 1253.7] for each 5 \(\mu\)g/m\textsuperscript{3} increase in fine particles during childhood). Higher childhood exposure to air pollution was also associated with larger pial surface area. Conversely, we observed associations between higher exposure to air pollution and a decrease in cortical thickness, although these associations disappeared when we corrected the results for multiple testing.

Conclusion. Higher fetal and childhood exposure to air pollution was associated with larger brain volume and pial surface area. These brain structural alterations observed at ages 9-12 years could be an indication of a delay or deficiency in synaptic pruning, an essential process in brain development.
Genetic and environmental factors contribute to the development of Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD). One suggested environmental factor is air pollution, but knowledge of effects in low-exposure areas are limited. Here we examine risks for ASD and ADHD in children prenatally exposed to nitrogen oxides (NOx), in an area with levels generally below WHO air quality guidelines.

MAPSS (Maternal Air Pollution in Southern Sweden) is an epidemiological database consisting of virtually all (99%) children born between 1999 and 2009 (48,000 births) in Scania, Southern Sweden. It consists of Gaussian dispersion model derived NOx-levels at each maternal residencies during pregnancy, perinatal factors collected from a birth registry and socio-economic factors from Statistics Sweden. Malmö and Lund Departments of Child and Adolescent Psychiatry diagnosed all children with ASD and ADHD in the study area using standardized diagnostic instruments. Finally, we performed regression analyses on the risk of developing ASD and ADHD with adjustments for potential perinatal and socio-economic confounders.

In this longitudinal cohort study, we found positive associations between air pollution exposure during the prenatal period and an increased risk of developing ASD. For example, a Hazard Ratio (HR) of 1.50 and its 95% Confidence Interval (CI) (95% CI: 1.06-2.14) were found when comparing first to fourth quartile of NOx exposure in adjusted models. We did not find similar effects on the risk of developing ADHD. This study contributes to the growing evidence of a link between prenatal exposure to air pollution and ASD, suggesting evidence even below current WHO air quality guidelines.
Pre-natal exposure to urban air pollution and pre- and post-natal brain development: Barcelona Life Study Cohort (BISC)

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The evidence of the effects of air pollution on brain development is still inadequate, mainly due to the limitations in (i) characterizing brain development (most studies were based on subjective tools) and (ii) air pollution exposure (most studies only used residential levels based on geographical modelling), (iii) the lack of studies during the most vulnerable stages of brain development (foetal and early life (first two years)), and (iv) the lack of structural and functional imaging data underlying these effects. To evaluate the effect of pre-natal exposure to urban air pollution on pre- and post-natal brain structure and function we are establishing the Barcelona Life Study Cohort (BISC), evaluating brain imaging (pre-natal and neo-natal brain structure, connectivity and function), and post-natal motor and cognitive development; measuring total personal exposure and inhaled dose of air pollutants during specific time-windows of gestation, noise, paternal stress and other stressors, using personal samplers, sensors and geographical data; and detecting nanoparticles in placenta and its vascular function and biology. We aim to describe the characteristics of this new mother-child birth cohort including 1,000 mothers from the beginning of pregnancy. Studying pre-natal life is important because effects at this time are of a potentially irreversible nature and because the largest preventive opportunities occur during these periods. Funded by ERC-Adv785994.
Phthalate and bisphenol metabolite concentrations in urine during pregnancy and offspring non-verbal IQ

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Background

Prenatal exposure to phthalates and bisphenols are associated with impaired neurodevelopment in animals. However, the few epidemiological studies investigating the association between prenatal phthalate and bisphenol exposure and cognition produced mixed findings. We aimed to examine the association between maternal urinary concentrations of phthalates and bisphenols and non-verbal IQ in children aged 6 years.

Method

Data came from 1282 mother–child pairs participating in the Generation R Study, a population-based birth cohort in Rotterdam, the Netherlands (enrollment 2002–2006). We measured maternal urine concentrations of 18 phthalate metabolites and 8 bisphenols, at <18, 18–25, and >25 weeks of gestation. Child non-verbal IQ was measured at age 6 years using the Snijders-Oomen Non-verbal Intelligence Test–Revised. First, linear regression models were fit for each of the three collection phases separately, the three collection phases jointly, and for the averaged prenatal exposure across pregnancy. Second, effect modification by sex was explored. All associations were adjusted for relevant confounders.

Results

We found associations between maternal urinary concentrations of phthalates during early pregnancy and child non-verbal IQ (e.g., B per a natural log increase in Σ low molecular weight phthalates = 0.7, 95%CI: 0.1, 1.3). This association remained unchanged when adjusted for mid-, and late pregnancy exposures. There were no associations between mid- and late pregnancy phthalate concentrations and child non-verbal IQ. Maternal urinary concentrations of bisphenols were not associated with child non-verbal IQ. There was no effect modification by sex.

Conclusions

We found no evidence of the association between prenatal bisphenol exposure and child non-verbal IQ. We observed a consistent inverse association between early pregnancy phthalate exposure—but not in mid and late pregnancy—and child non-verbal IQ scores at the age of 6 years, suggesting that early pregnancy may be a susceptible period for adverse effects of phthalate exposure on cognitive development.
Exposure to traffic related air pollution in pregnancy and infancy in relation to autism spectrum disorder in California

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Background/Aim: Studies are accumulating that suggest associations between air pollutants and autism spectrum disorder (ASD) in children. However, most studies include rather small numbers of cases. Our objective was to conduct a statewide study in California focusing on road traffic related exposure during pregnancy and the first year of life to assess related risks for childhood ASD.

Methods: We used a population based registry linkage design including state-wide California birth data retrieved from Office of Vital Statistics birth data 1998-2010. ASD (during the study period assessed as autistic disorder (DSM IV-R)) cases (n= 30,514) were identified through records maintained at the California Department of Developmental Services and linked to birth records. Birth record controls were matched on sex and year 1:10. Exposure to road traffic related CO, NOx and PM2.5 concentrations during pregnancy and first year of life were estimated using the California Line Source Dispersion Model 4, a modified Gaussian line-source dispersion model. We estimated unadjusted and adjusted odds ratios (OR) and 95% confidence intervals (CI) using logistic regression.

Results: Exposure to interquartile-range increases of the correlated pollutants CO, NOx and PM2.5 related to increased ORs for ASD of 10-13% (e.g. NOx: OR=1.11; 95% CI:1.10,1.12) for prenatal and similarly for infant exposure, adjusting for maternal age, education, race/ethnicity, maternal birth place and other potential confounders. Including prenatal and infant exposure in the same model suggested potentially stronger associations for infant exposure.

Conclusions: Our state-wide population based study including a large number of ASD cases and avoiding self-selection bias, indicates small to moderately increased risks for ASD related to pregnancy and early life exposure to traffic generated air pollution. These findings confirm and extend earlier smaller studies suggesting the need for public health policies to regulate air pollution exposure to protect populations from the adverse impacts on the developing fetus.

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Heterogeneity of urban form in relation to cognitive impairment among a Chinese elderly cohort in Hong Kong: a high densely urbanized city

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Aim: In the context of worldwide rapid urbanization and population aging, this study aims to examine the association between heterogeneity of urban form and cognitive function of older population and to compare its association strength with that of the well-studied individual characteristics.

Methods: A total of 3940 Chinese older adults aged ≥65 years from the Mr. and Ms. Olds cohort (Hong Kong) were included, and a buffer of 300-meter radius was circled around each participant’s residence, the standardized variation of building height was measured via GIS to indicate the resident’s neighboring heterogeneity of urban form. A cut-off cognitive score of 29.5 from the Community Screening Instrument for Dementia (CSI-D) was used to identify the participant as either cognitively impaired or normal, which was then linked to the quartiles of building height variation by multivariate logistic regression models.

Results: Of the 3940 participants, 26.8% (n=1055) were identified as cognitively impaired. Comparing with subjects living in a neighborhood with the lowest level of building height variation, the risk of cognitive impairment significantly increased for those living with the third quartile (OR=1.51, 95%CI 1.11, 2.06) and the fourth quartile in building height variation (OR=1.81, 95%CI 1.24, 2.64). Such increased risk of cognitive impairment is comparable with that from an increment in age of 5 years (OR=2.12, 95%CI 1.81, 2.94), being female (OR=2.30, 95%CI 1.85, 3.01), being educated higher than bachelor’s degree (OR=0.04, 95%CI 0.02, 0.08), being frail (OR=1.22, 95%CI 1.02, 1.46), and being depressed(OR=1.62, 95%CI 1.23, 2.13).

Conclusions: The Chinese older adults living in neighborhoods with the greater variations in building height was associated with an increased risk of cognitive impairment, with the effect size comparable with that from some well-known individual characteristics, which highlighted the need to extensively explore modifiable risk factors for cognitive impairment among older adults.
Monday August 26, 1:30 PM – 3:00 PM

S04: Expanding the Role of the Environment in the Global Burden of Disease

Putting data to work: Environmental risk factors and the global burden of disease

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The Global Burden of Disease is an international collaboration involving more than 3600 researchers from over 145 countries with the goal of enumerating on an annual basis the causes of death and disability from more than 350 diseases and injuries and their trends over time in 195 countries stratified by age, sex and measures of socioeconomic development. Of specific relevance to environmental epidemiologists, the proportion of disease attributable to 84 behavioural, environmental and occupational, and metabolic risks factors are also quantified, providing necessary data upon which governments and other organizations can prioritize interventions. In the most recent cycle (GBD 2017), 8.3 million deaths and 12.3 % of all disability-adjusted life years were attributable to environmental (air pollution [ambient particulate matter, ozone, household air pollution]; unsafe water, sanitation and handwashing; lead; radon) and occupational [ergonomic, injuries, noise, airborne pollutants, chemical exposures] risk factors. This presentation will describe the current attribution of disease burden to environmental risk factors in the Global Burden of Disease to outline the methodology that is used and to illustrate the ways in which this effort can help epidemiologists focus their work on the most critical issues. Importantly, such a comprehensive project has also helped identify areas where important data are lacking, providing opportunities for high-impact future data collection and research efforts. In addition the presentation will outline the requirements and procedures for consideration of new environmental risk factors, introduce data visualization tools to allow users to interactively work with the available data, and present examples of use of Global Burden of Disease data in external analyses focused on global and national level policy.
Assessing the Global Burden of Disease from Air Pollution

Causey K1

1Institute for Health Metrics and Evaluation

In 2017, the Global Burden of Disease (GBD) study estimated that 4.90 million deaths (95% Uncertainty Interval (U.I.) 4.42—5.39) and 147 million disability-adjusted life years (DALYs) (95% U.I. 132—162) were attributable to air pollution—ambient ozone, ambient PM2.5, and household air pollution due to the use of solid fuels for cooking. I will give an overview of the sources used to model exposures and to quantify risk for the associated outcomes. In addition to the six previously estimated outcomes of particulate matter pollution—ischemic heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute lower respiratory infections—in GBD 2017, we added diabetes mellitus type 2 as an outcome of both ambient PM2.5 and household air pollution. I will describe the process of assembling sufficient data to establish the causal relationship, generating the integrated-exposure response function, and estimating the attributable burden. This example will demonstrate how we use environmental epidemiologic studies in the GBD air pollution burden estimation process. I will also discuss current methodological and data improvements for air pollution estimation and areas where more evidence would enable us to improve exposure models, more accurately capture risk relationships, and introduce new risk-outcome pairs.
Climate Change and the Global Burden of Disease

Burkart K¹

¹Institute for Health Metrics and Evaluation

S04: Expanding the Role of the Environment in the Global Burden of Disease, Beatrix theater, August 26, 2019, 13:30 - 15:00

There are multiple direct and indirect pathways through which climate change is linked to human health outcomes. Future research effort aims at quantifying these climate change impacts and incorporating them into the Global Burden of Disease (GBD) study. The short-term temperature effect is one of the most direct pathways linking climate change with health and is the first climate-related risk factor to be included into the GBD. This direct temperature impact occurs on a timescale of days to weeks and contrasts with indirect climate effects occurring via intermediate pathways, such as changes in infectious and vector-borne disease transmission or disrupted ecological, economic and social systems. While numerous studies have assessed the relationship between temperature and all-cause or cardio-respiratory mortality, very few studies have been conducted on detailed cause-specific mortality analyses. In addition, few studies have investigated the temperature-mortality relationship in low-latitude regions with high temperatures. To address this knowledge gap, and in order to adequately estimate the location-specific temperature-attributable disease burden, we analyzed daily mortality data from the United States, Mexico, Brazil, Guatemala, Chile and New Zealand. We linked daily mortality data with daily temperature data from the ERA5 reanalysis data set and estimated exposure-response curves for different climatic regions. These historical exposure-response curves will then be linked to future projections of temperature from the NEX-GDDP data set, which is comprised of 21 downscaled and post-processed global climate scenarios derived from General Circulation Model runs conducted under the Coupled Model Intercomparison Project Phase 5 and available for the Representative Concentration Pathway (RCP) 4.5 and RCP 8.5. We focus on challenges of burden estimations, especially in data scarce regions and will outline approaches to provide reliable global estimation of climate and climate change impacts.
The 2018 Lancet Commission on Pollution and Health used Global Burden of Disease (GBD) data to estimate that in 2015, pollution was responsible each year for 9 million premature deaths and 268 million disability-adjusted life years (DALYs) lost, with the greatest burden in low- and middle-income countries. These are likely underestimates, since the GBD’s scope of environmental risk factors is limited to certain air pollutants, water, lead, radon and airborne occupational exposures. The GBD-Pollution and Health Initiative (GBD-PHI), launched at a March 2018 workshop hosted by the Institute for Health Metrics and Evaluation (IHME; home of the GBD), aims to address this and other limitations so that the true global environmental “footprint” on health, including that of climate change, can be understood, as well as the connections between pollutants, pollution sources and policies. By doing so, countries and communities will be better able to prioritize pollution control and pursue the Sustainable Development Goals while avoiding the environmental health tragedies of the past. Given the data needs of proposing and adding new “Environmental Exposure-Outcome Pairs” to the GBD, the GBD-PHI aspires to engage ISEE and ISES scientists in creating a community of collaborators that can contribute their knowledge and expertise to this effort. This community can generate data on exposures in regions where data are scarce; assist in systematic reviews with a focus on evidence for the causality of new pollutant-outcome pairs to justify their for entry in the GBD; and develop innovative methods for measuring outcomes related to pollution that are not yet captured by the GBD, such as impacts of neurodevelopmental toxicants on human capital and outcomes related to climate change. Regarding climate change, given its accelerating pace of change, efforts will be needed to utilize tools recently developed by the GBD for projecting impacts into the future.
Environmental degradation and pollution, climate change, and deterioration of biodiversity of ecosystems damage health and quality of life, affecting especially socially disadvantaged and vulnerable populations. Action is urgently needed to drastically reduce exposures that are destructive to the environment and human health and promote healthy environments and sustainable development. The HERA project, funded by the EU Horizon2020 research framework programme, will set priorities for an environment and health research agenda in the EU for 2020-2030, closely connected to policy needs. I will present the approach, delineate the main themes and discuss the challenges for defining priorities in environmental health research and policy in Europe.

HERA specifically aims: 1) to proactively identify key sectors and policy areas in the field of environment and health that will benefit from additional scientific evidence in the next decade; we will address specific exposures (e.g. endocrine disruptors), sectors (e.g. transportation) and global issues particularly climate change; 2) to develop a European medium-term research and innovation agenda covering key strategic research and policy aspects; 3) to propose strategies and tools to respond to the new and continuing challenges in environment and health nexus, by ensuring the engagement of stakeholders, increasing coordination and cross-fertilisation of ideas, and contributing to the European environment and health process and policy activities. HERA is structured in workpackages addressing policy needs, knowledge gaps, establishment of new guidelines, stakeholder community consultation, knowledge transfer and establishment of the research agenda.

This large initiative involves researchers and a wide spectrum of stakeholders and ample consultations, and will set priorities for environmental health research to underpin policies for 2020-2030 for Europe. ISEE has a key role in this process. This will be the first time that such a wide-scale initiative on setting environment and health research agenda takes place in Europe.
Identify Research Gaps for Future Research on Environment, Climate Change and Health

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¹Helmholtz Zentrum München, ²Utrecht University

S08: Setting the European Environment and Health Research Agenda, 2020-2030: the HERA project, Room 217, Floor 2, August 26, 2019, 13:30 - 15:00

The research gaps existing within the area of environment, climate change and health are identified using three different complementary approaches. First, a classical exposure assessment paradigm is used to assess the research needs according to the urban environment including air pollution, noise, green; biological agents interfacing bacterial, plant and animal origins of exposures; chemicals including endocrine disruptors and pesticides; water contamination considering sea, surface and underground water; and ionizing and non-ionizing radiation. Second, a sector- or problem-based approach is used assessing the research needs according to urbanization (including healthy cities); transport and mobility; sustainable food production (including agriculture); energy transition (including fracking); waste, contaminated industrial sites and circular economy; and industrial and occupational changes. Third, research gaps are assessed in holistic approaches to environment and health employing a one health, planetary health perspective and focusing on ecosystems under pressure and ecosystem services; animal and human interactions and health: the role of wild fauna, domestic animals and farming practices in pathogen transmission and evolution; and socioeconomic factors and the environment, environmental injustice. We will present first results of an online expert survey and a face-to-face workshop. We will invite the audience to provide further insights into research gaps and discuss the approaches for prioritization of the research needs.
The HERA-project will develop a European Environment and Health Research Agenda in close collaboration with different stakeholder communities to achieve wide societal participation in deciding on research priorities. It will develop strategies and tools to ensure the engagement of stakeholders, increasing coordination and cross-fertilisation of ideas, and contributing to the European environment and health process and policy activities.

Stakeholders at EU, national and regional level will be identified to ensure a large and inclusive consultation process. Important stakeholder groups are relevant research-communities in the field of environment, health and climate change, policy makers (EU, national), civil society organisations, industries and businesses, workers and patients representatives, practitioners and international organisations. Stakeholders will be engaged via an interdisciplinary Consultation Group, national and regional focal points of larger networks (e.g. EEA-EIONET; WHO-Environmental Health Task Force) and seven regional consultative workshops. HERA will apply a multi-actor approach that will include stakeholders from different sectors and disciplines, thus allowing cross-fertilisation of ideas and research needs. It will encourage participation of representatives of countries with less developed environment and health policies by organising stakeholder workshops in all regions of Europe, by local partners. These groups will identify the actual needs across major topics as well as for cross-cutting issues and thus will provide input for the European environment, climate and health research agenda.

Guidance for the stakeholder consultation will be developed to harmonize information gathering and to get synergies. A mix of consultation approaches and methods will be applied, including websurveys, workshops and webinars. As the stakeholder groups are very diverse, it is important to consider their specific perspectives and aims while selecting appropriate methods of engagement for each of them. The usefulness of various qualitative methods will be assessed regarding their potential to produce knowledge that is usable on a European scale.
Research on environment and health has been supported by the European Union’s Framework Programmes of Research and Innovation at least for 25 years. Until today, over 400 multi-partner projects have been funded, which have received over €1.2 billion from the Framework Programmes. My presentation will give a short overview of the major achievements of activities supported in the past 20 years and the principal policy drivers behind. I will present the priorities for the three final years of Horizon 2020 (the current Framework Programme for Research and Innovation), especially the recent and planned calls for proposals. In addition, I will highlight some of the potential drivers and programmes for research to be undertaken under the environment and health-related activities planned under the European Commission’s proposal for Horizon Europe – the next Framework Programme for Research and Innovation, to run from 2021 until 2027.
Global environmental change and health. The need for collaborative, transdisciplinary research and action

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S08: Setting the European Environment and Health Research Agenda, 2020-2030: the HERA project, Room 217, Floor 2, August 26, 2019, 13:30 - 15:00

Pervasive environmental trends including climate change, biodiversity loss, land use change, ocean acidification and overfishing, freshwater depletion and ambient air, water and soil pollution as a result of increasing consumption of material goods, energy use and food by a growing world population threaten to undermine the progress in health which has occurred in recent decades. Although the direction and magnitude of environmental trends is increasingly apparent there are significant knowledge gaps which need to be addressed by transdisciplinary research. First there is a need for better evidence about the critical pathways by which multiple environmental changes, both singly and in combination, affect health, and the magnitude of those effects. The pathways may be direct, mediated through natural systems or through social systems. Second, it is important to evaluate the (cost) effectiveness of policies, new technologies, and products to reduce environmental damage and harmful emissions in different settings. Such assessment needs to consider unintended adverse consequences and potential trade-offs. Third is the need for evaluation of different strategies to promote resilience and adaptation to environmental change, including ecosystem-based approaches, considering the cost effectiveness of different strategies. The fourth priority area for research is to develop and assess the performance of robust indicators of human welfare and the integrity of underpinning natural systems, including how these measures should be weighted across time (discount rates). Finally, implementation research is needed to understand how best to promote the uptake of effective policies and interventions in real world settings. The emphasis should be on strengthening research capability in those locations where effects are felt most severely and where adaptive capacity is lower.
S09: Assessing health co-benefits of climate change mitigation in the Asia-Pacific region

Spatial-temporal Analysis for the Interactive Effects between Ambient PM2.5 and Meteorological Factors on Population Mortality in Beijing, China

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Background/Aims: To analyze the main/interactive health effects of ambient PM2.5 and meteorological factors on population health and Years of Life Lost (YLL), building the spatial-temporally exposure-response relationship and quantitative models to describe the interactive effects between PM2.5 and meteorological factors on population health.

Methods: The daily data of PM2.5 concentration and meteorological factors in Beijing were collected and Kriging and Nearest-neighbor interpolation were used to estimate the spatial-temporal distribution of PM2.5 and meteorological factors at 1 km spatial resolution. Bivariate response surface model, product term parametric model and stratified parametric model were developed to analyze the acute effects between ambient PM2.5 and meteorological factors on population mortality and YLL. Bayesian conditional autoregressive (CAR) spatial-temporal models were built and deviance information criterion was used to choose the best fitting model, which was used to quantitatively analyze the cumulative effects between monthly ambient PM2.5 and meteorological factors on cause-specific population mortality.

Results: The results from the bivariate response surface model showed that there were potential interactive effects between mean temperature and ambient PM2.5 on cause-specific mortality and YLL. In the stratified parametric model, the adverse health effects of PM2.5 were statistically significant in low temperature level. With the increase of every 1 units (µg/m3 °C) for the interaction between monthly average PM2.5 and mean temperature, the excess risk was 9.98% (95%CI: 9.52%, 10.44%), 9.91% (95%CI: 9.36%, 10.47%) and 7.67% (95%CI: 5.53%, 9.86%) for non-accident, cardiovascular and respiratory mortality in 2006-2009, respectively.

Conclusions: There were interactive effects between ambient PM2.5 and daily mean temperature, which could adversely affect population mortality and YLL. The effects were more significant in low temperature level. There were cumulative interaction between monthly average PM2.5 and mean temperature.
Reduction of air pollution-related deaths associated with climate change mitigation in Sydney, Australia

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.S09: Assessing health co-benefits of climate change mitigation in the Asia-Pacific region, Room 417, Floor 4, August 26, 2019, 13:30 - 15:00

Increasing population growth and energy demands are leading to increasing carbon dioxide emissions, a major greenhouse gas. Climate change will have environmental, health and economic effects. The next five to ten years are the critical years for action on climate change. Effective policies at the local, national and international levels to combat global warming will determine our climate future and our health. It has been suggested that “tackling climate change could be the greatest global health opportunity of the 21st century”. Fossil fuel combustion from the power, transportation and industrial sectors are the major emitters of carbon dioxide. Fossil fuel combustion from these same sectors are also the major contributors to ambient air pollution (for example, particulate matter, sulphur dioxide, oxides of nitrogen), some of which are also short-lived climate pollutants. Mitigating climate change will therefore also improve air quality with consequent health benefits. It is estimated that air pollution reduction through climate change mitigation under the 2°C goal will reduce premature deaths by about 2.4 million annually. It is important that we are able to quantify the co-benefits to air quality (and consequently to health) of climate change mitigation policies. Quantification of health benefits due to reduction in air pollution is particularly important as it can be achieved in the short-term and hence will have a greater impact on decision making. This presentation will quantify air pollution-related deaths in Sydney, Australia, associated with different climate change mitigation scenarios.
Structure of urban green space and its associations with heat and air pollution related deaths

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^1Seoul National University

S09: Assessing health co-benefits of climate change mitigation in the Asia-Pacific region, Room 417, Floor 4, August 26, 2019, 13:30 - 15:00

Background/Aim

Today, 54% of the world’s population lives in urban areas, and the proportion is expected to increase to 66% by 2050. Rapid urbanization and population growth are one of the biggest environmental health problems. A number of studies has provided evidences that green area has a beneficial effect on human health. Recently, these results have been published that summarize the pathways by reducing risks, such as exposure to air pollution and heat, and restoring capacities. Stress reduction and attention restoration theories can be associated with the beneficial effects of green area. By investigating the positive impacts of green spaces, we expect to provide clues to solve the environmental problems caused by urbanization.

Methods

In this research, we calculated greenness index from normalized difference vegetation index (NDVI) images of MOD13Q1 products, the satellite image from 2004 to 2013. We explored the definitions of high vitality green space by comparing the changes of descriptive statistics according to cut-off points. In order to examine the effect of green space structure and health, the green space structure is divided into the composition and the configuration. We used a time-stratified case-crossover method for the data analysis.

Results

We found that hyperthermia mortality increased by 2.92 times at the low level compared with high level of the patch density index on the extreme high temperature days. This association of the patch density per unit greenness area was increased 2.88 times. At heat waves days, the hyperthermia mortality increased 3.24 times and 3.31 times at the low levels on the patch density and patch density per unit greenness area, respectively.

Conclusions

We found the reduced hyperthermia mortality risks in the greener spaces. It might have a beneficial impact on health as proper use of the greenness structure at the urban area.
Assessing health co-benefits of climate change mitigation in the Asia-Pacific region: Challenges and solutions

Tong S\textsuperscript{1,2,3}

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Fossil fuel combustion by-products (PM2.5, NO2, PAH and CO2) are a significant threat to population health and well-being. Policies to reduce carbon emissions can reduce air pollution and mitigate climate change, with substantial health and economic benefits. However, the evidence on the co-benefits of climate mitigation is scarce in the Asia-Pacific region (APR) even though the largest amount of emissions worldwide come from this region. Climate change mitigation is likely to reduce air-pollution-related mortality. As an example, the evidence suggests that climate change contributes 14% of the overall increase in ozone mortality estimated for RCP8.5 in 2100 relative to 2000, and the effect on ozone mortality in 2100 is greater in East Asia than other regions. It is estimated that air pollution reduction through climate change mitigation under the 2 °C goal could reduce premature deaths in Asia by 0.79 million (95% CI: 0.75–1.8 million) by 2050. This co-benefit is equivalent to a life value savings of approximately $2.8 trillion (6% of the GDP), which is decidedly more than the climate mitigation cost ($840 billion, 2% of GDP). The health co-benefits of climate mitigation significantly outweigh its costs. The assessment of health benefits of climate mitigation will provide an important incentive for government policies and immediate action but little resources are available in low-income countries of APR. This presentation will explore effective strategies to address this issue.
S21: When the Answer is “Big(ger) Data” in Environmental Epidemiology: What are the Questions?,
Meta-analysis vs pooling: Tradeoffs in precision, confounder control, effect modification, and nonlinear dose-response

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Large datasets, often combined across multiple cohorts, are increasingly important in environmental epidemiology to understand nonlinear dose response, effects at low exposure levels, and vulnerable sub-populations. One strategy is to combine cohorts in a pooled analysis. An alternative is cohort-specific analyses followed by meta-analysis. We discuss strengths and weaknesses of these two analytic approaches and explore implications in the ECHO Pathways consortium of three thousand children and a separate consortium of one million adults.

Cohorts typically have distinct target populations, locations, and epochs. Meta-analysis automatically adjusts for cohort-stable characteristics, and it is straightforward to achieve the same effect in a pooled analysis with dummy variables.

Harmonization presents a greater challenge, as confounders are often measured differently and/or missing across cohorts. Meta-analysis typically adjusts for the best confounder data available in each cohort. We describe a method to accomplish the same result in a pooled analysis with multiplicative interactions between non-harmonized variables and dummy variables for cohort. Additional insights come from restricting to confounders available in all cohorts and to cohorts with all key confounders. Pooled analysis may have greater precision if harmonized covariates are included without effect modification by cohort.

A motivation for combining cohorts is to estimate nonlinear dose-response over a wider range of exposure levels than is available in a single cohort and effect modification by covariates like race or socio-economic position. A pooled analysis has more power to identify these aspects of the health effect association than a meta-analysis. Notably, this benefit persists if the pooled analysis includes adjustment for cohort and non-harmonized covariates.

Meta-analysis and pooled analysis can adequately account for confounding and covariate harmonization in multi-cohort datasets. An advantage of pooled analysis is efficient estimation of nonlinear dose response including health effects at low exposure levels, and susceptibility of vulnerable sub-populations using effect modification models.
Approaches to outcome and covariate harmonization--the perfect as the "enemy of the good"

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1University Of Washington, 2Harvard T.H. Chan School of Public Health, 3University of North Carolina, 4Brown University

.S21: When the Answer is “Big(ger) Data” in Environmental Epidemiology: What are the Questions?, Room 315, Floor 3, August 26, 2019, 13:30 - 15:00

As discussed in other talks in this session, pooling multiple generally similar studies allows more flexibility in data analysis compared to meta-analysis methods but requires careful attention to details of harmonization. Though the design of pooling projects may consider similarities in available data when selecting cohorts for inclusion, it is nearly inevitable that harmonization of exposures, outcomes, and covariates pose specific challenges. This talk will discuss approaches to harmonization for cohort studies, acknowledging the tradeoffs with each choice made.

Even when cohorts use the same methods and tools to collect data, there are differences in cohort design including differences in time periods data were collected, differences in locations of participants, and meaningful differences in how environmental exposures differ over time and space. Harmonization of outcome measures may pose additional challenges, particularly due to changes over time in both standard definitions of health endpoints and data collection methods. For example, blood pressure may be measured, taken from medical records, a self-reported value or self-reported as “high”. It may be reported at baseline only, or reported during follow-ups. Also, standard definitions of high blood pressure have changed over time. When considering how to harmonize all of these aspects must be considered.

Most existing pooling projects have harmonized covariates by attempting to create unified variables; is this sufficient? What other considerations should we be taking into account, particularly in environmental epidemiology? Are there other methodological approaches that can be considered? An open discussion of the advantages and disadvantages to different approaches to harmonization will help guide future pooling projects.
Big" Electronic Health Records Data in Environmental Epidemiology: Opportunities, Pitfalls, and Variation

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.S21: When the Answer is “Big(ger) Data” in Environmental Epidemiology: What are the Questions?, Room 315, Floor 3, August 26, 2019, 13:30 - 15:00

Big data has been proffered as providing unique opportunities to uncover previously unobserved associations or links in health-related research, especially in the context of artificial intelligence (AI) or machine learning (ML) approaches. There are a wide variety of (definitions and) sources for “big” data, and one relevant large data systems involve detailed Electronic Health Records (EHRs). These systems vary in what types of administrative and clinical data are available. For example, the accessibility of data domains related to personal characteristics, location (residence), health related behaviors, diagnostic and procedure codes for inpatient and outpatient care, and pharmacy, laboratory, pathology and imaging data can all vary by organization or system. Moreover, the implementation of EHRs varies across the global with North America and Western Europe having the most widespread systems.

The expansion of EHR data is likely to become increasingly leveraged for use in environmental health research. The advantages can include the completeness of the clinical record and ‘health status’ of the covered individuals, the costs of executing large sized epidemiological studies, key standardized data elements, ‘complete’ populations can be studied, and ability to merge data from one or more systems. However, the individual characteristics of each EHR system and the associated data need to be assessed in terms of the breadth and detail of data, and the longitudinal record and retention of included patients, among other features.

Challenges in using EHR systems include privacy concerns, and variation in host organizational structure, EHR architecture, internal clinical workflows or services semantics/coding/taxonomy, secular changes within a system, local data knowledge, and the ability to link to external data sources.

EHR data will have greater potential in environmental epidemiology as the systems become more uniform (interconnected), cover more of the entire population, and are able to be linked to large spatial-temporal exposures. In addition, as distributed data sources derived from portable or mobile platforms (for exposure or health endpoints) expand and can be linked with EHR data, there will additional opportunities. Finally, research is needed to assess the performance of studies conducted with an EHR system relative to other epidemiologic approaches.
Indirect Versus Direct Adjustment; Limitation of Administrative Cohorts

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.S21: When the Answer is “Big(ger) Data” in Environmental Epidemiology: What are the Questions?, Room 315, Floor 3, August 26, 2019, 13:30 - 15:00

Use of large administrative cohorts linked to national registries and environmental exposures has facilitated consistent population-based risk coefficients. However, despite their size advantage, the lack of person-level behavioural risk factors (e.g. smoking, diet) is an important limitation with the potential to bias risk estimates.

In environmental epidemiology, indirect adjustment for unmeasured confounding has taken several forms. A recently proposed method by Shin et al. (2014) uses partitioned regression. This method does not attempt to estimate the missing risk factors directly from supplementary data, but rather estimates the association between the missing factors and the available factors contained in the survival model using a representative ancillary dataset. The advantage of this method is that adjustment is at the individual-level and can accommodate multiple missing risk factors simultaneously.

This symposium presentation will, 1) describe the partitioned regression indirect adjustment methodology including modifications that incorporate time-varying exposure data and proportional weighting of datasets, 2) formally evaluate the method and representativeness of the ancillary dataset using Cox proportional hazard models, and 3) compare it to other indirect adjustment methods. As an example we apply the method to the relationship between fine particulate matter (PM2.5) and non-accidental mortality, but keep the discussion general to any exposure-disease outcome relationship. We use the 2001 Canadian Census Health and Environment Cohort (CanCHEC, N=2.4 million, 16-years follow-up) as our primary dataset, and the 2001 cycle of the Canadian Community Health Survey (CCHS, N=130,000) as the ancillary matching dataset. Our validation tests showed minimal adjustment bias (-1.2% to +2.3%), depending on the modifications applied, cause of death, and covariates in the model. Adjustment direction and magnitude were very similar (<0.5%) compared to equivalent models using a CCHS-mortality linked cohort. Discussion will focus on the generalizability of the validation tests and how to assess adjustment results using sensitivity tests.
Modelling multi-level survival data in multi-center epidemiological studies: applications from the ELAPSE project

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Aim: Multi-center collaborations provide the opportunity for harmonized epidemiological analyses in large data sets that increase statistical power to detect associations. We assessed methodological approaches for the analysis of multi-level survival data within the framework of the ELAPSE project that pooled data from nine European cohorts to assess the association of long term residential exposure to air pollutants with mortality.

Methods: After harmonizing individual and area-level variables between cohorts, we applied Cox proportional hazard models adjusting for these covariates. The data presented two levels of clustering: one corresponding to the initial cohort and one to the residential neighborhood level. We assessed five approaches to account for the first level: 1) not accounting for the cohort or using 2) dummies for cohorts, 3) strata per cohort, 4) a frailty term for cohort identification, 5) a random intercept per cohort under a mixed Cox. We further assessed second level clustering by applying 1) a random intercept per neighborhood and 2) a variance correction method -recognizing that approaches have different interpretations. We finally assessed the frailty vs the stratified approach for cohort adjustment through 1,000 simulations under nine scenarios for varying amount of heterogeneity between cohorts and pollutants’ effects.

Results: Our results support that effect estimates derived from any of the approaches to account for different initial cohorts are stable except absence of any adjustment, while adjustment for the neighborhood clustering increased the estimates’ standard errors. Simulations confirmed the identical results between the stratified and frailty model except in the case of large heterogeneity between the underlying hazards and the pollutant effects that resulted in a difference of 0.0001 in the pollutant coefficient between methods.

Conclusions: It is important to account for across cohort heterogeneity although the specific approach may be less important. We encourage investigators to consider study-specific conditions and objectives.
OPS 09: Cookstoves and children

Acute changes in heart rate variability and cardiac repolarization following controlled exposure to cookstove air pollution: the Subclinical Tests of Volunteers Exposed to Smoke (STOVES) study
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Background: Household air pollution from solid fuel combustion for cooking and heating is an important risk factor for premature death and morbidity worldwide. Current evidence supports an association of ambient air pollution and cardiovascular disease, but limited information exists specifically for household air pollution. We investigated acute impacts of short-term, controlled exposures to emissions from several cookstoves on heart rate variability (HRV) and cardiac repolarization, risk factors for adverse cardiovascular events.

Methods: Forty-eight healthy adults underwent six, 2-hour exposures, including emissions from five cookstoves and a filtered-air control. The target PM2.5 exposure concentrations for each were: control, 0 µg/m³; liquefied petroleum gas (LPG), 10 µg/m³; gasifier, 35 µg/m³; fan rocket, 100 µg/m³; rocket elbow, 250 µg/m³; three stone fire, 500 µg/m³. Five-minute means of HRV and cardiac repolarization outcomes were measured immediately and three hours following exposure. Linear mixed effects models compared the outcomes after cookstove exposure to after control.

Results: Compared to control, overall HRV (SDNN: standard deviation of duration of all NN intervals) was lower immediately after exposures to gasifier (difference compared to control = -0.12 milliseconds (ms); 95% confidence interval = -0.22, -0.03 ms) and three stone fire (-0.12 ms; -0.21, -0.02 ms); there were no differences for other cookstoves. SDNN was higher at three hours after LPG (0.13 ms; 0.04, 0.23 ms) and rocket elbow (0.15 ms; 0.06, 0.25 ms) exposures compared to control; there were no differences for other cookstoves. There were no differences in changes of cardiac repolarization (QTc: interval of time between Q and T interval) following cookstove exposures compared to control.

Conclusions: Results immediately following exposure suggest small adverse impacts on HRV for some cookstoves compared to control; however results overall were inconsistent. Immediate adverse impacts (during the 2-hour controlled exposure) for these parameters may not have been captured in this design.
Indoor urban environment and conventional risk factors for pediatric tuberculosis among 1-12 years old children in a megacity in Pakistan: a matched case control study.

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Introduction: TB among children is less well-defined and its risk factors are less well-studied. Indoor environment may play a significant role particularly for childhood TB.

Objectives: To determine the association of indoor urban environment and conventional risk factors for pulmonary TB among children aged 1 to 12 years.

Methods: An age matched case control study was conducted in two hospitals (a large tertiary and a secondary level) of megacity Karachi, Pakistan. The study recruited pulmonary TB cases (n=143), diagnosed by trained physicians using Pakistan Paediatric Association Scoring Chart for Diagnosis of Tuberculosis (PPASCT), and two age matched (±1 year) controls for each respective case (n=286) during June 2015-May 2016. The conditional logistic regression was conducted to determine the risk of pulmonary TB due to exposure to second hand smoke (SHS) and other conventional risk factors.

Results: Female child (mOR: 1.8), children belonging to minor communities in the city (mOR: 2.3 - 4.5), household TB contact (mOR: 7.5), use of open kitchen for cooking (mOR: 2.7), though insignificant but exposure to second hand smoke among under-5 year old children (mOR: 1.4), and time spent inside home (mOR: 1.1 per hour) increased the risk for TB.

Conclusions: This study strengthens the evidence that indoor air environment including time spent indoors, SHS (though insignificant), and low socioeconomic condition and being female and belonging to minor communities increase the risk for childhood TB. Concerted efforts are needed to improve indoor air environment in urban areas for healthier future generations.
Prenatal exposure to indoor PM2.5 and infant neurodevelopment at 1.5 and 3.0 years in Sri Lanka
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background/aim. prenatal exposure to household air pollution (hap) is linked with several adverse health effects in children, but evidence is limited for child neurodevelopment. we evaluated the association between prenatal hap exposure and child neurodevelopment at 1.5 and 3.0 years of age, in a birth-cohort study of 545 mother-child pairs in sri lanka.

methods. prenatal exposure to hap was ascertained from questionnaires; additional 2-hour area measurements for particulate matter of size ≤2.5μm (pm2.5) were conducted in 56% of households (n=303). the bayley scales of infant development (bayley) iii assessed child’s cognitive, fine and gross motor development at 1.5 and 3 years. linear regression models were used to determine the association between hap and developmental outcomes.

results. at 1.5 years, children of wood-using households had lower cognitive (adj. means, 101 vs. 103, p = 0.09) and motor scores (107 vs. 109, p = 0.06) on bayley iii compared to children in lpg households, adjusted for covariates. at 3.0 years, children in households using wood had lower cognitive scores on bayley iii (88 vs. 90, p = 0.06) compared to lpg using households, respectively. a unit increase in log-transformed pm2.5 (10% increase on pm2.5) was significantly associated with decrements in cognitive scores (β= -0.58, se =0.26, p=0.02). lower scores for cognition on bayley iii (p=0.03) were associated with increasing wood use, adjusted for covariates; exposure-response trend was significant across the three fuel use categories (100% LPG use, 50-100% LPG use and <50% wood use, and >50% wood use, ; p<0.05). differences in fine and gross motor scores for bayley iii by exposure status at 3.0 years were unremarkable.

conclusion. the results of the study indicate the potential neurotoxic impact of hap on child’s cognitive scores with the impact continuing through early childhood.
The effect of a cluster-randomized cookstove intervention to reduce household air pollution exposures on child growth trajectories through age one year

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Background/Aim: Household air pollution from biomass fuel combustion on traditional cookstoves may impair child growth. The effect of a prenatally-delivered cookstove intervention on child growth trajectories through age one year is unknown.

Methods: The Ghana Randomized Air Pollution and Health Study (GRAPHS) was a cluster-randomized cookstove intervention study that randomized pregnant women to liquefied petroleum gas (LPG) stove, improved combustion efficiency biomass stove (BioLite), or control (3-stone fire). Trained fieldworkers measured weight, height, mid-upper arm circumference (MUAC) and head circumference at birth and 3, 6, 9, and 12 months of life. Latent class growth trajectories were determined for all measurements. We employed ordinal logistic regression to examine associations between intervention arm and each growth trajectory, in the entire cohort and stratified by child sex.

Results: We enrolled 1,414 non-smoking, pregnant women prior to 24 weeks gestation resulting in 1,303 live births. 1,144 infants were followed for the first year of life with repeated growth measurements. Three growth trajectories for height and head circumference and four for weight and MUAC were identified. All trajectories were distinct from birth; no catch-up growth patterns were identified. Intention-to-treat analyses demonstrated that infants born to mothers randomized to BioLite and LPG arms had decreased odds of lower head circumference trajectory (OR 0.74, 95% CI 0.56-0.98, p=0.03 and OR 0.68, 95% CI 0.51-0.92, p=0.001 respectively) while LPG had decreased odds of lower MUAC trajectory (OR 0.44, 95% CI 0.33-0.59, p<.001) as compared to 3-stone fire. Sex-stratified analyses suggested girls were most vulnerable to the effects on head circumference and identified an effect of LPG cookstove on height only in girls (OR 0.63, 95% CI 0.40-0.99, p=0.04).

Conclusions: A prenatally-delivered cookstove intervention sustained through year one of life decreases risk for lower head circumference and MUAC growth, with potential implications for health across the life course.
Associations between Indoor Air Pollution and Acute Respiratory Infections among Under-Five Children in Afghanistan: Do socioeconomic status and sex matter?

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Background: Low-income families often depend on fuels such as wood, coal, and animal dung for cooking. Such solid fuels are highly polluting and are a primary source of indoor air pollutants (IAP). We examined the association between solid fuel use (SFU) and acute respiratory infection (ARI) among under-five children in Afghanistan and the extent to which this association varies by socioeconomic status (SES) and sex.

Methods: This is a cross-sectional study based on the de-identified data from Afghanistan’s first standard Demographic and Health Survey conducted in 2015. The sample consists of ever-married mothers with under-five children in the household (n=27,565). We used mixed-effect Poisson regression models with robust error variance accounting for clustering and household level variations to examine the association between SFU and ARI among under-five children after adjusting for potential confounders and effect modification by SES and sex. Additional analyses were conducted using an augmented measure of the exposure to IAP accounting for both SFU and the location of cooking (High Exposure, Moderate, and No Exposure).

Results: Prevalence of SFU was 70.2% whereas the prevalence of ARI was 17.6%. The prevalence of ARI was higher in children living in households with SFU compared to children living in households with no SFU (adjusted prevalence ratios [aPR]= 1.10; 95%CI: 0.98, 1.23). We did not observe any effect modification by SES and child sex. When using the augmented measure of exposure incorporating the kitchen’s location, children highly exposed to IAP (aPR 1.17; 95% CI: 1.03, 1.32) had higher prevalence of ARI compared to unexposed children to IAP. This association was modified by SES with the strongest associations observed among children from the middle wealth quintile.

Conclusion: The findings have significant policy implications and suggest that ARI risk in children may be reduced by acting on clean fuels and socio-environmental pathways.
The detrimental effect of Cook Stove Exposure on Infant Neurodevelopment in Rural Bangladesh

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Background/Aim
There is a growing body of evidence that in-utero exposure to air pollution is associated with the developing brain of infants based on studies in the developed world. However, little is known about the effect of biomass fuel (BMF) exposure on the infant neurodevelopment in the developing world. Here, we report the effect of BMF exposure on neurodevelopment among 3-5 months old in rural Bangladesh.

Methods
We investigated the effect of BMF exposure on neurodevelopment in a pregnancy cohort of 903 women from rural and semi-urban Bangladesh. Women between 6-18 weeks of pregnancy were recruited through active surveillance from northern region of Bangladesh and followed for 12 months after the delivery. Detail information on maternal and infant exposure and health was collected throughout the period. Infants’ developmental milestones were assessed through the ASQ-3 instrument involving at home interview of the mothers by trained field team. The associations between use of solid fuel (compared to clean fuel- LPG or electricity) for cooking and time spent for cooking on five different aspects of neurodevelopment: communication, gross motor, fine motor, problem solving and personal-social aspects, were assessed using multivariable linear regression models.

Results
After controlling for potential confounders, a strong detrimental effect was observed between use of BMF and hours of cooking on all the developmental milestones except gross motor function. For example, on average the score for communication was 3.55 (p-val:0.01) lower for Infants born in the households using solid fuel compared to clean fuel and it decreased by 0.52 for each hour the mother spent cooking beyond 1.7 hrs (average cooking time).

Conclusions
Based on this study, we found evidence that in utero exposure to BMF might have detrimental effect on the neurodevelopment in 3 to 5 months old infants living in rural and semi-urban areas of Bangladesh.
OPS 13: Heat, cold and mortality

Heat-related mortality impacts attributed to climate change: a global study over historical period.

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Background & Aim: While it is widely accepted that climate change will increase heat-related deaths in the future, limited quantitative evidence exists on current and past impacts already attributable to climate change. This large global study aims at estimating the proportion of excess heat-related mortality attributed to global warming experienced in recent decades across various regions of the world, by comparing impact estimates derived under actual trends and pre-industrial projection scenarios.

Methods: We studied 601 locations across 30 countries included in MCC database for which observed daily temperature-mortality data was available for at least 2 years between 1995 and 2005. Location-specific summer-only temperature-mortality associations were estimated through two-stage time-series analyses with quasi-Poisson regression with distributed lag non-linear models and multivariate meta-regression. Excess mortality attributable to climate change was calculated as the difference in heat-related excess deaths occurring above the city-specific minimum mortality temperature, estimated using modelled temperature series consistent with current actual emission trends (“warming”) and pre-industrial forcings (“non-warming”), respectively, obtained from the ISIMIP2b database.

Results: Overall excess heat-mortality fractions of 1.60% [95%CI: 0.30–2.76] and 1.03% [0.13–2.04] were estimated during summer under the “warming” and “non-warming” scenarios, respectively. This translates to 35% of historical heat-excess mortality attributed to climate change. Statistically significant differences between scenarios were observed in Central America (0.80 [0.16–1.63] vs.0.29 [-0.02–0.86]), North of Europe (0.86 [0.09–1.53] vs. 0.61 [0.03–1.18]), Central Europe (2.62 [1.52–3.67] vs.1.62 [0.49–2.64]), South of Europe (8.00 [5.15–10.88] vs. 5.32 [1.95–8.50]), and Australia (1.54 [0.15–2.82] vs. 0.98 [-0.02–2.12]), translating to 63%, 29%, 38%, 34% and 36% of the heat-excess mortality attributed to climate change, respectively.

Conclusions: Our preliminary findings suggest that climate change is already responsible for a considerable increase in heat-related mortality burden. These results stress the importance of strengthening current mitigation strategies to reduce further warming of the planet and related health impacts.
Geographical variability of the minimum mortality temperature: A multi-country analysis

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OPS 13: Heat, cold and mortality, Room 117, Floor 1, August 26, 2019, 13:30 - 15:00

Background/Aim: The temperature-mortality relationship has been described as a J- or U-shaped with a temperature at which risk of mortality is at the minimum (MMT). Little is known about the geographical variation of the MMT worldwide and the underlying factors that could explain adaptation to climate. We aim to investigate the determinants of the geographical variation in the MMTs according to climatic zones.

Methods: We collected data from 564 locations in 33 countries between 1985 and 2015. We applied a two-stage time-series design. First, for each location, we modelled mortality-temperature associations across 21 days of lag using quasi-Poisson regression and distributed lag nonlinear models to derive the city-specific MMT and its standard error. Second, we used random-effects meta-analysis to summarize the MMTs distribution by country, geographical region and climatic zone. We explored the association with the locations’ climate characteristics using random effects meta-regression.

Results: The country pooled MMTs ranged from 8.9ºC (in Sweden) to 29.9ºC (in Taiwan). We observed an increasing North-to-South pattern in the distribution of the MMTs in all the geographical regions. Similarly by climatic zones with increasing MMTs from less-to-warm climates (continental 18.4ºC, temperate 21.9ºC, arid 24.1ºC and tropical 28.7ºC). The MMTs increase by 1.5ºC for a rise of annual mean temperature of 1ºC in arid climates, by 1ºC and 0.9ºC in tropical and temperate climates respectively, and by 0.2ºC in continental climates.

Conclusion: The geographical variation of the MMTs is mainly driven by the temperature distribution and might affect differently according to the climatic zone. Our findings suggest that locations in arid climates are more adapted to heat than those in tropical and temperate climates. Locations in continental climates might not be yet adapted, indicating the need for the implementation of public health policies under climate change.

On behalf of the MCC Collaborative Research Network.
Temperature-mortality relationship in hot, hyper-arid regions: Results from a time-series analysis in Kuwait

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**Background**—There is a gap of knowledge on the possible health impacts and vulnerabilities to climate change in the Gulf and the Arabian Peninsula Region. In this hyper-arid part of the world, population health data is not abundantly available while temperatures soar to unprecedented record high levels. Our research group previously showed acute negative effects of temperature extremes on daily non-accidental mortality in Kuwait. However, little is known about the most vulnerable subpopulations.

**Objective**—To assess the risks of mortality from extreme temperatures among different groups of the Kuwaiti population.

**Methods**—From 2010 to 2016, mortality data were analyzed using a time-series design and a negative binomial distribution for the daily counts of deaths, stratified by cause of death, gender, age, and nationality. The temperature lag was modeled with distributed lag non-linear models (dlnm). The relationship was adjusted for PM10 and ozone daily levels.

**Results**—In total, both heat and cold effects showed increased risks of mortality among most subpopulations. For the heat effect, comparing extreme temperature at the 99th percentile to the optimum temperature (OT), the relative risk (RR) of death among men and non-Kuwaitis were 2.08 (1.23-3.52) and 1.96 (1.10-3.52), respectively. Similarly, the RR of death from a cardiovascular cause during extremely hot days was 3.09 (1.72-5.55). Among the elderly population (>65 years), the RR of death from extreme hot and cold temperatures compared to OT were 1.86 (1.02-3.39) and 2.31 (1.13-4.73), respectively.

**Conclusions**—Our findings suggest that men, the elderly, non-Kuwaitis, and people with cardiovascular diseases are most vulnerable to extreme hot temperatures. The evidence overwhelmingly prompts policy considerations and adaptation methods to temperature exposure. We now uncover vulnerabilities to temperature extremes from a region that is overshadowed by the question of human inhabitability by the end of the century due to increasing global temperatures.
Modifiers of temperature variability-related mortality: A multi-country study

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Background/Aim
Recent studies showed that temperature variability is a risk factor for human mortality. Some studies also reported that high temperature, demographic characteristics (e.g., age structure), and regional climate modified the association between temperature variability and mortality. However, comprehensive and potential modifiers in community-scale have not been fully discussed. Investigating potential modifiers may contribute to establishing better public health interventions. This study aims to investigate the possible modifiers of temperature variability-related mortality with multi-country dataset and satellite data.

Methods
We collected historical time-series data covering mortality and weather variables from over 400 cities of 24 countries from 1972 to 2015 and estimated an association between modifiers of the temperature variability-mortality association using meta-regression models. The community-scaled modifiers were obtained through various sources; regional/national weather stations, World Bank, OECD and Moderate Resolution Imaging Spectroradiometer (MODIS).

Results
The temperature variability-related risk of mortality was modified by regional characteristics: average temperature variability, average temperature, economic status, population, air pollutions, and environmental factors (such as greenness).

Conclusions
The study shows community-scaled characteristics (e.g., climate, socioeconomic status, etc.) may modify the temperature variability-mortality relationship, and suggests possible mechanisms of the modifiers.

On behalf of the MCC Collaborative Research Network.
Attributable Risk of Mortality associated with Heat and Heat waves: A time-series study in Kerman, Iran during 2005-2017

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Background: The association between heat or heat waves and mortality should often be reported in a way that makes it sensible by health policymakers. In this study we aimed to assess the effect of heat and heat waves on mortality using attributable risks.

Methods: Nine Heat Waves (HW) were defined using a combination of severity and duration of mean daily temperature. Heat wave effects were assessed using added and main effects. Added effects were assessed as a binary variable and main effects were assessed by comparing the median temperature (in heat wave days) to Minimum Mortality Temperature (MMT). The effects of heat, mild heat and extreme heat on mortality were also assessed. Distributed Lag Non-linear Models were used to assess the relations in a bi-dimensional perspective in which the quadratic b-spline was chosen as the basis function for the dimension of the exposure and the natural cubic b-spline was chosen for lag dimension. The backward perspective was used to estimate the attributable risks.

Results: The total mortality attributed to non-optimal temperatures for all days was 1.91% (CI 95%: -6.36, 8.47). The Attributable Risks (AR) were 2.23%, 2.02% and 0.25% for heat, mild heat and extreme heat days, respectively. AR was more for females and the above 65 years old groups than other groups in heat, mild heat and extreme heat days. While the stronger heat waves defined based on temperature above the 95 and 98th percentile had a significant attributable risk for total mortality in the added effects; the weaker heat waves (defined based on temperature above of the 90th percentile (HW1, HW2, HW3) had higher attributable risks, significant for HW1 and HW2 in the main effects.

Conclusion: Apparently weaker heat waves show more immediate effects, while stronger heat waves increase mortality over several days.
District level spatial variability of heat-related mortality in Barcelona from 1992-2015: a case crossover study design

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OPS 13: Heat, cold and mortality, Room 117, Floor 1, August 26, 2019, 13:30 - 15:00

Background Numerous studies have demonstrated the relationship between summer temperatures and increased heat-related deaths around the globe. Epidemiological analyses of the health effects of climate exposures usually rely on observations from the nearest weather station to assess exposure-response associations for geographically diverse populations. Urban climate models provide high-resolution spatial data that may potentially improve exposure estimates, but to date, they have not been extensively applied in epidemiological research.

Objectives We investigated temperature–mortality relationships in the city of Barcelona, and whether estimates vary among districts.

Methods We considered geo-referenced daily mortality data during the summer months (June-September) for the period 1992-2015. We extracted daily summer mean temperatures from a 100-meter resolution simulation of the urban climate model UrbClim. Summer hot (above percentile 70) and reference (below percentile 30) temperatures were compared by using a conditional logistic regression model in a case crossover study design applied to all districts of Barcelona.

Results Relative Risks (RR) and 95% Confidence Intervals (CI) were calculated for all-cause mortality and several population subgroups (age, sex and education). Hot temperatures were associated with an increased risk of death (RR= 1.13; 95% CI=1.10-1.16), and the risk ratio was higher among women (RR=1.16; 95% CI= 1.12-1.21) and the elderly (RR=1.18; 95% CI=1.13-1.22). Individuals with education (RR=1.13; 95%CI=1.08-1.18) and without education (RR=1.10; 95%CI= 1.05-1.15) showed higher risk. 6 out of 10 districts showed statistically significant associations.

Conclusion Findings identified vulnerable districts and suggested new insights to public health policy makers on how to develop district-specific strategies to reduce risks.
OPS 18: Cardiometabolic effects of chemical exposures

Environmental contaminant body burdens and the relationship with blood pressure measures among Indigenous Canadians: Results from the Nituchischaaayihtitaau Aschii: Multi-Community Environment-and-Health Longitudinal Study in Eeyou Istchee, a cross-sectional study

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Blood pressure (BP) increments increase cardiovascular disease (CVD) risk. Recently, clinical practice guidelines lowered hypertension definitions. Indigenous Canadians experience slightly higher CVD compared to non-Indigenous Canadians. Environmental contaminant body burden from persistent organochlorine pollutants, organic compound concentrations (OCs), and metals have been linked with hypertension risk. This study examined the role of OCs, and metals on hypertension among Indigenous Canadians.

Methods: Using data from the Environment-and-Health Study in Eeyou Istchee territory of northern Québec, Canada, the sample restricted to adults over 20-years of age, with valid BP measures and detectable body burden mixtures. In total, n=774 participants were eligible, of which, n=452, 58% females. Principal Component Analysis (PCA) was used to reduce the complexity of the contaminant data. Orthogonal principal component (PC) variables were used as independent predictors in both multivariable linear regression, and modified Poisson regression models with robust variance estimation, deriving relative risk for hypertension defined using systolic BP (SBP) ≥ 140 mm Hg or diastolic BP (DBP) ≥ 90 mm Hg.

Results: Three PCs were extracted from the PCA analysis. PC-1, PC-2, and PC-3, explained 72%, 5.5% and 4.8% of the variation, respectively. Polychlorinated biphenyls and OCs positively highly loaded on the first axes (PC-1), followed by moderate loadings for metal mercury. Lead loaded positively, whereas DDT negatively loaded on PC-2, and cadmium strongly loaded on the third PC axis. Systolic BP measures were significantly associated with PC-1 across all models. In the final model, PC-1 increased SBP β=1.72 (95% CI 0.42, 3.02). PC-3, represented by cadmium was associated with SBP but after adjusting for body mass, PC-3 was no longer associated with SBP. Hypertension was consistently and significantly associated with PC-1 across models, RR=1.14 (95% CI 1.02, 1.28) in the final adjusted model.

Conclusion: Using a reduction technique, this cross-sectional analysis found OCs to be associated with increased SBP.
Exposure to Acrylamide and Reduced Heart Rate Variability in Chinese Adults: The Potential Mediating Role of Inflammatory Response

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OPS 18: Cardiometabolic effects of chemical exposures, Room 110, Floor 1, August 26, 2019, 13:30 - 15:00

Background: Exposure to acrylamide has been reported to be linked with cardiovascular damage. However, the effect of acrylamide exposure on heart rate variability (HRV), a marker of cardiac autonomic function, and the underlying mechanisms remain unknown. We aimed to investigate the associations of urinary acrylamide metabolites with HRV and potential role of inflammatory response in such associations.

Methods: We measured HRV and urinary acrylamide metabolites including N-Acetyl-S-(2-carbamoylthyl)-L-cysteine (AAMA) and N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine (GAMA) for 2,997 general Chinese adults from the Wuhan-Zhuhai cohort. Among these participants, 2,414 subjects were tested for plasma inflammatory cytokines including C-reactive protein (CRP) and transforming growth factor-β1 (TGF-β1). Associations among urinary acrylamide metabolites, HRV and inflammatory cytokines were evaluated by linear mixed models and their dose-response relationships were graphically characterized by restricted cubic spline models. Mediation analysis was performed to investigate the mediating role of inflammatory cytokines in relations between urinary acrylamide metabolites and HRV.

Results: Both urinary acrylamide metabolites and TGF-β1 were negatively associated with 5-min HRV indices (LF, low frequency; HF, high frequency; TP, total power; SDNN, standard deviation of all normal-to-normal intervals; r-MSSD, square root of the mean squared difference between adjacent normal-to-normal intervals; SDNN index, mean of SDNN for all 5-min segments of the entire recording) (all P<0.05). GAMA (P<0.05) rather than AAMA (P>0.05) was positively related to TGF-β1. Spline regressions showed significantly linear dose-response relationships of urinary acrylamide metabolites and TGF-β1 with HRV, as well as GAMA with TGF-β1. Mediation analysis indicated that elevated TGF-β1 significantly mediated 4.77%, 7.05%, 4.62%, 7.15%, 7.41% and 5.56% of the GAMA associated LF, HF, TP, SDNN, r-MSSD and SDNN index reduction, respectively. No mediated effect by CRP was found.

Conclusions: Acrylamide exposure may be associated with HRV reduction, and which may be partially mediated by inflammatory response of increasing plasma TGF-β1 rather than systematic inflammation.
Life-course exposure to perfluoroalkyl substances and clinical markers of type 2 diabetes in early adulthood

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OPS 18: Cardiometabolic effects of chemical exposures, Room 110, Floor 1, August 26, 2019, 13:30 - 15:00

Aim: To investigate the longitudinal associations of developmental and adult exposures to perfluoroalkyl substances (PFASs) with clinical markers of type 2 diabetes in early adulthood.

Methods: We studied a Faroese cohort born in 1986-1987 (n=699). PFASs were measured in cord blood and participants’ serum at ages 7, 14, 22 and 28 years. Clinical indices of type II diabetes were calculated from a 2-hour, 75gr oral glucose tolerance test performed at age 28 (i.e., Matsuda insulin sensitivity index [ISI], homeostatic model assessment of insulin resistance [HOMA-IR], insulinogenic index [IGI], corrected insulin response [CIR] and glucose and insulin areas under the curve [AUC]). To evaluate potential differences in the associations across exposure periods, we used multiple informant models fitting generalized estimating equations adjusted for an interaction term between PFAS and age at exposure assessment, and confounders.

Results: Higher PFOS exposure at all ages was associated with lower ISI and higher HOMA-IR, IGI, CIR and insulin AUC. Even though interactions by age were non-significant (p PFOS*age interaction>0.10 for all outcomes), associations were mostly significant and of larger magnitude for prenatal PFOS exposure (%GM change per PFOS doubling [95% CI]= -6%[-11%, 0%] for ISI, 4%[-2%, 11%] for HOMA-IR, 13%[2%, 25%] for IGI, 10%[1%, 21%] for CIR, and 8%[1%, 15%] for insulin AUC. We also found some indication of stronger associations in women compared to men (p prenatal PFOS*sex interaction<0.10 for IGI and CIR only). Associations of PFHxS and PFNA were in the same direction as those for PFOS, but mostly non-significant. We did not observe consistent association patterns suggesting a diabetogenic effect for PFOA and PFDA.

Conclusions: Findings suggest that life-course PFAS exposures are associated with increased insulin secretion by the pancreatic β-cells, and insulin resistance in young adults. Associations were the strongest for prenatal PFOS exposure, and for women as compared to men.
Urinary concentrations of phthalate metabolites in relation to circulating fatty acid profile

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OPS 18: Cardiometabolic effects of chemical exposures, Room 110, Floor 1, August 26, 2019, 13:30 - 15:00

Background: Animal studies suggested that phthalate exposure may alter plasma fatty acid composition. However, limited epidemiological study has been applied to examine the association. We conducted a cross-sectional study to examine whether urinary concentrations of phthalate metabolites were associated with circulating fatty acids among the U.S. general population. Methods:
The 2003-2004 National Health and Nutrition Examination Survey was used to assess the association between urinary phthalates and fatty acid profile. A total of 10 urinary phthalates metabolites and 24 fatty acids were assessed. Demographic information was obtained by household interview using questionnaires. Fatty acid patterns were identified using principal component analysis (PCA) with an eigenvalues greater than 1. Urinary concentrations of phthalate metabolites were log-transformed to normalize distributions. Multiple linear regression model was used to evaluate whether urinary phthalate metabolites were related to PCA-derived components of blood fatty acid levels. Results: A total of 436 participants (53.21% women) were included in the final analysis. Six components were derived from 24 plasma fatty acids. Components 1 to 6 explained 82.54% of the total variance. The fatty acid component 1 explained the most variance (47.36%) of all fatty acids. Among component 1, myristic, palmitic, stearic, myristoleic, palmitoleic, oleic, cis-vaccenic, eicosenoic, γ-linolenic, homo-γ-linolenic, docosatetraenoic, and docosapentaenoic-3 acid were highly loaded. After adjusting age, gender, body mass index, family income, ethnicity, and education level, monobenzyl phthalate (MBzP), mono-n-butyl phthalate (MnBP), ad mono-isobutyl phthalate (MiBP) were positively associated with fatty acid component 1. Conclusions: Our findings provided the epidemiologic evidence that phthalate may alter the fatty acid composition.
Pregnancy per- and polyfluoroalkyl substances (PFAS) and maternal glucose intolerance

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OPS 18: Cardiometabolic effects of chemical exposures, Room 110, Floor 1, August 26, 2019, 13:30 - 15:00

Background/Aim: Per- and polyfluoroalkyl substances (PFAS) exposure may alter glucose tolerance (GT). However, research on the association between PFAS and altered GT during pregnancy is limited. Few studies have assessed potential effect modification by maternal factors.

Methods: We assessed PFAS exposure and GT in 1,585 pregnant women from the Project Viva cohort in Boston, MA, USA. We quantified six PFAS in maternal plasma samples (median 9.6 weeks gestation; collected 1999-2002). GT was assessed by 50-g non-fasting, oral glucose challenge tests (GCT) (median 28 weeks gestation) and 3-hr fasting, 100-g oral glucose tolerance tests (OGTT). Women with abnormal GCT results (glucose ≥140 mg/dL) were classified as having isolated hyperglycemia (IH) (normal OGTT), impaired GT (IGT) (1 abnormal OGTT value), or gestational diabetes mellitus (GDM) (≥2 abnormal OGTT values) (American Diabetes Association criteria). As a secondary analysis we classified women as having abnormal vs. normal GCT results. We used multinomial logistic regression to assess associations of natural log-transformed continuous PFAS concentrations (ln-PFAS) with GT, adjusting for maternal age, race/ethnicity, pre-pregnancy BMI, education, smoking status, and parity. To explore potential effect modification, we used logistic regression to assess associations of ln-PFAS with abnormal vs. normal GCT, stratified by maternal BMI and age.

Results: 265 (17%) women had abnormal GT. PFAS concentrations were not associated with GT in the full cohort [e.g. ln-perfluorononanoate (PFNA): OR (95% CI): IH, 1.23 (0.85, 1.78); IGT, 1.11 (0.62, 1.98); GDM, 1.15 (0.74, 1.78)]. In stratified analyses, ln-PFNA was positively associated with abnormal GCT among overweight (BMI 25 - <30 kg/m²) [OR: 1.76 (1.04, 2.97)] and younger (<35 years) [OR: 1.48 (1.05, 2.09)] women.

Conclusion: We observed modest associations between PFNA and increased odds of abnormal GCT in certain population subgroups. However, we found no evidence of an effect of PFAS exposure on glucose tolerance in the full cohort.
Maternal Urinary BPA level and Cardio-metabolic Risk Factors in Toddlers

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OPS 18: Cardiometabolic effects of chemical exposures, Room 110, Floor 1, August 26, 2019, 13:30 - 15:00

Background/Aim: Exposure to endocrine disrupting chemicals during the first 1000 days may have long-lasting effects on cardio-metabolic health in later life. This study aimed to examine the associations between prenatal Bisphenol A (BPA) exposure and child adiposity measures and metabolic risk factors (blood glucose/insulin, serum lipids, and blood pressure) at age 2 years.

Methods: This study included 218 mother-infant pairs. Pregnant women were recruited at late pregnancy from Shanghai, China in 2012-2013. The infants were followed up to 2 years. Urinary BPA concentration was measured with high-performance liquid chromatography-tandem mass spectrometry (HPLC-MS/MS), and categorized into high, medium and low in tertiles. We took adiposity measurements including weight, height, skinfold thicknesses (triceps, subscapular and abdominal), and assessed metabolic risk factors including serum glucose, insulin, and lipids (high-density lipoprotein (HDL), low-density lipoprotein (LDL), cholesterol, triglyceride) and blood pressure in children. Linear regression was used to evaluate the associations between prenatal BPA level and each of the cardio-metabolic risk factors in children.

Results: BPA was detectable (>0.1 ng/mL) in 98.8% mothers (median 3.8 μg/g creatinine). Compared to that in the low prenatal urinary BPA level, infant mean systolic blood pressure (SBP) was 3 mmHg (95%CI: 0.3 - 6 mmHg) higher in the medium BPA level, and 4 mmHg (95%CI: 0.4 - 7.3 mmHg) higher in the high BPA level in children, with adjustment for urinary creatinine, infant age and sex. No associations were observed between maternal BPA level and child BMI, skinfold thicknesses, serum glucose, insulin, HDL, LDL, cholesterol, triglyceride or diastolic blood pressure in children.

Conclusions: In this study, we found that prenatal urinary BPA level was associated with higher systolic blood pressure in toddlers. Further independent cohort studies are needed to confirm the findings.
OPS 39: Metals and biomarkers
Infant toenail metal concentrations associated with gut microbial diversity and specific taxa abundance
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Background/Aim: The infant microbiome may contribute to health status across the lifespan, but environmental factors affecting microbial community composition and specific taxa abundance are poorly understood. Recently, our group observed an association between infant urinary arsenic concentrations and their six-week gut microbiome. Here, we aimed to identify the associations between a spectrum of other metal exposures and the gut microbiome in six-week-old infants in the New Hampshire Birth Cohort Study.

Methods: Infant six-week toenail samples were analyzed for an array of trace elements including metals and metalloids (manganese-Mn, arsenic-As, mercury-Hg, and lead-Pb) using inductively coupled plasma mass spectrometry. Stool samples were collected from infant’s diapers at approximately six weeks of age and 16S rRNA sequencing of the V4-V5 hypervariable regions was performed on the Illumina MiSeq. Alpha diversity was calculated using Shannon and Simpson Indices and community composition was assessed using generalized UniFrac distances. Taxon-level analyses were conducted using multivariate zero-inflated logistic normal regression. All analyses were adjusted for maternal pregnancy characteristics (parity, fruit and dairy intake), delivery characteristics (birth mode, intrapartum antibiotic exposure), and infant characteristics (sex, feeding mode).

Results: Complete data were available on 179 infants in the cohort for our preliminary analyses. Arsenic and mercury were associated with decreases in alpha diversity. Similarly, arsenic and mercury were associated with differences in community composition. Associations (positive (+) or negative (-)) with the relative abundance specific taxa abundance were also observed including with As (-Erwinia, +Streptococcus), Hg (-Escherichia coli, +Staphylococcus, +Veillonella dispar, +Erwinia), Pb (+Streptococcus), and Mn (-Clostridium neonatale).

Conclusions: Early postnatal metal exposure is associated with differences in the infant microbiome. Further research is needed to clarify the clinical relevance of these alterations.
Differential Transcript Usage in the Placenta is Associated with in utero Arsenic Exposure and Fetal Growth Restriction

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OPS 39: Metals and biomarkers, Room 411, Floor 4, August 26, 2019, 13:30 - 15:00

Background/Aim: Intrauterine arsenic and cadmium exposures have been linked with reduced birth weight as well as alterations in placental molecular features. However, studies thus far have focused on summarizing transcriptional activity at the gene level and do not capture isoform specification, a major driver in development that enables adaptive responses to the rapidly changing physiological conditions experienced early in life. In this study, we conducted a genome-wide analysis of the placental transcriptome to evaluate the role of isoform specification as a potential mediator in the pathway between intrauterine arsenic/cadmium exposure and fetal growth restriction.

Methods: Transcriptome-wide RNA sequencing was performed in placenta samples from the Rhode Island Child Health Study (RICHS, n=200). Arsenic and cadmium levels were measured in maternal toe nails using ICP-MS. Differential transcript usage (DTU) between small (SGA) and appropriate (AGA) for gestational age infants was assessed using the DRIMSeq R package. Generalized linear models were assessed to determine the association between placental transcript proportions and arsenic/cadmium levels.

Results: We identified 223 genes demonstrating SGA associated DTU (FDR<0.05). Among these, only 5 genes (SCAP, INHA, HNRNPA1, RAC1, CSNK1E) demonstrated differential expression at both the gene and transcript level. The transcript proportion of one SGA-DTU gene, TUSC3, was associated with intrauterine arsenic exposure (FDR<0.05). No differences were observed in association with intrauterine cadmium exposure.

Discussion: We report the first genome-wide characterization of placental transcript usage and associations with intrauterine metal exposure and fetal growth restriction. Despite no difference in overall TUSC3 gene expression levels, both arsenic exposure and SGA status were associated with the expression of a specific TUSC3 transcript, suggesting a pathway by which an intrauterine exposure impacts fetal growth through perturbations of placental processes. These results highlight the utility of interrogating the transcriptome at deeper transcript-level resolution to identify novel placental biomarkers of exposure-induced outcomes.
Relationship between urinary levels of heavy metals and formation of serum microparticles in young population

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OPS 39: Metals and biomarkers, Room 411, Floor 4, August 26, 2019, 13:30 - 15:00

Backgrounds: Association between cardiovascular diseases (CVD) and heavy metals have been established in large population studies. However, less attention has been devoted to investigating the link between heavy metal exposures to biomarkers of cardiovascular toxicity, particularly in the young population.

Methods: A cross-sectional study with 739 adolescents and young adults between the ages of 12 – 30 were recruited from the previously established cohort (Young Taiwanese Cohort Study; YOTA) from 2006 to 2008. For our study, urine samples were collected and subsequently analyzed to evaluate the association between urinary concentrations of cadmium, lead, chromium, manganese, iron, nickel, copper, and zinc with selected serum microparticles.

Results: Increases in serum counts of endothelial microparticles (CD31+/CD42a-), indicative of endothelial cells apoptosis, reached statistical significance with increases in urinary levels of lead, cadmium, magnesium, and zinc, after adjusting for covariates of CVD. Significant increases in apoptotic platelet microparticles (CD31+/CD42a+ and CD62p) and biomarkers of monocytes (CD14) correlate with increases in urinary concentrations of cadmium and lead. Multivariate logistic regression analysis revealed that higher quartiles of urinary levels of lead and cadmium were associated with higher counts of microparticles (greater than 75th percentile). Compared to subjects with lower concentrations of urinary lead (lowest quartile; <0.657 μg/L), the adjusted odds ratios (aORs) for developing higher counts of CD31+/CD42a-, CD62p, CD31+/CD42a+ and CD14 are 13.22 (95% confidence interval: 7.12 - 24.55), 1.68 (1.02 - 2.78), 2.10 (1.28 - 3.46) and 3.49 (2.06 - 5.91) for those at Q4, respectively. Moreover, those with lower urinary cadmium are more at risk to developing platelet microparticles, with an aOR of 1.74 (0.85 - 3.54) in Q2, 4.76 (2.49 - 9.09) for Q3, and 15.72 (8.18 - 30.20) for Q4.

Conclusion: Higher urinary concentrations of lead and cadmium were strongly associated with increases in endothelial and platelet microparticles in young population, which signal cardiovascular toxicity.
Association between prenatal exposure to multiple metals and maternal and child thyroid hormone levels

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OPS 39: Metals and biomarkers, Room 411, Floor 4, August 26, 2019, 13:30 - 15:00

Background/Aim: Metals and trace elements may affect thyroid homeostasis, but the role of prenatal exposure is unclear. We evaluated the association of pregnancy exposure to mixtures of trace elements with maternal and child thyroid function in 800 mother-child pairs from the RHEA pregnancy cohort in Crete, Greece.

Methods: Concentrations of 11 essential and non-essential trace elements were determined in first trimester maternal urine using inductively coupled plasma mass spectrometry. Thyroid hormones (thyroid stimulating hormone (TSH), free T(4), and free T(3)) were measured in serum samples collected from mothers (1st trimester) and their children at 4 years of age. Associations of each element and mixtures with thyroid hormone levels were assessed using linear regression and Bayesian Kernel Machine Regression (BKMR), respectively.

Results: In BKMR analysis, higher total urinary element concentration was associated with lower maternal TSH and higher FT3 levels, while there was no association with FT4. Results from BKMR were in line with findings from linear models, with negative associations of urinary copper (adj. b= -49.7 %, 95%CI: -65.6, -26.5), selenium (b= -51.2 %, 95%CI: -66.8, -28.1) and cadmium (b= -23.1 %, 95%CI: -38.1, -4.5) with maternal TSH levels. Exposure to urinary copper was positively associated with maternal FT3 levels (b= 0.6 pg/mL, 95%CI: 0.2, 1.0). Cobalt was associated with lower maternal FT4 levels (b= -0.05 ng/dL, 95%CI: -0.1, -0.01) while copper (b= 0.1 ng/dL, 95%CI: 0.02, 0.2), zinc (b= 0.1 ng/dL, 95%CI: 0.02, 0.1), selenium (b= 0.1 ng/dL, 95%CI: 0.1, 0.2) and cadmium (b= 0.1 ng/dL, 95%CI: 0.02, 0.11) were associated with higher maternal FT4 levels. We observed no interactions between the different elements. No associations were observed with child thyroid hormones.

Conclusions: The present results suggest that exposure to metals and trace elements at exposure levels relevant for the general population, can alter maternal thyroid homeostasis.
Maternal blood trace metal concentrations and whole blood DNA methylation during pregnancy in the Early Autism Risk Longitudinal Investigation (EARLI)

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OPS 39: Metals and biomarkers, Room 411, Floor 4, August 26, 2019, 13:30 - 15:00

**Background/Aim:** Metals exposures have important health effects in pregnancy, and blood measures reflect recent exposure (cadmium half-life (t₁/₂)=~75 days, manganese t₁/₂=~40 days, mercury t₁/₂=~70 days, selenium t₁/₂=~100 days), and lead t₁/₂=~30 days). The maternal epigenome may be responsive to these exposures. We tested whether metals are associated with concurrent differential maternal whole blood DNA methylation.

**Methods:** In the Early Autism Risk Longitudinal Investigation (EARLI) cohort, we measured first or second trimester maternal blood metals concentrations (215 participants) using inductively coupled plasma mass spectrometry. Maternal blood DNA methylation was measured in the same specimens on the Illumina 450K array (201 participants); 97 non-smoking women had both measures available for analysis. Linear regression was used to test for site-specific associations between individual metals and DNA methylation, adjusting for cell type composition and confounding variables. In targeted enrichment analysis, genes with altered DNA methylation (p-value<0.05) were tested for overlap with innate immunity genes. Discovery gene ontology analysis was conducted on the top 1,000 sites associated with each metal to elucidate downstream pathways.

**Results:** In multivariable regression, we observed DNA methylation sites associated (p-value<10⁻³) with cadmium (n=3), manganese (n=21), mercury (n=1), and lead (n=63). The top sites associated with cadmium, manganese, mercury, and lead, were near the genes ITPKB, ARID2, SPTBN2, and CYP24A1 respectively. Cadmium and manganese associated DNA methylation sites had the greatest enrichment for innate immunity genes (Fischer’s test p-value<10⁻³). Cadmium was associated with cell adhesion (q-value<0.01), manganese was associated with cellular metabolism (q-value<0.01), mercury was associated with organ morphogenesis (q-value<0.01), and lead was associated with cell adhesion (q-value<0.001) and nervous system development (q-value<0.001).

**Conclusions:** We report site-specific associations between DNA methylation and blood metals in early pregnancy. Sites associated with cadmium, manganese, mercury, and lead may be potential biomarkers of exposure or implicate downstream gene pathways.
Loci-specific DNA methylation is associated with urinary arsenic: an epigenome-wide association study among adults with low-to-moderate arsenic exposure in the United States

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Background/Aim: At least 140 million people are exposed to arsenic in drinking water. Arsenic exposure affects all organ systems and health risks persist after exposure has ended, suggesting that epigenetic dysregulation is a mechanistic link between exposure and health outcomes. This study investigated the association between total arsenic measured in urine and loci-specific DNA methylation (DNAm) among adults with low-to-moderate arsenic exposure in American Indian communities from the Strong Heart Study.

Methods: DNAm was measured at >850,000 CpGs in 2,325 participants using the Illumina MethylationEPIC array. We used linear models implemented with limma to identify differentially methylated positions (DMPs), and DMRcate to identify differentially methylated regions (DMRs). Gene ontology (GO) analysis was conducted using GOmeth. Models were adjusted for estimated cell type proportions, age, sex, BMI, smoking, education, estimated glomerular filtration rate, and study site.

Results: After false discovery rate (FDR) correction, 20 CpGs were associated with ln(total urinary arsenic concentration) (PFDR < 0.05). After Bonferroni correction, 5 CpGs were associated with arsenic (PBonferroni < 0.05), located in SLC7A11, ANKS3, LINGO3, CSNK1D, ADAMTSL4. We identified one DMR in chromosome 11 (annotated to C11orf2 and TSPAN32). 198 GO terms were overrepresented among DMPs (P < 0.05), including cysteine/glutamate transport although none were significant after FDR correction.

Conclusion: In this large epigenome-wide association study of arsenic exposure, the top DMP was located in SLC7A11A, a protein-coding gene involved in cystine/glutamate transport, a molecular function also identified in GO analysis. Cystine/glutamate transport is important for the biosynthesis of glutathione, an intercellular antioxidant that may protect against As-induced oxidative stress, and may be involved in liver function. Additional DMPs were located in genes associated DNA replication and repair, apoptosis, cellular growth and adhesion, and glucose metabolism. Further research is needed to investigate associations between low-to-moderate levels of arsenic exposure and gene expression.
Background: Pyrethroids (PYR) are insecticide that common use in households. PYR are the main effect on voltage-sensitive sodium channels in the nervous system, which neurotransmitter including gamma-aminobutyric acid (GABA). This work focused on PYR exposure in relation to PYR metabolite and GABA concentration in child’s urine sample.

Methods: Children aged 2-3 years provided urine sample (n=80). Mother completed questionnaires. We focus on children living at household all time, used of PYR insecticide every day. Urine sample were analyzed for PYR metabolite represented by 3-phenoxybenzoic acid (3-PBA) using a gas chromatography (GC/MS) method. GABA was analyzed as same as urine sample using enzyme-linked immunosorbent assay kit (ELISA).

Results: The 3-PBA was detected in 91% of tested urine sample. The median and maximum for 3-PBA in the urine sample were showed 0.53 and 2.02 µg/mL, respectively. GABA concentration of urine sample were showed median (355 ng/mL) and maximum (7,490 ng/mL). New finding of the 3-PBA concentration was correlation with GABA concentration (p=0.04). Moreover, 3-PBA concentrations were correlation with child’s age (p=0.018), exposure characteristics including daily use of PYR insecticide in household and floor-cleaning less than 2 time/week were showed (p≤0.033), personal hygiene including play on the floor, non-wash hands/foots in the day, walk bare feet inside/outside household (p≤0.031) and contact variable behavior including touch furniture-to-mouth, put hand-to-mouth, put toy-to-mouth and craw on the floor (p≤0.04).

Conclusions: Using PYR insecticide daily may become main pathway for PYR exposure to children who play on the floor, non-wash hands/foots, and craw on the floor. And those factors may be effect to neurotransmitter GABA concentration.
Prenatal exposure to organophosphate pesticides and functional neuroimaging among adolescents living in proximity to agricultural pesticide application

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OPS 55: Pesticides and neurological outcomes, Room 412, Floor 4, August 26, 2019, 13:30 - 15:00

Background/Aim: We have reported consistent associations of prenatal organophosphate pesticide (OP) exposure with poorer cognitive function and behavior problems in our Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS), a birth cohort of Mexican American youth in California’s agricultural Salinas Valley. However, there is little evidence to date on how OPs affect neural dynamics underlying cognitive function.

Methods: We used functional near-infrared spectroscopy (fNIRS) to measure cortical brain activation during tasks of executive function, attention, social cognition, and language comprehension in a subset of 95 adolescent CHAMACOS participants. We estimated associations of residential proximity to OP use during pregnancy with cortical activation in bilateral frontal, temporal, and parietal regions, adjusting for sociodemographic characteristics, and examined differences by sex.

Results: We found that prenatal OP exposure was associated with altered brain activation patterns during tasks of executive function, including cognitive flexibility and working memory. For example, for a ten-fold increase in total OP pesticide use within a 1 km radius of maternal residence during pregnancy, there was a bilateral decrease in brain activation in the inferior frontal poles of the prefrontal cortex during the Wisconsin Card Sorting Test ($\beta$=-4.74; 95% CI: -8.18, -1.31 and $\beta$=-4.40; 95% CI: -7.96, -0.84 for the left and right hemispheres, respectively). We also found that prenatal OP exposure was associated with sex differences in brain activation during a language comprehension task. We did not observe consistent associations during tasks of attention/response inhibition and social cognition.

Conclusions: This first human study of prenatal OP exposure and brain activation suggests neural underpinnings for previously reported OP-related associations with poorer cognitive function and behavioral problems. Use of fNIRS in environmental epidemiology offers a practical alternative to other neuroimaging technologies and enhances our efforts to assess the impact of chemical exposures on neurodevelopment.
Organophosphate insecticides (OP) are widely used for agricultural purposes because of their acute toxicity and non-persistence. Epidemiological studies suggest a neurotoxicity in children, after exposure at low levels but possible pathways remain unclear. The present study aims at investigating effects of prenatal exposure to OP on inhibition control of 10-12 year-old children assessed by a motor inhibition task during functional MRI (fMRI) sequence.

Ninety-five children from the PELAGIE cohort (Brittany-France, from 2002) underwent fMRI examination during which inhibition was assessed with a Go/No-Go task: they were asked to press a button as quickly as possible in response to green smileys but not press when seeing a red smiley (300 items, 10 minutes). Task performance was assessed by average reaction time (RT), commission rate (CR) and composite performance score (PS). Whole brain activations were estimated by modeling hemodynamic response related to successful inhibition and inhibition demand perception. OP exposure was assessed by measuring six dialkylphosphate (DAP) metabolites in urine of women in early pregnancy (<19 WG). Concentrations were summed to obtain overall levels of diethylphosphate (DE), dimethylphosphate (DM) and total non-specific metabolites (DAP), standardized to homogenize sampling conditions and categorized into levels of exposure: low (reference), moderate or high. Regression models were adjusted on potential cofounders considered by restriction and statistical criteria.

Moderate levels of DAP were associated with decreased CR (p=0.04), without increased PS. There was a suggested lower PS in association with moderate DE levels (p=0.06). Moderate DE and highest DM levels were associated with decreased brain activities in bilateral middle frontal or left anterior cingular regions during successful inhibition. We didn’t report any differential activations related to inhibition demand perception.

We suggested associations between prenatal OP exposure and motor inhibition, in particular differential brain activity in areas related to inhibition, which required to be confirmed by others studies.
Organophosphate pesticide metabolite concentrations in urine during pregnancy and offspring brain structural alterations

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OPS 55: Pesticides and neurological outcomes, Room 412, Floor 4, August 26, 2019, 13:30 - 15:00

Background
Prenatal exposure to organophosphate pesticides (OPs) is associated with neurodevelopment in humans and animal models. However, only few studies investigated the effect of prenatal exposure of OPs on brain structure and function. The aim of this study was to investigate whether prenatal OPs exposure was associated with brain structural alterations in children at 9-12 years old.

Method
Data came from 441 mother–child pairs participating in the Generation R study, a population-based birth cohort in Rotterdam, the Netherlands. Maternal urine concentrations of six dialkylphosphates (DAPs), collected at <18, 18–25, and >25 weeks of gestation, were determined. Structural magnetic resonance imaging in children (age 9-12 years) was used to investigate brain morphology using volumetric indices and whole-brain analyses (n=441); diffusion tensor imaging was used to assess white matter microstructure (n=398). Large fiber tracts of white matter integrity were combined to create global measures. Linear regression models were fit for each of the three collection phases separately, the three collection phases jointly, and for the averaged concentrations of exposure across pregnancy.

Results
Overall, DAP concentrations were not associated with volumetric brain indices. However, early- and mid-pregnancy, and averaged DAP concentrations across pregnancy were inversely associated with lower fractional anisotropy (e.g. -1.05 (95%CI:-1.92,-0.18) per 10-fold increase in averaged DAP concentrations across pregnancy). Next, mid-pregnancy and averaged DAP concentrations across pregnancy were positively associated with higher mean diffusivity (e.g. 0.11 (95%CI:0.02,0.20) per 10-fold increase in averaged DAP concentrations across pregnancy).

Conclusions
In this study of maternal urinary DAP concentrations during pregnancy, we did not observe associations with brain volumes. However, there was some evidence for an association of early and mid-pregnancy urinary DAP metabolite with lower fractional anisotropy and some evidence for a association between mid-pregnancy urinary DAP concentrations with higher mean diffusivity, which are generally considered indicators for atypical white matter microstructure.
In utero exposure to organophosphate pesticides has been associated with neurodevelopmental delay. This study examined whether maternal report of inability to pay for basic needs (food, housing, medical care and heating) modified the relationship between prenatal pesticide exposure and autism spectrum disorder (ASD).

Methods: We studied 488 children with ASD and 329 typically-developing controls aged 2-5 years enrolled between 2003 and 2008 in the CHARGE (Childhood Autism Risks from Genetics and the Environment) study, a population-based, case-control investigation. Diagnoses were confirmed by standardized assessments and information regarding maternal factors was determined from a structured interview with the mother. Residential proximity to agricultural application of organophosphate pesticides, based on California Department of Pesticide Regulation data, was determined by spatial analysis of maternal residence before and during pregnancy. Multiple logistic regression was used to examine the association between exposure during several time points during the pregnancy, and effect modification by the experience of financial hardship.

Results: 213 (26%) CHARGE study mothers lived within 1.5 km of agricultural application of organophosphate compounds during their pregnancies. ASD odds were elevated in those exposed to pesticides between the 3 months prior to conception up through delivery (adjusted odds ratio (aOR) 2.44; 95% CI [1.05, 5.63]). Odds for mothers with 2nd trimester organophosphate exposure was higher for women with financial hardship compared to those without, 3.01; 95% CI [1.34, 6.75] vs 1.92; 95% CI [1.35, 2.76], respectively. This disparity was particularly pronounced for chlorpyrifos exposure, where those with financial hardship exhibited odds ratios ranging from 5 to 15 at all pregnancy timepoints.

Conclusions: This study identified financial hardship as an amplifier of the association between organophosphate pesticide exposures during pregnancy and offspring ASD. It adds to the existing evidence highlighting the importance of studying the co-exposure of social and environmental factors affecting children at early developmental stages.
Pyrethroid exposure, attention and executive function in 6-year old children from the Infants’ Environmental Health Study (ISA)

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OPS 55: Pesticides and neurological outcomes, Room 412, Floor 4, August 26, 2019, 13:30 - 15:00

Background: Pyrethroid insecticides may impair children’s neurodevelopment but little evidence from prospective studies is available. In Costa Rica, pyrethroids are widely used for vector control. We examined whether prenatal and current pyrethroid exposure was associated with impaired attention and executive function in children from the Infants Environmental Health Study (ISA).

Methods: To evaluate attention and executive function, we applied the Conners Continuous Performance Test (CPT-II) and Dimensional Change Card Sort (DCCS) in 6-year old children (mean 6.4 ± 0.4 years) (n=268). We obtained repeated urine samples during pregnancy and 5-6 years of age, determined 3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylicacid (DCCA) and 3-phenoxybenzoicacid (3-PBA), and summed concentrations of both. We subsequently ran separate linear regression models for log-10 transformed mean prenatal, and mean child metabolite concentrations and CPT-II, and ran separate logistic regression model for DCCS. We adjusted a priori for child age, child sex, HOME score, and maternal education. We also ran analysis stratified by sex.

Results: Median (p25-p75) prenatal and current specific gravity-adjusted summed DCCA and 3PBA were 2.4 (1.3-3.9) µg/L and 6.4 (3.8-10.5) µg/L, respectively. Prenatal summed DCCA and 3PBA concentrations were associated with increased CPT-II T-scores of error commissions for boys (ß= 4.5, 95%CI -0.1, 9.1, per ten-fold increase in exposure), but not for girls (ß= -5.1, 95%CI -11.9, 1.8), or all children (1.6, 95%CI -2.3, 5.6). Prenatal summed DCCA and 3PBA were associated with lower scores of DCCS for all children (OR=0.25; 95% 0.1-0.9). Current DCCA and 3PBA concentrations were not associated with measures of attention or executive function.

Conclusion: Children aged six years with higher prenatal exposure to pyrethroids had poorer executive function as compared to children with lower prenatal exposure. Boys with higher prenatal exposure also had poorer attention, whereas girls did not. Prenatal exposure to pyrethroid may affect children’s neurodevelopment, some effects may be stronger in boys.
The subject of research ethics training is relatively new and is becoming more prominent in more developed countries where funding agencies require institutions and individuals to receive certifications in responsible conduct of research before receiving funding. This has led to improved quality of research and prevention of research misconduct. In less developed countries there is still a lack of understanding of the importance of such certification and in some countries they even lack Institutional review boards. In this presentation a training model that successfully trained over 100 researchers and faculty from the Middle East and North Africa is presented. The challenges and opportunities will be discussed and the type of curriculum that is focused on epidemiology and environmental health is presented for other institutions in less developed countries to adopt. ISEE has been a leader in research ethics among professional epidemiology societies through the first established ethics committee in the early 1990s. ISEE could become a leader in supporting training of research ethics for its different chapters and especially among the younger researchers and those members from less developed countries.
Social Susceptibility to Urban Air Pollution in Cardiovascular Disease

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Background/Aim: Cardiovascular disease (CVD), the leading cause of death in the U.S., has been linked to chronic and acute air pollution exposures. Research has identified stronger effects of air pollution in lower-socioeconomic position (SEP) communities, where exposures are also often higher. While specific factors underlying this susceptibility are unknown, chronic psychosocial stress related to social adversity is hypothesized as a key component. In this study, we use data on 1.3 million New York City (NYC) CVD emergency department (ED) visits, multiple air pollutants [fine particles (PM2.5), nitrogen dioxide (NO2), sulfur dioxide (SO2)], and community-level SEP, violence, and race-based residential segregation to: (1) examine associations between spatiotemporal pollution exposures and CVD events in NYC for 2005-2011, and (2) assess effect modification of pollution-CVD associations by community social factors.

Methods/Results: In case-crossover models examining associations between spatio-temporal air pollution and CVD, we found significant same-day associations between NO2 and risk of any CVD event, ischemic heart disease, and heart failure; this association remained significant with any form of co-pollutant adjustment. Significant associations for PM2.5 and SO2 on all CVD, heart failure (for PM2.5), and ischemic heart disease (for SO2) were less robust to co-pollutant adjustment. We implemented case-crossover models exploring effect modification by SEP, violence, and residential segregation. However, community stressor exposures are confounded by race/ethnicity in NYC. Because case-crossover adjusts for age, the method obscures the fact that the median age of CVD cases in non-Hispanic blacks in our CVD case-only dataset is 60 years old, compared to 74 years for non-Hispanic whites.

Conclusion: To better understand the role of social stressors in shaping racial differences in air pollution response we have begun to explore Cox proportional hazards models. Preliminary results suggest a dose-response relationship between exposure to chronic NO2 and CVD onset with increasing levels of violent crime and SEP.
Variation in Asthma Clinical Trial Results by Environmental and Socioeconomic Exposures

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Randomized clinical trials (RCTs) are generally considered the gold standard in medical research; by randomizing participants to treatment and control arms, they maximize internal validity and reduce between-group biases. RCTs, however, do not routinely examine variation by environmental and social exposures, which may impact clinical outcomes, treatment response, and generalizability.

To assess whether variation in socioeconomic position (SEP) and environmental exposures modify treatment response, we have developed and applied Geographic Information Systems (GIS)-based methods to three RCTs performed by the NIH AsthmaNet network, which is recruiting and implementing RCTs using the same protocols across 17 U.S. cities.

In preliminary analyses, we have found that: (1) compared to race-specific U.S. averages, blacks recruited into AsthmaNet disproportionately live in impoverished census tracts; recruited whites disproportionately live in wealthier tracts. (2) At baseline, traffic density and SEP predicted variation in lung function, in the hypothesized directions. (3) In one trial, we found that near-residence roadway density explained greater variation in asthma symptoms than did corticosteroid use, and that children in higher-poverty areas had significantly shorter times to first corticosteroid use.

We are now refining analyses of effect modification by near-residence roadway traffic and noise exposures, neighborhood violent crime, and health care access. Using spatial analysis and GIS to understand the lived context of RCT participants – better accounting for socioeconomic and environmental factors – may improve the interpretability and applicability of RCT results, by more clearly identifying subpopulations for whom a given intervention may be most effective.
Social inequalities in environmental noise exposure: A review of evidence in the WHO European Region

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Background
In the European Union 100 million people are exposed to traffic noise levels that are considered as health threatening by scientists and health experts. There seems to be an unequal distribution of the burden of environmental noise. The aim of this review was to systematically assess published evidence on social inequalities in environmental noise exposure in the WHO European Region taking different sociodemographic and socioeconomic dimensions as well as subjective and objective measures of environmental noise into account.

Methods
Original studies written in English and published between 2010 and 2017 in peer reviewed journals were included. The obtained evidence will be part of an update of the report "Environmental Health Inequalities in Europe", which has been published by the WHO Regional Office for Europe in 2012. This review has been registered with the PROSPERO international prospective register of systematic reviews database and was carried out following the PRISMA statement.

Results
Together 194 studies were identified by three databases. After duplicate removal 139 studies were included in the title and abstract screening process. Eight studies were included in qualitative synthesis. Four studies analysed individual data and four studies analysed aggregated data. Deprivation indices and socioeconomic indicators reflecting material aspects, such as income or ownership of dwelling, point to a higher environmental noise exposure in groups of low SEP. For other socioeconomic indicators results of social inequalities in noise exposures were mixed across and within studies.

Conclusion
There is a need for more research on inequalities in environmental noise exposure. More studies are needed to gain valid results on which social indicators are linked to environmental noise exposure and who are the most affected groups. Social inequalities in environmental noise exposure on a small spatial scale should be monitored. This may be implemented in structural health monitoring activities.
Human seasonal influenza and climate change: a systematic review of the methods used to examine the relationship between meteorological variables and influenza

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Background: Influenza is an acute respiratory viral infection, contributing to significant global mortality, morbidity and financial burden. Meteorological variables may impact virus behaviour, survival and transmission, and thus the severity and timing of influenza activity. Variables implicated include temperature, humidity (relative, absolute and specific), vapour pressure, precipitation and climatic phenomena. Global climate change has the potential to bring about substantial changes in these variables, and the subsequent effect on influenza is currently poorly understood. This paper aimed to review the methodology and analytical approaches currently used to assess the relationship between meteorological variables and influenza, to enable an improved understanding of how climate change may impact influenza.

Method: A systematic review of the current literature on the methods used to examine the relationship between meteorological variables and human seasonal influenza activity was conducted. Three databases were searched with a focus on peer-reviewed journal articles published from January 2000 through December 2018.

Results: Fifty articles met the inclusion criteria, including five animal studies and four in vitro studies. The majority of studies demonstrated statistically significant relationships between either influenza incidence, transmission or infection processes and meteorological variables, particularly temperature and relative humidity. Most studies used linear and logistic regression, autoregressive integrated moving average, and generalised additive models. Methodological issues were identified in study design, model type, spatial and temporal characteristics, outcome variables and meteorological variables used.

Conclusion: No studies have directly addressed the impact of climate change on influenza. A better understanding of the relationship between influenza and meteorological variables will improve predictions of influenza activity under future climate change scenarios, which in turn will inform public health prevention and responses. Developing appropriate and accurate models, recognising spatial characteristics and non-meteorological factors, incorporating suitable meteorological variables, and increasing the observation time period within human studies is crucial to explore this relationship.
Continued firewood use after decades of access to low-cost LPG: Implications for clean cooking fuel policies and air pollution exposure in Ecuador

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Background: Household air pollution, one of the world’s largest environmental health hazards, is a modifiable risk factor amenable to intervention through cleaner cooking. Over the last 40 years, large direct consumer subsidies for LPG have facilitated the national transition of Ecuador’s population from cooking with biomass and kerosene to cooking with LPG. Now, more than 90% of households cook primarily with LPG.

Methods: We administered 808 surveys to primary household cooks in eight rural and peri-urban communities across four provinces in the coastal and Andean regions of Ecuador to identify current fuel use patterns, fuel costs and accessibility, and motivations for observed patterns. A sub-sample of 160 primary cooks across four communities received 48-hour time-resolved PM2.5 exposure monitoring, with a 20% subset receiving a co-located gravimetric filter PM2.5 monitor. All stoves were monitored using temperature loggers.

Results: Over 99% of households reported daily LPG use and most more than once a day. Households reported more than 20 years of historic LPG use and unconstrained access to cylinders. Nevertheless, 40% of households reported using firewood as a cooking fuel, nearly always as a secondary alternative to LPG (20% peri-urban; 52% rural), and 60% of rural firewood users reported at least weekly use. Mean 48-hour PM2.5 exposure was estimated to be 35 µg/m³ and 20% of estimates were above the WHO Interim-I guideline of 35 µg/m³.

Conclusions: By leveraging the unique conditions of Ecuador, we offer novel assessments of cooking fuel use patterns and personal exposure to PM2.5 in the context of decades of low cost, accessible clean cooking fuels in a middle-income country. Our data suggest that cessation of traditional biomass use is a separate behavioral transition from the adoption of clean fuels, potentially limiting the health benefits of adoption-focused clean cooking efforts.
Development of behavioral message strategy for participants who get LPG stove in an environmental trial - experience from the Indian arm of Household Air Pollution Intervention Network (HAPIN) multi-country trial

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Abstract
Background:
Guatemala, India, Peru, and Rwanda are participating in a randomized controlled trial conducted by household air pollution intervention network (HAPIN). This trial is to assess the health impact of liquefied petroleum gas (LPG) stove intervention to households using solid cooking fuel. A stove and 18 months of free LPG refill is the intervention in the trial. The success of any intervention in a randomized trial, especially in an environmental trial, is based on the effectiveness of the behavioral messaging component. In order to develop a behavior messaging strategy, which is tailor made for Indian context, in-depth interviews were conducted.

Methods: Investigators developed a detailed sampling plan with good participant diversity in terms of age, socio economic status and current use of cooking stoves. A probing guide was developed to conduct in-depth interviews. The field coordinators conducted the interviews with women participants which were audiotaped. The interviews were later interpreted as per the standard protocol to develop appropriate behavior messaging strategy.

Results: It was found out that cooking with LPG was the aspiration of all interviewed participants. The acceptability factor for LPG stove was 100% and availability of LPG was not an issue. The major reason cited for not using the LPG stove was affordability. Many participants who already own a LPG stove didn’t use it exclusively due to cash flow crunch at the time of refill request and that was the main barrier, which was found out by the in-depth interviews.

Conclusions: Given the presence of enablers for LPG usage, i.e. very high levels of aspiration, acceptability and availability of LPG refills in this community, if the only barrier that is affordability is taken care by the study, exclusive LPG usage among intervention participants can be achieved by a simple task based behavioral messaging.
Health benefits of reducing Australian coal-fired power stations emissions

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Although air quality in Australian cities is generally good by international standards, research suggests that substantial health benefits are attainable with even modest reductions in air pollution. The New South Wales (NSW) State Government in Australia is investing in clean energy and energy efficiency, which are likely to result in reducing air pollution exposures.

Currently, coal-fired power stations (CFPPs) account for about 80% of NSW electricity generated and are a major source of ambient air pollution in the Sydney Greater Metropolitan Region. This work outlines applied health impact assessment methods to quantify the mortality burden due to long term exposure to the population-weighted annual average PM2.5 concentration of 0.15 $\mu$g.m\textsuperscript{-3} attributable to CFPPs emissions (using 2013 as the baseline year), and the mortality benefits of reduced PM2.5 emissions from CFPPs over 2017-2042 due to potential NSW energy efficiency and renewable energy measures compared to a ‘business as usual’ scenario. Medium and large energy demand change scenarios were modelled to assess the impact of potential energy efficiency and clean energy measures on energy demands, CFPPs emissions and associated air quality and health benefits.

The ‘business as usual’ modelling of baseline emissions, air quality and health impacts accounted for the three CFPPs that ceased operation in 2014-2015, announced retirement of CFPPs in 2022-23 and 2035-36, and retirement of a CFPPs in the neighboring State of Victoria in 2017 which influenced NSW power generation.

The central estimate for the mortality burden was 31 premature deaths and 382 years of life lost. Mortality benefits for the medium and large energy demand changes were estimated as 448 and 922 life years gained respectively as a central estimate.

The results illustrate the public health benefits of energy efficiency and clean energy programs which result in a quantifiable increase in the life expectancy of the population.
Educational intervention on the risk perception of pesticides exposure and organophosphate metabolites urinary concentrations in rural school children in the Maule Region, Chile

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Background: Organophosphate pesticides (OP) can be hazardous to human health if not applied with appropriate precautions. There is evidence in Chile that rural school children are exposed to OP. The objective is to evaluate the effectiveness of an educational intervention on OP exposure and understanding of pesticides and their hazards in two school communities in the Maule Region, Chile during 2016 and 2017.

Method: Cross-community randomized trial among 48 schoolchildren from two rural schools. The intervention was directed to groups of parents and school children separately. We measured 3,5,6-trichloro-2-pyridinol (TCPy), 2-isopropyl-4-methyl-6-hydroxypyrimidine (IMPY), malathion dicarboxylic acid (MDA), p-nitrophenol (PNP), diethylalkylphosphates (DEAPs) and dimethylalkylphosphates (DMAPs) in multiple samples of schoolchildren collected before and after the intervention. The risk perception of both children and parents was also assessed through a questionnaire. Generalized Estimated Equations were used to account for each child’s repeated measures. Results: Higher DEAPs urine concentrations (Year=2016) were associated with eating more fruit at school (p=0.03), a younger age (p=0.03), and being male (p=0.01). In 2017, DEAPs, was associated with higher consumption of fruit in school (p=0.013), the control group (p=0.017) and with less distance from home to farms (p=0.040). In 2016, DMAPs showed no associations with potential predictor variables and 2017, the greater presence only associated with the control group (p = .027). Higher TCPy was associated with attending a school closer to farms (p=0.04) and living in a home closer to farm fields (p=0.01); In 2016 and 2017 higher PNP was associated with children younger age (p=0.10). The intervention had a significant effect in increasing the perception of risk in adults and children. Conclusion: The environmental exposure to OP prevails in despite of the change of risk behaviors, so there is a need of a stricter regulation and control of the use of pesticides from the corresponding government agencies.
A comprehensive analysis of racial disparities in chemical exposure biomarkers in US women

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Background: African American women are 2 to 3 times more likely to be diagnosed with triple negative breast cancer, compared to European American women. The biological mechanisms for this disparity are not well understood but are likely due to an interaction between genes and environmental exposures. To better understand environmental factors which may impact triple negative breast cancer risk, we implemented an untargeted approach to systematically compare chemical exposure differences by race.

Methods: We used the National Health and Nutrition Examination Survey (NHANES) of 148 chemical biomarker concentrations measured in 38,080 female participants 1999-2014. We conducted a series of multiple survey weighted regression models with chemical biomarker levels as the outcome variable and race/ethnicity as the main predictor while adjusting for age, cotinine levels (biomarker of smoking), poverty-income ratio (surrogate variable of socioeconomic status), and cycles (years) in which the participant was sampled. To understand chemical exposures by age and race, we conducted stratified analyses by age groups (0-11, 12-25, 26-50, and 51-up).

Results: Across age groups, African American women had significantly higher biomarker concentrations of many chemicals, including methyl paraben (2.39-fold), propyl paraben (2.09-fold), mono-ethyl phthalate (1.74-fold), 1,4-Dichlorobenzene (2.35), and 2,5-dichlorophenol (4.56-fold), relative to non-Hispanic white women. For the youngest age group (0-11 years), the chemical exposure disparities between African American and non-Hispanic white women are further exaggerated for parabens and 1-4 dichlorobenzene.

Conclusions: Overall, we identified substantial differences in chemical body burden by race in a representative sample of US women. Many of the chemicals with exposure disparities are found in cosmetics, pesticides, and other consumer products. Ongoing work is determining whether these toxicants impact biological pathways associated with breast cancer to better understand the link between the environment and triple negative breast cancer disparities.
Qualitative insights from evaluating the first micro-finance initiative in Cameroon to support households switching to liquefied petroleum gas (LPG) for cooking: the LPG Adoption in Cameroon and Evaluation Studies

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Background: Purchasing start-up equipment for cooking with LPG represents a key barrier to adoption in resource-poor settings. To address this barrier, a micro-finance package for LPG (double burner, cylinder and accessories) was introduced in Cameroon, and offered to 150 households on a first-come, first served basis, repayable over 6 months at no interest. We evaluated the perceived impact on LPG adoption by a peri-urban community in South-West Cameroon.

Methods: One to 2 months after receiving the equipment, semi-structured interviews (SSIs) were conducted with 10 purposively selected participants: 5 households that took the loan (beneficiaries) and 5 households that had not taken the loan (non-beneficiaries), investigating the decision-making process surrounding the loan and cooking practices. After 6 months, we conducted SSIs with 10 additional beneficiaries, exploring experiences of loan repayments and how LPG use impacted on daily life. To generate discussion around the micro-loan and cooking patterns, we conducted a focus group with participants (n=8) sampled from the above groups. Transcripts were analysed thematically.

Results: Beneficiaries reported that the loan allowed them to purchase the start-up equipment, which they would not have been able to afford otherwise. Monthly payments made the loan more affordable to beneficiaries and attractive to non-beneficiaries. Beneficiaries described that cooking with LPG improved their lives, through reduced smoke, better health and time savings. They reported cooking most dishes with LPG almost daily, including traditional meals, and LPG use increased during the rainy season. Conserving LPG was the main reason for continued use of biomass. Although 94\% of beneficiaries (n=141) repaid the loan, some struggled to pay on time. Suggestions for improvement included a three/four-burner stove to accommodate multiple dishes.

Conclusions: Through qualitative methods, we gained unique insights into the facilitators/inhibitors surrounding the loan, and benefits of LPG. Findings are informing further LPG microloan initiatives across Cameroon.
Potential Human Health Effects Associated with Unconventional Oil and Gas Development: Review of the Epidemiologic Literature and Identification of a Path Forward

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Background
Unconventional oil and natural gas development (UOGD) has expanded rapidly in the last decade. Accompanying this expansion is a growing body of scientific literature about its potential for exposure and health effects. We present a review of the relevant epidemiologic literature and offer a research path forward to resolve questions that remain.

Methods
The Health Effects Institute’s (HEI) Energy Research Committee (the Committee), consisting of multidisciplinary experts from across the U.S., along with HEI staff critically reviewed analytical epidemiology studies published between January 2000 and December 2018 with an objective of exploring relationships between environmental exposures originating directly from UOGD in the United States and human health outcomes. The Committee systematically assessed strengths and limitations of each study and the overall body of literature by health outcome. The Committee developed a set of research needs following its assessment.

Results
The twenty-five epidemiology studies reported associations between surrogate measures of UOGD exposure and perinatal, respiratory, and cardiovascular outcomes, cancer, and various symptoms. Studies employed different study designs and reported inconsistent findings. The passage of only a few years since the rapid growth of UOGD marks an early phase of exploratory research; thus, the Committee notes that investigators typically made thoughtful use of available data to re-construct potential UOGD exposures and assess health outcomes. The Committee recommends further study to improve on methodologic limitations noted in its review, in particular, careful control of confounding and improved exposure assessment approaches that include enhanced characterization of spatial and temporal variability and measurements of chemical and non-chemical agents originating from UOGD.

Conclusions
To better characterize potential UOGD-related exposures, a main limitation identified in the body of epidemiology studies, the Committee conducted a review of the exposure literature related to UOGD. Results from both literature reviews have informed planning efforts for population-level exposure research.
Evaluating the effectiveness of labor protection policy on heat-related work-related injuries in a large subtropical city Guangzhou, China

Su Y

Su Yat-sen University

Background: Positive relationship between occupational injuries and extreme high temperatures is well documented. However, rarely studies have assessed the effectiveness of high-temperature labor protection policy (HPP) on occupational health as well as industrial costs.

Objectives: We aim at evaluating the intervention effects of the HPP issued on March 1, 2012 in Guangzhou, China on occupational injuries and industrial costs towards extreme hot weather.

Methods: Interrupted time series (ITS) analysis combined distributed lag non-linear model (DLNM) was used with daily occupational compensation claims and meteorological monitoring data within Guangzhou from January 2011 to February 2013 to investigate the effectiveness of the HPP. Further, we stratified the data by individual, industrial and detail injuries characteristics to explore the possible benefitted subgroups.

Results: There were totally 10,090 occupational injuries included in our study during this period. Both ITS and DLNM analysis showed a protective intervention effect of the HPP in Guangzhou on occupational injuries. Occupational injuries declined to 90.0% 95%CI (0.817, 0.991) in the post period after policy implementation according to ITS analysis. The DLNM results showed that the proportion of occupational injuries attributing to daily maximum temperature (Tmax) over 35°C on the lag 0-2 days for 2011 was 1.73% 95%CI (0.27, 2.83), and for 2012 was 0.82% 95%CI (-0.02, 1.44). Related industrial costs decreased 2.13% and this means almost 2.72 million reduce in Chinese Yuan. Furthermore, we found that male workers, middle aged workers, and workers with high educated experiences could benefit much from this policy. Occupational injuries in indoor sectors especially manufacturing sector decreased significantly after policy implementation.

Conclusions: Our findings suggested that HPP significantly reduce occupational injuries and industrial costs within Guangzhou after policy implementation. This study provided enlightenments for researchers around the world to better assess the intervention effects of the HPP on occupational health.
Background
Current research encourages citizen participation in policy-making processes. Yet, the interface between citizens and urban transport planning remains under-studied in developing countries. The paper assesses urban transport planning policies of a middle-income country and determines whether the goals of existing policy measures meet self-reported citizens’ needs. We detect association between needs and population indicators to better assess whether needs are unevenly expressed across population groups.

Methods
We assess the alignment of three policy measures with citizens needs in Mauritius by using mixed-methods. The policy document was reviewed using qualitative content analysis in order to select and analyse relevant measures. Citizen needs were obtained with a nationwide survey. Quantitative logistic regression models were run for each need and to detect associations with population indicators.

Findings
Three policy measures were selected for assessment: light metro rail system, bus modernization scheme and road decongestion program. Citizen needs were extracted from 1523 surveys. At least one measure addressed the improvement of public spaces, construction of new buildings, centralization of hawkers at main bus stations, and preference for less active travel modes (ex: own private vehicle). None of the measures addressed (1) improvement of sidewalks, (2) green spaces increase, (3) pedestrianizing of strategic areas, (4) regulation of private vehicle entry in town and (5) preference for more active travel modes (ex: foot, bicycle). Three unmet needs were expressed by vulnerable population groups.

Conclusion
We successfully exposed gaps between citizen needs and three urban transport planning measures in Mauritius. The study shows that citizen participation enable a subtler understanding of the social and economic environment in which transport measures take place. Finally, we propose that using participation within wider frameworks such as health impact assessment (HIA) provides a unique opportunity to reform urban transport planning policies towards more healthy, sustainable and equitable outcomes.
Google Street View car measurements of traffic related air pollution within neighborhoods and asthma-related emergency department visits and hospitalizations

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PDS 64: Health impact assessment and environmental justice, Johan Friso Foyer, Floor 1, August 26, 2019, 13:30 - 15:00

Background: New technologies can measure traffic-related air pollution (TRAP) at an unprecedented spatial resolution, but little is known about how these street-level spatial differences in TRAP relate to clinical health outcomes such as asthma exacerbations.

Objective: We estimated the relationship between highly resolved spatial measurements of TRAP and asthma-related emergency department (ED) visits and hospitalizations among children, adults, and elderly subjects with asthma.

Methods: Our study population included 9,802 children, 33,869 adults, and 5,239 elderly subjects with asthma who were members of Kaiser Permanente Northern California during 2013 to 2017. Concentrations of nitrogen dioxide [NO2], nitric oxide [NO], black carbon [BC] and ultrafine particles [UFPs] were along 30 m road segments in neighborhoods of Northern California and linked to geocoded residential addresses. Records of ED visits and inpatient hospitalizations with an asthma diagnosis as a reason for visit were obtained from electronic medical records. We fit Poisson models to estimate the relationship between TRAP exposures and rates of asthma-related ED visits and hospitalizations, adjusting for age, sex, race, and neighborhood socioeconomic status.

Results: Among children with asthma, a 1 SD increase in NO2 was associated with a 5% (95% confidence interval [CI] 0% to 10%) increase in the rate of ED visits and a 15% (95% CI 1% to 32%) increase in the rate of hospitalizations. Associations with NO, UFPs, BC were similar, but generally weaker. Associations among adults and elderly subjects were similar.

Conclusion: Street-level spatial differences in TRAP exposures, particularly to NO2, are associated with differences in the rates of emergency department visits and hospitalizations among children, adults, and elderly with asthma.
Background/Aim: Air pollution is a big problem that affects public health worldwide, especially in developing countries. The public engagement and risk perception about air pollution is a challenge to promote healthy behaviors and to implement decisions. The aim of the study was to investigate public engagement and scientific literacy of high school students through a citizen science project about air pollution. Method: This study used a quantitative and qualitative approach in 3 phases. In the first phase, students attended a workshop to learn relevant topics on air pollution and were trained to collect data. In the second phase, students measured PM 2.5 in 7 sites around their school, using a portable monitor and answered pre-test to evaluate their previous knowledge. In the third phase, students attended written activities (tests) to measure indicators of scientific literacy, individual and group participation in the research project. Results: The levels of air pollution observed varied from 6µg/m³ (green spaces) until 124µg/m³ (traffic, streets). The results showed a correlation between scientific literacy and engagement of students in the citizen science project. The students who participated in the project obtained better performance, with 63.2% of the learning of content addressed during the lessons. Conclusions: The study demonstrated that citizen science contributes to design strategies for public engagement, promoting knowledge about air pollution in the local context. Citizen science can be an opportunity to investigate environmental issues and reflect on scientific evidence. We conclude that this approach is a valid pedagogical strategy to improve the learning of science.
National disparities of air pollution exposure level by socioeconomic status in China

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Background:
Disparities in exposure to ambient air pollution among demographic group have been studied in the US and other high-income countries, yet little information exists for China. We aim to quantify disparities in exposure to nitrogen dioxide (NO\textsubscript{2}) and fine particulate matter (PM\textsubscript{2.5}) for China.

Methods:
We combine two datasets: (1) estimated 2015 annual-average PM\textsubscript{2.5} and NO\textsubscript{2} concentrations, derived from a national Land Use Regression model at 1km spatial resolution; (2) demographic data for ~20,000 individuals from the China Health and Retirement Longitudinal Study (CHARLS) 2015 cohort. We summarize ambient exposure levels at residential locations with univariate statistics for demographic attributes (age; socioeconomic status (SES), which includes Hukou [place of origin], education attainment, employment type, and income), geographic region of residence (Western, Central, Southeast Coastal, Jing-Jin-Ji, Northeastern) and population density. We use regression analyses to investigate multivariate statistics.

Results:
Results for China, which differ substantially from most literature for the US, indicate consistently higher exposures for populations with higher socioeconomic status. For example, combining the four socioeconomic variables, people with highest SES (top 20%) experience 43% higher NO\textsubscript{2} concentrations and 20% higher PM\textsubscript{2.5} concentrations than those with lowest SES (bottom 20%). Disparities are larger in high population density areas than low density areas. For NO\textsubscript{2}, disparities are similar among geography regions as among SES categories; for PM\textsubscript{2.5}, disparities among regions are larger than among SES categories.

Conclusion:
Unlike in the US, in China air pollution exposures (NO\textsubscript{2}, PM\textsubscript{2.5}) appear to be higher for individuals with higher socioeconomic status.
Estimation of PM2.5-associated disease burden in China in 2020 and 2030 based on population and air quality scenarios

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Background: In recent years, policies and measures have been implemented to reduce air pollution and its adverse effects in China, and the air quality has improved steadily. However, with continued population growth and ageing, the future disease burden associated with air pollution in China is still unclear. This study aimed to estimate the future disease burden associated with particulate matter (PM2.5) across China to quantify the health benefits of air quality improvement targets, and determine the effect of population growth and ageing on PM2.5-associated disease burden.

Methods: On the basis of air quality scenarios and population scenarios for 2020 and 2030, we use the integrated exposure–response model used for the Global Burden of Disease Study to estimate the number of PM2.5-related premature deaths and then calculate the year of life loss (YLL) under each scenario using the National Life Expectancy Table 2013 for Chinese people from WHO.

Results: If the air quality improved according to the target and the population remains the same with 2010, the number of PM2.5-related premature deaths is estimated to decrease by 13.5% and 22.8%, and YLL decrease by 14.89% and 24.80% by 2020 and 2030, compared with 2010. However, if considering the population increasing and ageing, PM2.5-related premature deaths were estimated to increase by 8.8% and 25.6% by 2020 and 2030, and YLL change slightly (decrease by 0.12% and 3.07% by 2020 and 2030).

Conclusion: The projected health benefit of the air-quality-improving targets is substantial, but would be offset by the effect of the population increase and ageing. To reduce the future disease burden in China, stricter targets and stringent policies to improve air quality and protect public health are needed, especially for at-risk population, such as older individuals and patients with cardiovascular diseases, particularly in regions with dense population and high pollution.
PDS 74: Pregnancy outcomes
Maternal exposure to polycyclic aromatic hydrocarbons (PAHs) exposure and its impact on anthropometric measures of neonates

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Abstract:
Background of the study: PAHs are known reproductive toxicant even though evidences showing links between PAHs exposure and adverse birth outcomes is inconsistent or poorly understood. Present study was aimed to evaluate the association between PAHs exposure of pregnant women and anthropometric measures of infant including birth weight, height and head circumference.

Methods: Study population consisted of 90 pregnant non-smoking women whose placental tissues were collected for measurement of 16 PAHs with Gas Chromatography equipped with mass detector. Questionnaire regarding demographic characteristics of pregnant women, sources of occupational and environmental exposures to PAHs and body size measures of infant were recorded instantly after delivery.

Results: Average birth weight of infants was 2528.2 gm while the frequency of low birth weight infants was 39%. Among all the detected PAHs, chrysene (24.61%) and benzo(k)fluoranthene (28%) were predominant ones. Majority of PAHs were found to be higher in low birth weight group (n=35, BW<2.5 kg) than normal birth weight group (n=55, BW≥2.5 kg). Results showed inverse correlation of most PAHs with birth weight, length and head circumference. Additionally, regression analysis indicated significant decrease of 2.72, 4.91 and 0.93 gm for unit increase in fluoranthene, chrysene and benzo(a)pyrene. Birth length and head circumference also showed negative but non-significant association with PAHs.

Conclusions: These results shed light on drastic scenario of deteriorating fetal growth among Indian infants due to PAHs exposure.

Keywords: PAHs, birth weight, placenta, fetal growth
Maternal Blood Metal levels in Association with Birth Outcomes in Northern Puerto Rico

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background: In previous studies exposures to heavy metals such as Pb and Cd have been associated with adverse birth outcomes; however, knowledge of effects at low levels of exposure and of other elements remain limited.

Methods: We examined individual and mixture effects of 10 metals on birth outcomes among 810 pregnant women in the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) cohort. We measured As, Cd, Co, Cs, Cu, Mn, Hg, Ni, Pb, and Zn in maternal blood collected at 16–20 and 24–28 weeks gestation. We used linear and logistic regression to independently examine associations between geometric mean (GM) concentrations of each metal across visits and 1) gestational age and birthweight z-scores; and 2) preterm birth and small for gestational age (SGA). We evaluated effect modification with infant sex*metal interaction terms. To identify critical windows of susceptibility, birth outcomes were regressed on visit-specific metal concentrations. We used elastic net (ENET) regularization to identify individual metals most critical to each outcome, accounting for correlated exposures.

Results: In adjusted models, an interquartile range increase in GM Pb was associated with 1.70 higher odds of preterm birth (95%CI:1.24, 2.34) and 24% shorter gestational age (95%CI:-36.7%, -8.6). Mn and Zn were also associated with higher odds of preterm birth and shorter gestational age, although only significant among the highest tertile and females, respectively. Co, Cs, and Ni measured later in pregnancy were positively associated with birthweight z-score, and Ni was associated with decreased odds of SGA. ENET yielded similar results.

Conclusions: As the PROTECT cohort has lower Pb concentrations (GM=0.33 ug/dL) compared to the mainland US, our findings suggest that low-level prenatal lead exposure, as well as higher Mn and Zn exposure, may adversely affect birth outcomes. Higher concentrations of certain essential metals later in pregnancy were associated with increased size at birth.
Revisiting unconventional natural gas development and adverse birth outcomes in Pennsylvania: the potential mediating role of antenatal anxiety and depression

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background/Aim: Studies have reported associations between unconventional natural gas development (UNGD) and adverse birth outcomes. None have described potential mediating mechanisms. We aimed to evaluate associations between (1) UNGD and antenatal anxiety and depression and (2) antenatal anxiety and depression and preterm birth (< 37 weeks gestation) and reduced term birth weight, (3) stochastic direct and indirect effects of UNGD on preterm birth and term birth weight operating through antenatal anxiety and depression, and (4) effect modification by individual-level socioeconomic status (SES).

Methods: This retrospective cohort study included mothers without prevalent anxiety or depression at time of conception, who delivered at Geisinger in Pennsylvania between January 2009–January 2013. We assembled phase-specific UNGD activity data from public sources. Mothers were categorized as exposed (quartile 4) or unexposed (quartiles 1–3) based on average daily inverse distance-squared UNGD activity metric between conception and the week prior to anxiety or depression (cases) or the pregnancy-average daily metric (non-cases). We estimated associations with a doubly robust estimator and adjusted for potential individual- and community-level confounding variables.

Results: Analyses included 8,371 births to 7,715 mothers, 12.2% of whom had antenatal anxiety or depression. We found 4.3 additional cases of antenatal anxiety or depression per 100 women (95% CI: 1.5, 7.0) under the scenario where all mothers lived in quartile 4 of UNGD activity versus quartiles 1–3. The risk difference appeared larger among mothers receiving Medical Assistance (low SES surrogate) compared to those who did not, 5.6 (95% CI: 0.5, 10.6) versus 2.9 (95% CI: -0.7, 6.5) additional cases of antenatal anxiety or depression per 100 women. We found no mediation effect either overall or when stratifying by Medical Assistance.

Conclusion: We observed a relationship between UNGD activity and antenatal anxiety and depression, which did not mediate the overall association between UNGD activity and adverse birth outcomes.
Elemental constituents of particulate matter and pregnancy outcomes

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background/Aim
The health effects of particulate matter (PM) could depend on its chemical composition. Few studies examined the associations between maternal exposure to chemical constituents of PM and pregnancy outcomes. Our aim was to investigate the association between elemental constituents of PM and term low birth weight (LBW: weight < 2,500 g among births after 37 weeks of gestation), preterm births, and small for gestational age (SGA, according to the Italian curves).

Methods
We considered all singleton livebirths from mother who lived in Rome for the entire pregnancy in the period 2006-2014. We used land-use regression models to estimate annual average concentrations of elemental constituents of PM ≤ 2.5 and ≤ 10 μm (PM2.5 and PM10) at maternal home addresses during pregnancy. We considered eight elements: copper, iron, potassium, nickel, sulfur, silicon, vanadium, and zinc. We used logistic regression to evaluate the association between exposure and outcomes, taking account of maternal age, parity, maternal education, season of conception, sex of the newborn, census block index of socioeconomic position.

Results
Among the 172,325 singleton livebirths, 2.31% were term low birth weight, 6.07% were preterm births, and 8.59% were SGA. All the elemental constituents considered were associated to LBW and SGA. A 200-ng/m\textsuperscript{3} increase in sulfur in PM10 was associated with an increased risk of LBW (OR = 1.38; 95%: 1.22-1.57), an increased risk in SGA (OR=1.13; 95%CI: 1.06-1.21), and an increased risk in preterm births (OR=1.09; 95%CI: 1.01-1.17). The association was independent of PM10.

Conclusions
The association between PM and pregnancy outcomes can be attributed to several components. Sulfur and Nickel components seem to be important.
Exposure to Atmospheric Metals Using Moss Bio-Indicators and Neonatal Health Outcomes in Portland, Oregon

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background: Exposures to certain metals is associated with adverse birth outcomes, including inhibited fetal growth and congenital defects. Previous studies focused on metals such as lead and arsenic, and primarily assessed exposure using biological monitoring, which does not provide insights into sources. Examining exposure to atmospheric metals is challenging due to a lack of high-resolution air-pollution data. We applied a unique map of atmospheric metal pollution, derived from bio-indicator epiphytic moss samples, as a screening tool to study neonatal health risks of atmospheric pollution in Portland, Oregon, a city of 640,000 people with several metal-emitting industrial sources.

Methods: Metal concentrations were measured in 346 moss samples in December 2013, and an inverse-distance weighting scheme was applied to map ambient/environmental metal concentrations. Birth records for Portland live births (2008-2014) were obtained from the Oregon Health Authority. Exposure to atmospheric metals was assigned based on mother’s residential address. Metal exposure was evaluated continuously and by quartile. Associations were evaluated for six metals (arsenic, cadmium, chromium, cobalt, nickel, lead) and two birth outcomes (preterm (<37 weeks), very-preterm (<32 weeks)) using logistic regression models with adjustment for birth characteristics and demographic variables.

Results: Preliminary results indicate statistically significant associations between cadmium exposure and preterm birth (OR=1.04, 95%CI: 1.00-1.07), lead exposure and preterm birth (OR=1.05, 95%CI: 1.01-1.09) and very-preterm birth (OR=1.16, 95% CI: 1.05, 1.27). and chromium exposure and very-preterm birth (OR=1.14, 95% CI: 1.05-1.24). Stratifying these metals by quartiles found some evidence of a dose-response in the third and fourth quartiles of lead for odds of preterm birth, but not for other metals.

Conclusions: Preliminary results suggest that atmospheric metal exposure to cadmium, lead and chromium, measured via bio-indicator moss samples, may be associated with preterm and very-preterm birth. This novel exposure metric is useful when bio-monitoring and more invasive/expensive exposure metrics aren’t feasible.
Critical windows of telomere susceptibility to PM2.5 over gestation: modification by fetal sex and maternal antioxidant intake

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background/Aim: Telomeres progressively shorten throughout the lifetime, thus length at birth has lifelong importance. Telomere length (TL) is inherited, but also influenced by environmental conditions. Owing to their guanine-rich structure, telomeres are particularly susceptible to oxidative stress. We examined prenatal exposure to fine particulate matter (PM2.5), which has known pro-oxidant properties, in relation to cord blood TL and examined the modifying effects of fetal sex and maternal antioxidant intake.

Methods: Pregnant women (n=150) were recruited from prenatal clinics in Boston and New York City. We estimated daily PM2.5 exposure based on residence using a 1km-resolution hybrid satellite land use regression model. We analyzed relative leukocyte TL (rLTL) in cord blood using quantitative polymerase chain reaction. We used multivariable Bayesian distributed lag interaction models (BDLIMs) to identify critical windows of telomere susceptibility to PM2.5 exposure (weekly) in the context of fetal sex and maternal antioxidant intake estimated from Block98 food frequency questionnaires completed during pregnancy.

Results: In main effect models, we identified gestational weeks 12 through 20 as a sensitive window; during this period a 1-unit (µg/m3) increase in PM2.5 was associated with a 0.29 unit shortening in rLTL (95% CI: -0.49, -0.10). In analyses investigating sex interactions, associations remained significant and were marginally larger among boys between weeks 17 to 18 (β=-0.30, 95% CI: -0.59, -0.01). When considering maternal antioxidant intake dichotomized at the median, cumulative associations remained significant only among boys born to mothers with low antioxidant intake, however, we were unable to identify a specific window of susceptibility (βpregnancy: -0.39, 95% CI: -0.80, -0.00).

Conclusions: These analyses extend prior research linking prenatal PM2.5 exposure to shortened TL at birth in addition showing that boys may be more impacted. Moreover, these findings suggest that higher maternal antioxidant intakes during pregnancy may mitigate the influence of PM2.5 on fetal TL.
Ultra-fine, fine, and coarse particulate air pollution exposure during pregnancy in relation to birth outcomes in a Dutch population

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background/Aim:

Ante-natal exposure to ambient air pollution has been implicated in multiple detrimental health outcomes including impaired fetal development, premature birth, and low birthweight. Due to their high biological reactivity and small size, ultrafine particles (particles smaller than 100 nm [UFP]) may play an as-yet under-explored role in these outcomes. The aim of the current study was to examine the effect of maternal UFP exposure on fetal development, specifically by the outcomes of premature birth and low birthweight at term (TLBW).

Methods:

Using data from the Amsterdam Born Children and their Development (ABCD) cohort of 7,592 pregnant women, we examined the relationship between maternal exposure to ambient UFP and routinely monitored air pollutants (PM2.5, PMcoarse, PM10, PM2.5 absorbance, NOx, NO2, and traffic density and load) and pre-term birth and TLBW using adjusted logistic regression models. Concentrations of pollutants were estimated at the maternal home address using established land use regression (LUR) models.

Results:

A 5 µg/m³ increase in PM2.5 resulted in ORs of 1.43 (95% CI: 1.07, 1.93) for preterm birth; and 1.20, (95% CI: 0.70, 2.04) for TLBW while a 10 µg/m³ increase in PM10 resulted in an OR of 1.36 (95% CI: 0.98, 1.88) for preterm birth and 1.12 (95% CI: 0.62, 2.03) for TLBW. Exposure to UFP during pregnancy was negatively associated with both pre-term birth (OR: 0.92, 95% CI: 0.85, 1.00 per 2,500 particle/m³ increase) and TLBW (OR: 0.85, 95% CI: 0.72, 1.01). Sensitivity analyses on the UFP LUR models using historical data resulted in similar findings.

Conclusions:

Exposure to UFP during pregnancy was not associated with an increased risk of either premature birth or TLBW, although ambient PM2.5 and PM10 were. Future studies, incorporating broader populations and examining different endpoints will help explore any role that UFP may have in detrimental pregnancy outcomes.
Exposure to traffic-related air pollution and thyroid function during pregnancy: a multi-cohort study

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

**Background/Aims:** Air pollutants interact with estrogen nuclear receptors, but it is not clear whether air pollutants might also disrupt thyroid signaling. Thyroid disruption is of particular importance in pregnant women due to the critical role of thyroid hormones for fetal brain development. Here, we examined the association between exposure to traffic-related air pollution and thyroid function during pregnancy.

**Methods** We included 9931 pregnant women from 4 birth cohorts in Europe (ABCD, Generation R, INMA, and Rhea) and 1 cohort in the US (Project Viva). Iodine status of participants varied across cohorts. We estimated residential air pollution concentrations (i.e., nitrogen oxides [NO] and particulate matter [PM]), during the 1st trimester of pregnancy using land-use regression and satellite aerosol optical depth models. We measured free thyroxine (T4) and thyroid stimulating hormone (TSH), and thyroid peroxidase antibodies (TPOAb) at around 13 weeks of gestation. We defined hypothyroxinemia as free T4 in the lowest 5th percentile within each cohort with normal TSH. We estimated OR (95%CI) with logistic regression models and combined adjusted cohort-specific effect estimates using random-effects meta-analysis.

**Results** We found no association between NO exposure and thyroid function. Higher exposures to particles with diameters ≤ 2.5 μm (PM2.5) were associated with higher odds of hypothyroxinemia in pregnant women (OR per Δ5 μg/m3 =1.20, 95%CI: 1.01-1.43). Exposure to PM10 was also positively associated with hypothyroxinemia but the estimates were imprecise (OR per Δ10 μg/m3 of PM10 =1.15, 95%CI: 0.93-1.44). PM10 and PMcoarse were positively but non-significantly associated with TPOAb-positivity (OR per Δ10 μg/m3 of PM10=1.25, 95%CI: 0.74-2.13; OR per Δ5 μg/m3 of PMcoarse=1.27, 95%CI: 0.73-2.19), with heterogeneity among cohorts.

**Conclusions** Our finding on associations between PM exposures and low thyroid function during pregnancy are of global health importance because air pollution exposure is widespread and hypothyroxinemia may adversely influence offspring brain development.
Maternal toenail manganese and pregnancy-induced hypertension in the New Hampshire Birth Cohort Study

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background/Aim: Manganese is an essential element, which can be toxic at higher levels. Previous studies have observed associations between manganese exposure and blood pressure, but few have evaluated these relationships during pregnancy, a vulnerable period when blood pressure changes dramatically.

Methods: Associations between maternal toenail manganese and blood pressure in late pregnancy were evaluated in participants from the New Hampshire Birth Cohort Study (N=808). Manganese concentrations were measured by ICP-MS in toenails collected ~6 weeks postpartum, representing the mid-to-late pregnancy period. Third trimester systolic (SBP) and diastolic (DBP) blood pressure measures and information on physician-diagnosed pregnancy-induced hypertension (PIH) were abstracted from medical records. Logistic regression was used to examine associations between continuous manganese and PIH. Linear regression models were used to examine associations between continuous manganese and the average of the last three SBP and DBP measures taken in the third trimester. Potential non-linear relationships between toenail manganese and SBP and DBP were also examined using generalized additive models (GAMs). Logistic regression models were adjusted for maternal age, ever smoking status, second hand smoke exposure, parity, weight gain during pregnancy, education, and the development of gestational diabetes or glucose intolerance. Linear regression models and GAMs were additionally adjusted for the average gestational age at blood pressure assessment.

Results: A 1 μg/g difference in toenail manganese was associated with a 0.93 mmHg (95% CI: 0.19-1.66; P=0.01) higher SBP and with a 1.27 (95% CI: 1.02, 1.58; P=0.03) higher odds of PIH. However, GAMs revealed a possible U-shaped relationship between toenail manganese and DBP (P=0.02 for smooth term).

Conclusions: Manganese exposure in mid-to-late pregnancy may increase gestational SBP and risk of PIH, which in turn can increase risk for pregnancy complications. However, the impact of manganese on DBP may depend on the level of exposure, with lower levels possibly being protective.
Persistent Organic Pollutants and the Association with Thyroid Hormone Homeostasis in Placenta

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Background: Prenatal exposure to persistent organic pollutants (POPs) can interfere with thyroid hormone (TH) homeostasis, resulting in disorders in fetal and postnatal development [1]. Here we aim to develop a method for TH determination in placenta and examine the associations of THs with POPs.

Methods: Liquid chromatography with quadrupole time-of-flight mass spectrometry (LC-Q-TOF-MS) method was developed for the quantification of thyroxine (T4), 3,3',5-triiodothyronine (T3), and 3,3',5'-triiodothyronine (rT3), 3,3'-diiodo-L-thyronine (T2), 3,5-diiodo-L-thyronine (rT2), 3-iodo-L-thyronine (T1) and 3-iodothyronamine (T1AM) in placenta [2]. Fifty-eight placenta samples were collected from a Danish birth cohort study. The levels of THs and a wide variety of POPs, including polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins/furans (PCDD/Fs), organotin chemicals (OTCs), organochlorine pesticides (OCPs) were measured. The associations between placental THs and various POPs were analyzed using multiple linear regression [3].

Results: The LC-Q-TOF-MS method developed here showed high sensitivity and selectivity. T4, T3, rT3, and T2 were measured in human placenta. Five PBDEs, 35 PCBs, 14 PCDD/Fs, 3 OTCs, 25 OCPs were also quantified. Some significant associations were observed here: a) T4 was inversely associated with BDEs 99, 100, ZPBDE, and 2378-TCDD, and positively associated with 1234678-HpCDF; b) T3 was positively associated with 2378-TCDF and 12378-PeCDF; c) rT3 was positively associated with PCB 81, 12378-PeCDF and 234678-HxCDF, and inversely associated with tributyltin (TBT), ΣOTC, and methoxychlor (MOC).

Conclusion: This study shows that POP exposures were associated with TH levels in placenta, which leads to the concerns of environmental exposure on the proper development of the fetus and children. The method here allows a comprehensive evaluation of TH homeostasis in research of environmental exposures.

References:
Trimester-specific urinary phenol, paraben, and phthalate metabolite concentrations in relation to singleton preterm birth


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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background: Preterm birth is the strongest predictor of neonatal mortality and long-term morbidity. Accumulating epidemiologic evidence has shown associations of environmental exposures such as phthalates and air pollution with preterm birth. Less is known about critical windows of vulnerability in pregnancy in relation to exposure to phenols and parabens. Methods: We examined associations of trimester-specific urinary concentrations of select phenols, parabens, and phthalate metabolites in relation to preterm birth among 364 singletons born to couples from the Environment and Reproductive Health (EARTH) Study, an ongoing prospective preconception cohort of couples seeking fertility evaluation in Boston, Massachusetts. Gestational age was abstracted from delivery records and validated using clinical guidelines for births following medically assisted reproduction. We estimated the risk ratio (RR) of preterm birth (live birth <37 weeks gestation) in relation to natural log concentrations of bisphenol A (BPA), bisphenol S (BPS), benzophenone-3, triclosan, the molar sum of three parabens (Σparabens), and the molar sum of four di(2-ethylhexyl) phthalate metabolites (ΣDEHP) using modified Poisson regression models, adjusted for covariates. Results: The mean gestational age among singletons was 39 weeks with 8% born preterm. We observed largely null associations for benzophenone-3, triclosan, and Σparabens across all three trimesters. Third trimester ΣDEHP concentrations were associated with an increased risk of preterm birth (aRR= 1.5, 95% CI: 1.1, 2.2). We also observed associations between second trimester BPA concentrations (aRR= 1.3, 95% CI: 0.95, 1.9) and first trimester BPS concentrations (aRR= 1.3, 95% CI: 0.70, 2.3) and higher risk of the outcome. Conclusions: These results show that phthalates and bisphenols are associated with the risk of preterm birth but through different specific exposure windows during pregnancy. While this study warrants confirmation, a better understanding of the underlying pathways between ubiquitous environmental exposures and preterm birth is needed.
Environmental epidemiology of perinatal outcomes: pitfalls of conditioning on intermediates such as timing of birth.

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

The issue of conditioning on intermediates in perinatal epidemiology has been known to be problematic for quite some time. For example, conditioning on gestational age or term-birth status in studies of the effects of exposures on birth outcomes will (a) remove part of the effect of exposure, which will be problematic if the total effect of exposure is of interest and (b) introduce potential for collider bias if unmeasured common causes between the intermediate and outcome exist. However, despite these limitations this type of conditioning remains the norm in environmental epidemiology studies of perinatal outcomes. Typically, a study interested in the effects of an environmental exposure on a birth outcome will condition on preterm birth in the hope of estimating this effect among neonates that don’t differ in terms of developmental maturity. Even in the presence of modest effects of exposure on the intermediate (preterm birth) and low prevalence of this intermediate, a strong common cause of both preterm birth and the outcome is expected to introduce bias if preterm birth is conditioned for. The mechanisms and potential magnitude of bias are demonstrated in hypothetical examples of environmental exposures and both continuous and binary birth outcomes, with timing of birth as a proposed mediator. This bias is also examined in the context of quantile regression. Approaches to address this issue have been proposed in the literature and are presented in the context of the aforementioned examples.
Associations of Prenatal Paraben Exposure with Markers of Fetal Growth: Mediation by Gestation Duration

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background/Aim: Parabens, endocrine disrupting chemicals in personal care and consumer products, are detected in most pregnant women. Associations of parabens with birth outcomes have been inconsistent; thus we investigated associations between gestational paraben concentrations and birth outcomes.

Methods: In 294 predominantly Caucasian, college-educated Illinois women, butylparaben, ethylparaben, methylparaben, and propylparaben concentrations were quantified in cross-pregnancy pools of five first-morning urine samples. Covariate-adjusted generalized linear models assessed associations between natural log (ln)-parabens and gestational age at birth (GA, weeks), birthweight (BW, g), and birth length (BL, cm). Mediation analyses assessed whether GA mediated associations of parabens with birth size. Interactions of parabens with infant sex were explored.

Results: Paraben concentrations were similar to reported concentrations in U.S. women. Butylparaben was not associated with birth outcomes. Associations with other parabens were only observed in female newborns. Only methylparaben (which had the highest concentrations) was negatively associated with GA. Specifically, each ng/mL increase in ln-methylparaben was associated with 0.1 weeks shorter gestation in newborn girls (95%CI: -0.3, 0.004). Furthermore, maternal urinary methylparaben was negatively associated with birth size in girls. Each ng/mL increase in ln-methylparaben was associated with 81.3g smaller BW (95%CI: -134.1, -28.4), and 24.1% (β: -19.6g; 95%CI: -40.2, 1.0) of this association was attributable to the association of methylparaben with GA. Similarly, each ng/mL increase in ln-methylparaben was associated with 0.3cm shorter BL (95%CI: -0.6, -0.1), and 28.3% (β: -0.1cm; 95%CI: -0.2, 0.01) of this association was due to the association of methylparaben with GA.

Associations of ethylparaben and propylparaben with BW and BL were significant, but with smaller effect estimates than methylparaben.

Conclusions: Methylparaben, ethylparaben, and propylparaben maternal concentrations were negatively associated with fetal growth in newborn girls. Methylparaben additionally decreased gestation duration, which partially mediated associations of methylparaben with birth size. These findings should be corroborated in other populations.
Maternal exposure to indoor PM2.5 and associated adverse birth outcomes in low socio-economic households, Durban, South Africa

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Background: PM2.5 exposure is associated with adverse pregnancy outcomes such as reduction in birth weight and gestational age. However, this association has not been adequately described with regard to the indoor environments of urban households in low socio-economic countries.

Aim: To identify the association between maternal exposure to indoor PM2.5, birth weight and gestational age in mothers participating in the Mother and Child in the Environment birth cohort study in Durban, South Africa.

Methods: Pregnant females were recruited from public sector antenatal clinics in Durban, South Africa and followed through to delivery. Households of 770 pregnant females were assessed using a structured walk-through questionnaire to collect information on household materials, occupant activities and outdoor sources. PM2.5 measurements were undertaken in 300 of the 770 households for a period of 24 hours using MiniVol samplers. A predictive model was used to predict PM2.5 levels in unmeasured homes (n=470). The effect of PM2.5 exposure on birth weight and gestational age was assessed by multivariable linear regression models.

Results: The mean (SD) for mothers age, gestational age and birth weight was 26 years (5), 39 weeks (2) and 3113 g (546), respectively. For every 1µg/m³ increase in indoor PM2.5, there was 15 g (95% CI: -17.66 to -13.17) reduction in birth weight and 0.01 weeks (95% CI: -0.02 to -0.01) reduction in gestational age, after adjusting for maternal education, smoking status of the mother, sex of infant, marital status and prenatal environmental tobacco smoke.

Conclusions: The results add to the evidence that exposure to PM2.5 is associated with adverse pregnancy outcomes such as reduction in birth weight and gestational age. The results suggest that, in order to protect population reproductive health, public health policy should also focus on indoor PM.
Spatial analysis of birth defects and proximity to unconventional natural gas developments in Texas, USA

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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Background/Aim: The link between environmental risk factors and common birth defects is still unclear. There are concerns that unconventional natural gas developments (UNGD) may emit air pollution and contaminate drinking water, potentially leading to adverse health effects. Our objective was to investigate the spatial relationship between birth defects and UNGDs.

Methods: We analyzed geocoded data for 10,957 birth defect cases and 649,132 controls born from 1999 to 2011 from the Texas Department of State Health Services (DSHS). UNGD locations were obtained from the Texas Railroad Commission (RRC) and were used to create a density raster of UNGD per km² to estimate exposure. We used separate generalized additive models to produce maps of smoothed odds ratios (ORs) across Texas while simultaneously estimating the association of UNGD density with neural tube defects (NTDs), gastroschisis, and oral cleft birth defects adjusted for maternal age and parity.

Results: UNGD density and risk of NTDs were positively associated [OR (95%CI): 1.27 (1.20, 1.34)] per increased interquartile range of UNGD density. UNGDs were inversely associated with oral cleft defects [OR (95%CI): 0.88 (0.85, 0.92)]. There was no association with gastroschisis [OR (95%CI): 1.00 (0.95, 1.06)]. Risk patterns for birth defects varied spatially across Texas. Statistically significant areas of increased ORs for NTDs and gastroschisis were identified in central or south Texas. ORs for cleft defects were elevated in north Texas.

Conclusion: Study results suggest that proximity to UNGDs are associated with increased risk of NTDs in Texas. Two prior studies found possible associations between proximity to natural gas wells and prevalence of some NTDs and heart defects, but spatial distributions were not examined in those studies. Further exploration of spatial-temporal patterns associated with UNGDs may add to our understanding of birth defect risks.
Solid fuel use and adverse pregnancy outcomes in a Ghanaian Cohort


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PDS 74: Pregnancy outcomes, Exhibition Hall (PDS), Ground floor, August 26, 2019, 13:30 - 15:00

Abstract

Background/Aim: Domestic solid fuel use (wood, coal etc.), and its associated air pollution is linked with multiple adverse health outcomes that disproportionately affects women and children in low-middle income countries. Accruing evidence suggests that prenatal exposure to household air pollution is associated with low birth weight and stillbirth. This study aimed to investigate the relationship between solid fuel use and various pregnancy-related outcomes in a cohort of Ghanaian women.

Methods: A secondary analysis was conducted on a prospective cohort of pregnant mothers (N=1010) recruited <17 weeks gestation from Accra, Ghana. Solid fuel use was self-reported use of charcoal, coal or crop residue as main cooking fuel and was compared to gas, kerosene, or electricity as primary cooking fuels. Logistic and multivariate linear regression analyses were conducted to examine the association between solid fuel use and multiple pregnancy-related outcomes adjusted for BMI, maternal age, maternal education, and SES.

Results: Of the 819 women included in the analysis, 33% (n=270) used solid fuel as their main cooking fuel. Self-reported use of solid fuels was associated with an increased likelihood of perinatal death (OR: 8.88, 95%CI 1.88, 43.32) and an adverse Apgar score (<7) after 5 minutes (OR: 3.35, 95%CI: 1.22, 9.05). Elevated (but non-significant) ORs were observed for post-partum hemorrhage (OR: 2.00, 95%CI: 0.59, 6.74), preterm birth (OR: 1.09, 95%CI: 0.51, 2.30), and low birthweight (<2500g; OR: 1.14, 95%CI 0.61, 2.12).

Conclusion: In this exploratory analysis of 12 obstetric outcomes we report an increased likelihood of perinatal death and low Apgar scores with solid fuel use and potential increased risks of other pregnancy outcomes. As solid fuel use is a modifiable risk factor, further investigation is required to better quantify the consequences and possible alternatives to solid fuel use to effectively ease future transition up the energy ladder.
Meta-analysis of Small for Gestational Age Births and Disinfection By-product Exposures

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Background: Epidemiological studies have shown associations between disinfection byproducts (DBPs) and adverse reproductive outcomes.

Methods: We conducted a systematic review and meta-analysis of all available studies examining DBP exposure and small for gestational age (SGA) births. Eighteen studies were included following exclusions for non-English publications or other DBP measures that did not include trihalomethane (THM) or haloacetic acid (HAA) concentration data with at least three exposure categories. As part of the systematic review, a study quality evaluation was conducted with scores based on outcome and exposure data quality (e.g., temporal/spatial resolution) and potential for bias including confounding. We also conducted sub-group and meta-regression analyses that evaluated the impact of these scores along with other quantitative predictors and modifying factors.

Results: We detected statistically significant risks for SGA associated with THM⁴ (OR=1.06;95%CI:1.03, 1.10), chloroform (OR=1.05;95%CI:1.01, 1.08), BDCM (OR=1.08;95%CI:1.05, 1.11) and brominated THMs (OR=1.05;95%CI:1.02, 1.09). Although no overall risk was detected among the seven HAA studies, statistically significant risks were associated with HAA⁵ (OR=1.10;95%CI:1.02, 1.19), dichloroacetic acid (DCA) (OR=1.25;95%CI:1.10, 1.41), and trichloroacetic acid (TCA) exposure (OR=1.21;95%CI:1.07, 1.37) following removal of statistical outliers after heterogeneity was detected. Sub-group analysis showed larger SGA risks for exposure to THM⁴ (OR=1.08;95%CI:1.04, 1.12), chloroform (OR=1.07;95%CI:1.02, 1.11), BDCM (OR=1.09;95%CI:1.06, 1.13), brominated THMs (OR=1.05;95%CI:1.02, 1.09) and dibromochloromethane (OR=1.16;95%CI:1.07, 1.25) among participants with chloraminated/other disinfectant supplies. In contrast, chlorinated sites showed larger risks for SGA and HAA⁵ (OR=1.22;95%CI:1.02, 1.46), DCA (OR=1.26;95%CI:1.11, 1.43), and TCA (OR=1.23;95%CI:1.08, 1.39) exposures.

Conclusions: Our meta-analysis of 18 studies is consistent with a meta-analysis based on six THM⁴ studies but also presents data on individual THMs and HAAs not previously examined. Our results show an increased risk of SGA following exposure to many of the regulated DBPs and were robust after accounting for outliers, publication bias, type of SGA classification, different exposure windows, and other factors.
Associations of prenatal urinary phthalates and blood pressure during pregnancy

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Background
Phthalates exposure is ubiquitous worldwide and pregnant women may be particularly susceptible. Pregnancy is a sensitive period with numerous physiological changes, including increased blood pressure (BP). Given the inconsistent findings across limited previous research, we examined whether urinary phthalate metabolites concentrations were associated with BP during pregnancy.

Methods
Between 2007 and 2011, 948 pregnant women with singleton pregnancies from Mexico City were recruited during the second trimester (baseline) as part of the Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) cohort. Spot urine samples collected during the second and third trimesters were analyzed for 15 phthalate metabolites. BP (average of two Baumanometer measures), lifestyle, anthropometric, and demographic measures were collected at second trimester, third trimester, and one month postpartum. Multivariable linear regression and Bayesian Kernel Machine Regression (BKMR) models were fitted to estimate the relations of urinary phthalate metabolites with maternal BP.

Results
Adjusting for baseline BMI, baseline BP, and other relevant covariates, second trimester urinary concentrations of MCOP (Interquartile Range [IQR] \(\beta=0.70, p=0.03\)), MCNP (IQR \(\beta=0.73, p=0.03\)), MBzP (IQR \(\beta=0.81, p=0.03\)), and molar sum of DEHP metabolites (IQR \(\beta=0.64, p=0.04\)) were associated with higher maternal third trimester diastolic BP. When examining 1 month postpartum diastolic BP, second trimester urinary concentrations of MCPP, MBP, and MHBP were associated with higher systolic and diastolic blood BP. In contrast, none of third trimester urinary concentrations were associated with maternal diastolic BP measured at one month postpartum. BKMR models did not identify non-linearity or interactions between metabolites.

Conclusions
Our results show that exposure to select phthalates during mid-gestation was associated with higher BP in late pregnancy and one month postpartum. These associations are time-specific, as exposure late in pregnancy was not associated with BP at one month postpartum. Such results suggest that early to mid-pregnancy may represent a sensitive period.
TPS 621: Exposure to metals

Analysis of heavy metals concentrations in Earthworms and Cattle Egret feathers and eggs collected around an informal electronic waste recycling and dumpsite

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Background/Aim:
The Agbogbloshie electronic waste recycling and dumpsite is considered one of the most polluted places on earth. Processes involved in recycling activities are ostensibly informal, including dismantling with locally made tools, and burning of cables to retrieve copper wires resulting in release of toxic chemicals into the ambient environment. This study analyzed heavy metal concentrations in earthworms and Cattle egrets feathers and eggs around the Agbogbloshie informal e-waste recycling and dumpsite.

Methods:
Earthworm and Cattle egret quill feathers and eggs were collected around the e-waste site and analyzed for arsenic (As), cadmium (Cd) and lead (Pb) concentrations using an Atomic Absorption Spectrophotometry. Descriptive statistics was used to summarize data. Correlation analysis was done to establish relationship between heavy metal concentrations earthworms, bird feathers and eggs.

Results:
The order of heavy metals concentrations were As > Pb > Cd. Median As, Pb and Cd concentrations in earthworms, feathers, eggshells and egg content were; As [18.46 (IQR: 8.24-24.33); 6.67 (IQR: 5.78-7.18); 6.20 (IQR: 0.26-9.50) and 6.23 (IQR: 4.53-7.14) µg/g], Pb [5.39 (IQR: 4.71-9.99); 1.89 (IQR: 1.44-2.25), 1.17 (IQR: 1.11-1.99) and 1.18 (IQR: 0.86-1.47) µg/g] and Cd [5.102 (IQR: 4.98-5.99), 0.024 (IQR: 0.01-0.05), 0.142 (IQR: 0.00-0.41) and (0.000 (IQR: 0.00-0.00) µg/g]. There was a positive correlations in concentrations of heavy metals between feathers, shells and egg content.

Conclusion:
Heavy metal levels in earth burrowers (earthworms), bird feathers and eggs reflect the level and scope of environmental pollution due to informal e-waste recycling.
A longitudinal study of chronic lead exposure in Beninese children

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background and aims:
Lead is a well-known neurotoxic metal. Children are particularly vulnerable to its adverse neurocognitive effects. Within a birth cohort, elevated Blood Lead Levels (BLL) (>50 µg /L) were observed in one-year-old infants in Benin in 2011-13. Sources of exposure included the presence of paint chips in the house and consumption of animals killed by lead bullets. We aimed to investigate lead exposure in the same children at six years of age in 2016-18.

Methods:
424 children with BLL at one year of age and reassessed at six years were included in the analysis. Blood samples were drawn and analyzed by inductively coupled plasma mass spectrometry. The study took place in the district of Allada, Benin. We estimated geometric mean BLL. Using the Wilcoxon rank-sum test BLL between boys and girls are compared. The proportion of children with BLL above 50 µg/L and above 100 µg/L are described and compared at both periods.

Results:
Among 424 children (208 boys and 215 girls), the geometric mean BLL in children was 56.5 µg/L (95% CI: 53.5-59.7) at one year of age, and 56.3 µg/L (95% CI: 53.9 - 58.6) at six years of age. The distribution of BLL between boys and girls was not statistically different at any given age. The proportions of children with BLL >50 µg/L at one and at six years of age were not statistically different (55.0% versus 59.7%, respectively; McNemar’s p=0.1183). However, the proportion of children with BLL >100 µg/L was higher at one year of age than at six years of age (14.2% versus 8.3%, respectively; McNemar’s p=0.002).

Conclusion:
Children continue to suffer from elevated BLL and thus constitute an important public health problem in this population of children, and deserves preventive strategies. Sources of exposure may evolve and merits further investigation.
Background/Aim: Arsenic exposure through drinking water affects at least 40 million people in Bangladesh and 140 million people worldwide. Inorganic arsenic (InAs) is methylated to mono- (MMAs) and di-methyl (DMAs) arsenicals; methylation to DMAs decreases toxicity and facilitates urinary arsenic excretion. Nutrients involved in one-carbon metabolism, the pathway that generates the methyl donor S-adenosyl-methionine, may influence arsenic methylation capacity. This study investigated folic acid (FA) and/or creatine treatment effect on the concentrations of arsenic metabolites and arsenic methylation indices in blood.

Methods: In a 24-week randomized, placebo-controlled trial, 622 participants were randomized to receive FA (400 or 800 μg/day), 3 g creatine/day, 400 μg FA + 3 g creatine/day, or placebo. Participants received arsenic-removal water filters. Primary (PMI) and secondary methylation indices (SMI) were calculated as MMAs/InAs and DMAs/MMAs concentrations, respectively. Treatment effects on the concentrations of arsenic metabolites and methylation indices in blood were assessed using linear models with repeated measures.

Results: In the 800 μg/day FA group, the mean decrease in ln(InAs concentration) exceeded that of the placebo group at week 12 (P = 0.001). We previously reported that 400 ug/day FA did not significantly lower total blood arsenic; however, in all groups receiving FA, the mean decreases in ln(MMAs concentration) exceeded that of the placebo group (e.g., MMAs concentration decreased by 20% and 27% in the 400 and 800 μg FA groups, respectively, and by 8.7% in the placebo group) (P < 0.05). Compared to placebo, the mean decreases in PMI were greater among FA groups (P < 0.05), and the mean increase in SMI was greater among all treatment groups, including creatine (P < 0.05).

Conclusion: FA supplementation decreased the concentrations of InAs and MMAs and increased arsenic methylation capacity measured in blood. Creatine supplementation also increased arsenic methylation, but to a lesser extent than FA.
Background/Aim: Cigarette smoking is a major source of human exposure to cadmium (Cd), a known human lung carcinogen (IARC Group 1). In addition to smoking, certain occupations may serve as a source of substantial Cd exposure because Cd is also an environmental and industrial pollutant. Such additional exposures to this known carcinogen could be an important contributing factor to the inter-individual variation in lung cancer risk among smokers. We investigated the relationship between occupation and urinary Cd levels in 1,977 smokers from five race/ethnicity groups.

Methods: Urinary Cd was measured by inductively coupled plasma mass spectrometry. Internal smoking dose was estimated by the biomarker urinary total nicotine equivalents (TNE). Occupation was measured by grouping participants based on their response to questions regarding longest history of industry and occupational categories. Urinary Cd was modeled using a log-normal distribution and censored linear regression, adjusting for age, gender, creatinine, education, TNE and smoking duration.

Results: Urinary Cd levels varied substantially, ranging from below the limit of quantification to 6.0 ng/mL, with an adjusted geometric mean (GM) of 0.81 ng/mL (95% CI: 0.79, 0.84) for all smokers. Ethnic-specific analysis showed higher adjusted GM urinary Cd levels in Latino Americans (0.84 ng/mL), Native Hawaiians (0.84 ng/mL), Japanese Americans (0.81 ng/mL) and African Americans (0.81 ng/mL) as compared to Whites (0.74 ng/mL; p<0.05). Moreover, results showed that workers in occupations known to pose a risk for Cd exposure (e.g. mining, quarrying, and metal production or processing) had 11.4% (95% CI: 0.1%, 24.1%) higher levels of urinary Cd as compared to workers not likely to be exposed to Cd in the workplace, even after accounting for internal smoking dose and duration.

Conclusions: Findings suggest that occupation may be an important factor contributing to Cd burden and may contribute to the differences in lung cancer risk among smokers.
Folic acid intake, urinary creatinine, and arsenic concentrations in Canadian pregnant women
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Background: Inorganic arsenic (As) contamination is expected to affect over 140 million people around the world. The methylation process plays a critical role in As excretion from tissues and folate status has been associated with the ability to methylate As. Furthermore, urinary creatinine (Cr) has been shown to be a strong predictor of As methylation capacity. Creatine, the precursor of Cr, is synthesized in the body or can be consumed in the diet. Nearly 50% of all S-Adenosyl Methionine (SAM)-derived methyl groups in the liver are used in endogenous synthesis of creatine. Since As methylation also requires methyl groups, these two pathways may compete for this limited substrate. Currently, randomized controlled trials are being conducted in Bangladesh to investigate the effect of folic acid and creatine supplementation on the proportion of As metabolites in the urine.

Methods: Using data from the Maternal-Infant Research on Environmental Chemicals Study (MIREC), we are examining the association of questionnaire-derived folic acid supplement intake, and urinary Cr concentrations (1st trimester) with total blood As (1st and 3rd trimester) and speciated As (arsenite, arsenate, dimethylarsinic acid, monomethylarsinic acid, and arsenobetaine) in 1st trimester urine. Multivariate linear regression and quantile regression are being used to look at the associations.

Results: Total blood As (logged) was negatively associated with urinary Cr concentrations (β=-0.01, p=0.01). The quantile regression analysis shows this effect to be most prominent at lower blood As levels (10th and 20th percentile). Folic acid supplement use was not associated with blood As concentrations. Further analyses will examine the association of Cr and folate with As species.

Conclusions: The observed association between urinary Cr (1st trimester) concentration and reduced blood As (1st and 3rd trimester) indicates that Cr could play a role in As methylation and excretion.
Continual decrease in blood lead levels in children of Hoboken (Antwerp, Belgium)
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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background:
In the early 1970s, in the district northeast of a non-ferrous metallurgy in Hoboken, health problems were observed and related to environmental heavy metal exposure. As a result, lead exposure in children living in the neighbourhood of this industry has been monitored via blood tests twice a year since 1978. The study focuses on children because they have both higher health risk at lower doses and higher exposure risk e.g. due to more frequent hand-to-mouth contact and higher intestinal absorption.

Method:
From 1978 to 2018, all children between the age of 1 and 12 years living in the district approximate to the metallurgy were invited for a blood test at school or at a service centre. Capillary blood samples were obtained through a finger prick. A control school was included since autumn 1993.

Results:
Over the last thirty years, the mean blood lead level declined from 21.5 µg/dl to 3.9 µg/dl. Blood lead levels were higher in children living in the zone close to the factory and in the youngest age group (preschool children). In the most recent campaign, i.e. in autumn 2018, 206 of the 404 children from the district were investigated. The mean blood lead level of children living in the district was significantly higher than the control group (district: 3.9 µg/dl; control: 1.9 µg/dl). Twenty-three percent of the children living in the district had a blood lead level above the reference value of 5 µg/dl.

Conclusion:
Even though the levels of lead in blood are decreasing over time, we still observe elevated blood lead levels in children living in the neighbourhood compared to those living outside the neighbourhood. A quarter of the children exceeds the health-based guideline. Therefore, continuous monitoring in hotspot areas is important and further actions are needed to promote and protect public health.
Characterizing manganese in children’s teeth in a community-based pilot research study in Holliston, MA
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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims: Manganese (Mn) exposure through drinking water is common in many communities, but the level that is considered safe, particularly during sensitive developmental periods, is unknown. This pilot study responded directly to community concerns about the safety of their public drinking water supply and potential for past and current Mn exposure. We characterized Mn exposure and explored correlates of early life Mn levels.

Methods: We collected naturally shed teeth from 30 school-age children whose mothers resided in Holliston, Massachusetts during pregnancy. Dentine Mn, measured using laser ablation ICP-MS, was used to characterize exposure at weekly intervals during the prenatal period through 12 months of age. Mn was measured in residential tap water to estimate current exposure. Questionnaires were administered to collect information on sociodemographics and past and current drinking water consumption habits. Linear regression models estimated associations between dentine Mn and participant characteristics.

Results: Tap water Mn ranged from 0.4 – 4135.8 μg/L (median 3.4 μg/L). Median (25th, 75th percentile) dentine Mn (as 55Mn43Ca) across prenatal and early postnatal time points was 1.8E-3 (8.0E-4, 2.3E-3). Dentine Mn was highest in the second trimester and decreased over time. Males had higher dentine Mn than females prenatally through 6 months of age (e.g., 1.2E-3 vs 7.0E-4 birth-6 months old), but females had higher Mn from 6 to 12 months. Use of private wells during pregnancy was associated with higher dentine Mn (β = 0.34 – 0.52, p<0.001) compared to use of the public drinking water supply. Infant formula vs breastmilk as the primary source of milk in the first year was associated with higher postnatal dentine Mn (p<0.001).

Conclusions: Deciduous teeth provided time-specific concentrations of past Mn exposure, which may be associated with environmental sources. Exploratory data suggest elevated Mn in residential tap water warrants further investigation of potential health risks.
Preschool children’s exposure to metals via measurements of hand deposition

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background
Since we spend most of our time indoors the indoor environment can lead to exposure to substances like metals. Small children are often more exposed than adults, for instance due to their hand-to-mouth behaviour. Since some metals can have adverse health effects in children the aim of this study was to investigate indoor exposure to metals on children’s hands in preschools.

Method
In the study, 60 children at 8 preschools in two cities in Sweden participated. Metals on the hands were sampled at two different periods (winter and spring) giving a total of 109 samples. During sampling, both hands were wiped using hand-wipes soaked in 1 % HNO₃, and sampling was done after two hours of indoor activities. The following metals were analyzed using ICP-MS; beryllium, magnesium, aluminium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, arsenic, molybdenum, silver, cadmium, antimony, barium, thallium and lead.

Results
All samples were above limit of quantification (LOQ) except for beryllium and molybdenum (4 %<LOQ) and silver (100 %<LOQ, LOQ=0.001 µg/sample). The lowest mean level was seen for beryllium (0.0034 µg/sample) and highest for magnesium (140 µg/sample). For cadmium, arsenic and lead the mean levels were 0.023, 0.049 and 0.51 µg/sample, respectively. For about half of the metals statistically significantly higher levels (p<0.05) were seen during spring and in one of the cities.

Conclusion
Metals linked to severe health effects like cadmium, arsenic and lead as well as a range of other metals could be detected on children’s hands. These findings indicate an exposure to metals for children both via dermal uptake and oral intake due to hand-to-mouth transfer, but potential contributions to the body burden are unknown. Higher levels were seen during spring and in one of the cities, possible explanations to these observations needs to be looked into more closely.
Assessment of Heavy Metal Exposure to Residents around Abandoned Metal Mines
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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Abandoned metal mines are areas of great concern for the health effects of residents due to hazardous substances such as heavy metals. The purpose of this study was to compare the exposure of heavy metals to residents of the abandoned metal mines and general population through National Health Survey.

Methods: We examined 4,499 residents of the abandoned mines of 2nd phase health effects survey of abandoned metal mines(AMS, ’13~’17). We used data from the Korea national health and nutrition examination survey(KNHANES, ’12, ’13, ’16) and the Korean national environmental health survey(KNEHS ’09~’15). Based on the gender and age distribution of AMS, KNHANES(n=980) and KNEHS(n=1,412) were randomly sampled for the same distribution. The geometric mean concentrations(95% confidence interval) of blood lead, blood cadmium, urinary cadmium, and urinary arsenic concentration were presented, the excess proportion was given by reference to the 95th percentile concentration of the general population.

Results: The geometric mean concentration of lead in blood was significantly higher in AMS than those of the general population(AMS: 2.27(2.24–2.30)a µg/dL; KNHANES: 2.11(2.06–2.17)b µg/dL; KNEHS: 2.23(2.18–2.29)b µg/dL; p<0.001). The geometric mean concentration of blood cadmium in AMS was also higher than those of the general population(AMS: 1.42(1.40–1.44) µg/L; KNHANES: 1.24(1.20–1.28) µg/L; p<0.001), and cadmium in urine was remarkably different and statistically significant(AMS: 1.47(1.42–1.53) µg/L; KNEHS: 0.47(0.45–0.49) µg/L; p<0.001).

Conclusions: The concentration of heavy metals in residents of the abandoned metal mines was higher than those of the general population. We considered the routes of exposure of crops ingestion, groundwater intake, soil contact, and inhalation of scattered dust in contaminated environment. Therefore, continuous individual and national management are needed to evaluate the health risks of residents in the abandoned metal mine areas.
The Truth Fairy Project: Assessing legacy pollution in communities near a lead-acid battery smelter

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/ Aim: Lead (Pb) is a potent neurotoxicant with no safe level of exposure. Elevated levels of Pb and arsenic (As) are found near facilities that recycle lead-acid batteries in the United States. Assessing historical exposure to toxic chemicals, especially in situations of a specific industrial source of pollution affecting a community, is critical for informing appropriate public health and policy responses. We describe a community-driven approach to integrate retrospective environmental hazard exposure assessment with community organizing to address concerns about the extent of exposure to toxic metals in a predominantly working-class, Latinx community living near a now-closed lead-acid battery smelter facility.

Methods: In this pilot study coined the “Truth Fairy” Project, 50 shed deciduous teeth from 43 children living their entire lives within 2 miles of the smelter to understand in retrospective exposure to toxic metals using community-driven research approach. Concentrations of Pb and As in teeth were assessed using laser-ablation-inductively coupled plasma-mass spectrometry. Soil Pb concentrations were determined using spatial kriging of surface soil measurements.

Results: The mean prenatal calcium normalized Pb concentration in teeth samples (reported as a ratio 208Pb:43Ca), was 4.104 x 10^-4 (SD 4.123 x 10^-4), and the mean postnatal 208Pb:43Ca level was 4.109 x 10^-4 (SD 3.369 x 10^-4). Adjusted for maternal education and analytical batch, we observe positive significant relationship between prenatal teeth Pb per 100 ppm increase in soil Pb (β=3.48, 95% CI 1.11, 5.86), indicating higher Pb exposures near the site of industrial exposure. Study results were disseminated to the community using infographics.

Conclusions: The Truth Fairy study provides insights into assessing retrospective exposure to toxic metals among children living near legacy sources. This project integrated community mobilization with empirical research, informing residents about toxic metal exposures and improving the community’s capacity to respond to a public health crisis.
Introduction: Copper contamination is increasing and can be a threat to human health. This study tries to summarize copper levels measured in humans in Iran.

Methods: Persian databases such as SID, Magiran, IranMedex and English databases such as Scopus, Pubmed, Science Direct and the Google Scholar were searched using both English and Persian keywords. 28 articles that measured the concentration of copper in human samples in Iran were included.

Results: According to the results of the reviewed studies, copper levels in some Iranian populations was higher than normal levels. These populations included pregnant women with preeclampsia, patients with oral cancer, patients with Giardiasis infection, Parkinson's patients, children under the age of 12 years with β-thalassemia major, Pregnant women in the third trimester, type 2 diabetic patients. Copper levels were less than normal, in patients with tuberculosis after treatment and post-menopausal women with osteopenia and osteoporosis. Also, Copper concentrations in patients with with tuberculosis, cutaneous leishmaniasis, brucellosis and Molybdenum unit workers was higher ; and copper concentrations in patients with Pemphigus Vulgaris and coronary artery disease was less than their controls, but all were in the normal range (70-140 μg/dl). The amount of copper adsorption in different teeth is different.

Conclusion: High levels of copper have been reported in some Iranian populations and this can be a threat to human health. Monitoring copper levels in some Iranian populations is necessary.
Background/Aim
The Kingdom of Cristal, an area in southern Sweden, is historically heavily burdened by heavy metals. Cadmium, lead, mercury and arsenic have previously been used in glass production and large amounts of glass crust have been deposited around the Kingdom of Cristal and used as filling material for the construction of new residential areas, parks and schools. The purpose of the project was to monitor whether the high levels in the contaminated soil is reflected in blood and urine among school children in this area.

Method
Blood and urine samples were collected from 87 children in the autumn of 2017 (2 only urine). The levels of B-Pb, B-Cd and B-totHg were determined by inductively coupled plasma mass spectrometry (ICP-MS; iCAP Q, Thermo Fisher Scientific, Bremen, GmbH) equipped with collision cell with kinetic discrimination and helium as collision gas. The speciation of arsenic in urine was performed by ion chromatography (Dionex 5000+, Thermo Fisher Scientific, Bremen, GmbH) coupled to ICP-MS (iQAP Q).

Results
The geometric mean of cadmium, lead and mercury in the blood were 0.09 µg/L (max 0.26 µg/L), 9.9 µg/L (max 42 µg/L) and 0.70 (max 2.4 µg/L). The geometric mean of inorganic arsenic (AsIII+AsV) with the metabolites DMA and MMA in urine was 6.1 µg/L and 6.94 µg/g Creatinine. Independent t-tests were performed to compare geometric mean values and children that were not born/raised outside the area had statistically higher levels of cadmium (p-value 0.02) and lead (p-value 0.02) in the blood.

Conclusions
The study shows that children in Lessebo municipality have blood levels of lead, cadmium and mercury that correspond to levels generally found in children in Sweden. The levels of inorganic arsenic and its metabolites in urine did not differ compared to studies performed in children in the rest of Europe and the United States.
Influence of maternal characteristics on child blood lead levels in selected locations of Kabwe district in Zambia

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim:
Kabwe, the provincial headquarters of Central Province of Zambia has recorded very high Blood Lead Levels (BLLs) in children owing to long term large scale mining of Lead, Zink and other minerals resulting in it being named among the top ten most polluted places in the world.
The maternal role in the exposure of children to lead and subsequent blood lead level has been studied in various settings. However, to date there is no known study that explores the influence of maternal characteristics on child blood lead levels in resource limited settings such as the ones found in Kabwe. We therefore aimed to quantify lead levels in mothers and children and study the extent to which maternal characteristics affected these levels.

Methods:
We conducted a survey targeting mother and child pairs in the five townships of Kabwe District in Zambia. Utilizing the lead care kits, Blood Lead Levels were quantified in both mothers and children. Further, information about maternal characteristics was collected by the use of an interviewer administered questionnaire.

Results:
Our results revealed median BLLs of 35.1 μg/dl (IQR <LOD - 381.6 μg/dl) for all the areas surveyed. There were significantly higher levels from the townships in close proximity to the mines. Positive significant correlations were found for Mother’s BLLs, duration of breastfeeding and the children’s BLLs. Length of stay, visiting the mine, mother’s marital status and pregnancy complications were also associated with child’s BLLs.

Conclusion:
These results call for increased investment in improving the social well being of communities and women in particular. This will further enable them reduce their exposures to the lead. and also promote awareness of preventive measures.
Background: Epidemiological analyses of urine arsenic (As) species to evaluate inorganic As (iAs) exposure and internal dose in the US population have been limited by high analytical limits of detection (LODs) for inorganic (arsenate, As+5 and arsenite, As+3) and methylated (monomethylarsonate, MMA and dimethylarsinate, DMA) species in the National Health and Nutrition Examination Survey (NHANES).

Methods: We used a Bayesian Tobit regression model to multiply impute values below the LOD for As species (As+5, As+3, MMA, DMA, and arsenobetaine) for 16,398 NHANES 2003-2016 participants. We evaluated the performance of the Bayesian-imputed distributions in comparison to previously published biomarkers of iAs internal dose via simulation and by replicating an analysis of drinking water As trends.

Results: Before Bayesian-imputation, the percent of values below the LOD was 96.5% (As+5) 76.5% (As+3), 59.1% (MMA), 21.9% (DMA), and 45.3% (arsenobetaine); the median and interquartile range (IQR) for the sum of inorganic and methylated species (∑As) replacing the samples below the LOD by the LOD/square root of two (the standard NHANES method) was 5.42 μg/L (3.59, 8.05). After Bayesian-imputation, the median and interquartile range (IQR) was 0.39 μg/L (0.30, 0.50) for As+5, 0.47 μg/L (0.27, 0.63) for As+3, 0.51 μg/L (0.35, 0.97) for MMA, 3.35 μg/L (1.98, 5.63) for DMA, 0.83 μg/L (0.42, 4.72) for arsenobetaine, and 4.87 μg/L (3.07, 7.54) for ∑As.

Conclusions: Original distributions replacing values below the LOD with the LOD divided by the square root of two likely overestimate inorganic arsenic exposure at the lowest exposure levels and introduce significant bias. Bayesian-imputed distributions and statistical code are made available for public use.
Lead Levels in Blood Donors at the Kintampo Municipal Hospital, Ghana
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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Lead contamination is an environmental health threat to humans worldwide and blood transfusion is considered a hidden source of lead exposure. Lead toxicity causes permanent neurological damage in children and affects more than 70% of those exposed to higher lead levels. The study determined the blood lead levels (BLL) in donor blood to ascertain whether blood recipients were at increased risk of lead poisoning.

Methods: Qualified blood donors (BDs) at the Kintampo Municipal Hospital, in the middle belt of Ghana were consented and involved in the study. The background information of the BDs was collected and about 200μl of venous blood was aseptically taken into ethylene diamine tetra-acetic acid (EDTA) tubes, transported to the Kintampo Health Research Centre Laboratory and analyzed for BLL using the Leadcare lead analyzer. Haemoglobin (Hb) levels were determined using ABX Micros 60 Haematology Analyzer and thin blood smears were prepared and stained with Leishman stain for basophilic stipplings.

Results: A total of 420 BDs made up of 389 (93%) males and 31 (7%) females participated in the study. The mean age of BDs was 29 years (18 – 58 years) and their Geometric mean BLL was 3.1µg/dl (95%CI: 2.9 – 3.3). The prevalence of elevated blood lead level (EBLL) was 17% (≥5µg/dl) whiles 1.4% of BDs had lead poisoning (≥10µg/dl), representing 8.5% of those with EBLL. The prevalence of anaemia was 41% among all BDs (40% and 55% among male and female BDs respectively). There was significant linear correlation between BLL and Hb measured; correlation coefficient -0.1027 (p=0.0354). Blood slide results did not show any basophilic stipplings.

Conclusion: Elevated blood lead levels among blood donors is high in the study area. This has health implications on vulnerable groups like children and pregnant women requiring frequent blood transfusions.
Exposure to mixtures of heavy metals and metalloids in the adult population of Andalusia: analysis in a sub-cohort of the European Prospective Investigation into Cancer and Nutrition (EPIC)

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: To determine the serum levels of 15 heavy metals and metalloids in adult population of Andalusia, to analyze the correlation between these elements and to characterize exposure to metal mixtures.

Methods: Cross-sectional study on a sub-cohort of 486 randomly selected participants from the EPIC-Granada cohort (n=7879). The serum samples collected in the recruitment of the cohort (between 1992 and 1996) were analyzed by means of ICP-ORS-MS to determine the concentration of 15 metallic elements (Be, V, Cr, Mn, Co, Cu, Zn, As, Se, Mo, Cd, Sb, W, Hg y Pb), with limit of detection (LOD) equal to 0.001 ng/ml. Geometric means (GM) were calculated and the correlation between the metals was assessed by the Spearman coefficient. The number of metallic elements with values higher than the 75th percentile (P75) was calculated for each subject.

Results: The percentage of samples with levels above the LOD was greater than 98% for all elements except beryllium (85%). The highest mean levels were observed for zinc (GM=1082.1 ng/ml), copper (875.3), selenium (81.0), lead (12.0), arsenic (7.58), manganese (7.28), chromium (4.66), mercury (3.62) and antimony (1.64). The rest of the elements did not exceed 1.5 ng/ml. The mercury correlated positively (with values greater than 0.2) with arsenic, selenium, and tungsten. The lead had the highest correlations with manganese and zinc. 49% of the participants had levels higher than P75 in at least 4 metals simultaneously, and in 5% of samples the values exceeded P75 in more than 7 of the 15 elements analyzed.

Conclusions: Moderate positive correlations between some of the elements were found. Almost half of the study subjects had high levels in a combination of between 4 and 10 metals, highlighting the importance of considering exposure to mixtures of pollutants for risk assessment.

Funding: Andalusian Ministry of Health (Exp:PS-0281-2016)
Variability of 24h urine excretion of 22 elements in healthy individuals

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim
Urinary excretion of elements varies considerably over the day, so 24h excretion (mass per 24 hours) is a better metric, considered the gold standard which spot samples (often adjusted for creatinine) are compared with. There is, however, normal variability also between days in 24h urinary excretion, but since few studies did repeated sampling there is little information on the relation between within- and between person variability in 24h excretion of elements.

Methods
We used a variability biobank with total 24h urine (split into 6 voids) on two separate days (about one week apart) from 60 healthy non-smokers (31 women and 29 men) from Gothenburg, Sweden, aged 21 – 64 years (mean 34 years). The 24h excretions of 22 elements were quantified using ICP-MS. Variability and intra-class correlation (ICC) were calculated using a mixed effects model of log-transformed 24h excretions, including sex as a fixed factor and individual as a random factor.

Results
Variability between days was low for Cd, Co, Hg, Pb, Sn, Se, V, and Zn, having within-person variability of only 10 - 25% of total variability (ICC 0.75 – 0.90). It was moderate for As, Br, Cu, Fe, Li, Mn, Mo, Ni, P, S, U, and W (ICC 0.35 – 0.75), and highest for Cr (ICC=0.3) and Sb (ICC=0.18). For Fe, ICC was much lower in women than in men, but for other elements there were small differences.

Conclusions
Although 24h excretion is the gold standard for urinary biomonitoring of elements, variability between days is high for some elements. For the toxic elements Pb, Hg, and Cd between-individual variability dominates.
Exposure to metals in adult population residing in industrial areas: a systematic review
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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: The heavy metals lead (Pb), cadmium (Cd), mercury (Hg), nickel (Ni), and the metalloid arsenic (As), are among the most hazardous substances to human health. Excessive exposure to some essential metals such as manganese (Mn) can also be toxic. Populations living near industrial areas are at higher risk of exposure to environmental chemicals when compared to those living in non-industrialized areas. Human biomonitoring (HBM) contributes to surveillance of health risks and identification of vulnerable groups. This research aimed to review the HBM studies that assessed exposure levels to Pb, Cd, Hg, Ni, Mn and As in adult residents in industrial areas. Methodology: A systematic review of studies published up to the end of 2017 was conducted using PRISMA criteria and MEDLINE and BVS databases. Original studies in English, Portuguese or Spanish using internal biomarkers of exposure were eligible. The review was restricted to studies with a comparison group and/or probabilistic sampling. Results: Of 28 selected studies (Cd=19, Pb=13, As=11, Hg=8, Ni=5, Mn=4), 54% were conducted in Europe, 36% in Asia, 7% in North America and 4% in Africa. Smelting (43%), metallurgical plants (18%) and steel mills (14%) were the most frequent pollution sources. Urine (82%) and blood (50%) were used as exposure matrices the selected studies. Metal levels were higher in exposed population than comparison groups, i.e.: studies with comparison group and probabilistic sampling - urine: Cd=0.35-2.16 versus 0.32-0.87, As=1.44-288 versus 1.26-56.2, Pb=1.00-1.79 versus 1.02-1.12, Hg=0.32-2.59 versus 0.20-1.49, Ni=1.15-11.3 versus 1.42-8.33 μg/g creatinine, and Mn=0.11-1.60 versus 0.12-2.20 μg/l. Conclusion: Higher levels of metal exposure, particularly As and Hg, were observed in populations living close to industries than those in more distant areas.
Feasibility of lead exposure assessment in blood spots using x-ray fluorescence

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Lead has been a centerpiece for environmental health studies over the past few decades. Lead has been shown to have effects even at relatively low levels both on neurodevelopment and cardiovascular health. Blood spots are widely collected in hospital settings and have potential for field studies in low- and middle-income countries where resources may be limited. In our study, we wanted to test the feasibility of using a high-powered x-ray fluorescence (XRF) device to accurately measure the concentration of lead in blood spots. We created spotted standards of known concentration of lead on filter paper at different volumes and concentrations. We determined the detection limit through repeated measurements of our standards as well as known value human blood spots to be 1.7 ug/dL of blood lead on average. This detection limit is similar to those of the atomic absorption spectrometer techniques, which were used for blood lead surveillance for decades. We also tested the variability of measured lead concentration with variations of spotted blood volume and found no significant correlation between volume and measured concentration. Finally, we tested the accuracy of the technique to determine concentrations of blood lead from whole blood samples previously measured via inductively coupled plasma mass spectrometry (ICP-MS) as well. We spotted the blood (average blood lead of 2.9 ug/dL) onto filter paper and dried the blood spots thoroughly prior to measurement with the XRF. We found a significant correlation (rho=0.7 p-value <0.001) between the lead measured via XRF on spotted blood and ICP-MS results from the whole blood. This indicates blood spots measured via XRF can be effectively used as a surveillance tool for lead exposure, but future studies should be done to identify proper controls for contamination in field studies.
Deficient calcium, zinc, and iron intake on absorption of cadmium from diet

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: In vitro and in vivo studies have demonstrated that deficient calcium, zinc, and iron dietary intake upregulates metal ion transporters to increase intestinal absorption. However, these gut transporters are not specific and bind to other metals, including cadmium. Few human studies have investigated whether deficient calcium, zinc, and iron intake increases intestinal absorption of dietary cadmium. Methods: We used enrollment data (2010-2012) from the Study of Environment, Lifestyle & Fibroids, a cohort of 1693 African American women ages 23-35 who reside in the Detroit, Michigan area. Whole blood cadmium concentrations (proxy for cadmium absorption) were measured in 1548 participants. Dietary and supplemental calcium, zinc, and iron intake was estimated using Block 2005 Food Frequency Questionnaire data; deficient intake was defined as <80% of the recommended daily allowance. Daily dietary intake of total grains was used as the proxy for dietary cadmium intake as grains are a major source of cadmium exposure in U.S. diet. We estimated the percent difference in blood cadmium concentrations per median daily intake of total grains (4.55 ounce equivalents) using multivariable linear regression, stratified by deficient and sufficient calcium, zinc, and/or iron intake. We restricted the analyses to never smokers with plausible values for total energy intake (>400 and <5000 kcal/day) (n=1087). We adjusted for age at enrollment, total energy intake, body mass index, height, education, and natural log-transformed blood lead concentrations. Results: The observed percent difference in blood cadmium concentrations in relation to intake of total grains was stronger among those with deficient intake of calcium, zinc, and/or iron (28%, 95% CI: 6, 53%) than among those with sufficient intake of all 3 essential nutrients (5%, 95% CI: -7, 19%). Conclusions: Our preliminary findings suggest that women with deficient calcium, zinc, and/or iron intake have increased absorption of cadmium from the diet.
This study focuses on comparing total mercury concentrations, between 2017 and 2018, in fish and sediment samples of rivers in the lowlands of Central and Western Suriname. The use of mercury, as an amalgamation agent, in the artisanal and small scale gold mining (ASGM) industry has resulted in the release of this heavy metal into the environment. Previous studies have shown that mercury accumulates in areas downstream and downwind of ASGM activities. Subsequently, anaerobic bacteria will convert mercury into methylmercury, a highly neurotoxic organic compound. Climate variables (such as temperature, rainfall) and water quality parameters (pH, temperature, conductivity, dissolved oxygen content, etc.) influence the rate and amount of methylation. In fish, methylmercury accounts for approximately 83% of total mercury concentrations. This ongoing research, which started in October 2017, assessed total mercury concentrations in fish tissue and riverine sediment samples at seven locations close to communities that incorporate fish into their diet. Sampling took place in both a cool and a warm period of the year. In addition to fish and sediment sampling, water quality measurements at each location were taken. For both fish and sediment, sampling was conducted in duplicate. Total mercury concentrations in fish ranged from 0.01 ug/g to 1.01 ug/g between sites, with one site (Pikien Saron) consisting of more than 50% of sampled fish above the EPA screening level of 0.3 ug/g. Total mercury concentrations in sediment ranged from 0.02 ug/g to 0.24 ug/g. For sediment there is a Threshold Effect Level (TEL) of 0.17 ug/g total mercury concentration. At or below this level rarely results in adverse biological effects. For the sampling site of Pikien Saron, all sediment samples were above the TEL. Ultimately, these data will support future health risk assessments with regards to the exposure of local communities to methylmercury by consuming fish.
Urinary Metals and Metal Mixtures in Midlife Women: Study of Women’s Health Across the Nation (SWAN)

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background: Little is known about the extent of exposure to multiple metals among midlife women.

Objectives: We assessed exposure to multiple metals in the Study of Women’s Health Across the Nation (SWAN), a multi-site, multi-ethnic cohort of women at midlife.

Methods: We measured urinary concentrations of 21 metals (arsenic, barium, beryllium, cadmium, cobalt, chromium, cesium, copper, mercury, manganese, molybdenum, nickel, lead, platinum, antimony, tin, thallium, uranium, vanadium, tungsten and zinc) using high-resolution inductively coupled plasma-mass spectrometry among 1,335 white, black, Chinese and Japanese women aged 45-56 years at the third SWAN annual visit (1999-2000). Least squared geometric mean concentrations were compared across race/ethnicity, education, financial hardship, smoking, secondhand smoking, seafood intake and rice intake groups. Overall exposure patterns of multiple metals were derived using k-means clustering method.

Results: The percentage of women with detectable concentrations of metals ranged from 100% for arsenic, cesium, molybdenum and zinc, to less than 5% for platinum; 15 metals had detection rates of 70% or more. Asian populations, including both Chinese and Japanese women, had higher urinary concentrations of arsenic, cadmium, copper, mercury, molybdenum, lead, thallium, compared with other racial/ethnic groups, independent of sociodemographic, lifestyle, dietary, and geographic characteristics. Seafood and rice intakes were important contributors to arsenic, cesium, mercury, molybdenum and lead uptake. Two distinct overall exposure patterns- “high” vs. “low” -- were identified. Women in the “high” overall exposure pattern were more likely to be Asians, current smokers, and those with high consumption of seafood and rice, while they were less likely to be black.

Conclusions: Exposures of midlife women to metals differs by racial/ethnic, sociodemographic, lifestyle, dietary, and geographic characteristics. Asian women may be experiencing the highest exposures to multiple metals compared with other racial/ethnic groups in the United States.
Effect of Dietary Sodium and Potassium Intake on the Mobilization of Bone Lead among Middle-aged and Older Men: the Veterans Affairs Normative Aging Study


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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

Background: Bone is the major store and endogenous source of lead. Dietary intake of high sodium and low potassium and their ratio have been associated with higher bone resorption and lower bone mineral density. The role of dietary sodium and potassium intake in the mobilization of lead from bone to the circulation remains unclear.

Objective: We examined whether association between bone lead and urinary lead, a marker of mobilized lead in plasma, was modified by dietary intake of sodium and potassium among 312 middle-aged and older men in the VA Normative Aging Study.

Design: Dietary sodium and potassium were assessed by flame photometry using 24-hour urine samples, and a sodium-to-potassium ratio was calculated from the resulting measures. Patella and tibia lead were measured by K-shell-X-ray fluorescence. Urinary lead was measured by inductively coupled plasma mass spectroscopy in 24-hour urine samples. Linear regression models were used to regress creatinine clearance-corrected urinary lead on bone lead, testing multiplicative interactions with tertiles of sodium, potassium, and sodium-to-potassium ratio, separately.

Results: After adjustment for age, body mass index, smoking, vitamin C intake, calcium intake and total energy intake, participants in the highest tertile of sodium-to-potassium ratio showed 28.1% (95% CI: 12.5%, 45.9%) greater urinary lead per doubling increase in patella lead, whereas those in the second and lowest tertiles had 13.8% (95% CI: -1.7%, 31.7%) and 5.5% (95% CI: -8.0%, 21.0%) greater urinary lead, respectively (p-for-interaction=0.04). No statistically significant effect modification by either sodium or potassium intake on their own was observed.

Conclusions: These findings suggest that relatively high intake of sodium relative to potassium may play an important role in the mobilization of lead from bone into the circulation. Additional research is needed to confirm these findings in longitudinal settings.
Demographic Characteristics of the U.S. Population with the Lowest and Highest Blood Metals Concentrations from NHANES 2013-2016 Biomonitoring Data

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TPS 621: Exposure to metals, August 26, 2019, 3:00 PM - 4:30 PM

The Centers for Disease Control and Prevention’s Environmental Health Laboratory in the Division of Laboratory Sciences measures elements and elemental species for the National Health and Nutrition Evaluation Survey (NHANES) in the U.S. Lead, cadmium, mercury (total), mercury species (ethyl mercury, methylmercury and inorganic mercury), manganese, and selenium are measured in the blood of participants age 1 and older in the survey. Chromium and cobalt are measured for participants age 40 and above. We present the 2.5th, 95th, and 97.5th percentiles for blood metals from the NHANES 2013-2016 survey results. We applied multiple logistic regressions and assessed the demographics of people who had blood concentrations at the highest and lowest percentiles. In a recent NHANES survey cycle, we found that 95.3% of the people that have blood cadmium at the 95th percentile or higher smoke (i.e., serum cotinine $\geq 10$ ng/mL). Smoking appears to be a significant factor contributing to people having the highest blood cadmium concentrations. Smokers also have an increased likelihood of having blood lead concentrations at the 95th percentile or higher. People with blood mercury concentrations at the 95th percentile or higher were primarily males of higher income and higher education levels. Women and individuals with metal objects inside their bodies had statistically significant higher levels of cobalt than other demographic groups. Individuals with higher incomes and metal objects inside their bodies had statistically significant higher levels of chromium. The NHANES blood metals data provides an opportunity to look at the demographics of the U.S. population that have the highest and lowest amounts of toxic elements like lead, cadmium and mercury or essential elements like selenium that are found in people. This presentation will highlight some of the significant blood metals statistics from the 2013-2016 survey years.
TPS 622: Exposure to flame retardants and plasticizers
PVC flooring as a source for phthalates in indoor dust, the SELMA study
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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Introduction
Human are constantly exposed to many chemicals via the products and/or environment we come in contact with in our everyday life. Phthalates are synthetic chemical which has been used as plasticizers in poly vinyl chloride (PVC) materials, and due to its weak chemical bonds, it may leak into the surrounding environment and then become a source for human uptake. Studies have shown the associations between phthalate exposure during prenatal and/or postnatal and human health risks.

Methods
The current data is from the Swedish Environmental Longitudinal, Mother and child, Asthma and allergy (SELMA) study including 493 mother-child pairs followed from early pregnancy over birth and up in school age. The purpose of this analysis is to evaluate the levels of phthalates, non-phthalate plasticizers in dust from Swedish home, as well as to identify the associations between PVC flooring and indoor dust by using two different statistical methods, logistic regression and weighted quantile sum (WQS) regression.

Results
Seven out of the eight examined phthalate esters were more than 90% detectable, whereas the non-phthalate replacement Di-iso-nonyl-cyclohexane-di-carboxylate (DINCH) were only 26% detectable. The most abundant plasticizers in house dust were Di-n-butyl phthalate (DnBP) phthalate ester. By using traditional regression method, Butyl-benzyl phthalate (BBzP) concentration in dust increased approximately two-fold in the dust samples where PVC flooring in both bedroom and kitchen when compared with no PVC flooring in either the rooms. The residential PVC flooring was related to Di-isobutyl Phthalate (DiBP), BBzP, and Di-ethyl-hexyl phthalate (DEHP), which contributed to more than 22%, 34%, and 21% respectively in the WQS model.

Conclusions
This study has found significantly higher correlation of dust levels of the BBzP, DiBP and DEHP in Swedish homes with PVC flooring. Since BBzP is a regulated phthalate, our findings may bring the awareness of the usage of BBzP.
Ultra-processed food consumption and exposure to phthalates and bisphenols in the United States: Results from the National Health and Nutrition Examination Survey (NHANES), 2013-2014
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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Consumption of ultra-processed foods, which have low nutritional quality and have been associated with poor cardiometabolic health outcomes, may increase exposure to chemicals used in food packaging and production. We assessed associations of ultra-processed food consumption with exposure to currently used phthalates and bisphenols in the general U.S. population.

Methods: Among 2,212 NHANES 2013-2014 participants, we classified items reported in a 24-hour dietary recall according to the NOVA food processing classification system and calculated the proportion of energy intake from ultra-processed foods. Urinary concentrations of mono-benzyl (MBzP), mono-(3-carboxypropyl) (MCPP), mono-(carboxyisononyl) (MCNP), mono-(carboxyisocyt) (MCOP), and four metabolites of di(2-ethylhexyl) (∑DEHP) phthalates and bisphenols A, S, and F were measured in spot urine samples. We estimated percent changes in natural log biomarker concentrations per 10% higher energy from ultra-processed food in covariate-adjusted multivariable linear regression models. We also examined associations per 1% higher energy from ten ultra-processed food groups.

Results: In adjusted models, ultra-processed food consumption was associated with higher urinary MCPP, MCNP, and MCOP concentrations, but not with MBzP, ∑DEHP, or bisphenols A, S, and F. Each 10% higher energy from ultra-processed food was associated with 8.0% (95% CI: 5.6%, 10.3%) higher urinary MCOP concentrations. Sandwiches and hamburgers; French fries and other potato products; ice cream and ice pops; and sauces, dressings, and gravies were associated with higher concentrations of these three phthalate metabolites, whereas salty snacks; sweet snacks; and instant and canned soups were associated with lower concentrations. Certain ultra-processed food groups were associated with higher urinary bisphenol A (soft and fruit drinks), bisphenol F (French fries and other potato products; milk-based desserts), and bisphenol S (pizza) concentrations or lower bisphenol F concentrations (pizza).

Conclusions: Ultra-processed foods are an important source of exposure to currently used phthalates, which may contribute to adverse health outcomes associated with ultra-processed food consumption.
Pre- and early post-natal exposure to plasticizers (phthalates and DINCH) in a new type of mother-child cohort relying on the collection of repeated urine samples.

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background: For non-persistent chemicals such as phthalates a single spot urine sample only reflects exposure in the past few hours. New studies relying on numerous urine samples per participant are needed to accurately characterize exposure over long time periods such as pregnancy and the first year of life.


Methods: We assessed phthalate concentrations in within-subject pools of urine samples at first and third trimester of pregnancy and at 6 weeks and 1 year of age. Each pool contained up to 21 samples for mothers and 7 samples for children collected for 7 consecutive days.

Results: Most of the metabolites were detected in more than 95% of the pooled samples except for the 2 DINCH metabolites ohMINCH and oxoMINCH, MMCHP and ohMPHP measured at 2 months. Intra individual spearman correlations were overall low (rho < 0.64). Median levels for children at 1 year were higher than pregnant mothers for cxMiNP and MMCHP and the 2 DINCH metabolites (ohMINCH and oxoMINCH). Maternal levels of all compounds but MEP, ohMiNP, and the DINCH metabolites decreased between 2014 and 2017 (p-values < 0.04). For children only MEHP, a DEHP metabolite (p-value = 0.002) decreased during that time and an increase was observed for two metabolites of DiNP (oxoMiNP, cxMiNP, p-values < 0.01).

Conclusions: This is to our knowledge one of the first exposure estimates to phthalate based on a within subject biospecimen pooling approach. Our results suggest decreasing levels of DEHP metabolites and widespread exposure to emerging phthalate substitutes such as DINCH among both pregnant women and young children.

Abbreviations: DINCH: Di-(iso-nonyl)-cyclohexane-1,2-dicarboxylate; DEHP: Di-(2-ethylhexyl)-phthalate; DiNP: Di-isononyl-phthalate; ohMiNCH: 2-(((Hydroxy-4-methloctyl)oxy)carbonyl)cyclohexanecarboxylic-Acid; oxoMiNCH: 2-(((4-Methyl-7-oxyoctyl)oxy)carbonyl)cyclohexanecarboxylic-Acid; MMCHP: Mono-2-carboxymethyl hexyl-phthalate; ohMPHP: 6-Hydroxy Monopropylheptyl-phthalate; cxMiNP: Mono-4-methyl-7-carboxyoctyl-phthalate; oxoMiNP: Mono-4-methyl-7-oxooctyl-phthalate.
Phthalate Metabolites in the Urine of German Preschool Children in 2017/18 – Health Relevance and Exposure Trends of the last 15 Years

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim
Children are frequently in contact with a range of consumer products which may contain plasticizers like phthalates. Many of these substances are concerning for health, for example toxic for reproduction. Compared to other age groups only few epidemiological studies about the internal phthalate exposure of preschool children are available. This study aims to assess the current phthalate exposure in German preschool children and to compare the obtained data with results from previous studies, focusing on the same age group, to detect tendencies of exposure. Furthermore, the data will be compared with health evaluation criteria.

Methods
Within this cross-sectional study, the urine of 251 children (2-6 years) in North Rhine-Westphalia was collected in 2017/18 and analysed for ten metabolites of nine selected phthalates. The estimated daily intakes of the different phthalates were determined via back-calculation and compared to tolerable daily intakes (TDI).

Results
Five metabolites showed values far predominantly below the limit of quantification. The highest median urinary concentration was found for mono-iso-butylphthalate (MiBP) (48 µg/L), followed by mono-n-butylphthalate (17 µg/L), mono(2-ethyl-5-hydrohexyl)phthalate (9,7 µg/L), mono(2-ethyl-5-oxohexyl)phthalate (7,5 µg/L), and 7-oxo-mono-iso-nonylphthalate (3,9 µg/L). Analyzing data from previous studies, a continuous decrease for the last 15 years was observed for all these metabolites with the exception of MiBP. The TDI for di-iso-butylphthalate (DiBP), the parent substance of MiBP, was exceeded in 10% of the study population. For all other parent substances of the metabolites the exposure fell below the specific TDI’s.

Conclusions
A continuous decrease of exposure in the last 15 years was observed for most phthalate metabolites, though this tendency was not found for MiBP. Because a high proportion (10%) of our study population exceeds the TDI for DiBP the exposure to this harmful phthalate should be reduced, especially to protect the health of children between 2 and 6 years.
Patterns of phenol, paraben, and phthalate exposure in NYC women


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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims. Women are disproportionately exposed to environmental chemicals linked to adverse health outcomes through their use of personal care products. Identification of exposure patterns and associations with potential exposure sources can inform the design of targeted policies and interventions.

Methods. We used information on pregnant women aged 18-35 from New York enrolled in the Mothers and Newborns cohort. Five phenols, three parabens, and nine phthalate metabolites were measured and adjusted for specific gravity in spot urine samples collected during the third trimester in 362 women. Personal care product use was assessed via questionnaire. We used principal component pursuit (PCP), a novel robust pattern recognition and dimensionality reduction technique, to simultaneously identify consistent patterns of chemical exposure and to isolate unique or extreme exposure events. We included individual pattern scores in regression models to evaluate their relationship with personal care product use.

Results. Separating variance due to extreme events from common patterns, PCP explained 81% of the variance in exposure. We identified five patterns that, 1) represent overall exposure, 2) separate phthalates from phenols and parabens, 3) separate two phenols (2,4-dichloro-phenol and 2,5-dichloro-phenol) from parabens, 4) separate di(2-ethylhexyl) phthalate metabolites from other phthalates, and 5) represent disproportionately high triclosan exposure. Personal care products contain varying mixtures of these chemicals. Pattern 1 was associated with make-up, perfume, and liquid soap use. Pattern 2 was associated with eye make-up and hair gel use. Pattern 3 was associated with lotion use. Pattern 4 was associated with lotion, hair spray, and sunscreen use. Pattern 5 was associated with lipstick and deodorant use.

Conclusions. Phenol, paraben, and phthalate exposure comes from various environmental sources, including personal care products. PCP serves as a useful tool to aggregate exposures into consistent patterns that, if found to be related to adverse health, are amenable to targeted public health messaging.
Temporal trends and risk assessment of perfluorinated alkyl acids (PFAAs) in food on the Swedish market 1999-2015

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

The European Food Safety Authority (EFSA) has proposed tolerable weekly intakes (TWIs) of PFOS (13 ng/kg body weight/week) and PFOA (6 ng/kg/w). EFSA concluded that a considerable portion of the European population exceeds these TWIs. We determined the per capita intake PFOS and PFOA from foods on the Swedish market in relation to TWIs, and temporal trends of PFAA intake from 1999 to 2015. Per capita consumption data were derived from Swedish producers and trade statistics reported by the Swedish Board of Agriculture. Food items consumed on average more than 0.5 kg per person per year were purchased from major food chains in Sweden. Food items were homogenized and pooled in 12 food categories per food chain in proportions based on the per capita consumption, including cereals/products, pastries/baked goods, meat/products, fish/products, dairy products, eggs, fats/oil, fruits, vegetables, potatoes/products, sugar/sweets and soft drinks/low alcohol beer. PFAAs in the pooled food group homogenates were analyzed by UPLC-MS/MS. PFBS, PFHxS, PFOS, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, and PFHxDA were quantified in several individual food group baskets 1999-2015. Log-linear regression analysis showed decreasing concentrations from 1999 to 2015 of PFOS (fish/products 7.6%/year; meat/products 15%), PFHxA (vegetables 9.3%), PFOA (eggs 5.3%; sugar/sweets 3.7%) and PFTrDA (fish/products 12%). For PFNA, PFDA, PFUnDA and PFDoDA in fish/products we observed a pattern of increasing concentrations from 1999 to 2005/2010 and then a decrease 2015. Per capita intake of PFOS and PFHxA significantly decreased by 9.6% and 4.5% per year, respectively. The medium-bound per capita intake of PFOS (3.2 ng/kg body weight/week) and PFOA (2.0 ng/kg/w) for adults were below the EFSA TWIs. However, there are sub-populations that have intakes exceeding TWIs due to consumption of contaminated drinking water and fish. Moreover, possible cumulative toxic effects of PFAAs have to be considered in future risk assessments.
Estimated daily dose and cumulative risk of phthalates Exposure in the general Children and Adolescents: Results from Taiwan Environmental Survey for Toxicants (TEST) 2013-16.

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Introduction. In 2011, some Taiwanese children exposed to phthalate-tainted products due to a phthalate contamination episode. However, no information is available to evaluate the exposure doses and risk of phthalates in Taiwanese children and adolescent after the episode. We aim to investigate the daily exposure dose and cumulative risk of phthalates in Taiwanese youth using a biomonitoring approach.

Materials and Method. We conducted a national-wide human biomonitoring study, the Taiwan Environmental Survey for Toxicants (TESTs), to systematically assess the exposure doses and cumulative risk of phthalates in Taiwanese children and adolescents. A total of around 300 participants (7-18-year-old) were recruited during 2013 to 2016. First morning urine sample was collected and analyzed for 11 phthalate metabolites using LC-MS/MS. We estimated the daily intake doses of 6 phthalates and the cumulative risk for reproductive and hepatic hazard in our participants.

Results and Discussion. Median and range of estimated daily dose of DiBP, DnBP and DEHP in children were 0.75 (<0.01~33.6), 0.83 (<0.01~29.5) and 3.2 (0.73~23.6) μg/kg/day, respectively. Median levels of 7 urinary phthalate metabolites (included DBP, DiBP and DEHP metabolites) in children were significantly higher than those in adolescent, whereas no significant difference was found between boys and girls. We observed that median levels of phthalate metabolites in children and adolescent in Taiwan were around 1.5-4 fold higher than those from NAHANES 2011-12, except for MEP and MBzP. About 1.45% of our participant had cumulative HI above 1 for reproductive hazard. Our data indicated that part of Taiwanese children were still exposed to high level of DnBP, DiBP and DEHP.
Dietary contribution to bisphenol A and bisphenol S body burden among mother-children pairs

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Due to health concerns on bisphenol A (BPA), alternatives including bisphenol S (BPS) has been used in greater quantity. Diet is considered as one of major sources, however, its relative contribution to the total body burden is not fully understood. This study was conducted 1) to evaluate the extent of the reduction of bisphenol exposure through dietary intervention, and 2) to identify the sources of BPA and BPS exposure.

Methods: Mothers and children (N=93) from 37 families were participated in the dietary intervention study. During the 3-day intervention period, participants were asked to refrain from the foods in cans and plastic containers, instant foods, and delivery foods. Questionnaire was conducted to obtain demographic and behavioral characteristics. Urine samples were collected every day. Mixed effect model was used to estimate within-individual change in urinary bisphenol concentrations by the intervention, controlling for demographic and behavioral factors.

Results: By the dietary intervention, among the mothers, urinary levels of BPA and BPS decreased by 53.1% (95% CI: -30.0, -68.6), and 63.9% (95% CI: -37.1, -79.3), respectively. Among children, BPA concentrations decreased by 47.5% (95% CI: -25.6, -62.9), however, BPS was not significantly changed. Consumption of several food items (canned foods, take-out drinks, or fast-foods) were significantly associated with elevated levels of urinary BPA or BPS concentrations. In addition, consumption of chicken soup with rice and bottled water, and use of plastic boiling pot were identified to be correlated with urinary BPA levels.

Conclusions: Dietary contribution of BPA exposure among the mothers and children was estimated at around 50%. BPS exposure was also reduced by 64% among mothers. However, dietary intervention did not reduce BPS exposure in children, suggesting different source characteristics. Further studies are warranted to identify the sources of BPS exposure among children.
Pre- and postnatal levels of phthalates in indoor dust in the SELMA study.

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background
Phthalates are common in our everyday products and they may leech into the environment and therefore adhere to indoor dust, one potential human exposure source. The aim of this study was to compare phthalate levels in indoor dust collected before and after birth.

Methods
Indoor dust was collected by families participating in the Swedish Environmental Longitudinal, Mother and child, Asthma and allergy (SELMA) study, conducted 2007-2010, using a supplied filter attached to a vacuum cleaner. Dust was collected during early pregnancy (prenatal) and when the child was 2-6 months old (postnatal), 12 month apart. Prenatal (n=501) and matched postnatal (n=501) dust samples were analyzed for phthalates (DEP, DnBP, DIBP, BzBP, DEHP, DINP, DIDP, DPHP), and the alternative plasticizer DINCH, using GC-MS/MS. Geometric mean (µg/g dust) was used to describe dust levels, t-test to compare means and Pearson Correlation to investigate the correlation between each log10 phthalate level, prenatal and postnatal.

Results
In both prenatal and postnatal dust samples, phthalates were detectable in more than 89%, except for DINCH, which was present in only 26% compared to 61% of the samples. The geometric mean for prenatal phthalate samples was significantly higher compared to postnatal samples (p<0.05); DEP (1.93µg/g;1.32µg/g), DIBP (8.01;6.83), DnBP (21.75;7.81), BzBP (29.87;19.98), DINP (52.90;32.48), but not for DPHP (1.52;1.67), DEHP (145.49;133.93) and DINCH (26.30;38.26). Analyses showed a significant correlation (p<0.002) between pre- and postnatal samples DEP (R=0.48), DIBP (R=0.35), DnBP (R=0.33), BzBP (R=0.58), DEHP (R=0.16), DPHP (R=0.47), DINCH (R=-0.29). For DINP, no significant correlation was seen (R=0.05;p=0.356).

Conclusions
Prenatal phthalate levels in indoor dust was significantly correlated with phthalate in postnatal dust. The non-phthalate DINCH was more detectable and more present in postnatal dust samples compared with prenatal dust. This indicate that “older” phthalates slowly is phased out and replaced by newer compounds like DPHP and DINCH.
Bisphenol A (BPA), a well-known endocrine disrupting chemicals (EDCs), is widely used in food containers, paper, and electronics. Other bisphenols substituting to BPA are also suspected to have EDC effects. The aim of this study was to investigate the exposure sources by matching urinary bisphenols to their activities among Korea adults. Twelve adults (5 men and 7 women) were recruited in 2015. Participant were asked to collect all urine void and record the total volume of urine and the collection time for continuous seven days. A total of 401 urine samples (24-41 samples per participants) was collected. Urine samples were analysed for eight bisphenols (BPA, bisphenol S (BPS), F, Z, AF, AP, P, and B) using high-performance liquid chromatography/tandem mass spectrometry. During the period, time-activity diaries were recorded with 10-min intervals, which contained all meals, snacks and beverage, used consumer products, transportation, places and their activities. For BPA and BPS, peaks were set as levels greater than average+2 standard deviations of all samples of each participant. The activities were tracked for 6 hours prior to that time considering the half-life of BPA. The detection rate of BPA and BPS were 72 and 81%, respectively, and the others were below 15%. Average concentrations (50-95th) of BPA and BPS were 0.87 (0.48-2.84) and 0.21 (0.08-0.78) ng/ml, respectively. Urinary BPA levels in male was significantly higher than in female. A total of 20 and 21 peaks of BPA and BPS were identified, respectively, from twelve participants. BPA peaks was appeared to be associated with taking meals, beverage, snack, tooth brushing, and facial washing. BPS peaks were appeared after food consumption, tooth brushing, facial washing and wearing cosmetics. More comprehensive analysis is guaranteed to identify specific behaviours and product usage relating to bisphenols exposures.
Consistency between serum concentrations of perfluorinated compounds measured in early and late gestation in a Swedish cohort

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Epidemiological studies investigating associations between maternal concentrations of perfluorinated compounds (PFAS) and birth weight have shown inconsistent results. The gestational stage of sampling has varied substantially between studies but there is limited knowledge as to how concentrations in early and late gestation correlate. The aim was to assess the correlations of serum concentrations of perfluorooctanoate (PFOA), perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS) between early and late gestation and to investigate the magnitude of the absolute and relative changes that occur during pregnancy.

Methods: We studied 72 healthy women that were recruited during 2009 to 2014 as a control group in the Pregnancy Obesity Nutrition and Child Health study (PONCH). Serum concentrations of PFAS were measured in early and late gestation (median day 82 and 252, respectively). We used Spearman rank correlations to assess the consistency of concentrations measured in early and late gestation. Absolute changes of concentrations during pregnancy were investigated using the Wilcoxon signed ranks test and the one-sample median test was used to test whether the relative change differed from 0.

Results: All samples had detectable levels of PFAS. The median concentrations in early pregnancy were 1.8 ng/mL of PFOA, 5.6 ng/mL of PFOS and 1.9 ng/mL of PFHxS. The correlation coefficients between concentrations measured in early and late gestation were 0.89, 0.91 and 0.60 for PFOA, PFOS and PFHxS, respectively. The concentrations of PFOA and PFOS decreased by 0.3 and 0.8 ng/mL, respectively, which corresponded to relative decreases of -19 and -15 %. The concentration of PFHxS increased by 1.2 ng/mL, or by 69 %.

Conclusions: The correlations between concentrations of PFOA and PFOS measured in early and late gestation were high but that of PFHxS was moderate. We observed slight decreases of PFOA and PFOS concentrations during pregnancy, whereas the concentration of PFHxS increased.
The GenX Exposure Study: Engaging community through reporting back of per- and poly-fluoroalkyl substances exposure data in Wilmington, NC

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background: Emerging environmental health threats leave communities seeking information regarding their exposures and how those exposures may impact health. At the same time, researchers are concerned about communicating exposure data without overinterpreting limited and complex information. Drinking water contamination by per- and poly-fluoroalkyl substances (PFAS) presents a challenging environmental and public health problem globally. In Wilmington, North Carolina, USA approximately 200,000 residents were exposed to PFAS through drinking water contaminated by an upstream fluorochemical manufacturing plant. Many PFAS are “newly identified”, with little to no information about impacts on human health and limited regulatory guidelines.

Methods: In response to community concerns about this exposure, we launched the GenX Exposure Study. We enrolled Wilmington residents served by municipal drinking water. Participants were aged >5 years and English or Spanish speaking. Participants completed a questionnaire and provided tap water, blood, and urine samples. An important objective of the study was to report-back individual results to participants and overall findings to the Wilmington community.

Results: We enrolled 344 participants (84% adults; 76% white; 3% only-Spanish speaking). To accomplish our report-back aim, we established a community science advisory board representing diverse stakeholders. The board provided input on community concerns and recommended what to emphasize in the report-back materials. We developed individualized PFAS reports for each participant that provided overall study interpretations and illustrated where the person’s level was relative to other participants in the study. Subsequently, we hosted community meetings in Wilmington to present aggregate-level results and answer questions.

Conclusions: The GenX Exposure Study engaged community members in the development of exposure reporting materials for both individual and community-level PFAS results. The report-back process and dissemination of environmental exposure data are a critical step for translating results findings, especially for community member participants.
Monitoring of perfluorinated compounds from the imported fishery products in Korea by liquid chromatography-tandem mass spectrometry (LC-MS/MS)

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TPS 622: Exposure to flame retardants and plasticizers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim
Dietary intake is thought to be an important route of exposure source for perfluorinated compounds (PFCs). PFCs are highly detected in seafood, consumption of fishery products in Korea was 59.9kg per person in 2016. Therefore, it should be meaningful to monitor the PFCs level in fishery products consumed by Korean. In this study, we analyzed 19 PFCs in the imported fishery products using LC-MS/MS.

Method
A total of 286 fishery products were collected from fish market and retail market in South Korea. The five groups of samples were tested; fish (n=162, 22 countries), crustacean (n=31, 9 countries), cephalopoda (n=40, 7 countries), gastropoda (n=8, 3 countries), pelecypod (n=45, 4 countries). The pretreatment of sample was applying enzyme hydrolysis and ion-paring extraction, analysis was performed using LC-MS/MS.

Results
Of the 19 PFCs, PFBA and PFPeA were detected frequently in samples but levels of those were low. PFHpS, MePFOSAA and EtPFOSAA were detected only a few samples or at very low concentrations. Level of PFOA and PFOS in crustacean was 0.92 ± 1.83 ng/g and 0.39 ± 0.60 ng/g, respectively, and PFTrDA was highly detected in Cephalopoda (0.71 ± 0.64 ng/g).

Conclusions
We compared the level of PFCs in various imported fishery products. The levels of PFCs in this study were similar or less than other researches. Intake of PFOS and PFOA through consumption (0.9 g/day) of crab as the highest PFCs concentration among in this study was estimated to be 56.7 and 15.4 ng/kg/day for 60 kg bw adults. These values were significantly lower than the tolerable daily intake (TDI) for PFOA (1500ng/kg/d) and PFOS (150.0ng/kg/d), set by EFSA. As a result, the intake of PFCs through imported fishery products was found to be low risk.
TPS 623: Exposures to pesticides

Urinary pesticide metabolite concentrations in pregnant women from Suriname

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Pesticides are widely used in Suriname, a middle-income Caribbean country. The primary agricultural area is district Nickerie. Exposure to pesticides leads to adverse health effects and pregnant women and children are vulnerable. The Caribbean Consortium for Research in Environmental and Occupational Health (CCREOH) assesses the impact of environmental exposures on birth outcomes and neurodevelopment in 1000 mother/child dyads. This study represents a subset of the CCREOH cohort and is aimed at comparing pesticide metabolite concentrations in pregnant women from Nickerie and the capital Paramaribo. Urine samples from 220 participants were collected. A total of 50 samples (42 from Paramaribo and 8 from Nickerie) were recently analyzed at the US Centers for Disease Control and Prevention’s environmental health laboratory for three pesticide classes, including the commonly used 2,4-D, organophosphate insecticides, and pyrethroid insecticides. Pregnant women in Nickerie had the highest geometric mean urinary metabolite concentrations of 2,4-D and pyrethroids: 3-phenoxycbenzoic acid compared to those living in Paramaribo, (0.56 vs. 0.16 ug/L), (0.52 vs. 0.24 ug/L), respectively (p<0.05). Pregnant women living in Paramaribo had significantly higher geometric mean urinary metabolite concentrations of organophosphates: para-Nitrophenol, diethylthiophosphate and diethylphosphate compared to those living in Nickerie, (0.44 vs. 0.22 ug/L), (0.73 vs. 0.22 ug/L), (1.54 vs. 0.54 ug/L), respectively. The above-mentioned levels are higher in Suriname compared to those in the United States based on data from the National Health and Nutrition Examination Survey. Urinary metabolite concentrations of pesticides varied in Paramaribo and Nickerie. This could be due to residential use, intensive spraying during mosquito control programs in Paramaribo and excessive use in Nickerie, as it is a rice production area, respectively. Analysis of an additional 170 urine samples is underway.
Neonicotinoid exposure in the U.S. general population
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TPS 623: Exposures to pesticides, August 26, 2019, 3:00 PM - 4:30 PM

Background: Neonicotinoids, agricultural insecticides, are also used for flea control in household pets. Neonicotinoids have become popular replacements for other insecticides (e.g., organophosphates, carbamates), and use may be on the rise.

Methods: We measured urinary concentrations of six neonicotinoid biomarkers: acetamiprid, clothianidin, imidacloprid, thiacloprid, N-desmethyl-acetamiprid, and 5-hydroxy-imidacloprid in 3,038 samples from participants 3 years and older from the 2015–2016 National Health and Nutrition Examination Survey. We calculated distribution percentiles and used regression models to evaluate associations of various demographic parameters with urinary concentrations above the 95th percentile (a value that represents higher than average concentrations) of neonicotinoid biomarkers.

Results: The weighted detection frequencies were 35% (N-desmethyl-acetamiprid), 19.7% (5-hydroxy imidacloprid), 7.7% (clothianidin), 4.3% (imidacloprid), and <0.5% (acetamiprid and thiacloprid). Concentrations ranged from <0.40–40.4 µg/L (5-hydroxy imidacloprid), <0.20–34.7 µg/L (N-desmethyl-acetamiprid), <0.20–31.1 µg/L (clothianidin), and <0.4–4.94 µg/L (imidacloprid). Children 3–5 year old who fasted <8 hours were more likely to have N-desmethyl-acetamiprid concentrations above the 95th percentile than adolescents (adjusted odds ratio (OR) = 3.12; 95% confidence interval [CI], (0.98-9.98) and adults (OR = 4.29; 95% CI, (2.04-9.0)). Asians were two times more likely than non-Asians to have concentrations above the 95th percentile of N-desmethyl-acetamiprid and 5-hydroxy-imidacloprid (OR = 1.94; 95% CI, (1.08-3.49) and 2.25; 95% CI, (1.44-3.51)), respectively. The probabilities of having N-desmethyl-acetamiprid and 5-hydroxy-imidacloprid concentrations above the 95th percentile in the summer were 1.55 and 2.43 times higher than in winter, respectively.

Conclusions: These first reference ranges of neonicotinoid biomarkers in the U.S. general population 3 years of age and older suggest human exposure to select neonicotinoids. The data also suggest metabolites are better biomarkers of background exposure than the parent compounds themselves. Compared to others, young children and Asians may experience higher exposures although reasons for such differences remain unknown.
Household exposure to pesticides in pregnant women of a Birth cohort study – Project PIPA pilot study

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The effects of the pesticide during pregnancy have been investigated increasingly. Studies on environmental exposure to pyrethroids have adverse effects on pregnancy and infant pregnancy, including the immune system of birth size and neurological development. The realization of a birth cohort to investigate the effects of environmental pollution and children’s health in the city of Rio de Janeiro (MRJ) - Brazil is a proposal of the Childhood and Environmental Pollution Project (PIPA), which included a study pilot (PS). This work aims at the profile of exposure to an animal pesticide in pregnant women resident in MRJ- Brazil.

Methods: Cohort study with 10 months duration. Population composed of pregnant women and their children born in a maternity school. The study protocol included investigations in the third trimester of gestation at birth and continuing through the 6th month. Biological samples from the mother and baby were collected and clinical evaluations were performed in the children. For the of the social date, demographic, anthropometric, nutritional, health and reference programs was applied a questionnaire. A total of 142 pregnant women participated in the study. Results: The mean age of pregnant women was 27.5 years (SD 8.05), 78% had less than 11 years of schooling and an average per capita was $ 242.83 (min $ 8.53 - max $ 1,616,28). The use of Spray insecticide was reported by 45.2% (61) of the pregnant women, 24 (16.9%) used more than 3x / week. The use of repellents was reported by 75 pregnant women (55.6%), the use of lice medicine by 6 pregnant women (5.1%) and the handling of pet products by 24 (20.7%).

Conclusions: Knowing the exposure profile of the population can direct the actions and identify the associated risks, subsidizing public policies.
Pesticides in indoor dust – A possible important route for residents' exposure

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approximately 30% of Dutch homes are located within 250 meters of agricultural fields. Concerns have been raised about the exposures of residents from these homes to pesticides. A possible source of exposure being contamination of indoor dust. Due to the lack of information on levels in homes close to agricultural fields, pesticides were measured in dust from newly placed clean doormats (ddm) and vacuumed floor dust (vfd).

Homes located within 250 m from bulb fields were invited to participate in the study. Homes not having agricultural fields within 500 m were selected as controls. In total 96 homes (16 being controls) participated in the study. In all homes, dust was collected one week after a spraying event. Besides sampling during spraying season, we also sampled dust outside of the spraying season. For determination of pesticides in the dust, a multi-residue method was used based on quenchers extraction and LC-MS/MS. A total of 46 pesticides were analyzed.

We evaluated concentrations in dust of pesticides that were applied on bulbs during and outside spraying seasons. In addition, we compared concentrations in dust from homes located within 250 m from bulb fields and control locations. We assessed correlations between vfd and ddm as these types of samples provide information regarding routes for pesticide distribution in the environment that contribute to residents' exposure via dust (e.g. air and drag-in).

All of our samples have been collected, pesticide levels have been assessed, data analyzed and conclusions have been drawn. Results are currently embargoed but will be presented during the conference.
Variability and predictors of weekly pesticide exposure in applicators on organic, sustainable, and conventional smallholder farms in Costa Rica

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Background
Estimates of pesticide exposure within agricultural settings in low- and middle-income countries are scarce and hardly any exposure assessment method is readily available.

Aim
We examined the variability in weeklong pesticide exposure among applicators in Costa Rica and identified its predictors.

Methods
We conducted a cross-sectional survey among 221 pesticide applicators from organic, sustainable, and conventional smallholder horticulture farms in 2016. We administered structured questionnaires to assess pesticide application practices at two-time points during the application season (4-6 weeks apart). We adapted an existing algorithm to derive weekly pesticide exposure scores and used linear mixed-effect models to examine within- and between-worker score variability. We then identified socio-demographic and occupational predictors of weekly pesticide exposure scores.

Results
We observed large within- (180-fold) and between-worker (70-fold) variability in weekly pesticide exposures (ICC = 0.40). Training on pesticide use appeared to reduce weekly pesticide exposure scores by a third (β 0.66, 95% CI 0.98-1.01). Increasing work experience with pesticides also resulted in lower exposure scores e.g., an increase of 10 years resulted in a 10% decrease in exposure (β 0.99, 95% CI 0.45-0.98). Pesticide applicators working on conventional and sustainable farms had exposures two-fold (β 2.15, 95% CI 1.09-4.23) and 1.5-fold higher (β 1.63, 95% CI 0.79-3.39) than those working in organic farms, respectively.

Conclusions
We found that weekly pesticide exposure was highly variable within- and between-workers over a relatively short time window during the main pesticide spraying season in smallholder farms in Costa Rica. Younger less experienced pesticide applicators working on conventional farms and who did not receive training on pesticide use appeared to have the highest pesticide exposure.
Cumulative exposure to multiple pesticides in winegrowers and rural residents by hair analysis
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TPS 623: Exposures to pesticides, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims. A large number of pesticides are applied in vineyards; exposure to these chemicals occurs in farmers and the general population living near the treated crops. This work aimed to investigate cumulative exposure to pesticides using hair as a matrix for biomonitoring.

Methods. Twenty agricultural workers and 4 agricultural worker relatives took part in the study. Hair samples were collected before and after the application season. Agricultural workers recorded name and quantity of applied pesticides in a diary; pesticides in hair were measured by LC-MS/MS.

Results. 14 different pesticides were applied, with mean amount ranging from 12 to 7200 g and frequency of use from 6 to 94%. The pesticides with the highest frequencies were dimethomorph, penconazole, cyazofamid, fenamidone and quinoxyfen. In agricultural workers before the application season the majority of used pesticides was detectable, with median concentrations of few pg/mg hair; after the application season the frequency of detection increased from 25 to 100%, with median concentrations up to two orders of magnitude higher. In relatives most pesticides were quantifiable only after the season and with lower concentrations. In agricultural workers a linear correlation was found between the amount of pesticides used and their level in hair (r = 0.68 on log-transformed data, p<0.01).

Conclusion. The majority of assessed pesticides was incorporated into hair of study subjects. The increased frequency of detection and concentration at the end of the season and the correlation between pesticide in hair and amount of applied pesticides, indicate that pesticides in hair may be a useful tool to monitor cumulative pesticide exposure.
Background/Aims: To date, very few studies have evaluated the extent and amount of human exposure to glyphosate, a broad-spectrum herbicide and desiccant whose use is growing and widespread since 1974. To fill this gap, we reviewed existing publications on glyphosate levels in workers occupationally exposed and in the general population.

Methods: We conducted a review of scientific publications on glyphosate levels in humans, and identified 20 studies: 5 reported on occupational exposure to glyphosate, 11 reported the exposure in general populations, and 4 reported on both.

Results: Nine studies reported urinary glyphosate levels in 509 occupationally and para-occupationally exposed subjects; 15 studies reported glyphosate levels in various biofluids, including urine, on 3336 subjects from the general population. Among those with detectable glyphosate levels, average urinary levels in occupationally exposed subjects ranged from 0.26 to 73.5 μg/L, urinary levels in the general population ranged from 0.16 to 7.6 μg/L. The limits of detection in these studies ranged from 0.02 to 100 μg/L in urine, meaning that subjects who would have been detectable in some studies were missed in others, making it difficult to determine how common detectable exposure to glyphosate is. Two studies measuring temporal trends in exposure showed an increasing proportion of individuals with detectable levels of glyphosate in their urine over time.

Conclusions: This current review highlights the scarce amount of data on glyphosate levels among individuals exposed occupationally, para-occupationally, or environmentally to this herbicide. It is therefore challenging to fully understand the extent of overall exposure in the general population, in vulnerable populations particularly children, and populations occupationally exposed to glyphosate. Further work to evaluate exposure across populations and geographic regions is highly recommended, including apportion the exposure sources (e.g., occupational, household use, food residues), as well as more investigations to understand temporal trends.
Determinants of organophosphorus pesticide urinary metabolite levels in pregnant women from the CHAMACOS cohort

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TPS 623: Exposures to pesticides, August 26, 2019, 3:00 PM - 4:30 PM

Background:
Organophosphorus pesticides (OPs) are widely used in agriculture. Human exposure to OPs has been linked to a variety of effects including child neurodevelopment, reduced birth weight, altered serum hormone levels and reduced semen quality.

Methods:
We measured six OP dialkylphosphate (DAP) metabolites [three dimethyl alkylphosphates (DM) and three diethyl alkylphosphates (DE)] in urine samples from 596 pregnant women participating in the CHAMACOS cohort study in an agricultural community. Urine samples were collected two times during pregnancy (13th and 26th week of gestation). We examined associations between prenatal DAP metabolite levels and determinants such as age, season, years living in the US, housing characteristics, fruit and vegetable consumption, occupation and proximity to agricultural fields.

Results:
The final multivariable model indicated that season of urine collection was significantly associated (p<0.01) with specific gravity-adjusted DM, DE and total DAP metabolite levels, with higher concentrations in samples collected in fall and winter than those collected in spring-summer. Levels of DM and total DAP metabolites were significantly higher in women who had resided in the US for 5 years or less (p<0.05).
Levels of DM metabolites also increased with daily fruit and vegetable servings (p<0.01), and levels of DE metabolites were higher in residences with less clean housekeeping (p<0.01) and in mother’s that worked in agriculture (p<0.05).

Conclusions:
These findings suggest that there are multiple determinants of OP exposure in pregnant women.
Background: DDT or pyrethroid insecticides are sprayed inside homes in many malaria-endemic areas as part of Indoor Residual Spraying (IRS) programs, resulting in high levels of exposure to its inhabitants, including pregnant women. These chemicals are endocrine disruptors and may be linked to obesity.

Study Design: The Venda Health Examination of Mothers, Babies and their Environment (VHEMBE) is a birth cohort study based in Limpopo, South Africa, an area where IRS is conducted annually. Mothers were recruited between August 2012 and December 2013 upon presentation for delivery and biological samples were obtained. Congeners of DDT and its breakdown product DDE (o,p′-DDT, p,p′-DDT, o,p′-DDE, p,p′-DDE) were measured in serum and lipid-corrected, while pyrethroid metabolites (cis-DBCA, cis-DCCA, trans-DCCA, 3-PBA) were measured in urine and specific gravity-corrected. At the 5-year follow-up visit (n=634), children’s height, weight, BMI, fat percentage, waist circumference, and blood pressure were measured.

Methods: Multivariable linear regression was performed to investigate associations between each chemical and outcome measure, adjusted for demographic, reproductive, and dietary factors. The presence of effect measure modification by sex and poverty was investigated using interaction terms with each exposure.

Results: Overall, serum p,p′-DDT was associated with reduced fat percentage (change per 10-fold increase $\beta=-0.36; 95\%CI: -0.70,-0.02$). This association was more pronounced among those below the food poverty level ($\beta=-0.45; 95\%CI: -0.90,-0.01$) and among boys ($\beta=-0.58; 95\%CI: -1.06,-0.11$). Among boys, p,p′-DDE ($\beta=-0.63; 95\%CI: -1.20,-0.05$), and o,p′-DDT ($\beta=-0.62; 95\%CI: -1.22,-0.03$) were also associated with reduced fat percentage. Among girls, urinary cis-DCCA ($\beta=0.26; 95\%CI: 0.05,0.48$) and trans-DCCA ($\beta=0.28; 95\%CI: 0.09,0.47$) were positively associated with height z-scores.

Conclusions: We observed inverse associations between maternal DDT/E and fat percentage, particularly among boys, as well as positive relations between maternal pyrethroid metabolite concentrations and height z-scores among girls at age 5. Additional analyses will be conducted to further explore these associations.
Pesticides residue in children hands, home indoor surfaces and soil of conventional and organic farmers in Thailand
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Background: Children are particularly vulnerable to adverse health effects from pesticide exposures. This research aimed to evaluate children exposed to pesticides, home indoor wipe samples and home soil samples for both conventional and organic farmers.

Methods: Twenty-three children hands wipe samples (age 1-6 years) were collected in 2017 and only three children hands wipe samples were collected in 2018. Overall 19 and 35 wipe samples of indoor home surfaces were collected in 2017 and 2018, respectively. Twenty-three and 35 home soil samples were collected in 2017 and 2018. Indoor surface samples were collected with a 10x10cm cotton pad moistened with 70% ethanol from a 100 sq cm grid. Palmar hand wipes of children were collected after parental assent using the same pad as surface wipes, and composite. About 1 kg of soil were collected at a depth of 0-10 cm from several places around the house. All samples were analyzed for 16 organochlorines, 10 organophosphates, 4 pyrethroid, 6 carbamates, fipronyl, paraquat, glyphosate and alachlor pesticides using standard AOAC analytical protocols.

Results: For conventional farmers, children hand wipe samples detected cypermethrin, fipronyl in 2017 and cabofuran in 2018. For organic farmers, hand wipe samples detected mainly fipronyl and cypermethrin pesticides in 2017. Home indoor surface wipe samples of conventional farmers detected cypermethrin, fipronyl, amethrin and carbofuran. For organic farmers, home indoor surface wipe samples detected cypermethrin, fipronyl, permethrin and bifentrin. Home soil samples found paraquat dichloride, chlorpyrifos ethyl, carbaryl, AMPA, ametrin, glyphosate, atrazine, metribuzine, metalaxyl, carbofuran, etc. in conventional farmers. For organic farmers, the home soil detected was paraquat dichloride, AMPA and profenophos.

Conclusion: Children may expose to pesticides from pesticides using in homes for both conventional and organic farmers. Children may also expose to pesticide in home soil from playing on the ground.
Exposure of German Preschool Children to Organophosphate-Insecticides, Pyrethroids, Neonicotinoids and Glyphosate and Approaches for Health Risk Assessment

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Background/Aim
Pesticides are frequently used in agriculture and consumer products. In order to determine human exposure to these pesticides, their metabolites or the parent substance are usually analyzed in urine samples. Only for a few pesticides specific biomarkers are available which means that they can be used for a health based risk assessment on the basis of Acceptable Daily Intakes (ADIs). The aim of this study is to assess the internal exposure of German preschool children to various pesticide groups. For those pesticides with specific biomarkers the daily intake should be calculated and compared to ADIs.

Methods
The urine of 95 german preschool children between 3 and 6 years was analysed for 8 metabolites of organophosphate insecticides, 8 metabolites of pyrethroids, 4 metabolites of neonicotinoids and glyphosate. With an established toxicokinetic model we calculated the intake for compounds for which a specific biomarker is available.

Results
The highest concentrations in our urine samples could be found for the metabolites of organophosphate insecticides followed in order by pyrethroids, neonicotinoids and glyphosate. Quantitatively most relevant are the organophosphate insecticides dimethylthiophosphate, dimethylphosphate, trichloro-2-pyridinol (TCPy) and nitrophenol with median levels between 1.3 and 4.5 µg/L. The urinary concentrations of the specific biomarker TCPy showed that approximately 5% of our study group succeeded the ADI for chlorpyrifos. The estimated daily intake values for the pyrethroid deltamethrin and glyphosate were found to be far below their corresponding ADI.

Conclusion
Preschool children from Germany were found to be exposed to a wide variety of pesticides. Of the compounds we studied, organophosphate insecticides showed the highest relevance. Unfortunately, most of the measured pesticide metabolites are considered as nonspecific biomarkers and therefore cannot be used for health risk assessment. Exposure to the organophosphate insecticide chlorpyrifos may pose a public health concern for some children in preschool age.
Pesticide residues in farm and home soil of conventional and organic farmer in Thailand

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TPS 623: Exposures to pesticides, August 26, 2019, 3:00 PM - 4:30 PM

Background: Thailand exported many pesticides for pest management both on the farm and in the home. Pesticide residues could raise farmer health and environmental concerns. This research aimed to measure pesticide residues in home and farm soil of conventional and organic farmer in Thailand.

Methods: 140 soil samples were collected in farm and home soil during rainy and dry seasons in 2018. About 1 kg of soil sample were collected at depth 0-10 cm from several paces around the home and farm area. The soil samples were analyzed for parent pesticides (16 organochlorines, 10 organophosphates, 4 pyrethroid, 6 carbamates, fipronyl, paraquat, glyphosate and alachlor pesticides) using standard AOAC analytical protocols.

Results: For conventional farmers, the pesticide residues in farm soil found paraquat dichloride, AMPA, fipronyl, permethrin, metalaxyl, glyphosate. For the pesticide residue in home soil, this research found the type of pesticide residue more than that of farm soil because the conventional farmers collected the pesticide in home and mixed the pesticide near home area. However, the average concentration of pesticide residues in farm soil higher than that of home soil. The pesticide residue in home soil which was not detected in farm soil including cypermethrin, ametrin, metribuzine, metalaxyl, carbofuran, atrazine, metholcab, carbaryl. For the organic farmers, the pesticide residues found were paraquat dichloride and AMPA in both farm and home soil. Furthermore, the number of pesticide residue was higher in rainy seasons compared to dry season for conventional farmer.

Conclusion: This research indicated that the pesticide residues in home and farm soil of conventional farmers were more than those in home and farm soil of organic farmers. In case of pesticide residues in home soil, the families of conventional farmer may expose to pesticide and affect to their health.
Studies demonstrate increased pesticide contamination of home environments proximate to crop production. Fugitive emissions occur during application, and later through aeolian transport of pesticides volatilized or adsorbed on dust particles. Occupational exposure has been associated with a myriad of diseases (e.g., cancer, neurological disorders). Less is known regarding the extent to which non-occupational exposure results in adverse health impact. Our aims are to: 1) demonstrate evidence-based checklist of exposure risk factors, 2) assess which have been utilized in published studies, and 3) demonstrate the extent they are determinants of risk.

We reviewed literature concerning environmental airborne emissions from pesticides applied to crop fields, and derived an assessment grid of determinant domains ranging from land use to meteorological data, subsequently distilled into 21 relevant risk factors. We identified 89 related environmental health articles. We applied meta-analyses and scored each study in terms of "completeness" of 1) epidemiological methods using a standard method (STROBE), and 2) inclusion of the evidence-based exposure risk factors. For studies with the highest scores we statistically evaluated the relative impact of omitting these risk factors as determinants of exposure.

The meta-analyses are 67% completed. Results of STROBE indicated little difference in completeness of methods (med 83.5; IQR 59–95%) across 48 epidemiological studies. However, assessment of inclusion of the 21 risk factors indicated much lower completeness (35; 26-48%) over 45 unique exposure assessments, and only 29% among the epidemiological studies.

Our study indicates that exposure assessments in studies concerning pesticide airborne emissions from crop field might not include important risk factors. Based on the scientific evidence confirming emissions occur globally, pesticide contamination of proximate indoor/outdoor environments, and that the transport mechanisms involved are well understood, it is important to ascertain determinants of exposure that can and should be incorporated in such studies.
TPS 624: Exposures to pops, voc and other chemicals
Literature Review of Common Environmental Exposures (mercury, mold, pesticides and secondhand smoke) in the Eastern Mediterranean Region

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TPS 624: Exposures to pops, voc and other chemicals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Environmental exposures to agents such as mercury, mold, pesticides and secondhand smoke are common in many countries of the Eastern Mediterranean Region (EMR). This literature review aimed to present the types of studies conducted on these environmental agents and the major findings and recommendations as they relate to EMR.

Methods: A review of the literature up to March 2019 was conducted using the four environmental agents and the region as key words. Abstracts were screened using defined inclusion and exclusion criteria, and eligible publications were reviewed.

Results: Out of the 8 found mercury publications, 3 papers were eligible for examination and highlighted the history of mercury in the region. Out of the 12 found mold publications, 3 papers were examined and highlighted the diversity of the microorganisms in the region and the Mucormycosis as a seasonal disease. Out of the 15 found pesticides publications, 9 papers were examined and highlighted the distribution and burden of pesticides in the region. Finally, out of the 12 found secondhand smoke publications, 11 papers were examined and highlighted the exposure level, control policies and behaviors and attitudes related to smoking in the region.

Conclusions: Publications studying environmental exposures of such common agents in EMR is scarce. This literature review reveals some of the research gaps and needs for understanding the environmental exposure landscape in EMR and proxy measuring the burden of such environmental agents in this region.
Co-occurrence of Urinary Markers of Aflatoxin and Fumonisin exposure from a Crossover study in Kenya: A case for public health efforts targeting both toxins

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Background
Aflatoxins and fumonisins are mycotoxins that threaten public health and food safety worldwide. Aflatoxin B1 (AFB1) is the most frequently occurring and the most highly carcinogenic of the aflatoxin metabolites. Fumonisin B1 (FB1) has also been shown to cause hepatocellular cancer in animal models and has been associated with esophageal cancer in humans. FB1 is a food contaminant, and may act to enhance the toxicity of AFB1. There is little knowledge of the frequency of occurrence of FB1, either alone or with AFB1 in Kenyan vulnerable populations.

Methods
Levels of FB1 were measured in a subset of urine samples collected in a cross-over clinical trial conducted in 2014 in two villages in Eastern Kenya that had experienced aflatoxicosis outbreaks. Urinary FB1 levels were measured by liquid chromatography-mass spectrometry and compared to levels of urinary AFM1 (a metabolite of AFB1) reported from the same samples. The mean levels of AFM1 and FB1 were compared using t-test. The correlation between urinary AFM1 and FB1 pg/mg creatinine was estimated using Wilcoxon matched-pairs signed-rank test.

Results
Of 47 participants aged 21-75 years who consented to have their samples tested, 31 (66\%) and 32 (68\%) were recently exposed to aflatoxin and fumonisins respectively, and of those 21 (45\%) were exposed to both mycotoxins. There was no significant association between the presence of AFM1 and FB1 (Chi-square=0.0049, p-value >0.05).

Conclusion
In addition to high exposure to both mycotoxins in this population, there was extensive co-exposure to AFB1 and FB1, posing a significant threat to public health. The risk factors of exposure to both mycotoxins could be different. Determining the risk factors associated with co-exposure will enable public health and agricultural officials to develop prevention strategies to mitigate contamination and exposure to both toxins.
Exposure to selected phenols during pregnancy and the first year of life in a new type of mother-child cohort relying on repeated urine biospecimens

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TPS 624: Exposures to pops, voc and other chemicals, August 26, 2019, 3:00 PM - 4:30 PM

Background: Parabens, bisphenol A (BPA) and triclosan have been forbidden or restricted in specific types of consumer goods in France. No French biomonitoring data is available since implementation of these regulations, and there is no exposure data on French young children.

Aim: We describe levels, variability and predictors of exposure to 12 phenols among 479 pregnant women and 100 of their children (SEPAGES cohort, recruitment 2014-2017).

Methods: We studied phenol urinary concentrations in within-subject, within-period pools of repeated urine samples collected during the first and third trimesters of pregnancy (up to 42 samples per woman), at 6 weeks and 1 year (up to 14 samples per child). Time trends and associations with demographic, occupational and behavioral factors were studied using interval censored models to accommodate for undetected values.

Results: Detection rate was above 90% for BPA, ethylparaben, methylparaben, oxybenzone and triclosan and below 5% for bisphenol AF, B, F and triclocarban. Median levels of BPA, bisphenol S (BPS), methylparaben, propylparaben and ethylparaben were higher at 1 year than pregnancy. Intra individual spearman correlations were overall low except for oxybenzone and triclosan during pregnancy (rho > 0.65). For pregnant women all phenols but oxybenzone and BPS showed a linear decrease between 2014 and 2017 (p-values < 0.02). Cashiers had higher levels of BPS than unemployed women (p-value = 0.12) and so did women reporting eating canned food compared to those who did not (p-value = 0.13).

Conclusions: Despite recent regulations, BPA, triclosan and paraben detection rates were high in women and young children. BPS levels were higher among profiles known in the past to have higher levels of BPA, indicating a possible substitution between these two compounds. High bisphenol and paraben median levels at 1 year require further investigation as early childhood is a sensitive period for exposure to environmental contaminants.
Air pollution is the greatest environmental risk factor for the global burden of disease. Volatile organic compounds (VOCs) are constituents of air pollution that directly contribute to ozone formation and adverse health outcomes. It is unknown whether contributions of steadily declining ambient air VOC concentrations have resulted in decreases in individual exposures to VOCs. We aimed to examine secular trends in national ambient air VOC measures and individual-level biomarkers of exposure to VOCs in the United States. We hypothesized that personal-level VOC concentrations would reflect decreases in ambient air VOC measures.

Methods: Secular trends in eleven ambient air VOCs (2005-13) and individual-level biomarkers of exposure for fourteen VOCs (2005-14) were assessed using National Monitoring Program (NMP) for air toxics and National Health and Nutrition Examination Survey (NHANES) data, respectively. To isolate environmental exposures, individuals reporting exposure to tobacco smoke were excluded. Quantile regression models were used to assess secular changes in distributions of VOC exposures, and survey-weighted regression models were built to identify factors associated with trends in VOC exposures. Results: All annual mean ambient air VOC concentrations decreased from 2005 to 2013 (Range: 12.5%-77.2%). However, eleven of the fourteen corresponding VOC metabolites increased over approximately the same timeframe (Range: 0.3%-53.6%). The nature of VOC exposures has proportionally changed across NHANES waves, and middle quantiles of exposure have most significantly increased. VOC exposures were significantly associated with age, sex, race, education, and physical inactivity, but were not associated with secular VOC trends.

Conclusions: Decreasing national ambient air VOCs combined with increasing biomarkers of exposure to VOCs in participants of NHANES 2005-14 suggests ambient VOCs are not the primary source of VOC exposure in the United States population. Our study suggests decreasing ambient VOCs alone is not sufficient to protect against adverse health effects associated with exposure to VOCs.
Polybrominated diphenyl ethers (PBDEs) are organobromine compounds that are used as a flame retardant. PBDEs are not easy to cumulate in environment and adsorbed to soil, sediment because they have affinity with lipids. PBDEs are founded in human samples such as blood and breast milk and may cause chronic diseases like cognitive disorder and liver dysfunction when exposed to a body. This study is performed to measure the concentrations of PBDEs in environment.

Samples of soil, leaf, water, and sediment were collected at 12 sites near Asan Lake in Korea. Soil and sediment were lyophilized before analysis and extracted with 200mL dichloromethane: hexane mixed solution by the Soxhlet method and SPE. The Surface water samples filtered using a GF/C glass microfiber filter. Leaf samples extracted by the Soxhlet extraction after washing and drying and injected into a Gel Permeation Chromatography (GPC) column, 200mL of a mixture of dichloromethane: hexane was used to discard first 100mL and 150mL of the second fraction was used as a sample. Samples were analyzed by GC-MS.

The range of ∑PBDEs in samples was as follows; soil in summer 0-17.82 ng/g, soil in autumn 0.19-18.66 ng/g, soil in winter 0.07-1.59 ng/g, soil in spring 0-0.62 ng/g, sediment in summer 0.58-53.51 ng/g, sediment in autumn 1.67-471.07, sediment in winter 0.15-6 ng/g, sediment in spring 0.08-0.94 ng/g, water in summer 4.30-48.25 ng/L, water in autumn 0-2.49ng/L, water in winter 0.01-0.25 ng/L, water in spring 0-0.94 ng/L, leaf in summer 0.39-21.57 ng/g, leaf in autumn 0.11-4.43 ng/g, leaf in winter 0-0.01ng/g, leaf in spring 0.05-0.11 ng/g respectively.

Concentration of summer and autumn is much higher than that of spring and winter so the changes observed during the season show similar aspects. The concentration of PBDEs in environment is continuously detected therefore it is necessary to monitoring of environment Steadily.
Emerging chemicals framework – curation of a database of chemicals of emerging concern

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As part of the HBM4EU project, a generic framework is proposed for the detection and annotation of chemicals of emerging concern (CECs) in human samples. This framework incorporates both suspect screening in untargeted high-resolution mass spectrometry (HRMS) data and effect-directed analysis (EDA).

In order to support suspect screening and EDA, a comprehensive database of CECs is required.

Advances in untargeted HRMS techniques and computational tools facilitate the measurement and annotation of thousands of small molecules in environmental and biological samples. These techniques are also used in metabolomics. A putative identification can be acquired by comparing the masses of the measured features with the masses of known compounds. Therefore, the first element of the framework was the curation of a list of CECs to be used for suspect screening in untargeted HRMS data. This list is a compilation of 51 databases from various international sources reporting on CECs, resulting in more than 70,000 unique compounds both in terms of structure and stereochemistry. The CECs list includes chemical information generated from SMILES strings including molecular formula, charge, masses. Furthermore, information on toxicity and exposure will be included by making use of QSARs and web-based search of existing data. Finally, CEC metabolites will be simulated, which is of major importance for suspect screening of human samples. The CECs database aggregates for the first time different sources of information at international level on this topic as well as information on exposure, toxicity and possible metabolites.

Metabolomics is progressively more used in epidemiological studies. However, most of the detected features remain unidentified. Therefore, the interpretation is difficult, especially for exogenous compounds. The proposed framework, which incorporates this comprehensive database of CECs, can facilitate the interpretation by identifying a part of the features found.
Establishment of N-nitrosamines analytical methods in agricultural foods using LC-(APCI)-MS/MS

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TPS 624: Exposures to pops, voc and other chemicals, August 26, 2019, 3:00 PM - 4:30 PM

N-nitrosamines are reaction with secondary amines and acidic nitrite. N-nitrosamines are present in various places such as water, soil, air and food. Especially in food, fruits and vegetables are the main reason. It is reported that the cause of N-nitrosamines in food are vegetables is more than 90% of the total exposure. In this study, before identifying analytical methods for six N-nitrosamines were established for agricultural food matrices. Food matrices were classified according fat content, which pomegranate juice and rice soup as a fatless matrix and margarine and soybean oil as a fat-rich matrix.

Fatless matrix samples added 8mL of dichloromethane and followed by liquid-liquid extraction (LLE). For fat-rich matrix samples added 5mL of dichloromethane with 2 times after 8mL of water by liquid-liquid extraction (LLE). The extract samples were analyzed by LC-(APCI)-MS/MS. The calibration curve was prepared in the range of 0.1~50ng/mL. For the method validation, the accuracy and precision of 7 repeated experiments were evaluated by spiking each sample.

The accuracies of the established method in fatless matrix were 89.1%~106.4% and precisions were 2.1%~4.9%. The limit of detection (LOD) were between 0.07(NPIP) to 2.21(NDEA) ng/mL and the linearity r² value was 0.9997. A fat-rich matrix accuracies were 95.8%~108.5 and precisions were 0.8%~6.7%. The limit of detection (LOD) were 0.003(NMOR) to 0.296(NDEA) ng/mL and limit of quantification (LOQ) were 0.009(NMOR) to 0.898(NDEA) ng/mL.

This analytical method established in this study is simpler, environmentally and more economical.
Gasoline Vapor Emissions During Vehicle Refueling Events, New York City
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TPS 624: Exposures to pops, voc and other chemicals, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Gasoline formulations in the United States (US) contain large portions of harmful chemicals, including benzene, toluene, ethylbenzene, and xylene, which can be released during vehicle refueling at gas stations. Onboard Refueling Vapor Recovery (ORVR) and Stage II Vapor Recovery systems can reduce these emissions substantially, however it is possible that as vehicles, their ORVR systems, and Stage II Vapor Recovery systems age, emissions may increase due to equipment breakdown. The aim of this study was to qualitatively capture potential fuel vapor emissions from refueling events in New York City (NYC).

Methods: An infrared camera optimized for optical gas imaging of volatile organic chemicals (FLIR model GF320) was used to record 16 vehicles during typical gasoline refueling sessions at six gas stations in Northern Manhattan, NYC, during a single winter day. Researchers visually inspected gasoline pumps for hose damage, refueling shut-off valve functioning, and presence of Stage II Vapor Recovery systems. Vehicle make, model, and year were estimated using photographs.

Results: For the 16 vehicles, the average refueling session lasted 86 seconds. Fuel vapor emissions were observed for 13 out of 16 vehicles and at every gas station; one station had a Stage II system. The single vehicle older than the mandate of ORVR introduction in the US (1998) clearly had much larger refueling vapor emissions than the newer vehicles. However, the majority of newer vehicles also had substantial fuel vapor emissions, particularly at the end of refueling.

Conclusions: 13 out of 16 observed refueling events resulted in fuel vapor emissions, with severity varying substantially by vehicle make/model and age. These findings support the need for renewed investigation into the burden and potential health effects of fuel emissions released during vehicle refueling in the current network of ORVR and Stage II Vapor Recovery systems.
Development and Optimization of Biochar from Pyrolysis of Combustible Healthcare Waste

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TPS 624: Exposures to pops, voc and other chemicals, August 26, 2019, 3:00 PM - 4:30 PM

Background: Inappropriate hazardous healthcare waste management practices have direct and indirect effects on the environment and human health causing air, water and land pollution. Treatment of healthcare waste by incineration and sanitary land fill release pollutants in the environment. This study was aimed at developing and optimizing the production of biochar from combustible healthcare waste and compare pyrolysis efficiency and calorific value of locally made pyrolysis equipment with commercial one.

Methods: Healthcare wastes were collected from different wards of the Jimma University Hospital for seven consecutive days in 2017. The wastes were segregated to separate the organic biomass, mixed, weighed, sterilized, dried, shredded, and samples taken for pyrolysis. Pyrolysis experiments were carried out on a fixed bed of reactor under atmospheric pressure at different temperatures of 300° and 400°C using both locally made and commercial pyrolysis equipment.

Results: About 65% of the general healthcare waste was found to be combustible. Higher temperature gave less char in all types of pyrolysis reaction. Volatile matters were observed to be nearly the same figures in all observations. The yield of the bio-char at 300°C for commercial pyrolysis and Local pyrolysis was 40.56 and 33.13 w.t% and was estimated to produce bio-char of heating value of 24.85 and 25.83 MJ/Kg respectively. There was less bio-char yield and calorific value in the bio-char produced by commercial pyrolysis at 400°C. Generally the calorific value of bio-char produced by both local and commercial pyrolysis fulfills FAO standards.

Conclusions : Combustible healthcare wastes have the potential to be a very effective feedstock for bio-char production. For energy efficiency, both local and commercial pyrolysis at 300° were recommended. Pyrolysis of healthcare waste in different proportion by mixing with municipal solid waste may need another investigation. Life cycle analysis shows that bio-char reduces greenhouse gas emission.
Background/Aim
Phthalates and Bisphenol A (BPA) compounds are widely used as plasticizers and they are endocrine disruptors (EI) rapidly metabolized. These are used for production of packaging for food and drugs. Although many studies have been carried out by dietary exposure, conversely only few studies of risk evaluation by exposure during drug therapies are available. Aim of our study was to carry out a first risk evaluation on population of Catania exposed to DEHP and BPA by the drugs consume.

Methods
A transversal-observational study was carried out according to the standards of Good Clinical Practice. Urine of 54 volunteers was collected at LIAA. The volunteers joined the study by signing the informed consent and by filling out a semi structured questionnaire (anthropometric information, demographic, lifetime residential history, history of active, passive and cessation smoking, occupational exposure, presence of pathology and relative drug therapy). DEHP, MEHP, free BPA and BPA-glucuronide were detected by UPLC-ESI-TQD Xevo (Waters) using a ACQUITY® UPLC HSS C18 SB (1.8µm - 2,1 x 50 mm) column. Statistical analysis was carried out by SPSS software.

Results
The correlation of BPA and DEHP concentrations in the subgroups, "therapy" (T) or "not in therapy"(NT), was not significant. The correlations of BPA vs BPA glucuronide in all subjects and in the subgroups T and NT were significant, at the same the correlations of DEHP vs MEHP and of total BPA vs total DEHP. No distinction was made between the various diseases nor the type of drug taken.

Conclusions
Our results underline the possibility to use metabolites for the exposition evaluation with great environmental, reagents and costs saving. We need a larger sample for a powerful statistical analysis.
TPS 642: Environmental justice and impacts
National and Sub-national Exposure to Ambient Particulate Matter and its Attributable Burden of Disease in Iran from 1990 to 2016
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Background: This work was conducted as a part of the National and Sub-national Burden of Diseases, Injuries, and Risk Factors (NASBOD) Study in Iran. We aimed (1) to estimate national and sub-national long-term exposure of Iranian population to ambient particulate matter (PM) \(< 2.5 \mu m (PM_{2.5})\) from 1990 to 2016, and (2) to estimate the national and provincial burden of disease (BoD) attributable to PM_{2.5} in Iran.

Methods: We used all available ground measurements of PM \(< 10 \mu m (PM_{10})\) (used to estimate PM_{2.5} for some station-years) and PM_{2.5} from 91 monitoring stations. We estimated the annual mean exposure to PM_{2.5} for all Iranian population from 1990 to 2016 through a multi-stage modeling process. The BoD, in terms of mortality and years of life lost (YLL) attributable to PM_{2.5} exposure, was quantified according to the methods developed by the Global Burden of Disease Study.

Results: The national annual average PM_{10} concentration was about 121 \(\mu g/m^3\) in 1990 and 62 \(\mu g/m^3\) in 2016. Both of the PM_{10} and PM_{2.5} concentrations exceeded the World Health Organization (WHO) guideline value in all studied years. We estimated that only in 2016, about 41,000 deaths and approximately 3,000,000 YLL could be attributable to the long-term exposure to PM_{2.5} in Iran. Among the studied causes of death and YLL, ischemic heart disease was the leading, followed by stroke, lower respiratory infection, chronic obstructive pulmonary disease, and lung cancer. In 2016, about 43% of all PM related mortality in Iran was, respectively, in the following provinces: Tehran (12.6%), Isfahan (9.3%), Khorasan Razavi (8.0%), Fars (6.5%), and Khozestan (6.4%).

Conclusions: In summary, we found that the majority of Iranians were exposed to the levels of ambient particulate matter exceeding the WHO guidelines, and that the ambient particulate matter imposed substantial burden of disease in Iran in this period.
Background: Paraquat is a lethal herbicide. This study explored whether the effect of the Paraquat regulation on suicide deaths varied by the level of educational attainment.

Methods: Death certificate data between 2008 and 2015 and population denominators from census data for the years 2005, 2010, and 2015 were obtained from Statistics Korea. Age-standardized mortality rates in suicide by herbicide poisoning (ICD-10: X60-X84 & T603) for men and women according to education (no formal education or primary, secondary, and tertiary), absolute (rate difference) and relative (rate ratio) educational inequalities before (2008-2010) and after (2013-2015) the implementation of the Paraquat ban were examined.

Results: During post-regulatory periods (2013-2015), age-standardized mortality rates in suicide by herbicide poisoning decreased for all education groups in both men and women compared with pre-regulatory periods (2008-2010). However, the decrease rate of suicide by herbicide poisoning was the lowest in the people with no formal education or primary education. The absolute inequality between the highest and the lowest education groups decreased after the implementation of the Paraquat ban in both men and women, while relative inequalities remained stable in both men and women.

Conclusions: Not all intervention policies are intended to reduce health inequality. Some interventions improve the average health level of the population, but also exacerbate inequality. The Paraquat regulation reduced the magnitude of absolute inequalities in suicide by herbicide poisoning. More research needs to be done in the future to examine changes of socioeconomic inequalities in suicide death by other methods after the Paraquat regulation, or to explore whether the use of suicide methods to replace Paraquat vary by socioeconomic status.
Population attributable fractions of cancers due to environmental risk factors in France in 2015

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim

Cancer is a major cause of illness in France, with 380,000 new cases estimated in 2015. An important part of them is potentially avoidable through modification of various lifestyle and environmental risk factors. We aim to present the estimation of the cancer burden in adults attributable to exposure to outdoor air pollution and environmental chemicals in France in 2015.

Methods

The proportion of cancers that would not have occurred if exposure to avoidable risk factors had been at a safe level can be evaluated by estimating “population attributable fractions” (PAF). Three environmental risk factors were studied: fine particulate air pollution (PM2.5), arsenic in drinking water and indoor benzene. We obtained the following data (and source): annual PM2.5 mean concentration (the Gazel-Air model - a nationwide air quality model), mean arsenic concentration in drinking water (the Sise-Eaux database), and the mean concentration of indoor benzene (the French Observatory of the Indoor Air Quality). Cancer incidence data were obtained from the French network of cancer registries (FRANCIM).

Results

In 2015, about 1,500 lung cancer cases (PAF=3.6%) could be attributed to exposure to high air PM2.5 level in France. Depending on the risk model used, the PAF and total number of lung cancer cases associated with PM2.5 exposure ranged from 1.0% (416) to 26.5% (10,733 cases).

Estimation PAF for chemical agents was challenging due to lack of representative exposure data and robust risk estimates in the general population. Our estimates on the contribution of arsenic in drinking water and indoor benzene on cancer in France seems to represent only a negligible PAF.

Conclusions

Policy action to reduce PM2.5 concentration in France could potentially reduce a portion of lung cancer incidence. Improved surveillance and measurement of environmental chemicals and epidemiological studies to quantify populational risks are needed.
Air pollution health risk perception among residents in Biancavilla: a national priority contaminated site

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim
Environmental risk perception is an important source of stress in exposed population. Limited evidence suggests an association between perceived and actual air quality and concern for health. The present survey estimated the air pollution health risk perception and the quality of life among residents in Biancavilla, a national priority contaminated site and compared it to urban and suburban areas in Sicily (south Italy).

Methods
A survey was conducted in the period December 2018 – February 2019. Participants answered a series of questions about demographic data, air pollution risk perception (passive smoking, air pollution from cars, industries, eruption, incinerator-landfill, indoor air pollution, asbestos/fluoro-edenite) and a list of 4 sources of information on health risks (TV and radio, newspaper/magazines, doctors, internet). EuroQoL questionnaire was used to evaluate quality of life. A Risk Perception Index was used to express the propensity of respondents to rate environmental health issue as high health risks. Responses for each hazard were allocated a numerical result, with 1=no risk, 2=low risk, 3=moderate risk, and 4 = high risk and a mean response value was calculated. Bivariate analysis was performed.

Results
The survey involved 121 (52.1% females) subjects, median age 38 years (IQR 25.5-63.3). Subjects recruited in the three areas investigated had similar socio-demographic characteristics; they only differed in marital status (p=0.04). Urban residents showed significantly higher risk perception for industries air pollution than suburban and Biancavilla areas (p=0.027). Residents in Biancavilla expressed the maximum risk perception for fluoroedenite. Internet was the higher confidence source of information on health risks (mean 3.53, 95%CI 3.43-3.64). Self-reported quality of life was no different in each of the three areas.

Conclusions
The results of the present study offer the opportunity to investigate health risk perception and its determinants. Understanding people’s risk perception leads to better risk communication and policy implementation.
Introduction: Ambient air pollution in the form of fine particulate matter < 2.5µm (PM2.5) causes premature mortality. Anthropogenic emissions of PM2.5 include burning fossil fuels for energy, transport and home heating. We quantified the annual number of deaths attributable to anthropogenic air pollution in Australia.

Method: We used the all-cause death rates from the Australian mortality and population databases, linked with annual average PM2.5 between 2010 and 2016 from a satellite-based land use regression model at small area level. The anthropogenic component was estimated as the difference from the non-anthropogenic PM2.5. We assumed the lowest level in each sub-region within Australia represents the level expected to occur naturally. This accounts for different wildfire regimes and dust in the diverse landscapes across the country. We used the relative risk (RR) for those aged over 30yrs recommended by the World Health Organisation (as a linear response to PM2.5 with no lower risk threshold) to calculate the number of deaths attributable to anthropogenic air pollution each year.

Results: The long-term population weighted average of annual concentrations of PM2.5 across all years was 5.0 µg/m3 (min 4.5 - max 5.4). The population weighted average of the anthropogenic component was 3.0 µg/m3 (min 2.8 - max 3.2). There were on average approx. 2,900 deaths that were attributable to PM2.5 annually per year of the study (min 2,770 - max 2,950). This is equivalent to 2% of all deaths in Australia.

Conclusions: Anthropogenic emissions of PM2.5 contribute to a substantial burden of avoidable mortality in Australia. These results imply that emissions reductions for climate change mitigation will have co-benefits for the present burden of disease. Health risk assessments such as this can inform decision making for urban developments, the energy system, and in future studies that assess both the costs and benefits of human-made air pollution.
Distributions of mass concentrations and metal compositions of fine and ultrafine particles in lower socio-economic areas in a metropolitan city of Korea

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background
Socio-economic status (SES) would be a major risk factor of pollutant exposure. This study was conducted to reveal different concentrations and patterns of fine and ultrafine particle exposure in lower SES areas.

Methods
Study was performed from August 2015 to July 2016 in three lower SES areas, A (heavily industrialized area), B (port area), C (beach area), in a metropolitan city (Busan) Korea. Mini Volume Air Sampler with 47 mm QMA Filter of flow rate of 5.0 L/min were used to sample PM10 and PM2.5 for 24 hours in three roof tops in centers of those areas during a weekday and weekend of each month. ICP/OES and ICP/MS were used to check 8 elements and 14 metals.

Results
Average mass concentrations of PM10 and PM2.5 of area A were highest of 53.1 µg/m³ and 36.4 µg/m³, which exceeded Korean annual limit (PM10 50 µg/m³, PM2.5 25 µg/m³). Those of area C were lowest (PM10 (37.9 µg/m³), PM2.5 (22.1 µg/m³)). Mass concentrations of PM10 and PM2.5 of spring exceeded 1.16 times and 1.26 times of Korean limits. Artificial origin elements (Cd, Cr, Cu, Mn, Ni, Pb, Zn) of PM10 and PM2.5 were highest in area A. Annual average contribution rate of soil was 13.9%. Regional and seasonal contribution rate of soil of PM2.5 were different with PM10. Elements with over 100 of enrichment factor were S, Cd, Pb, Mo, As, Zn, Cu, Cr, V, Ni in order (higher PM2.5 than PM10). Elements such as As, Cd, Na, S, V were higher in area B.

Conclusions
Fine and ultrafine particle concentrations in three different area showed different patterns according to exposure source and season. This might be contributed by atmospheric difference such as wind speed and direction, which causes different effects of artificial origin from neighbor or remote area.
Introduction:
US outdoor concentrations of most Environmental Protection Agency (EPA) criteria air pollutants have declined on average since the 1990 Clean Air Act Amendments. We investigate how average exposures to each EPA criteria air pollutant changed over time for specific race-ethnicity and income groups, and across US states.

Methods:
Our approach combines outdoor annual average concentrations estimates for EPA criteria air pollutants (particulate matter [PM2.5, PM10], ozone [O3], nitrogen dioxide [NO2], carbon monoxide [CO], and sulfur dioxide [SO2]) from the Center for Air, Climate, and Energy Solutions (CACES) national empirical statistical models with demographic data from the US Census at the Census block group scale. We compare national and state-level population-weighted mean air pollutant concentrations based on home location for race-ethnicity and income groups in 1990, 2000, and 2010.

Results:
Average exposures in year 2010 were generally greater for racial-ethnic minorities than for non-Hispanic whites; estimated differences were 39% (2.83 ppb) for NO2; 7.9% (0.024 ppm), CO; 8.6% (0.78 μg/m3), PM2.5; 0.7% (0.31 ppb), O3; and, 7.0% (1.23 μg/m3), PM10. For SO2, the reverse holds: average concentrations were 0.6% (0.01 ppb) higher for non-Hispanic whites than for racial-ethnic minorities. Average exposure disparities were larger among racial-ethnic groups than among income categories. From 1990 to 2010, overall exposures and disparities in exposures by race-ethnicity declined for all pollutants except for ozone. In 2010, states in the highest decile racial-ethnic exposure disparities for three or more criteria air pollutants include California, New York, Wisconsin, and Illinois.

Conclusions:
Racial-ethnic disparities in air pollution exposures varied substantially among states, and generally declined over time from 1990 to 2010. Racial-ethnic minorities, on average, faced higher concentrations of outdoor criteria air pollution (particularly of traffic-related air pollution) at home than non-Hispanic whites, after controlling for income, in 2010.
Assessment of health impacts of fine particulate matter at small time scales
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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background
Fine particulate matter (PM2.5) is a hazardous air pollutant with complex chemical composition and various adverse effects. However, most of the previous epidemiology studies observed the association between PM2.5 and human health by just one time scale, and empirical data below the scale of one day are limited. Therefore, we conducted a study to evaluate the acute health effects associated with the levels of particulate matters measured at different small time scales.

Methods
We recruited participants in the southern Taiwan regions and conducted personal sampling of PM2.5 as well as monitoring of physiological parameters. The associations between the level of PM2.5 and physiological parameters at time scales less than one day were assessed by using mixed effect model for repeated measure at time scales that are less than one day.

Results
The results showed significant associations of short-term exposures to PM2.5 with heart rate variability and FEV1%, but not blood pressure or oxygen situation. We observed negative associations between the level of PM2.5 and heart rate variability, and the effect increased as the time scale increased. The result is consistent with existing literature, and we observed associations even at very small time scales.

Conclusion
We observed associations of exposures to PM2.5 with heart rate variability and FEV1% at small time scales that are less than one day.
Examining the relationship between air pollution and health inequalities in children in England using multilevel modelling

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background: Exposure to air pollution could be responsible for up to 36,000 premature deaths in the UK annually, with the most deprived members of society facing the highest exposures due to socio-economic patterning of residential and employment opportunities. Children face an increased susceptibility to air pollution exposure and exposure can result in a range of health issues, such as stunted organ development and asthma. At least 1.1 million children in the UK currently suffer from asthma and previous research found links between poor socio-economic status, increased air pollution exposure and asthma exacerbations in children.

Methods: The Millennium Cohort Study (MCS), a birth cohort study, is linked to modelled air pollution data from the EMEP4UK model and the Index of Multiple Deprivation (IMD) at the small area level (Lower Layer Super Output Area, LSOA). The relationship between asthma (self-reported if a child suffers asthma or not), familial socio-economic status, area level deprivation and air pollution are explored using a multi-level model from birth to 11 years.

Results: Previous cross-sectional analyses of MCS data found that renting from a local authority was significantly associated with the child’s chance of suffering from asthma. Furthermore, initial multilevel modelling found that 1.9% of the variance in whether or not a child suffers from asthma can be attributed to differences between LSOAs. Modelling over time will provide the opportunity to explore the causality of the health outcomes, as opposed to only exploring the association. Following more in-depth analysis, further findings shall be discussed at the conference.

Conclusion: Understanding the magnitude of individual-versus area-level deprivation on childhood asthma outcomes is important as it allows policy makers to target the optimum mix of individual and community-based health strategies that could address these risk factors.
Long-term Exposure to Outdoor Air Pollutants in Thailand: A Health Impact Assessment

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Air pollution is an important preventable cause of illness and premature mortality around the world. The aim of this research was to assess outdoor air pollutant trends in Thailand across three decades and to assess associated health impacts from long-term exposures.

Methods: We collected data and assessed trends on ambient concentrations of CO, NO2, O3, PM10, PM2.5, and SO2 from 68 automatic monitoring stations across Thailand over 1996 to 2017. We used historic exposure to PM2.5 to estimate the mortality in each province from lung cancer, chronic obstructive pulmonary disease (COPD), ischaemic heart disease, and cerebrovascular disease. We adopted risk estimates from the Global Burden of Disease (GBD) to conduct a health impact assessment (HIA) for the projected population of adults aged 30+ years in Thailand in 2020.

Results: Reductions in annual mean concentrations in the monitoring data from 1996 to 2017 were observed for CO (0.77 to 0.63 ppm; -19%), SO2 (5.0 to 2.3 ppb; -54%), NO2 (15.0 to 12.0 ppb; -20%), PM10 (72.5 to 39.5 μg/m³; -46%), and PM2.5 (41.5 to 18.5 μg/m³; -56%). Increases were apparent for O3 (32.4 to 47.3 ppb; +46%). For the year 2020, we estimate 1,853 lung cancer, 1,879 COPD, 2,640 ischaemic heart disease, and 3,363 cerebrovascular disease deaths attributed to long-term exposure to PM2.5, with overall population attributable fractions in provinces ranging from 10-17%.

Conclusions: Historic levels of PM2.5 are estimated to lead to thousands of attributable deaths annually in Thailand. Outputs from this HIA will be compared using alternative risk estimates, namely the recent Global Exposure Mortality Model (GEMM). In addition, we will extend the HIA to include neurodegenerative and metabolic disorders, as well as low birth weight and congenital anomalies, for which we will identify the most relevant risk estimates for application in Thailand.
Air Pollution and Poverty: The Perfect Storm for Adverse Childhood Respiratory Health in Developing Countries

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

The evidence for the social determinants of ill-health is convincing. Social determinants drive nutrition, education and residence. Residence is a key determinant of exposure to pollutants. Little work has been done on the relationship between social determinants and air pollution, and the modification of health effects arising from dual exposure.

The evidence for adverse health outcomes and air pollution is well established, particularly so for cardiorespiratory disorders. Not only does pollution have a pathophysiological effect on the lungs, but it is very likely that exposure results in impaired organ development, commencing in-utero, and continuing to early childhood. The work on infant lung function within birth cohorts provides emerging evidence for these outcomes.

Developing countries in south Asia and Africa are the most polluted according to recent WHO data. Within these countries, it is the most impoverished, living in informal housing communities that carry the largest burden of both pollution and ill-health. In the US, those in the lowest income group experienced the largest percent difference in pollutant exposure. The neuropsychological effects of polycyclic aromatic hydrocarbon exposure was most pronounced among children with greatest maternal hardship. Children in the lowest socio-economic strata experience the greatest risk for asthma or wheeze for each interquartile increase in pollutant. While the data for pollution and health outcomes in Africa is limited, studies from countries such as South Africa provide sentinel evidence.

Pathophysiological mechanisms for poverty and ill-health through stress mediated pathways, results in a range of adverse clinical outcomes among children. Better epigenetic understanding provides evidence for microRNA expression and telomere length, as markers of inflammation which vary with social factors.

This presentation presents a framework for understanding these relationships, and exploring the existence of synergistic effects, based on findings from the literature, as well as original studies conducted in South and Southern Africa.
Health risk and exposure assessment of indoor air pollutants in Shenzhen, China
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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim
With the rapid modernization and urbanization, indoor air pollution (IAP) has become a significant public health issue. The elderly and children are usually more susceptible to IAP exposure as they tend to stay indoors for longer. This study aims to identify the major environmental risk factors, explore the role of indoor thermal environment and air pollutants on human health; hence, characterize the corresponding environment-related health effects.

Methods
A questionnaire survey and two field measurements were performed during 2017, including indoor thermal environment and primary air pollutants measurements in kitchen and the living room. A total of 345 eligible questionnaires and 334 air samples were collected. Multivariable logistic regression model was performed to estimate the relationship between environmental factors and self-reported symptoms or diagnosed diseases, after adjustment for sex, age and household income. Odd ratio (OR) and confidence intervals were calculated with the SPSS software.

Results
The primary environmental health risk factors, including PM10, PM2.5, total Fungi(TF), CO2 and total bacteria count (TBC) were investigated with the corresponding rates of over-standard of 27.81%, 23.84%, 20.75%, 1.32% and 0.94%, respectively. Among the children included, 41 (58.6%) had a cold in the past year, which is significantly associated with humidity (OR=0.870, 95% CI:0.781, 0.980). Nearly one third of the elderly had cardiovascular diseases, which was negatively associated with temperature (OR=0.682, 95% CI:0.506, 0.918). Water purifiers were equipped in all the investigated classrooms with the filter element being replaced more than twice a year. About one-fifth of the households used air purifiers, 60% used water purifiers, while one-fifth of those never replace the filter.

Conclusions
This study provides new information regarding potential environmental health risk from IAP. Further studies should focus on mitigating IAP exposure through public health measures.
BACKGROUND: As part of burden of disease analysis due to poor air quality in Medellin, Colombia, we calculated the years lost due to disease (YLD) by sentinel events associated with short-term exposure to air pollutants. METHODS: Death records for respiratory (RD) and cardiovascular disease (CVD) were obtained for the National Social Protection Information System. Adjustment for underreporting deaths was calculated using Preston-Coale method. Mortality rates were calculated according to groups and defined subgroups, and the YLD was constructed according to the latest criteria proposed by Institute of Metrics in Health (IHME) of Washington University. RESULTS: 25.1% (23,611 of 96,796) of deaths occurred during the study period corresponded to sentinel events, with an underreporting of 2.94% (694 deaths). 66.5% (n = 15,694) corresponded to deaths from RD, lower respiratory tract infections were the most frequent RD. Regarding deaths due to CVD, the main cause was ischemic heart disease, with a higher proportion in men. 497,747 YLD due to sentinel events related to air pollution was calculated, the highest proportion of YLD was observed in 2010 and 2015, men contributed the highest proportion of YLD (51.7%). Between 2010 and 2015, the rate of YLD was reduced by 9.6%, from 2,872 YLD per 100,000 inhabitants in 2010 to 2,595 YLD per 100,000 inhabitants in 2015. A tendency to increase in the specific rates of YLD in men from 55 years of age. The causes related to ischemic heart disease and lower respiratory tract infections contributed to higher YLD among the sentinel events associated with the air pollution, also it was observed that premature death affected men in a greater proportion, especially due to ischemic heart disease (25% YLD), influenza and pneumonia (7% YLD). CONCLUSION: The results show an important contribution of sentinel events associated to air pollution in the mortality of Medellin.
Public Health Impact Attribution due to particulate matter from Biomass Burning Emissions

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background: Biomass burning emissions have a substantial impact on regional air quality and climate, we evaluated the short-term effect of particulate matter on acute respiratory disease morbidity and mortality, determinated by the risk of children under 5 years old and adults over 60 years old in three cities at 2016.

Methods: Daily Emergency Department (ED) visit records for respiratory illnesses and selected diagnosis, besides daily concentrations of PM2.5 obtained in Bogota as a high altitude city and other cities as Bucaramanga and Medellin, therefore we selected the back-trajectories of air masses reaching the receptor, that were linked with fire spots.
Colombia: Bogota, Medellin, Bucaramanga during 2016. Using conditional Poisson time series analysis we assessed the effect of air pollutants on health outcomes using single pollutant, controlling for meteorology and time trends. The percentages of change in the rate of ED visits and their 95% confidence interval were estimated for the joint effect of particulate matter.

Results and Conclusions: On one hand in dry season, the amount of firespots increases as single-pollutant model increases particulate matter were associated with 15% increases in ED visits for respiratory diseases. On the other hand during the wet season the incidence of ED visits decreases. The health charge of concentrations above 50 Micrograms per cubic meter of air represent the 17,6 % of Chronic Respiratory Illnesses. The cost linked with air pollution is US $1431, this amount increases when the poor communities are included.
Estimation of excess mortality due to long-term exposure to PM2.5 in Continental United States using a high-spatiotemporal resolution model

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background;
Exposure to fine particulate matter (< 2.5 mm in aerodynamic diameter, PM2.5) pollution, even at low concentrations is associated with increased mortality. Estimates of the magnitude of the effect of particulate air pollution on mortality are generally done on a coarse spatial scale, such as 0.5 degrees, and may fail to capture small spatial differences, which can be important when considering environmental justice. We estimated the burden of mortality attributable to long-term exposure to ambient PM2.5 among adults in the Continental United States on a 1km scale, in order to provide information for public health professionals setting health priorities.

Methods;
A health impact assessment for 2015 was performed using a validated high spatio-temporal resolution model predicting PM2.5 in Continental United States at a spatial resolution of 1km. We applied a concentration-response curve from a recently published meta-analysis of long-term PM2.5 mortality association which incorporates new findings at high and low PM2.5 concentrations. We computed the change in deaths in each grid cell, based on its population, county level baseline mortality rates, and exposure under two scenarios; a decrease of PM2.5 exposure levels by 20% and 40%.

Results:
We estimated the deaths would fall by 47,775 (95%CI; 29,124-66,246) and 96,787 (95%CI; 57,016-135,726) attributable to 20% and 40% reduction in annual level of PM2.5, respectively. The greatest mortality impact due to 40% reduction in PM2.5 was observed in California with; 11,621 (95%CI; 7156-15,989) and Texas with; 9,616 (95%CI; 5,798-13,352) excess deaths attributable to annual mean PM2.5 concentrations of 9.54 and 9.12 μg m⁻³, respectively. Attributable fraction (AF %) in locations with high PM2.5 levels estimated with 8.6 (95%CI 5.4-11.7) compared to the overall AF% ;4.9 (95%CI; 2.9-6.8).

Conclusions:
Our study provides evidence of major health benefits expected from reducing PM2.5 exposure, even in regions with relatively low PM2.5 concentrations.
Health disparities attributable to air pollutant exposure in North Carolina: Influence of residential environmental and social factors

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Understanding health disparities of air pollutant exposure is a public health priority. We examined which residential environmental and social factors affect disparities in air pollution-mortality relationship in North Carolina, USA.

Methods: To estimate the association between air pollution and mortality, we applied a time-stratified case-crossover design with referent selection based on same day-of-the-week of the same year when a death occurred. Non-accidental, cardiovascular, and respiratory deaths for 2002-2013 were included as cases. Daily census-tract level estimates of PM2.5 and O3 concentrations obtained from EPA downscaler output, which combines air quality modeling and monitoring data, as well as monitoring data. To examine disparities by individual-level, community-level, and residential environmental factors, we conducted stratified analyses by individual-level factors (i.e., sex, race, age, education, and marital status), residential greenness using the Normalized Difference Vegetation Index (NDVI), proximity to water bodies, median household income, and classification of urbanicity from the 2010 Census. We also evaluated associations by combinations of individual- and community-level factors.

Results: PM2.5 exposure was significantly associated with increased risk of non-accidental or cardiovascular mortality. A 10µg/m3 increase in 2-day moving average (lag 01) PM2.5 was associated with increased odds of mortality of 1.019 (95% confidence interval (CI) 1.012, 1.025) and 1.017 (95% CI 1.007, 1.028) for non-accidental and cardiovascular mortality, respectively. A 10ppb increase in O3 exposure was associated with increased odds of non-accidental mortality of 1.006 (95% CI 1.002, 1.010). Higher risk of PM2.5 exposure on non-accidental mortality was associated with some factors (male, low education, older age, urban areas, and low SES). For combinations of individual- and community-level factors, the highest and most significant effect was found in non-Hispanic Black in lower community-level SES.

Conclusions: Our findings have implications for environmental justice regarding which subpopulations and factors are most relevant for disparities in air pollution and health associations.
What makes us feel the risk? Predicting risk perceptions of environmental exposures through socio-demographic and psycho-environmental variables


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Background/Aim: Health-related risk perceptions towards environmental sources matter. They may inform about public's awareness about certain environmental issues that may compromise their health. They might also impact health and well-being through the experience of concern, anxiety or even fear. In this study we aimed at analyzing the roles of several demographic, social and psychological variables in the health-related risk perceptions attributed to environmental exposures.

Methods: A convenience sample of 338 inhabitants (208 women, 45.8 years on average) of Gipuzkoa (Basque Country) filled in a questionnaire measuring risk perceptions towards a set of seventeen environmental exposures. Personal unhealthy behaviours included smoking, alcohol consumption, unhealthy diet and sedentarism. Risk perceptions were assessed in a 0 (nothing) – 4 (high) scale. The questionnaire also comprised general sociodemographic, health-related behaviours, and three psycho-environmental scales assessing general environmental knowledge, nature relatedness, pro-environmental behaviour and political ideology.

Results: Environmental exposures received risk perception ratings ranging from 1.45 to 3.42. Air pollution, proximity to hazardous industry, waste incineration plants and landfills and food contamination were the highest rated (3.04-3.42). The predictive models showed that being a woman was consistently associated with greater risk perception for all the exposures. The following variables were found to be significant predictors in several models –numbers in brackets–: age (9), urban residence (vs rural; 4), education (university degree vs non-university education; 4) healthy behaviours (1), environmental knowledge (6), nature relatedness (1) and pro-environmental behaviour (11). Variance explained by the models ranged between 7.34 to 17.99%.

Conclusions: Environmental exposure risk perceptions were partially explained by a set of socio-demographic and psycho-environmental variables. The inclusion of emotional responses towards each kind of environmental exposure and specific knowledge about its effects on health may increase the explanatory power of future models.
Air Pollution and Health Care Costs in Oakland, CA

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Background: Air pollution is associated with multiple adverse health effects. In principle, the deleterious effects of air pollution should in turn be reflected in increased health costs. However, our understanding of air pollution’s full impact across the diversity of health outcomes is still limited. For example, recent advances have been made in understanding the relationship between air pollution and rare diseases, metabolic syndrome, neurodevelopment, dementia as well as severity of disease conditions. In this context, health care costs may be considered an additional useful metric of adverse health effects.

Objective: We hypothesized that higher exposure to air pollution is associated with higher total health care cost in population in Oakland, CA served by Kaiser Permanente Northern California (KPNC), a large integrated health care system.

Methods: Repeated mobile street-level mobile monitoring was used to measure pollutant concentrations for nitrogen dioxide [NO2], nitric oxide [NO], and black carbon [BC] at a resolution of 30 m road segments and linked to residential addresses of 41,869 adults living in Oakland during 2010 to 2016. Data on health care utilization and costs were derived from KPNC databases and were used to calculate individual annual total health care, inpatient, outpatient, and emergency room and pharmacy costs. We fit gamma linked generalized estimating equations models to estimate the relationship between air pollution exposures and annual health care costs, accounting for age, sex, race, BMI and smoking.

Results: Among the elderly (>65 years old) a 1 SD change in pollutant concentration was associated with 7% [95% confidence interval (CI): 1%, 15%], 10% [95% CI: 3%, 17%] and 9% [95% CI: 2%, 16%] increase in total health care cost for BC, NO and NO2 respectively.

Conclusions: Long term exposure to air pollution was associated with significantly higher total health care cost among the elderly in Oakland, CA.
Application of the Navigation Guide systematic review methodology and meta-analysis to evaluate the association between prenatal particulate matter air pollution exposure and birth weight

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TPS 642: Environmental justice and impacts, August 26, 2019, 3:00 PM - 4:30 PM

Background: Case-control and cohort studies have demonstrated a positive association between prenatal exposure to particulate matter (PM) air pollution and low birth weight (LBW). Previous systematic reviews and meta-analyses report varying effect sizes and significant heterogeneity between studies. The considerable variation in study outcomes reflects methodological differences employed across studies.

Objective: The objective of this study was to determine how developmental exposure to ambient particulate air pollution affects birth weight using the Navigation Guide systematic review methodology.

Methods: We developed a study protocol and established a criteria to identify the relevant studies. Further, we determined the risk of bias for each study, conducted a quality of evidence and strength of evidence assessment, as well as a meta-analysis across all studies.

Results: Forty-three studies met our inclusion criteria. We rated studies generally with low to probably-low risk of bias; however, several studies we judged as high or probably-high risk in the confounding and exposure characterization domains. Based on the meta-analysis, for every 10 µg/m³ increase in particulate matter, a decrease in birth weight was almost always negative. The strength of evidence assessment, for PM2.5, revealed “limited evidence of toxicity” for reducing birth weight when exposure is in the third trimester; for other exposure windows, the evidence is inadequate. For PM10, there is “limited evidence of toxicity” for reducing birth weight when exposure is in the third trimester and during the entire pregnancy; however, the evidence is “inadequate” for other exposure windows. For coarse PM (PM2.5–10), there is “inadequate evidence of toxicity” for reducing birth weight for all exposure windows.

Conclusion: While sufficient evidence supports an association between prenatal exposure to ambient particulate matter and low birth weight, the estimated effect depends significantly on study design. Standardizing exposure characterization techniques could help reduce the variation in outcomes.
Background/Aim
The summer of 2018 exposed the population of Sweden to record breaking temperatures in the entire country. The Swedish Public Health Agency reported an increase in mortality but could not attribute the increase to the high temperatures. The European mortality monitoring of excess mortality estimated the mortality to exceed 4 standard deviations above the normal during one week in July making it the 3rd largest deviation during the observation period starting in 2014.

Methods
We used mortality data from the previous year, during a summer of mild temperatures and mortality patterns that did not deviate from what was expected. Using that baseline mortality, the temperatures from the summer of 2018 and previously established temperature mortality relationships we calculated an estimate of the mortality based on temperatures. This estimate was compared to the observed mortality during the summer.

Results
The Public Health Agency estimated that 750 excess deaths occurred during a 5-week period from the beginning of July to the beginning of August. Our estimate based on temperatures and last year’s mortality estimated the excess mortality to 601-745 depending on what epidemiological model that was used. The temporal distribution of our estimates followed the pattern of the observed mortality quite well.

Conclusions
We find that we seem to have quite a good understanding of the relationship between high temperatures and mortality in Sweden. The fact that these relationships were established before the introduction of the Swedish heatwave early warning system raises the question about the effectiveness of the warning system. The estimate was accurate on the country level but there seems to be some local variations that is not explained solely by temperature.
Sex-age trends in heat- and cold-related mortality from cardiovascular diseases in a warming climate: A nationwide time-series study from Spain

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TPS 661: Climate change: temperature effects 1, August 26, 2019, 3:00 PM - 4:30 PM

Background. Human-driven climate change has increased annual temperatures in Spain by nearly 1°C on average since 1980. However, little is known about the extent to which the association between temperature and mortality has changed for the most vulnerable population groups within this context of generalized and rapid warming. We here assess heat- and cold-related mortality trends in Spain from cardiovascular diseases by sex and age groups, and we connect them with the observed rising temperatures and changes in vulnerability.

Methods. We analysed nationwide daily time-series of temperature and mortality counts from cardiovascular diseases by sex, age and province of residence for the period 1980-2016. We applied a quasi-Poisson regression model for each province, controlling for seasonality and long-term trend, and estimated the temporal variation in temperature-mortality relationships with time-varying Distributed Lag Nonlinear Models.

Results. The attributable fractions due to heat were higher for women in all the age groups, and the fractions due to cold in men. Moreover, heat-related mortality increased with age for both sexes, while cold-related mortality increased with age for men and decreased for women. Results of this investigation also showed a progressive warming of the MMT in each sex and age group, and a strong downward trend in heat- and cold-related vulnerability and attributable mortality.

Conclusions. In Spain, the observed warming has occurred in parallel with a substantial adaptation to both hot and cold temperatures. The reduction in the risk and attributable burden associated to heat would be compatible with an adaptive response specifically addressing the negative consequences of climate change. Nevertheless, the simultaneous reduction of the vulnerability and impact of cold temperatures also points to the necessary role of more general factors such as socioeconomic development, increased life expectancy and quality, and improved healthcare services in the country.
Effects of Temperature and Humidity (Heat Index) on the Incidence of Ventricular Tachyarrhythmias in Patients with an Implantable Cardioverter Defibrillator: Differential Association between Electrical Storm and Non-electrical Storm Patients

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Aims:
This study aimed to assess the role of heat index (HI) in ventricular tachyarrhythmias (VTAs), both electrical storm (ES) and non-ES, among patients with implantable cardioverter-defibrillators (ICDs).

Methods and Results:
Clinical records of 173 patients with an ICD who experienced sustained VTAs were abstracted to determine the association between VTA incidence and HI from January 2004 to June 2017 by time-stratified case-crossover analysis; we used cubic splines to account for the nonlinear effect of HI, adjusting for air pollutant concentrations and previous-day arrhythmia. The HI thresholds for VTA incidence were <15°C and >30°C, with percentage change in odds ratios of 1.06 (95% confidence interval (CI) 0.13–2.21) and 0.31 (95% CI 0.11–0.50), respectively, per 1°C. Lagging effects for low HI persisted up to 5 days, whereas the effects for high HI were up to 2 days. A significant seasonal effect for ES patients, i.e. in spring and summer, was noted. We did not find a statistical association with air pollutant concentrations.

Conclusion:
Compared with high HI (>30°C), low HI (<15°C) had a strong, long-lasting effect on sustained VTA occurrences in patients with ICDs. For high HI, ES patients were more vulnerable to VTA attack than non-ES patients. Those at risk of VTAs should avoid exposure to low and high HI to reduce mortality and improve the quality of life.
The Impact of Diurnal Temperature Range and Years of Life Lost in Six Major Cities in South Korea
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Background/Aim
Diurnal temperature range (DTR) is an important weather-related indicator of global climate change. Numerous studies have found DTR-mortality association, but there is little evidence regarding the association of DTR with years of life lost (YLL). Therefore, this study aims to examine the burden of DTR on YLL in six major cities of South Korea.

Methods
This study was conducted in Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon from 2001 to 2010. The DTR which describes the within-day temperature variability was derived as the difference between the daily maximum and daily minimum temperatures. Daily YLL were computed by matching the sex and age to the life tables of Korea and were then summed to yield the YLL for all deaths on the same day. We controlled for relative humidity, air pressure, sunshine duration, day of week, seasonality and long-term trends. Time-series generalized additive model (GAM) was used with a Gaussian regression to daily YLLs and a quasi-Poisson regression to daily deaths which were for comparison with YLL. Distributed lag non-linear model was incorporated in the GAM regression to control for the lagged and nonlinear effects of ambient temperatures. Also, we performed stratified analyses by sex and age groups.

Results
The average daily mean temperature and daily mean DTR of Seoul were 12.8°C and 7.6°C. We observed YLL effects associated with DTR were higher in males than females and the youth (0-64 years old) than the elderly. DTR-associated with YLL showed 4.2 and 3 years in Seoul and Busan.

Conclusions
This study found that DTR was associated with YLL and it highlights that the impact of DTR on YLL should be considered in public health policies and climate change research. Special interventions such as minimizing exposure to a higher DTR are necessary for vulnerable populations to reduce DTR-related YLL.
The use of high resolution temperature exposure data to estimate the short-term effects on cause specific mortality at municipal level in 5 Italian regions.

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Introduction: Health effects of high and low temperatures in urban areas are well known, however evidence in suburban and rural areas is scarce.

Aim: To estimate the short-term effects of heat and cold on cause-specific mortality at municipal level for the period 2001-2010 in 5 Italian regions.

Methods: Daily mean air temperature with a spatial resolution of 1km2 was derived using satellite land surface temperature (LST), observed temperature data and spatio-temporal land use and land cover predictors. Non-linear distributed lag (DLNM) models, adjusted for temporal trends, PM10 and influenza epidemics, were used to estimate the association between temperature and cause-specific mortality at municipal level. The percent change in risk (IR%), for temperature increases between the 75th and 99th percentile (heat) and decreases from the 25th to the 1st percentile (cold) are reported. Risk estimates by age, gender and urbanization (high, medium, low) were also calculated.

Results: A significant effect of both heat and cold was observed, with some heterogeneity among regions. The pooled effect estimates for heat and cold on total mortality were 1.33 (95%CI: 1.21-1.47) and 1.18 (95%CI: 1.12-1.25) respectively. In summer, significant effects were observed for cardiac, cerebrovascular, ischemic, respiratory, metabolic and mental disease, diabetes, and disease of the central nervous system. Estimates range from 1.21% (95%CI: 1.04-1.43) for ischemic heart disease to 1.97% (95%CI: 1.65-2.34) for disease of the central nervous system. In winter, significant effects were observed only for cardiovascular (1.21% CI95%:1.17-1.30) and respiratory disease (1.43% CI95%:1.24-1.65). A greater risk in mortality was found among the very old (75+ years) with higher risk estimates among females for heat and among males for cold. Risks were comparable between urban, suburban and rural areas.

Conclusions: Extreme temperatures are an important risk factor in both urban and rural areas.
Oppressive weather air masses and all-cause mortality in Sweden: A time-series analysis
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Background: Much is known about adverse health impacts of high and low temperatures. The Spatial Synoptic Classification is a useful tool for assessing weather effects on health because it considers the combined effect of meteorological factors rather than temperature only. The aim of this study was to assess the association between oppressive weather types and daily total mortality in Sweden.

Methods: Time series Poisson regression with distributed lags was used to assess the relationship between oppressive weather (Dry Polar, Dry Tropical, Moist Polar and Moist Tropical) and daily deaths over 14 days in the extended summer (May to September), and 28 days during the extended winter (November to March), 1991 to 2014. Days not classified as oppressive weather served as the reference category. We computed relative risks with 95% confidence intervals, adjusting for trends and seasonality. Results of the southern (Skåne and Stockholm) and northern (Jämtland and Västerbotten) locations, respectively, were pooled using meta-analysis for regional-level estimates. Analyses were performed using the DLNM and mvmeta packages in R.

Results: During summer, in the South, the Moist Tropical and Dry Tropical weather types increased the mortality at Lag0 through Lag3 and Lag6, respectively. Moist polar weather was associated with mortality at longer lags. In the North, Dry Tropical weather increased the mortality at shorter lags. During winter, in the South, Dry Polar and Moist Polar weather increased the mortality from Lag6 to Lag10 and from Lag19 to Lag26, respectively. No effect of oppressive weather was found in the North.

Conclusions: The effect of oppressive weather types in Sweden varies across seasons and regions. In the North, a small study sample reduces precision of estimates, while in the South the effect of oppressive weather types is more evident in both seasons.
Overlooked heat-related morbidity indicator: consequences from rising ambulance dispatches associated with high ambient temperature

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Background: Heat exposure is known to have a complex set of physiological effects and pose threat to the whole population. However, current investigations of heat effects were mostly based on several prespecified health outcomes, and less is known about heat impacts of population morbidity. As the front line of medical services, ambulance dispatches may provide a further understanding of health impacts of heat in the population scale.

Methods: Daily ambulance dispatches and temperature between 2015 and 2016 in Shenzhen were analyzed. Records of dispatch include individual characteristics and preliminary diagnoses. We first explored the relationship between temperature and ambulance dispatches and set the optimum temperature using distributed lag nonlinear model. Then, stratified analyses by gender, age and wide range of diagnoses were performed to identify vulnerable subpopulations. We estimated the temperature effect on dispatch by comparing the 95th percentile versus optimum temperature, as determined from the annual time series.

Results: A total of 334,495 ambulance dispatches were reported, with average daily demand of 458. Significantly rising risk of ambulance dispatches was found during heat events (RR= 1.19, 95%CI: 1.11-1.27). The risks generally occurred immediately and lasted for less than 1 day. Both male and female, along with people aged 18–44, and ≥60 years old were susceptible to heat. Highest risk was found for urinary disease (RR=1.75, 95% CI: 1.39-2.20), following 1.41 (95% CI: 1.19-1.67) for alcohol intoxication, 1.24 (95% CI: 1.03-1.50) for obstetric and gynecological disease, 1.23 (95% CI: 1.08-1.41) for dizziness, 1.22 (95% CI: 1.01-1.48) for respiratory disease, 1.19 (95% CI: 1.08-1.31) for traumatic disease, 1.18 (95% CI: 1.01-1.38) for gastrointestinal disease.

Conclusion: Heat poses a wide range of impacts on human health, especially among the middle-aged people and the elderly. Better understanding of these impacts and population vulnerabilities through heat-ambulance dispatches, local communities can improve early preparedness and interventions.
A high-resolution air temperature model for epidemiological studies in France

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Background: High, low, or variable ambient temperature (Ta) have been associated with increased morbidity and mortality. In the context of climate change and urbanization, understanding and monitoring these health impacts requires Ta estimates at higher spatiotemporal resolutions than currently available. To this end, we have developed a model of daily minimum, maximum, and mean Ta across continental France from 2000 through 2016 with a base resolution of 1 km² and an increased resolution of 200 x 200 m over large urban areas.

Methods: To predict 1 km² Ta we extend an established technique using linear mixed models to calibrate daily Ta observations with MODIS land surface temperature (LST), NDVI, elevation, population, land cover, and climatic region. We fill gaps (mostly due to cloud cover) with a second linear mixed model that captures the relationship between our predictions and nearby Ta observations. To increase the spatial resolution over urban areas, we train an ensemble of random forest and gradient boosting models to predict the residuals (R) of the 1 km² predictions using 17-year mean top-of-atmosphere brightness temperature and NDVI at ~100 m resolution from Landsat 5, 7, and 8.

Results: The 1 km² model performs very well, with cross-validated R² of 0.921 (Tmin), 0.968 (Tmean), and 0.954 (Tmax) and MAE of 1.4 °C (Tmin), 0.9 °C (Tmean), and 1.4 °C (Tmax) for the initial calibration stage. The 200 m model also performs well, with the ensemble stage achieving cross-validated R² of 0.792 (RTmin), 0.892 (RTmean), and 0.845 (RTmax) and MAE of 0.4 (RTmin), 0.3 (RTmean), and 0.3 (RTmax).

Conclusion: We demonstrate that satellite thermal data can be used to estimate Ta over large areas at an unprecedented spatiotemporal resolution (daily at 200 x 200 m). Our model will improve Ta exposure estimates in epidemiological studies, particularly those involving urban populations.
The fine-scale spatial variation of mortality risk attributed to urban heat island effect in Guangzhou, China

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Background: In the context of global warming and accelerated urbanization, the urban heat island (UHI) effect is becoming obvious, especially in large cities. From a health perspective, the UHI effect increases the risk of heat-related mortality and morbidity. However, previous studies focused on the heat-related mortality variation between different cities, and lack of directly quantified the magnitude of the UHI on mortality within a city.

Methods: We first used the k-means algorithm to cluster 161 streets in Guangzhou into 105 small-areas, due to the limited number of deaths in some streets. The inverse distance weight interpolation method was used to obtain the average daily temperature in each small area from 2011 to 2017, and the distribution lag nonlinear model was applied to investigate the heat-related risk in the central small-areas (68/105). Based on the UHI intensity, attributable fraction and the number of mortalities from UHI effect in each central small-areas were calculated during high-temperature season (June-September).

Results: The daily average UHI intensity (UHII) in Guangzhou is 0.71±0.41°C (range: -0.57 to 2.26 °C). Among central small-areas, the daily average UHII ranges from 0.10±0.26 °C to 1.13±0.34°C. During high-temperature season, the attributable fraction (AF) and attributable number (AN) of mortalities resulting from UHI were1.04% or 629 cases in the central city, with the variation of AF and AN ranging from 0.22% to 10.12% or 2 to 121 cases in different central small-areas.

Conclusion: UHII and its attributable fraction or the number of mortalities were found to be spatial variation, which make the geography-targeted UHI effect reduction strategy be important for improving public health in the climate chenage scenarios.
Is ‘tropical night’ an effective Heat-Health Indicator of Heatwave for South-East Asian Cities?
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**Background/Aim**
Due to climate change and fast urbanization, in South-East Asian cities, it can observed prolonged summers, intensified urban heat island effect (UHI) and a narrower diurnal temperature range which is caused by the daily minimum temperature has risen faster than the daily maximum temperature. All can lead to more tropical nights in this region. Thus, it is necessary to adopt the tropical night to analyze the association between the event of tropical night and the non-accidental mortality.

**Method**
Total daily non-accidental mortality (ICD-10 codes A00-R99) and hourly temperatures of the major cities in South Korea and China were collected for summer (June to September) between 2006 and 2015. We used generalized linear model (GLM) with quasi-Poisson distribution to analyze the relationship between tropical night events and daily non-accidental mortality. We also analyzed the relationship between the tropical night events and the next day mortality to see the lagged effect of tropical nights on mortality.

**Results**
The non-accidental mortality was increased in Seoul and Hong Kong by 5% and 2.4% during summer between 2006 and 2015, respectively. The mortality increase for elderly population (70+ years old) is higher (6.1%) than that for younger population (4.2%) in Seoul, while not in Hong Kong. In addition, we analyzed the lag effect of tropical night. The next-day mortality was increased in Seoul and Hong Kong by 4.3% and 1.5%, which is lower than the same-day mortality increase.

**Conclusions**
Our study results show that tropical night could be an effective indicator to evaluate heat-health impact for high-density cities of South Korea and China. We found a stronger association for the same-day mortality than the next-day mortality. In next step, we plan to take more cities into our study, consider the UHI effect into account and explore the spatial variation of heat-mortality under tropical nights.
The effects of climate and air pollution on people with chronic lung disease in Australia

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Background/Aim
While the deleterious effects of excessively cold and hot temperatures are well-documented in the general population, there is little evidence specific to people with cystic fibrosis (CF). We assessed the role of climate and air pollution on respiratory exacerbations using the Australian CF data registry.

Methods
We obtained de-identified registry data on Australian children and adults with CF during 2006-11. We linked their residential postcode to long-term climatological data, a national satellite-based model for nitrogen dioxide (NO2) exposure, remoteness categories, and indices of socio-economic advantage and disadvantage. We used negative binomial regression with generalised estimating equations to account for repeated measures per person, and assessed the association between temperature and the relative risk (RR) of respiratory admission episodes (as a proxy for respiratory exacerbations).

Results
There were 3,553 individuals with 17,868 person-years of records over 2006–2011, and postcodes were available for 73.2% of records. We adjusted for age, sex, Pseudomonas infection, pancreatic insufficiency, macrolide use, remoteness, distance to clinic, and socio-economic status. We found a 28% increase in the relative risk of respiratory episodes in the highest compared with the lowest mean daily temperature quintile (95% CI: 1.16, 1.49). We observed a protective effect in the third quintile (RR = 0.83, 95% CI: 0.73, 0.94). We found no significant associations with NO2 exposure.

Conclusions
We found evidence that the association between temperature and respiratory exacerbations in people with CF may be non-linear. Given Australia’s diverse and changing climates, clinicians and patients should be aware of the risks associated with higher temperatures.
Mortality effect of heatwaves in Finland – factors affecting sensitivity
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Background/aim: We studied mortality effects of heatwave days in Finland in 2000-2014. Mortality was analysed by age, sex, and cause of death. We also looked at mortality separately for homes and health and social care facilities, including different types of patients in health care.

Methods: Heatwaves were defined as periods when daily average temperature exceeded the 90th percentile for that in May-August for ≥ 4 days. Mortality analyses were based on linking registry data on i) daily mortality and ii) admission to a health or social care facility. Statistical analysis was conducted using generalised estimating equations for longitudinal data analysis, assuming a Poisson distribution for the daily mortality count.

Results: During heatwave days, non-accidental mortality increased among age-groups 65-74 years (6.7% [95% confidence interval 2.9-10.8%]) and ≥75 years (12.8% [9.8-15.9%]). Among total population, mortality effect was stronger in women (12.5% [9.1-16.0%]) than men (7.2% [4.4-10.0%]). Mortality increased due to cardiovascular diseases (7.6% [3.3-12.0%]), respiratory diseases (25.3% [16.0-35.3%]), renal diseases (38.4% [12.5-70.3%]), mental and behavioural disorders (29.7% [21.3-38.6%]), and diseases of the nervous system (17.3% [10.3-24.7%]). At homes, mortality increased by 8.1% (1.9-14.6%). In health care facilities, mortality increased both among inpatients (8.4% [5.6-11.3%]) and outpatients (31.4% [19.4-44.5%]). Among inpatients, the effect was stronger in long-term inpatients (stay >30 days, 13.1% [8.6-17.7%]) than others (5.8% [2.7-9.0%]). In social care facilities, there was a suggestive increase in mortality among women (8.5% [-1.1-19.1%]), and statistically significant effects were detected in cause-specific analyses.

Conclusions: Heatwaves are a significant health risk in Finland for the elderly and those suffering from various types of chronic diseases. Mortality increases both among those living at home and those residing in health and social care facilities. Health and social care preparedness for heatwaves should be improved.
Environmental Fate and Transport Analysis of Low Global Warming Potential (GWP) Refrigerant, R-514A

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Background

The growing international emphasis on climate change has stimulated interest in low global warming potential (GWP) refrigerants. The potential adverse impacts on human health through the life cycles of low-GWP refrigerants at a global scale has not been evaluated. We conducted an environmental fate and transport analysis of new low-GWP refrigerant R-514A, a mixture of two components, (Z)-1,1,1,4,4,4-hexafluoro-2-butene (HFO-1336mzzZ) and trans-1,2-dichloroethylene (t-DCE), 74.7% and 25.3% by weight, respectively.

Methods

Literature was reviewed and extracted for available physical and environmental properties for each component of R-514A. The environmental fate of each component was assessed separately to determine potential distribution of concentration in air, soil, and water following releases to the environment. In anoxic terrestrial and aquatic environments, t-DCE transforms into vinyl chloride (VC); therefore, VC was also evaluated as one of the components. Potential releases of R-514A components were evaluated by a series of simulations using the environmental model PEARL and the ECETOC TRA environmental model.

Results

With the worst-case scenario, the 80th percentile of the average annual concentrations of HFO-1336mzzZ and t-DCE in soil pore water were in a range of 0.009-0.066 µg/L (9-66 ppt), and 0.005-0.049 µg/L (5-49 ppt), respectively. For VC, the range was 0.0001-0.005 µg/L (0.1-5 ppt).

Discussion

Based on the conservative estimates, the potential concentrations of the two constituents of R-514A, and the potential transformation of t-DCE to VC, infiltrating through the soil profile present a negligible impact on the quality of groundwater resources. The worst-case concentrations of t-DCE and VC resulting from soil deposition of localized releases of R-514A are 10-to-100-fold lower than the typical concentrations currently reported in drinking water supplies, and local oral exposures based on soil pore water are well below general population DNELs. The PEARL model is significantly more conservative than the ECETOC TRA model and the differences are discussed.
Long-term Temperature Exposure and Cause-Specific Mortality in the U.S
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Background/Aim: While numerous studies have examined the effects of acute temperature changes on short-term mortality risk, potential effects of changes in chronic temperature exposure on long-term cause-specific mortality risk have not been previously evaluated. In this work, we assessed the potential link between annual cause-specific mortality and seasonal temperature average and/or variability in a large prospective cohort.

Methods: Extended Cox proportional hazards modeling was applied to analyze the NIH-AARP Diet and Health Study, a prospective cohort (N=550,638) across 6 states and 2 cities in the United States, with a follow-up period of 17 years (1995-2011). Annual summer and winter temperature average (TA), defined as the average of daily mean temperature; and temperature variability (TV), defined as the standard deviation of both daily minimum and maximum temperatures within the seasons, were linked to participants as time-varying exposures at the census-tract level. We assessed deaths due to all-causes (ALL), cardiovascular diseases (CVD), ischemic heart disease (IHD), cerebrovascular disease (CER), cardiac arrests (CAR), respiratory diseases (RSD), and chronic obstructive pulmonary disease (COPD).

Results: A 1° increase in summer TA was significantly associated with elevated CVD (HR =1.014; 95% CI: 1.007-1.021), IHD (1.016; 1.006-1.026), and RSD (1.016; 1.004-1.029) mortality risk, and a 1° increase in winter TA was significantly associated with decreased RSD (0.983; 0.971-0.995) mortality risk. A 1° increase in winter TV was significantly associated with elevated CVD (1.017; 1.002-1.03), IHD (1.032; 1.012-1.053), CER (1.013; 0.973-1.053), RSD (1.041; 1.014-1.069), and COPD (1.068; 1.033-1.104) mortality risk.

Conclusions: Results suggest that changes in prolonged exposure to changes in temperature and its variability are significantly associated with increased long-term cause-specific mortality, with greater life-shortening implications than acute exposure effects alone. Findings have implications for the public health threats of climate change, which will shift temperature averages and variability.
Estimation of heat-related deaths during heat wave episodes in South Korea
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Background/Aims: In 2016 and 2018, South Korea experienced extremely high temperatures and the Korea Centre for Disease Control and Prevention (KCDC) reported 17 and 48 heat-caused deaths respectively during the heat wave, mostly due to heat stroke. Because the reported number of heat-caused deaths is only a part of total deaths associated with heat waves, we aimed to estimate attributable deaths during heat wave episodes.

Methods: We linked mortality and meteorological data in 16 regions in South Korea and estimated relative risk at or above threshold of maximum temperature during summer using generalized linear regression models after controlling for confounders. We computed overall, age-, sex-, and cause-specific attributable death in 2006-2018.

Results: With 1.6% (95% Confidence intervals [CI], 0.8%, 2.4%) increase in all-cause mortality per 1°C increase in concurrent day’s maximum temperature during summer, this study estimates 349 (95% CI, 176, 520) and 790 (95% CI, 400, 1,171) all-cause deaths associated with heat waves in 2016 and 2018, respectively, in South Korea. The estimation was about 16~21 times more than the reported number by the KCDC. If we consider cumulative effects of heat wave, the estimations were greater.

Conclusion: This study addresses attributable heat wave deaths in South Korea and illustrates that the reports of medically classified heat-caused deaths seriously underestimate the number of deaths attributable to heat waves. Our findings may enable the implementation and reinforcement of government- and individual-level management strategies for heat waves.
The association between power outage and the exacerbation of Chronic Obstructive Pulmonary Disease (COPD)

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Background: More frequent and severe power outages (PO) are expected as potential results of climate change and increased weather extremes. Significant gaps remain in understanding the potential impact of PO on Chronic Obstructive Pulmonary Disease (COPD) hospitalizations. We examined the association between PO and COPD, as well as its variation across COPD subtypes, lag days, critical care indicators and socio-demographics.

Methods: We matched the 2001-2013 daily PO data with the COPD hospitalization numbers at the New York power operating division-level. Using distributed lag nonlinear models controlling for weather and time-varying factors, we compared the number of hospitalizations during PO versus non-PO periods to determine the association of PO with COPD and its subtypes at each of 0-6 lag days, and stratified the results by socio-demographics. We also compared differences in critical care indicators including average length of stay, cost and average number of comorbidities between two periods.

Results: Overall, we observed the relative risk (RR) of COPD ranged from 1.14 to 1.43 across lag days. The risk was strongest at lag 0 and lasted significantly for 6 days. Associations were stronger for acute bronchitis (RR: 1.33 to 1.63) and obstructive chronic bronchitis (RR: 1.10 to 1.47). PO impacts were significantly higher when PO coverage exceeded the 75th percentile or lasted longer than 5 days. No significant variations were observed across socio-demographics. Compared with the non-PO period, the PO period was observed to have 0.017 more COPD cases/day, $5367 increase in cost/case and 1.44 more comorbidities/case. Patients with hospital stays costing more than $30000 or having over 9 comorbidities increased to a greater extent during PO relative to other patients.

Conclusion: PO was significantly associated with elevated risk of COPD as well as increased cost and comorbidities. Patients at the highest-cost and most-comorbidity groups had the highest increase among all hospitalizations.
Impacts of Snow Storm and Power Outage on Critical Care for Multiple Health Outcomes in New York State

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TPS 661: Climate change: temperature effects 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: Extreme weather events are becoming more frequent, and snow storms are a major event seen in the Northeast. While prior research has focused on extreme heat or hurricanes, few have assessed the effects of snow storms and power outage (PO) on multiple morbidities. We evaluated the joint and separate effects of snow storms and PO on five health outcomes while comparing the impacts of ice storms and snow storms. Furthermore, we assessed if snow-health associations are modified by demographics, calendar month, ambient temperature and wind speed.

Methods: The Distributed Lag Nonlinear Model (DLNM) was used to examine the association between snow storm/PO and hospital admissions due to cardiovascular, respiratory, respiratory infection, food/water-borne illness and injury in New York State (NYS). By using non-snow storm/ non-PO period as the reference, we used DLNM in assessing lag effects (0-6 days) for the joint and separate impacts of snow and PO, and snow and ice storms on health while controlling for weather and time-varying factors. Additionally, hospital admissions were compared between snow/PO period and non-snow/PO period in a stratified analysis by month, temperature, and wind speed.

Results: We found significantly increased risks due to snow storms and PO on all five diseases examined (OR ranged: 1.15-1.67). The joint effect of snow and PO was the strongest, followed by snow storms while PO alone did not increase health risks. Ice storms (ORs: 1.33-4.16) had stronger health effects than snow storms (ORs: 1.11-2.29). The positive snow-health associations were stronger in October and November and during mild temperatures, or low wind speed periods.

Conclusion: Snow storms have significant impacts on multiple health outcomes, especially when accompanying PO or ice storms. Warning and prevention efforts may be issued in the transitional months before winter and during mild weather when people participate in more outdoor activities.
Moderate hot rather than extreme hot is mainly responsible for temperature-related excess outpatient visits for respiratory diseases: a case study in a subtropical city of China

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Background: Much evidence has revealed that there are significant associations between ambient temperature and human health. However, few studies have assessed the health burden of respiratory disease attributed to different temperature ranges in subtropical region.

Methods: Daily outpatient visits, weather variables and air pollution data were collected from January 2013 to July 2017 in a hospital of Dongguan city. A standard time series quasi-Poisson regression with distributed lag non-linear model (DLNM) was applied to estimate the associations between daily mean temperature and morbidity for respiratory diseases, bronchiectasis, chronic obstructive pulmonary disease (COPD) and asthma. Attributable risks were then calculated to quantify the disease burdens from different temperature components. Finally, a stratified analysis by age groups was conducted.

Results: Both low and high temperature were associated with an increased risk of morbidity of respiratory diseases. Compared with the optimum temperature, the accumulative relative risk (RR) during 7 lag days was 1.13 with 95% confidence interval (CI) 1.01 to 1.26 for extreme hot, and 1.02 (95% CI: 0.99 to 1.05) for extreme cold. Respiratory morbidity risk for young population mainly caused by hot weather, but a reverse J-shaped was observed for the elderly. About 8.4% (95%CI:2.8% to 13.3%) of respiratory morbidity was attributed to non-optimal temperature. Out of them, moderate hot was responsible for the major part of excess respiratory visits, accounting for 7.5% (95% CI:2.4% to 12.2%) of respiratory morbidity.

Conclusions: We found that moderate hot contributed most of excess respiratory outpatient visits caused by ambient temperature exposure in subtropical region, which indicates more attention should be paid to this temperature range rather than extreme temperature in subtropical regions.
Impact of temperature variability on cause-specific mortality in Japan

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TPS 661: Climate change: temperature effects 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: extreme temperatures are known to be associated with increased mortality risk. However, little is known about the mortality risk related to temperature variability (TV) accounting for both intra- and inter-day variations in temperature.

Objectives: The present study aims to quantify the associations between TV and cause-specific mortality in Japan, evaluate whether the effects of TV are modified by prefecture-level characteristics and examine the temporal trend in mortality risk of TV.

Methods: Data on daily all-cause and cause-specific mortality and meteorological variables in 47 Japanese prefectures from 1972 to 2015 were collected. TV was defined as the standard deviation of daily minimum and maximum temperatures during exposure days. A quasi-Poisson regression model combined with a distributed lag non-linear model was firstly applied to assess the prefecture-specific mortality effects of TV. The pooled effects of TV at the national level were then obtained via a meta-analysis through the restricted maximum-likelihood estimation. Potential effect modification by prefecture characteristics was firstly examined using a meta-regression analysis, and the joint modification of season and humidity was then evaluated after including product terms in two-stage analyses. Finally, the temporal trend in TV effects were evaluated by a random-effect meta regression model after obtaining the prefecture-year-specific effects.

Results: TV had significant adverse effects on all-cause and cause-specific mortality. The effects of TV were more detrimental to those with asthma and senility. In general, the estimates of mortality risk increased with longer exposure days. A 1°C increase in TV at 0–7 days of exposure was associated with a 0.9% (95% confidence intervals: 0.82%–0.98%) increase in all-cause mortality. The mortality risk of TV showed a decreasing trend during our study period. TV effects were larger in densely populated prefectures and on warm and humid days.

Conclusions: TV-related death is a significant issue in Japan that requires effective interventions.
Impact of Maximum Air Temperature on Ambulance Transports Owing to Heat Stroke During Spring and Summer in Tottori Prefecture, Japan: A Time-stratified Case-crossover Analysis
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TPS 661: Climate change: temperature effects 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: The frequency and intensity of hot weather have increased. In Japan, there have been many studies of the relationship between ambulance transports owing to heat stroke (ATHS) and high air temperature in the summer season. However, there have been very few reports focusing on ATHS in spring. Therefore, we investigated the effect of the maximum air temperature on ATHS not only in summer but also in spring, to help with development of effective measures to prevent heat stroke.

Methods: We obtained daily ATHS and meteorological data from April to September in 2017 in Tottori Prefecture. We used a time-stratified case-crossover method for data analysis.

Results: A total 382 cases of ATHS were identified from April to September in 2017 in Tottori. The number of cases was highest in July, followed by August and May. Maximum air temperature was significantly linked to ATHS. The risk of ATHS was increased 1.13 times when maximum air temperature rose by 1°C. In summer, the risk on extremely hot days (maximum air temperature ≥ 35°C) increased by 5.55 times or more compared with that on days below 30 °C (< 30°C). The risk was approximately four times greater on hot days (≥ 30°C and < 35°C) than that on relatively cooler days (< 30°C) during the spring months of April through May.

Conclusion: Maximum air temperature was significantly linked to ATHS. It is necessary to pay particular attention to heat stroke prevention not only on extremely hot days in summer but also on hot days in the spring.
Cold impacts on neonatal mortality in an extreme climate – the role of ethnicity in pre-industrial Sweden
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TPS 661: Climate change: temperature effects 1, August 26, 2019, 3:00 PM - 4:30 PM

Background and Aim
While the role of weather for mortality has been established in a large range of studies, we still lack insight into weather vulnerability of newborns living in pre-industrial societies. The aim of this study was to investigate cold impacts on neonatal mortality among two distinct populations in northern Sweden during the 19th century: The Sami (indigenous, predominantly reindeer-herders) and the non-Sami (settlers, mainly farmers).

Methods
We obtained digitized parish records and monthly temperature data from northern Sweden, 1800 to 1895. Neonatal mortality was defined as death during the first 28 days of life. Cold extremes were defined as mean monthly temperature below -15.4°C (5th percentile) in the month of birth or in one of the three months prior birth. We computed negative binomial regression models accounting for over-dispersion, trend and seasonality. In the present analyses, only births during winter (December to February) were included. Analyses were stratified by ethnicity and period (1800-1859 / 1860-1895).

Results
During the study period, there were 8024 winter live-births and 464 neonatal deaths. Neonatal mortality was higher among Sami, but approached the non-Sami’s rates in the late 1800s. We found higher neonatal mortality among Sami infants due to cold at birth in the first period (RR 1.60 [95% confidence interval 1.14-2.23]). Cold-related mortality risk was lower and statistically non-significant in the second period (RR 1.32 [0.85-1.98]). Non-Sami were not affected by cold at birth in either period (first period RR 0.84 [0.41-1.62], second period RR 1.26 [0.77-1.99]). In neither ethnic group, there was an association between cold prior birth and neonatal mortality.

Conclusions
In this pre-industrial society, Sami children appeared more vulnerable to extreme cold than non-Sami. This is most likely explained by their nomadic life style and a higher degree of exposure to outdoor climates during winter.
The impacts of anomalous temperature events on mortality outside the core of summer and winter

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In this research, relative extreme temperature events are defined using the percentile thresholds relative to the climatology for a particular time of year. Using the recently defined Excess Heat Factor, extreme heat events (EHE) and extreme cold events (ECE) are defined using absolute thresholds, and relative extreme heat events (REHE) and relative extreme cold events (RECE) using relative thresholds.

All-cause mortality outcomes using a distributed lag nonlinear model are evaluated for the largest 51 metropolitan areas in the US for the period 1975-2010. Both the immediate impacts and the cumulative 20-day impacts are assessed for each of the extreme temperature event types. The 51 cities were then grouped into 8 regions for meta-analysis.

For heat events, the greatest mortality increases occur with a 0-day lag, with the subsequent days showing below-expected mortality (harvesting) that decreases the overall cumulative impact. For EHE, increases in mortality are still statistically significant when examined through 20 days. For REHE it appears as though the day-0 increase in mortality is short-term displacement.

For cold events, both relative and absolute, there is little mortality increase on day-0, but the impacts increase in subsequent days. Cumulative impacts are statistically significant at more than half of the stations for both ECE and RECE. The response to absolute ECE is strongest, but to autumn RECE across a number of southern locations there is a statistically significant increase in mortality, suggesting that there may be a lack of acclimatization increasing mortality in early season cold events.
Association of ambient temperature with lung function of school children living in tropical climatic conditions.

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Little is known about the effects of acute exposure ambient temperature on lung function, especially in locations with a tropical environment. The current study evaluated the effects of acute ambient temperature on lung function in children in Dhaka, Bangladesh.

The study was conducted in three schools located in three cities inside and around Dhaka. Repeated lung function measurements were obtained from a panel of 315 school children aged 9-16 years in 2013. Linear mixed-effects models adjusted for potential confounders were used to examine the effect of ambient temperature on lung function.

Acute exposure to low ambient temperature was associated with a significant decrement in children’s lung function. For each 10 C decrease in daily mean temperature at cumulative lag of the current and previous day, lung function parameter values were -3.02% (95% CI, -1.69 to -4.35) for peak expiratory flow (PEF), and -1.48% (95% CI, -0.75 to -2.22) for forced expiratory volume within 1 second (FEV1). A significant seasonal variation was also observed in these associations, as the estimated adverse effects of low daily mean temperature on lung function measures were primarily evident in winter.

Although the magnitude of the effects varied between winter and summer, this study provides evidence that a decrease in temperature is an independent risk factor to the health of children living in an environment with a tropical climatic condition.
ASSOCIATION BETWEEN STROKE OCCURRENCE AND CHANGES IN ATMOSPHERIC CIRCULATION

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TPS 661: Climate change: temperature effects 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: The risk of stroke was associated mostly with changing weather. It is probable that the changes in the daily number of strokes may be associated with global changes in atmospheric circulation. According that we decided to detect the complex association between the daily numbers of ischaemic stroke (IS) and haemorrhagic stroke (HS) and daily North Atlantic Oscillation (NAO) and Arctic Oscillation (AO) and indices and monthly indices of Quasi-Biennial Oscillation (QBO).

Methods: The study was conducted in Kaunas city from 2000 to 2010. Kaunas stroke register presented the daily number of IS, subarachnoid haemorrhages (SAH), and intracerebral haemorrhages (ICH). We evaluated the association between types of stroke and NAO, AO, and QBO indices by applying Poisson regression, adjusting for month and significant weather variables.

Results: During the study period, we analysed 3992 cases (2205 men and 1787 women) with stroke. IS composed 3199 (80.1%), ICH 533 (13.4%), and SAH –260 (6.5%). A change in daily atmospheric pressure (AP) of >3.9 hPa from the previous day, cloud cover (CC)> 3.95, and strong east phase of QBO (QBO index<-27) were associated with an increased risk of SAH (RRs with 95% CI were, respectively, 1.54 (1.18-2.03), 1.47 (1.13-1.91), and 1.68 (1.06-2.66)). The risk of HS significantly associated with daily increases in AP, CC >3.95, and the stronger west phase of QBO (QBO index>8.37) has a protective impact on the risk of HS. The risk of IS negatively associated with AO index (RR=0.97 (0.94-0.99). During November-March, positive NAO associated with HS (RR=1.29 (10.03-1.62)), and a negative association between NAO index and IS (RR=0.91 (0.84-0.98)) was found.

Conclusions: The results of our study provided new evidence that the NAO, AO, and QBO pattern may affect the risk of stroke. The impact of these teleconnection indices is not identical for different types of stroke.
Time-series analysis of hot temperatures and mortality in Ahmedabad, 1987 to 2017

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TPS 661: Climate change: temperature effects 1, August 26, 2019, 3:00 PM - 4:30 PM

Introduction: Few studies have examined the impact of heat wave on mortality in developing countries most at risk due to warmer climate.

Methods: We collected daily data on all-cause mortality and air temperature in Ahmedabad, India from 1987 to 2017. We used quasi-Poisson regression models to estimate associations of mortality-heat wave and mortality-temperature over lags of 0-2 days, adjusting nonlinear confounding effects of relative humidity, long-term trend and seasonality. We considered different heat wave definitions as a period of ≥ 2 or 3 consecutive days with daily maximum, minimum, or average temperature exceeding the 95th, 96th, 97th, 98th, or 99th percentile. Models performance was evaluated by one-step time series cross-validation. Effect modifications by age, gender, and residential zone were examined.

Results: The model with daily maximum and minimum temperature, and without the indicator for heat wave gave the lowest root mean square error of cross-validation. The maximum and minimum temperature at lag 0 and lag 1-2 periods were statistically significantly associated with all-cause mortality. When the analysis was restricted to days with maximum temperature above 42 °C and minimum temperature above 28 °C, where dose-response curves were almost linear, an increase of 1 °C in maximum and minimum temperature at lag 0 were associated with increases in all-cause mortality of 9.6% [95% confidence interval (CI): 6.6%-12.6%] and 9.8% (95% CI: 6.3%, 13.4%), respectively. Females, older subjects, and those living in South Zone were more susceptible to high temperatures.

Conclusions: Results indicate that including an indicator for heat wave in the model lead to overfitting. Both daily maximum and minimum temperature had substantial adverse effects on mortality, particularly above certain thresholds. These findings may have important policy implications on developing threshold for activating excessive heat warning system, and designing of new plans for underdeveloped regions lacking the systems.
Abstract:
Background Fine particulate matter (PM2.5) exposure has been associated with hypertension, but no previous study has examined the association between longitudinal PM2.5 exposure and new subsequent hypertension. Currently, methods for lag day selection in evaluating short-term and long-term effect is still debatable and dose-response curves diverse even in same study with different lag day, which indicates the instability of previous lag day selection. We aimed to examine whether longitudinal trajectories of ambient PM2.5 concentration are associated with new onset of hypertension in Yinzhou, China.
Methods We used Cox-GAM (Generalized Additive Model) joint models to estimate effects of longitudinal PM2.5 on hypertension in a perspective cohort study. Dose-response analysis were also conducted in this study. A total of 26,249 participants were enrolled in this study.
Results The total number of visits calculated in current study was 525,635. Dose-response curves fit with smooth splines showed the non-linear relationships between PM2.5 and hypertension. PM2.5 showed adverse effects on hypertension when its concentration was above 40μg/m3.
Conclusions We found that PM2.5 tended to act as a protective factor when exposed with concentration between 25μg/m3 and 40μg/m3. Hierarchical analysis further indicated the robustness of our estimates.
Exposure to ambient volatile organic compounds in an area with excess cancer and asthma morbidity

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background: The Haifa Bay Area (HBA) has been documented to experience relatively high morbidity from asthma and cancer. Previously, association with emissions from industrial facilities in the HBA has been examined. However, ambient concentrations of fine particulate matter, nitrogen oxides and BTEX (benzene, toluene, ethylbenzene and xylene) are lower in HBA than in other districts (such as the Tel-Aviv area). It has been proposed that this discrepancy may possibly result from unmeasured concentrations of certain volatile organic compounds and/or heavy metals, which are uniquely emitted by industrial facilities and are not characteristic of traffic, such as 1,2-dichloroethane and Isoamyl alcohol. A list of such compounds was formulated by the regulatory bodies and bi-weekly measurements began in 2015.

Methods: Data on 25 distinct pollutants was collected from 30 locations spread within and outside of HBA. The measurements were generally performed on a bi-weekly basis from the start of 2015 until the end of 2018. The annual mean measurements within HBA were compared to those in other regions using a Mann-Whitney U-test.

Results: A preliminary analysis indicates that there are significantly lower concentrations of butadiene, benzo(a)pyrene, and trichloroethylene in HBA than in other regions. The only pollutant whose concentrations seem to be significantly higher in HBA is particulate vanadium, which is commonly emitted into the atmosphere by metallurgical industries, oil refineries and the combustion of fossil fuels. No significant differences were found in the concentrations of the remaining 21 pollutants.

Conclusion: The excess morbidity in the HBA was not found to be related to ambient air pollution. Future research of this issue should perhaps focus on indoor exposures and explanatory variables rather than on ambient air pollution.
Exposure to PM2.5 and its association with Type 2 Diabetes Mellitus in adults of Mexico City Metropolitan Area

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Mexico City Metropolitan Area (MCMA) has reached PM2.5 concentrations that exceed the WHO recommendations. Recent evidence shows that PM2.5 exposure is directly related to Diabetes Mellitus type 2 (DM2) incidence and prevalence. Therefore, the aim of the present study was to evaluate the association between exposure to PM2.5 and DM2, based on two sources of information of the pollutant, under two epidemiological approaches, in a representative sample of the MCMA.

We studied population ≥20 years, of both sexes living in the MCMA who participated in the National Health and Nutrition Survey (ENSANUT) in 2006 and 2012. The information was analyzed under two approaches: 1) cross-sectional analysis in 2006 and 2012 with representativeness for the MCMA and 2) nested case-control analysis in cross-sectional studies. PM2.5 concentrations were estimated at residence level using two data sources: monitors and satellite. Logistic regression models were used to evaluate the association between variables.

PM2.5 exposure was higher than recommended by the WHO and local standards. We observed a small trend to positive associations with satellite information in cross-sectional studies; however, under the monitor information and the nested case-control analyses, the results tended to a nullity. We were unable to detect greater differences due to small temporal and spatial exposure variability observed in 2006, 2012 and 2 years prior to DM2 diagnosis.

This is one of the first studies to describe PM2.5 exposure at this level and to evaluate this association in MCMA. Even though studies in other countries have found a positive association between these variables, our findings suggest that both, subjects with DM2 and those who do not present it, are exposed to similar PM2.5 concentrations. Population residing in MCMA is highly exposed to PM2.5, therefore they are at risk of suffering other complications related to this pollutant. Further research and monitoring are advised.
Long-term exposure to ambient air pollution and marker of inflammation and cardiovascular risk in Chinese older adults.; Data from WHO study on AGing and Adult Health (SAGE) wave1.

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background:

Air pollution is associated with cardiovascular disease, and systemic inflammation may mediate this effect. We assessed associations between long-term concentrations of ambient air pollution and C-reactive protein (CRP) in Chinese older adults.

Methods:

We used two-level linear regression models to examine the associations of particulate matter (PM), and nitrogen dioxide (NO2) on log-transformed CRP concentrations adjusted for confounders, among 7915 older Chinese adults enrolled in WHO Study on global AGEing and adult health (SAGE) China Wave1 in 2007-2010 from 64 townships. The average community exposure to ambient air pollutants (PM with an aerodynamic diameter of 10 μm or less [PM10], 2.5 μm or less [PM2.5], 1 μm or less [PM1] and nitrogen dioxide [NO2]) for each participant was estimated using a satellite-based spatial statistical model. CRP levels were measured for participants from dried blood spots. Potential effect-modifiers were examined by interaction terms, and two-pollutant models were calculated for pollutants with Spearman inter-correlation<0.70.

Results:

Single pollutant models using three years moving average pollutant exposure showed strong positive significant associations with CRP. An IQR increase in pollutant concentrations was associated with a CRP increase of 27% (95% CI: 19%, 35%) for PM1, (IQR: 23.7 u/m3), 46% (95% CI: 31%,63%) for PM2.5 (IQR 26.8 u/m3), 46% (95% CI: 31%, 61%) for PM10 (IQR 29.6 u/m3), and 28% (95% CI: 19%, 39%) for NO2 (IQR 21.4 u/m3). In two-pollutant models, adjustment for NO2 attenuates the effect estimates for PM10 (6.3% increase per 2000 particles/cm3 [95% CI: 0.4%; 12.5%]).

Conclusions:

This study adds to the growing body of literature showing associations between long-term exposure air pollution and inflammatory response in randomly selected Chinese older adults, which may contribute to the increased cardiovascular risk caused by air pollution.
Physical activity, long-term exposure to particulate matter, and risk of cardiovascular disease in women

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background: The positive association between physical activity and risk of cardiovascular disease (CVD) and the negative association between air pollution exposure and CVD risk are well established. However, increased respiration during physical activity may increase exposure to air pollutants, which may blunt the protective effects of physical activity. We aimed to assess the impact of long-term exposure to particulate matter (PM) on the association between physical activity and CVD in U.S. women.

Methods: We followed 113,325 female participants of the nationwide, prospective Nurses’ Health Study from 1988-2008 by biennial questionnaire. We determined Incident CVD (myocardial infarction and stroke) by medical record review or the National Death Index. We obtained information on physical activity and potential confounders through the questionnaires and calculated time-varying 24-month average exposure to PM₂.₅ based on residential address history. Physical activity was grouped into quintiles of MET-hours/week. We used Cox proportional hazards models to assess the main effects of physical activity and PM₂.₅ exposure and the interaction of the two on CVD risk, after adjusting for demographics, CVD risk factors, diet, and individual and area-level socioeconomic status.

Results: In models adjusting for potential confounders, increasing physical activity was associated with decreased risk of CVD (Hazard ratio (HR) for fifth quintile (≥42 MET-hrs/wk) compared to first quintile (<3 MET-hrs/wk): 0.62, 95% confidence interval [CI]: 0.55-0.69; p-value for trend: <0.01). As expected, PM₂.₅ was positively associated with risk of CVD (p-value for trend: 0.04). The interaction between physical activity and PM₂.₅ exposure was not statistically significant (p=0.8) and there was little change in the beneficial effects of physical activity on CVD risk, even in the highest PM₂.₅ exposed women (≥42 MET-hrs/wk and ≥16.7 μg/m³ HR=0.73, 95%CI: 0.55-0.95).

Conclusions: These results suggest that increasing exposures to PM₂.₅ do not blunt the benefits of physical activity on CVD risk.
Associations between air pollution and cardiovascular disease in the Taipei City

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Air pollution is known to affect human health. We conducted a study to explore the associations between different air pollutants and cardiovascular disease (CAD) in the Taipei City in Taiwan.

Method: In this study, the numbers of outpatient visits on each day between January 1, 2006 and December 31, 2010 were obtained from the National Health Insurance Research Database, which includes the information on all the claims from a random sample of one million people in Taiwan. The daily outpatient visits were divided into four groups according to the quartiles (Q1, Q2, Q3, and Q4). The Taiwan Environmental Protection Administration has a total of five air quality monitoring stations in Taipei, and we obtained data on ambient levels of carbon monoxide (CO), nitrogen dioxide (NO2), ozone (O3), and particulate matters less than 2.5 microns (PM2.5) and 10 microns (PM10) in diameter. Poisson regression analysis was used to evaluate the associations between the daily pollutants concentrations and the number of outpatient visits for CAD.

Results: During the study period, the cohort members paid a total of 191,974 CAD outpatient visits. We observed positive associations between the number of outpatient visits for CAD and levels of CO, NO, PM2.5, and PM10 (all with p < 0.001). Conclusions: This study provides evidence supporting the effects of CO, NO, PM10, and PM2.5 on CAD. Further studies should be conducted to identify the high risk populations.
Long term exposure to air pollution and atherosclerotic plaques in the Malmö Diet and Cancer Cohort


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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background
Long-term exposure to air pollution increases the risk of cardiovascular morbidity and mortality, but the mechanism is not fully known. It has been suggested that air pollution exposure contributes to the development of atherosclerosis, such as carotid artery plaques, a well known precursor of cardiovascular disease.

Methods
A Swedish population-based cohort (age 46–67 years) was recruited within the Malmo Diet and Cancer study between 1991 and 1994, of which 6103 underwent ultrasound examination of the right carotid artery. The definition of carotid artery plaque was “a focal thickening of the intima-media complex of >1.2 mm and with an area of ≥10 mm²”. Also intima-media thickness (IMT) was measured (1 cm proximal to the bifurcation). Participants were assigned individual residential air pollution exposure (source-specific PM2.5, PM10, NOx, BC) at recruitment from Gaussian dispersion models. Logistic and linear regression was used to examine associations between air pollution and the prevalence of carotid artery plaques, and IMT, adjusted for potential confounders and usual cardiovascular risk factors.

Results
The prevalence of carotid plaques was 34%. The mean levels of PM2.5 and PM10 at recruitment were about 10 and 14 µg/m³, most of which was due to long range transport. The mean NOx level was 39 µg/m³, most of which was due to local emissions. There was only a limited and non-significant association between PM2.5 and plaque prevalence (OR: 1.07, 95% CI 0.91 – 1.26, per µg/m³), and no association with PM10, NOx or BC. There was also no significant linear trend between plaque and air pollution levels in quartiles. There was a slight positive association between IMT and PM2.5, but not statistically significant.

Conclusions
Overall we found only limited support for the hypothesis that air pollution exposure for PM10, PM2.5, BC or NOx increases the risk of atherosclerosis in the carotid arteries.
Impacts of birth season on the burden of hypertension related to ambient ozone exposure in a coastal city in South China

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background Growing number of epidemiological studies have found ambient ozone is associated with increased cardiovascular mortality, including hypertension. Birth season is an important factor which reflects the environmental and maternal conditions during early development which will exert long-term effects on health. However, the impacts of birth season on the burden of hypertension related ambient ozone exposure have never been explored, especially in the elderly.

Methods A time-series study was conducted to explore the effects of ozone exposure on the burden of hypertension using years of life lost (YLL) in the elderly in Ningbo, China, 2013-2016. The modification of birth season was explored by stratified analysis, and the differences among seasons were detected by subgroup comparisons.

Results Averaged daily mean maximum 8-h average ozone concentration was 93.3 μg/m³ during the study period. Ozone exposure was significantly associated with increased burden of hypertension. And when the results were stratified by the birth season, YLL from hypertension related to ozone exposure was significantly higher in people who were born in autumn than those born in other seasons. To be specific, the largest effect was found at mv06 (moving average concentrations from day 0 to day 6), per 10 μg/m³ increase in ozone was associated with 0.68 (95%CI: 0.27, 1.10) years increase in YLL from hypertension in people born in autumn, while non-significant associations were found in those born in other seasons.

Conclusions The effects of ozone on the burden of hypertension were significantly influenced by birth season. Those who born in autumn have higher risk may due to their mother’s pregnant time is winter when the cold weather and generally higher air pollution level can lead to higher blood pressure. The results indicated birth season should be considered when exploring the health effects of ozone exposure.
Short-term and long-term effect of air pollution and its susceptibility factors on glucose metabolism in Korean adults: KNHANES study

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background
The role of air pollution in the pathogenesis of diabetes has been presented by recent studies. We have carried out an epidemiological study on glucose metabolism and air pollution by exploration of level of fasting blood glucose (FBG) and hemoglobin A1c (HbA1c) with changes in air quality, depending on the characteristics of susceptible group.

Methods
We conducted a cross-sectional analysis on 10,014 representative national sample of adults (4,267 males and 5,747 females) from Korea National Health and Nutrition Examination Survey after combining with the Korean Air Quality Forecasting System data. We performed the analysis using the generalized linear model stratified by sex, age, presence of diabetes and obesity. We assessed the change of FBG and HbA1c associated with exposure to short-term and long-term exposure to particulate matter (PM10), fine particulate matter (PM2.5) and nitrogen dioxides (NO2).

Results
There were 1,110 subjects of diabetes and 3,263 of obesity. Overall, the level of FBG elevated 7.83 mg/dL [95% confidence interval (CI): 2.80-12.87] per interquartile range (IQR) increment of NO2 at lag6 and HbA1c increased 0.57% (95% CI: 0.04-1.09) per IQR increment of PM10 at moving average 0 to 60 days. The change of FBG and HbA1c increased higher in diabetes and obese group, especially in 65 years or over in male. There was a strong association between the increase of diabetic-related factors due to exposure to air pollution.

Conclusions
Our study adds scientific evidence that exposure to short-term and long-term exposure to air pollution is associated with biological factors related with diabetes. This suggests that the impact of air quality should be reflected in aspects of chronic disease management when establishing local health care policies.
Public Health Impact Assessment of Asian dust in Japan
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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background: Long-range transboundary air pollution has become as one of global health issues. One of the key contributors to global aerosol loadings is “Dust particles” and “Asian dust” is observed in Asian countries. Epidemiologic studies have reported that increase of Asian dust concentration cause short-term effects. However, there are no study that evaluated the public health impacts of Asian dust. Therefore, we calculated the public health impacts of Asian dust in Japan.

Method: We selected 10 prefectures, where light detection and ranging (lidar) measurement sites were located, and obtained daily mean concentrations of Asian dust using lidar in 2015. We estimated the attributable number of all-causes of mortality caused by short-term exposure to Asian dust above the defined reference level for elderly residents (≥ 65 years). We used four scenarios that reduced the daily mean values to reference levels: 1) less than heavy concentration (100 μg/m³), 2) less than moderate concentration (60 μg/m³), 3) less than mild concentration (30 μg/m³), and 4) non-Asian dust, respectively. The relative risks were obtained from the previous multicity Asian-dust study (pooled relative risks: 1.003).

Results: Among the elderly (n=986,2177), total death was 333,934 (33,860 per 1 million). In the scenario 1, 7 deaths (95% CI: 2–11) would be preventable at the reference level of 100 μg/m³. In the scenario 2, 30 deaths (10–50) would be preventable at the reference level of 60 μg/m³. In the scenario 3, 116 deaths (39–194) would be preventable at the reference level of 30 μg/m³. This early deaths corresponds to 0.03% of mortality among elderly. In the scenario 4, 1025 deaths (342–1709) would be preventable at the reference level of 0 μg/m³. This early deaths corresponds to 0.3% of mortality.

Conclusion: Current transboundary air pollution, “Asian dust”, levels in Japan have a nonnegligible public health impact.
Critical periods for long-term exposure to PM10 associated with incident cardiovascular diseases

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

While increasing numbers of cohort studies have examined the association between long-term exposure to ambient particles and incident cardiovascular diseases (CVDs), there were little knowledge about an exposure period that critically affects the association. We aimed to compare four exposure periods to identify a critical period of exposure to particulate matter diameter less than or equal to 10 μm (PM10) associated with incident CVDs in a population-representative national cohort in South Korea. We used the National Health Insurance Service-National Sample Cohort (NHIS-NSC) that provides medical records, risk factors based on health screening, and annually-updated address information for one million people from 2002 to 2015 in South Korea. Our study population was restricted to 196,167 subjects who were aged 30-84 in 2007, underwent health screening for 2005-2007, and had not been diagnosed with any circulatory diseases for 2002-2006. Total CVDs consisted of ischemic heart disease, myocardial infarction, stroke, and heart failure, and the incidence was defined as the first diagnosis for 2007-2015. Using annual-average concentrations of PM10 at subjects’ district-specific addresses predicted by a previously-developed exposure prediction model, we calculated a long-term concentration of each subject for four periods: three periods for 1, 3, and 5 years prior to each CVD incidence and the fixed 5-year period for 2002-2006. We applied time-dependent and time-fixed Cox regressions to three time-varying exposures and one time-fixed exposure, respectively, and estimated adjusted hazard ratios (HR) of incident CVDs per a 10 μg/m3 increase in PM10. PM10 exposed for all three person-specific periods was marginally associated with incident CVD, while the 5-year exposure gave the highest HR (HR=1.04, 95% confidence interval=1.00-1.10). However, we did not find an association when early exposure for the fixed 5 years was used. This study suggests that recent exposure to PM is more responsible for incident CVD than early exposure.
Children's microvascular traits and air pollution exposure: prospective evidence to elucidate the developmental origin of particle-induced disease

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background: Particulate matter air pollution exposure during in utero development may entail adverse health outcomes later in life. The microvasculature undergoes extensive, organ-specific prenatal maturation. There is a growing body of evidence that cardiovascular disease in adulthood is rooted in a dysfunctional fetal and perinatal development, in particular that of the microcirculation.

Objectives: We investigate whether prenatal or postnatal exposure to PM2.5 or NO2 air pollution is related to microvascular traits in children at the age of four.

Methods: In young children (mean age 4.6 ± 0.4), followed longitudinally within the ENVIRONAGE birth cohort, we measured the retinal microvascular diameters, the central retinal arteriolar equivalent (CRAE) and central retinal venular equivalent (CRVE), and the curvature of the vessel system by means of the tortuosity index (TI). We modelled prenatal and postnatal PM2.5 (particulate matter with a diameter ≤ 2.5 µm) and NO2 exposure levels for each mother’s home address using a high resolution spatiotemporal model.

Results: An interquartile range (IQR) increase in prenatal PM2.5 exposure was associated with a 3.64 µm (95% CI: -0.07 to 7.41; p = 0.05), increase in CRVE and a 2.83 µm (95% CI: 0.05 to 5.61; p = 0.05) higher CRAE. Prenatal NO2 exposure was also associated with a widening of both the CRVE and CRAE. In addition, an augmented TI was observed in association with prenatal NO2 exposure. For postnatal exposure, we observe a short-term exposure effect of PM2.5 on the CRAE and a life-time exposure effect of NO2 on the CRAE, CRVE and TI.

Conclusions: Our results link both prenatal and postnatal particulate matter air pollution exposure with changes in children’s microvascular traits as a fundamental novel mechanism to explain the developmental origin of cardiovascular disease by ambient air pollution.
Assessing the Association between Pre- and Postnatal Air Pollution Exposures and Childhood Blood Pressure: Results from the CANDLE study

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background:
Limited data suggest traffic derived air pollution may contribute to pediatric hypertension, a known predictor of adult cardiovascular diseases. We investigated associations of pre- and postnatal air pollution exposures with early childhood blood pressure in an ongoing predominately African American, urban cohort in Tennessee (CANDLE - Conditions Affecting Neurocognitive Development and Learning in Early childhood).

Methods:
Mother-child dyads (N=816) who completed the age 4-6 years follow-up visit were included. Systolic (SBP) and diastolic (DBP) blood pressure percentile incorporating sex, age and height was categorized as elevated (90th-95th percentile) or hypertensive (≥95th percentile). Pre- and postnatal exposure to NO2 was predicted based on an annual average land-use regression model with spatial smoothing. We also estimated residential distance to nearest roadways. Poisson and linear regressions were conducted with adjustment for demographic and socioeconomics factors (encompassing education, marital status, income and neighborhood level indices), anthropometric measurements, maternal behaviors, medication use and calendar time at visit. Interaction by child sex was assessed.

Results:
Mean pre- and postnatal NO2 exposures were 10.0 and 8.7 µg/m3 respectively, and a quarter of participants lived within 150-meters of major roadways. Postnatal residence within 150-meters from roadways was associated with diastolic hypertension (Relative Risk (RR):1.50, 95% Confidence Interval (CI):1.07-2.11), even after adjustment for prenatal road proximity. Association was observed among boys (RR:1.93, 95%CI:1.32-2.84), but not girls (RR:0.87, 95%CI:0.46-1.67, P interaction=0.010). No significant effect of pre- or postnatal NO2, or prenatal residence to roadways on child blood pressure was detected.

Conclusions:
Using two measures of traffic derived pollutant, we found some evidence for an adverse influence of postnatal proximity to traffic on diastolic hypertension, particularly among boys. Continued follow up of this cohort as part of the Environmental Influences on Child Health Outcomes (ECHO) PATHWAYS consortium will allow consideration of effects in mid-childhood.
Identifying critical windows of prenatal particulate air pollution exposure and children’s blood pressure at age 4-6


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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

**Background:** Exposure to air pollution is associated with increased blood pressure (BP) in adults and children. Limited evidence suggests that air pollution exposure during the prenatal period may contribute to adverse cardio-renal health later in life. Here we apply a distributed lag model (DLM) approach to identify critical windows that may underlie the association between prenatal particulate matter ≤ 2.5 μm in diameter (PM2.5) and children’s BP at age 4-6 years.

**Methods:** Participants included 537 mother-child dyads enrolled in the longitudinal cohort study Programming Research in Obesity, GRowth, Environment, and Social Stress (PROGRESS) based in Mexico City. Prenatal daily PM2.5 exposure was estimated using a validated satellite-based spatio-temporal model and BP was measured using the automated Spacelabs system with a sized cuff. We used DLMs to examine associations between daily PM2.5 exposure and systolic BP (SBP), adjusting for child’s age, sex and BMI, as well as maternal education and indoor smoking report during the second and third trimester.

**Results:** We found that PM2.5 exposure between weeks 17 to 35 of gestation (days 115 to 244) was significantly associated with children’s increased SBP. To place this into context, a constant 10 μg/m³ increase in PM2.5 sustained throughout this critical window would predict a cumulative increase of 1.4 mmHg (CI: 0.3, 2.5) in SBP at age 4-6. In a stratified analysis by sex, this association persisted in boys but not in girls.

**Conclusions:** Second and third trimester PM2.5 exposure may increase children’s BP. Further work investigating PM2.5 exposure with BP and kidney function changes later in childhood will be important to understanding cardio-renal trajectories that may predict adult disease. Our results underscore the importance of reducing air pollution exposure among susceptible populations.
Traffic exposures, air pollution and outcomes in pulmonary arterial hypertension: a United Kingdom cohort study analysis

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim

While traffic and air pollution exposure is associated with increased mortality in numerous diseases, its association with disease severity and outcomes in pulmonary arterial hypertension (PAH) remains unknown.

Methods

Exposure to particulate matter ≤2.5μm3 (PM2.5), nitrogen dioxide (NO2) and indirect measures of traffic-related air pollution (distance to main road and length of roads within buffer zones surrounding residential addresses) were estimated for 301 patients with idiopathic/heritable PAH recruited in the UK PAH national Cohort study. Associations with transplant-free survival and pulmonary hemodynamic severity at baseline were assessed, adjusting for confounding variables defined a priori.

Results

Higher estimated exposure to PM2.5 was associated with higher risk of death or lung transplant (Unadjusted hazard ratio (HR) 2.68;95%CI 1.11-6.47 per 3μg/m3,p=0.028). This association remained similar when adjusted for potential confounding variables (HR 4.38;95%CI 1.44-13.36 per 3μg/m3,p=0.009). No associations were found between NO2 exposure or other traffic pollution indicators and transplant-free survival. Conversely, indirect measures of exposure to traffic-related air pollution within the 500-1000m buffer zones correlated with the ERS/ESC risk categories as well as pulmonary hemodynamics at baseline. This association was strongest for pulmonary vascular resistance.

Conclusions

In idiopathic/heritable PAH, indirect measures of exposure to traffic-related air pollution were associated with disease severity at baseline, whereas higher PM2.5 exposure may independently predict shorter transplant-free survival.
Long-term exposure to outdoor air pollution and risk factors for cardiovascular disease within a cohort of older men in Perth

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Background

While there is clear evidence that high levels of pollution are associated with increased all-cause mortality and with increased cardiovascular mortality and morbidity, the biological mechanisms that would explain this association are poorly understood. We examined the association between long-term exposure to air pollutants with blood pressure and other risk factors associated with cardiovascular disease (CVD).

Methods

A cross-sectional analysis of the risk factors and measures of outdoor air pollution was undertaken. Air pollutant concentrations were estimated at place of residence for cohort members in the Western Australian Health In Men Study. Blood samples and blood pressure measures were taken for a 4249 men aged 70 years and above between 2001 and 2004. We examined the association between 1-year average pollutant concentrations (fine particulate matter, black carbon, nitrogen dioxide, and nitrogen oxides) with systolic blood pressure, diastolic blood pressure, cholesterol (high and low-density lipoprotein), triglycerides, high sensitivity C-reactive protein, and total homocysteine. Linear regression analyses were performed, with adjustment for potential confounders, as well as assessment of effect modification.

Results

After controlling for potential confounders, we found that a 2.25 µg/m3 higher exposure to fine particulate matter (PM2.5) was significantly associated with a 1.4 percent lower high-density cholesterol (95% confidence interval: -2.5 to -0.2) and 4.2 percent higher serum triglycerides (95% confidence interval: 1.7 to 6.7). The strength of these associations was not modified by age, BMI, or socioeconomic status. We found no evidence of an association between any of the remaining risk factors with measures of outdoor air pollution.

Conclusions

These findings indicate that long-term exposure to fine particulate matter is associated with elevated serum triglycerides and decreased HDL cholesterol. This warrants further investigation to better understand the potential role that these risk factors have in mediating effects of air pollution on CVD.
Estimating joint effects of ambient air pollution on cardiovascular morbidity in the elderly U.S. population

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background
While ambient air pollution is a complex mixture, few studies have estimated joint effects of multiple pollutants or evaluated their heterogeneity across a large geographic region. We estimated joint effects of short-term exposures to air pollutant combinations on cardiovascular morbidity in the elderly U.S. population.

Methods
Across 79 core-based statistical areas (CBSAs) with >500,000 population, we obtained daily counts of cardiovascular hospital admissions (CVD-HA) among the 65+ year-olds from the Medicare Services. Daily concentrations of ambient air pollutants were obtained from U.S. Environmental Protection Agency’s Air Quality System during 1999-2010. In a time-series framework controlling for temporal trends and meteorology, we estimated joint effects of PM2.5, CO, NO2, SO2, and O3 on CVD-HA using multi-pollutant Poisson models in each CBSA. Individual pollutant effects were estimated using single-pollutant models. We computed I-square statistics to evaluate heterogeneity of effect estimates across CBSAs. Random-effect meta-analysis examining between-CBSA heterogeneity and obtaining national estimates are underway.

Results
Across CBSAs, mean daily counts of CVD-HA ranged from 5 to 249. Mean daily concentrations ranged from 6.39-20.01 ug/m3 (PM2.5), 0.37-1.41 ppm (CO), 9.62-43.36 ppb (NO2), 0.67-24.00 ppb (SO2), and 0.02-0.05 ppm (O3). Using single-pollutant models, the estimated rate ratios per interquartile-range-increase ranged from 0.93-1.03 (PM2.5), 0.89-1.15 (CO), 0.87-1.08 (NO2), 0.89-1.04 (SO2), and 0.95-1.02 (O3) across CBSAs. Using multi-pollutant models, joint effect estimates (i.e., rate ratios per interquartile-range-increase of five pollutants together) ranged from 0.93-1.06. I-square statistics suggested that joint effect estimates were more homogeneous across CBSAs (I-square =0.42) than individual-pollutant effects estimated by single-pollutant models (I-square from 0.81-0.98).

Conclusions
Our findings could help advance the understanding of health effects of air pollution mixtures and inform multi-pollutant air quality management.

The views expressed in this presentation are those of the authors and do not necessarily represent the views or policies of the U.S. Environmental Protection Agency.
Longitudinal associations of air pollution with biomarkers of inflammation and insulin resistance

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TPS 671: Cardiometabolic effects of long-term air pollution exposure, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Exposure to ambient air pollution has been associated with higher levels of systemic inflammation and insulin resistance (IR). However, the epidemiological evidence is inconsistent and mostly from cross-sectional studies. We investigated effects of long-term air pollution exposure on biomarkers of systemic inflammation and IR measured up to three times.

Methods: We used repeated measures of plasma high-sensitivity C-reactive protein (hsCRP), glycosylated haemoglobin (HbA1c), and homeostatic model assessment of IR (HOMA-IR) collected at three clinical examinations in the KORA study (Augsburg, Germany) between 1999 and 2014. Annual average concentrations of different size fractions of particulate matter (PM), particle number concentration, nitrogen oxides (NOx), and ozone at each participant residence were estimated by land use regression models. We applied mixed-effects models with random participant intercepts to assess associations of long-term air pollution exposure with biomarkers and linear regression models to assess associations with the annual rate of change in biomarkers adjusting for potential confounders.

Results: We included 9,536 observations from 4,232 participants aged 25 to 75 years at baseline. Elevated concentrations of PM and NOx were associated with higher levels of all three biomarkers. For example, an increase of 1.36 μg/m3 in PM between 2.5 and 10 μm in diameter (PMcoarse) was associated with an increase of 3.1% (95% CI: -0.2%; 6.6%) in hsCRP, of 0.4% (95% CI: 0.0; 0.9%) in HbA1c, and of 2.6% (95% CI: 0.5%; 4.8%) in HOMA-IR. Ozone was only positively associated with HOMA-IR. Our results also indicated an accelerated annual rate of increase in HOMA-IR associated with air pollution, which was statistically significant for PMcoarse.

Conclusions: Long-term exposure to ambient air pollution was associated with higher blood levels of hsCRP, HbA1c, and HOMA-IR, as well as an accelerated annual increase in HOMA-IR, indicating adverse health effects of air pollution on systemic inflammation and IR.
TPS 681: Short-term health effects of air pollutants 1
A systematic review and meta-analysis of the effect of landscape fire smoke particulate matter (PM) on asthma-related outcomes

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Background: Asthma-related outcomes are among the most reported from human exposure to landscape fire smoke. Robust summary estimates are required to adequately inform health protection policy.

Objective: To obtain summary estimates of the association between fine particulate matter (PM2.5) from landscape fire smoke and asthma-related outcomes.

Methods: We conducted a systematic review and meta-analysis following PRISMA guidelines and registered the protocol in PROSPERO. Four databases (PubMed, Medline, EMBASE and Scopus) and reference lists of recent fire smoke and health reviews were searched. The Newcastle-Ottawa Scale was used to evaluate the quality of case-crossover and cohort studies, and a previously validated quality assessment framework was used for time series and ecological studies. Summary estimates were obtained for hospitalisations and emergency department (ED) visits. A descriptive analysis was done for physician visits and medication use. Publication bias was assessed using funnel plots and Begg’s Test. The trim and fill method was used when there was evidence of publication bias. Sensitivity and influence analyses were conducted on all endpoints to test robustness of estimates. Analyses were conducted in R version 3.5.1.

Results: From an initial 181 articles (after duplicate removal), eighteen studies were included for the quantitative assessment. Fire smoke PM2.5 concentrations were positively associated with asthma hospitalisations (RR= 1.06, 95%CI: 1.03-1.09) and ED visits (RR=1.07, 95%CI: 1.03-1.09). Subgroup analyses found larger positive associations in adults aged over 65 years but not children for hospital admissions; and for all females, and adults aged over 65 years for ED visits. High heterogeneity between studies was observed, but results were robust to sensitivity analysis.

Conclusions: Results for all ages and both genders are positive, but these seem to be driven by strong positive associations for all females and adults aged over 65 years. Risk estimates were higher than those reported for exposure to urban PM2.5.
A Multi-Pollutant Air Quality Health Index (AQHI) Based on Short-Term Respiratory Effects in Stockholm

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TPS 681: Short-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background/aim
In this study, an Air Quality Health Index (AQHI) is introduced to capture the health risks associated with multi-pollutant exposure. The index is intended for public information regarding the expected health risks associated with current or forecasted concentrations of pollutants and pollen.

Methods
The AQHI is based on an epidemiological study of daily emergency department visits for asthma (AEDV) and urban background concentrations of NOx, O3, PM10 and birch pollen in Stockholm. The index is calculated as:

\[ \text{AQHI} = \sum (i=1...p) \left( 100 \left( e^{\beta_i X_i} - 1 \right) \right) \]

where the beta-coefficient \((\beta_i)\) represents the increase in AEDV per 1 µg m\(^{-3}\) increase of each individual air pollutant \((X_i)\). For birch pollen it is the increase per one pollen per cubic meter. The beta-coefficients are based on all age groups, and the exposure window is lag01 (mean of same day and yesterday).

Results
The epidemiological analysis showed per 10 µg m\(^{-3}\) increase an increase in AEDV of 0.5%, 0.3% and 2.5% for NOx, O3, and PM10, respectively. For birch pollen, the increase was 0.26% per 10 pollen m\(^{-3}\). The AQHI increase associated with NOx exhibits an even distribution throughout the year, except for a decrease during the summer due to less traffic. O3 contributes to an increase in AQHI during the spring. PM10 reaches a peak during early spring due to road dust suspension and pollen also peak during the late spring/early summer. Total monthly mean AQHI during 2015–2017 varied between 4 and 9%, with a peak value of 16%. Based on daily mean values, the most important risk contribution during the study period is from PM10 with 2.9%, followed by O3 with 2.0%.

Conclusion
An AQHI based on asthma emergency department visits can provide the overall daily adverse risks of exposure to air pollutants and pollen especially for people suffering from respiratory diseases.
Air pollution and cardiovascular death in Tehran, Iran

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TPS 681: Short-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: There is evidence that shows exposure to air pollution can be related to cardiovascular deaths. This study aimed to estimate the effect of ambient air pollutants on cardiovascular deaths in Tehran, Iran; which is one of the most polluted cities in the world.

Methods: In this ecological study, air pollutant data was inquired from the air quality control units of municipalities and the Tehran Province Environmental Protection Agency. Meteorological data was enquired from the meteorological organization, and death data was inquired from the Tehran’s cemetery registration (Behesht-e-Zahra). Generalized Additive Models (GAM) were used for data analysis and Incidence Rate Ratios with different lags were calculated for up to 30 days.

Results: During 2005 until 2014, 215373 cardiovascular deaths happen in Tehran in which 122911 (57.07\%) were male. NO\textsubscript{2} and PM\textsubscript{10} were associated with total cardiovascular deaths. The strongest relationship between NO\textsubscript{2} and respiratory death was seen after 4 day lags (RR= 1.00106, 95\% CI: 1.00073-1.00140), and for PM\textsubscript{10} was seen on the same day (lag 0) (RR= 1.00053, 95\% CI: 1.00030-1.00076).

Conclusion: The result of this study showed that PM\textsubscript{10}, and NO\textsubscript{2} are probably responsible for part of the cardiovascular deaths that happen daily in Tehran. There should be more efforts to control air pollution in Tehran.
Dust storms and years of life lost in Seoul, South Korea: a distributed lag analysis

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TPS 681: Short-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Dust storms have been evaluated as a risk factor for human health. However, previous studies have estimated the effect of dust storms on absolute numbers of death without considering premature death. To set public health priorities and allocate resources within limited budgets, it is important to know the actual burden of an exposure-induced mortality. We aimed to estimate years of life lost (YLL) due to Asian dust storm (ADS) in Seoul, South Korea during 2002-2013.

We performed a time-series analysis using a generalized additive model with Gaussian distribution to investigate the association between daily YLL and ADS. We assessed both single and cumulative lag effects of ADS by using a distributed lag model up to 5 days. In a main model, daily YLL was regressed on the ADS variable (ADS day:1) with a distributed lag parameterization. We adjusted for 2-day average of weather variables (temperature, relative humidity, barometric pressure, and wind speed), calendar time, influenza epidemic, holidays, and day of the week. We used a spline function for calendar time (6 df), temperature (6 df), and other weather variables (3 df).

We identified 108 ADS events during study period. Exposure to ADS was significantly associated with increased YLL of non-accidental deaths. Specifically, daily YLL was increased by 48.5 years (95% CI: 3.0–94.1) at lag 2 and by 104.8 years (95% CI: 30.9–178.4) over lags 0–5. In disease-specific analyses, the association between ADS and YLL of cardiovascular mortality was significant at lag 2 (19.6 years [95% CI: 1.6–37.7]) and over lag 0–5 (34.5 years [95% CI: 4.1–64.8]), while that for respiratory mortality was significant at lag 3 (7.9 years [95% CI: 0.2–15.5]).

Exposure to ADS occurrences was associated with an increased YLL of non-accidental death. These findings could help establish public health priorities.
The Seasonal and Demographic Modification Effects on the Association Between Particulate Matter and Outpatient Visits for Acne in Beijing

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Abstract
Background/Aims
There is increasing evidence that exposure to air pollutants, including particulate matter (PM), might aggravate skin diseases such as acne. And epidemiological investigations show the seasonal and age characteristics of incidence of acne. Here we investigate if a possible link exists between PM and acne in different seasons and different demographic characteristics. We assessed the association between ambient PM concentrations and the number of visits of patients for acne to a dermatological outpatient clinic in Beijing, China, from Jan. 1, 2013 to Dec. 31, 2016.

Methods
In this time period, 12,333 outpatient visits were recorded because of acne. Daily air pollution parameters for PM10, PM2.5, SO2, NO2 and O3 were obtained from the Beijing Municipal Environmental Monitoring Center. The generalized additive model was used to test the effects of air pollution on the number of daily visits of acne patients to the clinic.

Results
(1) In Single-Air Pollutant Model, there were no significant associations between PM and outpatient visits. In Two-Air Pollutant Model, PM2.5 showed a steady significant association with the number of outpatient visits after the effect of SO2 or NO2 or CO was controlled.
(2) Age-sex stratification. PM2.5 showed a steady significant association with the number of 20-40 years old and female outpatient visits.
(3) Seasonal stratification. In spring, PM2.5 showed a steady significant association with the number of outpatient visits with or without control of the effect of SO2 or NO2 or CO or O3. In spring and autumn, PM10 showed a steady significant association with the number of outpatient visits.

Conclusions
Women and people aged 20 to 40 are sensitive to the effects of PM on the pathogenesis of acne. PM in the spring has obvious harmful effects on the pathogenesis of acne.
Non-accidental mortality risk of short-term exposure to fine particulate matter and its components in Tokyo


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Introduction

Our previous nationwide study has demonstrated the positive association between short-term exposure to fine particulate matter (PM2.5) and all-cause mortality for the fiscal years of 2012-2014. In Japan, therefore, continuing combating atmospheric environment is needed to minimise the health effects of PM2.5. Identifying specific components of PM2.5 that affect human health may link with effective improvement of environmental health through the countermeasure of PM sources. We examined the association of short-term exposure to PM2.5 components with non-accidental mortality in Tokyo.

Methods

This time-stratified case-crossover study included total non-accidental deaths in Tokyo’s 23 wards (area: 626.7 km²) from April 2013 to March 2017. The daily mortality data were obtained from the Ministry of Health, Labour and Welfare, Japan. We performed daily sampling of PM2.5 at a monitoring site located at the Tokyo Metropolitan Research Institute for Environmental Protection. These filter samples were analysed for concentrations of PM2.5 components, including organic carbon (OC), elemental carbon (EC), nitrate, sulphate, ammonium, chloride, sodium, potassium, and calcium. We applied a conditional logistic regression model to estimate the mortality risk for interquartile range (IQR) increase in concentrations of PM2.5 mass and components.

Results

Average PM2.5 mass concentrations during the study period was 16.0 μg/m³ (standard deviation = 8.9). In the single-component model, OC, EC, nitrate, sulphate, ammonium, potassium, and calcium were positively associated with total non-accidental mortality. After adjustment for PM2.5 mass, mortality was associated with OC (percentage increase per an IQR increase (1.6 μg/m³) at lag0-1 = 1.4% 95% confidence interval (CI) = 0.5-2.2) and EC (IQR = 0.8 μg/m³, percentage increase = 1.3%, 95% CI = 0.5-2.1).

Conclusions

We observed that some specific components of PM2.5, including OC and EC, increased the mortality risk in Tokyo.
Background: Panel studies are an efficient means to assess short-term effects of air pollution and other time-varying environmental exposures. Repeated examinations of volunteers allow for in-depth analysis of physiological responses supporting biological interpretation of environmental impacts.

Methods: Twenty-four healthy students walked at least 4 times for one hour under each of the 4 settings: By a busy road, by a busy road wearing ear plugs (reducing noise by approx. 30 dB), in a park, in a park but exposed to traffic noise (65 dB) through headphones. Particles (PM2.5, PM1, particle number) and ambient noise levels were measured throughout each walk. Lung function and exhaled NO were measured before, immediately, one hour, and approximately 24 hours after each walk. Blood pressure and heart rate variability were measured every 15 minutes during each walk. Ambient temperature was estimated using data from a local meteorological station. Particle mass (PM10) data was also obtained from a nearby monitor.

Results: Personal particle exposures were highly correlated with each other and with the data from the fixed monitor. Particle exposure and noise levels were higher by the road compared to the park. But noise and air pollution were not correlated with each other due to different temporal trends. Temporal variation was by far stronger than differences between settings. Exhaled NO decreased immediately with increasing pollution levels but was significantly higher 24 hours after the walk by the road compared to the park. Air pollution levels reduced lung function levels. Effects mostly remained significant up to 24 hours. Cardiovascular effects of air pollutants were less pronounced. Effects were not confounded by noise or by temperature.

Conclusion: While immediate increases in airway resistance could be interpreted as protective (muscular) responses the persisting effects indicate an adverse inflammatory reaction.
Extreme heat and air pollution-related risk of hospitalization and mortality among end-stage renal disease patients

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Background/Aim. The joint effect of extreme heat events (EHE) and short-term air pollution exposures among end-stage renal disease (ESRD) patients is unknown. Furthermore, it remains unclear how this association may vary across individual characteristics. Here, we characterized the effect of EHE and short-term air pollution among ESRD patients and further investigated risk variability across race/ethnicity and co-morbidities.

Methods. Daily hospitalization and mortality counts were obtained from Fresenius Medical Care (FMC) in-center hemodialysis patients treated in Boston, MA; Philadelphia, PA; and New York City, NY between in 2001 and 2012 (N=7212). EHE were identified using 95th percentile threshold values derived from location- and calendar day-specific long-term baselines (1960-1989). We used time-stratified case-crossover analysis to estimate all-cause hospitalization and all-cause mortality risks associated with EHE and air pollution (ozone and PM2.5) using lag structures. We further stratified the analysis by race/ethnicity (Asian, Hispanic, Non-Hispanic (NH) Black, and NH-White) and co-morbidities (congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD) and diabetes).

Results. NH-Black and NH-White patients demonstrated consistent increased EHE-related hospitalization and mortality risk across same-day, one-day, and cumulative lag periods. Patients living with any co-morbidity responded with increased hospitalization risk across estimated lag-responses. Notably, diabetics had the highest hospitalization risk (RR: 1.32, 95% CI: 1.14-1.53). CHF and COPD exhibited substantially higher mortality risk. Same-day EHE exposure yielded the highest mortality risk (RR: 2.61, 95% CI: 1.67-4.10) for patients with COPD. Effect modification analysis between EHE and air pollution is ongoing and will be presented.

Conclusions. Our data suggest that EHE-related risk increases in hospitalization and mortality may vary across race/ethnicity as well as co-morbidity status. In light of the projected increased frequency of extreme heat events, future studies with national-outlook are needed to quantify geographic and demographic variability in risk and inform ESRD management guidelines under a changing climate.
Personal Exposure to Ultrafine Particles is Associated with Reduced Lung Function in Adolescents with Asthma

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Background: Few studies have examined personal exposure to ultrafine particles (UFP) and respiratory health in adolescents. Our objective was to characterize personal UFP exposure and examine their association with respiratory symptoms and lung function among adolescents with and without asthma.

Methods: Participants (ages 13-17 years) completed seven days of personal UFP sampling. On each day, personal UFP exposure was recorded at one second intervals for three hours using the PUFP C200, a wearable UFP monitor. Ecological momentary assessment was used to assess the frequency of respiratory symptoms and spirometry was performed by trained technicians at the completion of the seven day sampling period. The percent-predicted forced expiratory volume in 1 second (% FEV1), forced vital capacity (% FVC), ratio of FEV1/FVC, and forced expiratory flow between 25% and 75% of the FVC (% FEF25-75) were calculated for each participant based on their age, sex, race, and height. Linear and zero-inflated Poisson regression models were used to estimate the association between log-transformed weekly median UFP exposures, lung function, and frequency of respiratory symptoms adjusting for BMI.

Results: A total of 98 adolescents (35% with asthma) were included in this analysis. Median weekly UFP exposures ranged from 351 – 58,300 p/cm³ (IQR = 5,478 p/cm³). Personal exposure to UFPs was associated with decreased lung function among adolescents with asthma; for a 10-fold increase in median UFP exposure the %FEV1 was decreased 10% (95% CI: -21, 0%), %FEV1/FVC decreased 11% (95%CI: -19.0, -3.5%) and the %FEF25-75 decreased 31% (95%CI: -55.5, -7.6%). No significant associations were observed between UFP exposure and lung function in children without asthma nor was UFP exposure associated with the frequency of respiratory symptoms in either asthmatic or non-asthmatic adolescents.

Conclusions: Exposure to UFP is associated with reduced lung function, but not increased respiratory symptoms, in children with asthma.
Socioeconomic and climatic factors modifying the short-term association between ambient particulate air pollution and mortality: a multi-country multi-city analysis

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Background/Aim: Previous studies showed that short-term associations between ambient particulate air pollution (PM) and mortality are heterogeneous across populations in different areas of the world. However, little is known about the factors responsible for these inter-regional differences. In this contribution, we used data from a multi-country multi-city study to identify contextual factors that modify short-term mortality risks of PM.

Methods: We collected daily series of mortality counts and air pollution data (PM10, PM2.5) for 327 cities in 25 countries in the period 1985-2015. City-level standardized measures of demographic, socioeconomic, and environmental indicators were derived from the OECD Regional/Metropolitan Database, in addition to climatological variables from the weather series. We applied a two-stage time-series design. First, for each city we modelled the linear associations of two-day moving average PM10, and PM2.5 with total mortality using quasi-Poisson regression and distributed lag nonlinear models. Second, we used meta-regression models to evaluate the effect modification of each indicator.

Results: In preliminary analyses, the pooled percent mortality change for a 10 μg/m³ increase in PM10 and PM2.5 concentrations were 0.20% 95%CI(0.14%; 0.25%), and 0.31% 95%CI(0.21%; 0.41%) respectively. For PM10, significant changes of the figures above, for an IQR increase in each factor, were found for Gini index (0.12% to 0.29%, p=0.015), average temperature (0.13% to 0.27%, p=0.001), and Sprawl index (0.14% to 0.26%, p=0.033). For PM2.5, a tendency to increase the mortality risk was found for GDP (0.24% to 0.38%, p=0.073), while cities with an extended green area have a lower percent mortality change (0.41% to 0.20%, p=0.054).

Conclusion: This represents the largest study assessing effect modification of ambient particulate air pollution and mortality relationships, performed by comparing different populations across the world. Preliminary findings suggest larger PM-mortality risks, in urban communities characterised by a higher level of inequalities, warmer climate, and less green area.
Exposure to air pollution during the first 1000 days of life and subsequent health service and medication usage in children

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Background/Aim: A coal mine fire (09/02/2014-31/03/2014) caused markedly increased emissions of fine particulate matter (PM2.5) in the Latrobe Valley of Victoria, Australia over six weeks. Evidence of health effects following early life exposure to high dose, short duration pollution events is limited. We evaluated the impacts of exposure to mine fire emissions prenatally or during infancy on a priori decided health outcomes including general practitioner (GP) attendances, dispensations of prescribed asthma inhalers, steroid skin creams, and antibiotics during the first year of life or the year following the fire, respectively.

Methods: Participant’s daily average and peak mine fire specific PM2.5 exposures were estimated using chemical transport modelling at a resolution of 1x1 km2 based on address diaries. Outcome data were obtained from the Australian Medicare Benefits Schedule and Pharmaceutical Benefits Scheme. We used negative binomial or logistic regression models to assess risks of the outcomes associated with every 10 or 100 µg/m3 increase in average or peak PM2.5 exposure, respectively, while adjusting for age, tobacco smoke exposure, maternal prenatal stress and maternal education.

Results: 286 children were included, comprising 77 with no exposure, 88 with prenatal exposure and 121 with infant exposure. In the infant exposure analysis, every 10- and 100-unit increase in average PM2.5, and peak PM2.5 exposure, was associated with increased likelihood of antibiotics being dispensed during the year following the fire: adjusted incidence rate ratio 1.24 (95% CI 1.02, 1.50, p=0.036) and 1.14 (1.00, 1.31, p=0.048) respectively, but not with the other outcomes. There were no significant associations in the prenatal exposure group.

Conclusions: Infant exposure to coal mine fire emissions was associated with increased prescribing of antibiotics. This could have reflected increased childhood infections in the year following the fire.
Spatial analysis of hospital admissions for respiratory disease and the relationship with air pollution sources in Rio de Janeiro, Brazil

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Background/Aim: Urban air pollution is now acknowledged to be a significant public health hazard which is associated with the risk of respiratory diseases. This study aimed to analyze the spatial distribution of the ratio of hospital admissions for respiratory diseases and its relationship with potential sources of air pollution in Rio de Janeiro city. Methodology: An ecological study was carried out during 2013-2017, with the city planning areas as geographic units of analysis. The air pollution-related variables were industrial districts, traffic density, tunnel’s entrances and exits, sea port, airports and constructions/road work made in the city before the World Cup (2014) and the Olympic Games (2016). The outcome was the ratio of hospitalization for respiratory diseases (ICD-10, Chapter X: J00-J99) by population at risk. Data analysis was performed for the total population and by gender and age (0-4, 15-59 and ≥60 years old). All data were from secondary source and free public access. Bayesian models with Poisson regression were generated to analyze the relationship between variables. Results: There were 57,661 cases of respiratory disease admission, with highest ratios for the total population (4.81/1,000 inhabitants). The variable constructions was associated with the ratio of hospital admissions (total: mean=1.89, 95%CI 1.04-3.71; men: mean=2.69, 95%CI 1.69-4.10; women: mean=2.77, 95%CI 1.59-5.07; 0-4 years: mean=4.78, 95%CI 1.68-8.75). Traffic density and airports were associated with increased ratio among men (mean=1.26, 95%CI 1.09-1.51) and ≥60 year-old subjects (mean=2.22, 95%IC 1.08-3.46), respectively. An inverse association was observed for the interaction between traffic density and constructions in children (mean=0.65, 95%CI 0.50-0.87). Conclusion: Pollution originated from constructions/road work, road traffic and airports increased the risk of respiratory diseases hospitalizations.
Ambient air pollution and injury

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Aim. Ambient air pollution may affect cognitive function suggesting that it may also influence behaviour and thereby could lead to intentional or unintentional injuries. We tested the association between daily emergency department (ED) visits for injury and the daily concentration of ambient air pollutants. Methods. ED data were retrieved for Edmonton, Canada, for the period April 1992 – March, 2002, (3,652 days) using the ICD-9 codes: 800 – 999. Daily mean levels of six air pollutants, gaseous (CO, NO2, SO2, and O3) and particulate matter (PM2.5 and PM10) were estimated and linked with ED visits. We tested lags from 0 to 14 days. Case-crossover technique was applied in the study. Time-stratified approach was realized to associate cases and controls. In the constructed models temperature and relative humidity in the form of natural splines were included. The analysis was conducted for all patients, and by sex, age groups ([0-10], [11-60], [61, 61+]) and by season; warm (April–September) and cold (October–March) thus creating 18 different groups. Results. 827,084 diagnosed ED visits for injury were identified. Among these visits 497,399 (60.1%) were for male and 329,675 (39.9%) were for female. The associations were positive and statistically significant by the used lags in K (Total=18*15=270) estimations for CO (K=134), NO2 (101), O3 (19), SO2 (84), PM2.5 (55), and for PM10 (40). Excess risks (ER in %) for an increase of CO (0.4 ppm) in warm season for male: ER=2.39 (1.2-3.59), ER=2.29 (1.1-3.5), ER=1.67 (0.47-2.89) for lag 1, 2, and 3, respectively; for an increase of NO2 (12.8 ppb) in cold season for male: ER=2.45 (1.72-3.19), ER=2.59 (1.86-3.32), ER=2.52 (1.80-3.25) for lag 1, 2, and 3. The 95% confidence intervals are listed. Conclusion. Carbon monoxide and nitrogen dioxide indicate strong associations with injury mainly for the exposure lagged by 1, 2, and 3 days.
Short-term effects of desert dust and particulate matter on daily mortality in Iran

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Background/Aim: Increased atmospheric particulate matter (PM) concentrations are commonly observed during dust storm events in Iran, but there is still no evidence of their effects on human health. We aimed to evaluate the association between daily mortality and exposure to PM10 during dust events in Tehran and Ahvaz, two major cities with different sources, intensity, and frequency of desert dust episodes.

Methods: We identified desert dust episodes based on exceeding a daily PM10 concentration threshold of 150 μg/m³ jointly with a low PM2.5/PM10 ratio, typical of dust storms. We used a time-stratified case-crossover design to estimate the short-term effects of PM10 concentrations on daily mortality during non-dust days and dust episodes. Data was analysed using conditional Poisson regression, and we derived the attributable number of deaths for a counterfactual scenario of the World Health Organisation threshold for PM10 24-hour average of 50 μg/m³.

Results: Higher concentrations of PM10 and frequency of dust episodes were observed in Ahvaz than Tehran. In Ahvaz, the average lagged effects up to 3 days were higher during non-dust days (1.1%, 95%CI=[0.7 to 1.5%], for a PM10 rise of 10 μg/m³) and low-intensity dust episodes (1.4%, 95%CI=[0.6 to 2.1%]) compared to the medium and high-intensity ones (0.9%, 95% CI = [0.6 to 1.2%] and 0.5%, 95%CI=[0.1 to 0.8%], respectively). In Tehran, effects were higher during non-dust days (0.9%, 95%CI=[-0.1 to 2.0%]) than high-intensity dust episodes (0.6%, 95% CI = [-3.5 to 4.8%]), but not statistically significant. The attributable proportion of deaths was four times larger in Ahvaz during dust episodes (15.6%) than in non-dust days (3.7%) and twice in Tehran (7.9% and 3.3%, respectively).

Conclusion: We found novel evidence for the effects of PM10 on daily mortality, suggesting harmful effects when accounting for the whole range of PM10 concentrations during dust events in the Middle East.
Association between asthma symptoms and NO2 exposure

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Background/Aim
Exposure to air pollution is often estimated by one or two monitoring stations per city, which may lead to measurement error and potentially to underestimation of air pollution risks. A recently developed air quality sensor network in the city of Eindhoven, the Netherlands, measures air pollution at a fine spatio-temporal resolution. We set up a panel study in Eindhoven with the aim to evaluate associations between short-term variation of nitrogen dioxide (NO₂) and fine particles concentrations, and short-term variation of asthma-related symptoms and lung function in children.

Methods
Children with asthma-related symptoms, aged between 7-11 years, reported daily symptoms and use of on-demand asthma medication over a period of four months in an electronic diary. Lung function was measured daily at home by the children. Associations with air pollution of the past days from the nearest air quality sensor were obtained using a mixed effects model, correcting for potential confounders and baseline differences between participants.

Results
Only five children could be recruited. Some symptoms in the upper airways were positively related to NO₂ concentrations on the same day. Odds ratios per 10 µg/m³ (95% C.I.) were 1.06 (0.85, 1.33) for cough and 1.13 (0.87, 1.45) for nose complaints. For short breath related to NO₂ on the previous day, the odds ratio was 1.33 (1.01, 1.75). Odds ratios were 1.82 (1.29, 2.55) for short of breath after exercise, and 1.66 (1.10, 2.51) for on-demand asthma medication use, both related to the mean NO₂ concentration of the last three days. No associations were found between NO₂ and lung function and PM₁₀ with any symptom and lung function.

Conclusions
Despite the small sample, we found associations between short-term variation of NO₂ concentrations and short-term variation of asthma-related symptoms, possibly due to the use of fine resolution air quality sensor data.
Associations between residential exposure to fine particulate matter and days spent in hospital for heart failure patients

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Background
Heart failure (HF) is a severe form of cardiovascular disease which is increasing in prevalence. Mortality risks from elevated ambient fine particulate matter (PM2.5) exposure are well characterized for HF patients, but few studies have examined morbidity risks in the HF community. In particular, measures such as the days spent in hospital, which may correlate with quality of life and healthcare costs, have yet to be explored.

Methods
Using the EPA CARES resource, we examined associations between annual average PM2.5 exposure (assessed at the primary residence at the time of initial HF diagnosis) and the total visits, number of emergency plus inpatient visits, and total days spent in hospital for 24,798 North Carolina resident HF patients (559,664 total visits, 7.7% inpatient or emergency) who resided <30 km from a PM2.5 monitor. The observation period was 7/1/2004 to 12/31/2016. Models were adjusted for age at diagnosis, sex, race, and socioeconomic status indicators extracted from the 2000 census. We used a quasipoisson model to model the total visits and inpatient plus emergency visits and a linear model for the log-transformed total days spent in hospital.

Results
The average PM2.5 exposure was 10.2 µg/m³ (interquartile range 8.4-11.4 µg/m³). A 1 µg/m³ increase in PM2.5 exposure was associated with a 19% increase (95% confidence interval [CI] = 18-19%) in the total number of visits, a 11% increase (CI = 11-12%) in the number of inpatient and emergency visits, and a 4.4% increase (CI = 3.7-5.2%) in the total days spent in hospital.

Conclusions
Elevated PM2.5 exposure is a significant morbidity risk factor for HF patients. Increases in the number of hospital visits and the days spent in hospital are likely related to quality of life as well as healthcare costs for HF patients. This abstract does not necessarily represent EPA policy.
Apparent temperature as a modifier of the effects of air pollution on respiratory disease hospital admissions in Secunda, South Africa

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Background: Due to climate change, an increase of 34°C in ambient temperature is projected along the South African coast and 67°C inland during the next 80 years. Very few studies in Africa investigated effect modification by a temperature indicator (e.g. apparent temperature, Tapp) on the human health effects of air pollution. Methods: Respiratory disease (RD) admission data (ICD10 J00-J99) were obtained from MediClinic for the two hospitals located in Secunda; after ethics approval. The study period is 1 January 2011 to 31 October 2016. NO2, SO2, PM10, PM2.5, temperature and relative humidity data were obtained from the South African Weather Services. A case-crossover epidemiological study design was applied. The present study focused on lag0-1; as most other studies. Models were adjusted for public holidays and Tapp. Days with Tapp below and above/equal the median (14.9°C) were classified as cold and warm days, respectively. Results: Of the 14 568 RD admissions, approximately equal number of females and males were admitted. 47%, 45% and 8% of the admissions were from 0-14, 15-64 and >=65 year olds, respectively. The daily NO2, SO2, PM2.5 and PM10 levels were 12.4, 8.5, 32.3 and 68.6 μm/m3, respectively. Daily air pollutant levels regularly exceeded the WHO guidelines. On cold days there were no significant associations between the air pollutants and RD admissions, but there were strong associations on warm days, except for NO2. On warm days, 0-14 year olds and females were more susceptible to PM2.5, PM10 and SO2, e.g. RR 1.12 95%CI 1.02-1.23 for 14 year olds and PM2.5 compared to the unstratified analyses RR 1.01 95%CI 1.00-1.02. Conclusions: These results indicate that the risk of RD hospital admission due to ambient air pollution exposure is different on cold and warm days in Secunda.
Elevated PM2.5 increases the risk for hospital admissions and readmissions in end-stage renal disease patients

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Background/Aim:
Ambient air pollution increases the risk for cardiovascular and respiratory hospital admissions and readmissions in several populations. Readmissions have costly consequences and those occurring within 30 days of discharge cost Medicare approximately $17 billion annually. Here, we examine the role of fine particulate matter (PM2.5) on admissions and readmissions in a population with elevated readmission rates, end-stage renal disease (ESRD) patients.

Methods:
We used daily county-level counts of inpatient hospitalizations and individual-level rehospitalizations during summer months (April - October) between 2008 and 2012 among 554 counties. Hospital admission rates and likelihood of a 30-day readmission were calculated for 807,402 inpatient hospitalizations from 242,683 United States Renal Data System patients. Environmental data included daily average PM2.5 (µg/m³). We evaluated both immediate and lagged effects of environmental exposures on all-cause and cause-specific (heart failure, pneumonia) health associations per 10-unit increase in PM2.5 (µg/m³). Hospital admission risk was measured using daily admission counts and expressed as a rate ratio (RR). The likelihood of a 30-day readmission occurring following an index event was expressed as an odds ratio (OR).

Results:
Elevated PM2.5 increased the RR of all-cause admissions by 0.8% (95%CI: 0.3-1.3%) and pneumonia admissions by 2.8% (95%CI: 0.8-4.9%). PM2.5 also increased the OR of a 30-day readmission occurring following an all-cause index admission by 3.5% (95%CI: 2.6-4.3%). The OR for heart failure and pneumonia readmissions were also increased by PM2.5 by 3.6% (95%CI: 1.5-5.8%) and 2.9% (95%CI: 0.01-5.8%), respectively.

Conclusions:
We observed greater risk of all-cause and some cause-specific hospital admissions and readmissions in ESRD patients with increases in PM2.5. Our results suggest that reducing exposure to PM2.5 could reduce healthcare costs through reduced daily admissions and 30-day readmissions for ESRD patients. This abstract does not reflect EPA policy.
Effects of ambient air pollution exposure on frequency of hospital admissions for appendicitis in Taipei, Taiwan

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TPS 681: Short-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

The relationship between exposure to ambient air pollutants and hospital admissions for appendicitis is not known. This study examined whether an association existed between air contaminant levels and frequency of hospital admissions for appendicitis in Taipei, Taiwan. Ambient air pollution and hospital admission data for Taipei were obtained for 2009-2013. Relative risk (RR) of hospital admissions was estimated using a case-crossover approach, controlling for weather variables, day of the week, seasonality, and long-term time trends. In the single pollutant model, on warm days (> 23°C), number of appendicitis admissions was significantly associated with particulate matter (PM2.5), nitrogen dioxide (NO2), carbon monoxide (CO), and ozone (O3). On cool days (< 23°C), a significant rise in number of admissions for appendicitis was related to PM10, NO2, and O3 concentrations. In the two-pollutant models, on warm days, NO2 and O3 were significantly associated with increased number of admissions for appendicitis when combined with each of the other pollutants. On cool days, NO2, O3, and PM10 remained significant for higher appendicitis admission cases in all two-pollutant models. In conclusion, higher levels of ambient air pollutants may be associated with increase in the risk of hospital admissions for appendicitis in Taipei.
How Many Hospital admissions in Massachusetts Would Have Been Saved, Had the Particulate Air Pollution Level Been Lower?
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Background: Numerous studies have found higher cardiorespiratory risk associated with particulate matter smaller than 2.5μm in diameter (PM2.5). Most studies have used classical epidemiological methods, limited in their capacity for causal interpretation. We applied a causal modeling approach to assess the short-term impact of high PM2.5 exposure on hospital admissions in Massachusetts.

Methods: Daily ZIPcode counts of respiratory and cardiovascular admissions of Medicare beneficiaries >65 were constructed across Massachusetts (2000-2014). Daily PM2.5 exposure estimates were obtained from a satellite-based spatio-temporally resolved model. A propensity score matching approach was applied to estimate the number of cause-specific hospital admissions attributed to high levels of two-day average exposure to PM2.5 (exposure ≥the 95th percentile=18 µg/m3). Each high pollution ZIP code-day was matched to a low pollution ZIP code-day with similar background characteristics. Then, the impact of PM2.5 exposure was estimated by comparing the total count of admissions (all respiratory, all CVD, myocardial infarction (MI), Ischemic heart disease (IHD), ischemic stroke, congestive heart disease (CHF), and chronic obstructive pulmonary disease (COPD)) on high pollution ZIPcode-days and matched low pollution ZIPcode-days during the study period.

Results: Of the days in the study period 187,184 were high-pollution days. The mean and standard deviation of the PM2.5 exposure was 11.4 ± 3.7 µg/m3 in the low pollution days and 22.1 ± 4.5 µg/m3 in the high pollution days. A total of 1,729 (7.1%) respiratory, 618 (1.7%) CVD, 362 (6.4%) COPD, 127 (1.9%) stroke, 119 (1.9%) MI, 122 (0.9%) IHD, and 420 (3.7%) CHF admissions in high pollution days were attributed to PM2.5 exposure.

Conclusion
Had there been an intervention to lower the short-term exposure limit to PM2.5 below 18µg/m3, well below the current 24-hours 35 µg/m3 U.S.EPA threshold, a significant number of hospital admissions would have been saved among the study population within the study period.
Personal Exposure to PM2.5-bound Polycyclic Aromatic Hydrocarbons and Lung Function Alteration: Results of a Panel Study in China

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TPS 681: Short-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Fine particulate matter (PM2.5) exposure has been associated with lung function decline, but impact of PM2.5 constituents especially for polycyclic aromatic hydrocarbons (PAHs) on lung function is unclear among general population. We enrolled 224 Chinese volunteers who participated in two study periods (2014-2015 and 2017-2018) of the Wuhan-Zhuhai cohort as a panel. Linear mixed models were performed to quantify associations of personal PM2.5 and sixteen PM2.5-bound PAHs with lung function. Three-year changes of lung function related to different levels of PM2.5-bound PAHs were further estimated. We also calculated diagnostic ratios to identify potential sources of PM2.5-bound PAHs in Wuhan and Zhuhai City. We found significant declines in FVC and FEV1 for acute exposures to both low and high molecular weight PAHs (LMW-PAHs and HMW-PAHs respectively). Persistently long-term high levels of HMW-PAHs (BaA, DhA and BgP) rather than LMW-PAHs were associated FVC decline in three years, when compared with persistently low exposure level groups. The associations were different between Wuhan and Zhuhai. The results of diagnostic ratios that differences in PAH emissions between the two cities provided interpretation for the inconsistent associations. Our findings provide evidence that both short- and long-term PM2.5-bound PAH exposures might affect lung function.
TPS 684: Long-term health effects of air pollutants 1

Effects of traffic-related air pollution on asthma onset in children from a French birth cohort.

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Background/Aim: The effect of traffic-related air pollution (TRAP) on exacerbation of asthma symptoms has been well documented during the last decades. However, its role on the development of new asthma during childhood has been more recently studied and remains unclear, maybe due to discrepancies in exposure assessment and exposure time windows. In this context, we aimed to investigate the association of both early and cumulative TRAP exposure with asthma onset during the first 8-9 years of life.

Methods: We conducted this study among 1,265 children followed-up from birth to 8-9 years of age in the PARIS birth cohort. Data on asthma symptoms and diagnosis were collected annually with repeated questionnaires. Early (during the first year of life) and time-varying cumulative TRAP exposures were finely assessed by a NOx air dispersion model considering all the residences and day care/schools addresses. Associations of early/cumulative postnatal TRAP exposures with prevalence of persistent wheezing and incidence of doctor-diagnosed asthma were analysed by logistic regressions and Cox proportional hazard regressions, adjusting for potential confounders. Results were expressed as adjusted Odds ratios (aOR) and Hazard ratios (aHR) with their 95% confidence intervals (95%CI).

Results: We found a significant association between early TRAP exposure and (1) prevalence of persistent wheezing until 8-9 years (aOR=1.19, 95%CI[1.00 to 1.41] for a 20 μg/m³ NO2 equivalent increase in average NOx levels) and (2) incidence of doctor-diagnosed asthma during the first 8-9 years of life (aHR=1.21, 95%CI[1.06 to 1.38]). As for cumulative TRAP exposure, it was associated with the incidence of doctor-diagnosed asthma during the first 8-9 years of life (aHR=1.31, 95%CI[1.13 to 1.52] for a 20 μg/m³ NO2 equivalent increase in average NOx levels).

Conclusion: This study brings further insights into the effect of early and long-term TRAP exposure on asthma onset in children living in the Paris area.
Traffic-related fine particulate matter associated with carotid-intima-media thickness in young population

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: The contribution of long-term air pollution exposures to subclinical atherosclerosis in young age has not been fully studied.

Methods: We recruited 789 school age subjects who resided in Taipei City and participated in the YOung TAIwanese (YOTA) Cohort between 1992 and 2000. Of all study subjects, 303 subjects were elevated blood pressures (EBP) and 486 subjects had normal BP (NBP) in the childhood. The carotid intima-media thickness (CIMT) was measured at the age of 12-30 in the follow-up health examination from 2006 to 2008. Land-use regression models were used to estimate participants’ one-year exposures to particulate matter (PM) of different sizes and traffic-related exhausts, including PM2.5 absorbance, nitrogen oxides, and nitrogen dioxides. Generalized linear regression models were applied to assess the associations of maximum and mean CIMT values in adolescents or young adults with one-year exposures to six air pollutants.

Results: One-year PM2.5 absorbance exposures are associated with thicker mean and maximum CIMT values at common carotid artery, bulb, and internal carotid artery sites in subjects with childhood EBP, with estimates 5.17% (95% CI: 1.84, 8.50) and 5.29% (95% CI: 2.02, 8.56) thicker in both mean and maximum values of CIMT-mean exposed to 10^{-5} m^{-1} PM2.5 absorbance, respectively. Such relationships were not observed in subjects with childhood NBP. Subgroup analyses for childhood EBP subjects show those who are ≥18 years of age, females, overweight, high BP, hyperglycemia, or hypercholesterolemia either in childhood or adulthood experience thicker CIMT while exposed to high concentrations of PM2.5 absorbance (≥2.17 10^{-5} m^{-1}) than those of counterpart among subjects.

Conclusion: Long-term exposures to PM2.5 absorbance are associated with subclinical atherosclerosis in adolescents or young adults. The atherosclerosis developed since early childhood depending on individual cardiovascular risk factors and can be modified by long-term PM2.5 absorbance exposures.
PM2.5 exposure and oxidative stress in a cohort of obese with and without asthma
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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background. In Latin American more than 100 million people are exposed to air pollutants which, frequently are above WHO standards. Oxidative stress and airway inflammation are effects related to particulate matter (PM2.5) exposure.

Objective: To evaluate PM2.5 concentrations and its association with oxidative stress and airway inflammation biomarkers in adolescents from Mexico.

Methods: A longitudinal study was conducted in asthmatic and non-asthmatic adolescents with overweight and obesity along 2008 to 2011. PM2.5 concentrations were obtained from the Mexican air quality monitoring network and georeferencing. The 8-isoprostane, Glutathione (GSH), Oxidised glutathione (GSSG), nitrates, nitrites and nitric oxide (FeNO) were determined in exhaled vapor condensed. Statistical analyses of mixed models for longitudinal data, multiple regression models and interaction analysis between pollutants and biomarkers were performed.

Results. In the airway inflammation was observed a significant increase for each unit change in the PM2.5 in the nonasthmatic children, in contrast with asthmatic, it was a decrement. For the asthmatic group each increase of 10 µg / m3 in PM2.5 was related to a 5.09 times of increase in Ln(FeNO) based on its predicted value, and the increment for non-asthmatic was of 4%. For the exhaled nitric oxide, an interaction between PM2.5 and the asthmatic state (p = 0.008) was observed. For nitrates and nitrites as well as in the 8-isoprostane, resulting in a PM2.5 positive effect on biomarkers: 0.11 logarithmic units (95 % CI: 0.02, 0.20) and 1.92 pg / mL (95 % CI: 0.59, 3.24), respectively. In the case of GSH, the effect on asthmatics was 22.03 points for each increase of 10 µg / m3 in PM2.5 and 0.48 points for the non-asthmatic group.

Conclusion: Our results demonstrate that PM2.5 exposure increase inflammation and oxidative stress in obese non-asthmatic achieving levels similar to the asthmatic adolescents.
Childhood cancer and traffic-related air pollution in Switzerland: a nationwide cohort study


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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: A number of studies have investigated an association between childhood leukaemia and traffic-related air pollution, often using NO2 concentration as a proxy measure. However, few studies have accounted for the drop in NO2 levels over recent decades. We aimed to investigate whether the incidence of childhood cancer and the diagnostic groups of leukaemia, lymphoma, and central nervous system (CNS) tumours is associated with mean annual ambient NO2 concentration at children’s homes.

Methods: We included all children aged <16 years from the Swiss national census of 1990 to 2014 and identified all incident cancer cases from the Swiss Childhood Cancer Registry. We used land use regression models combining the results of a nationwide dispersion model for NO2 with spatial covariates on road network, traffic intensity, population density, and land cover to estimate current exposure at children’s precisely geocoded place of residence. Cancer incidence was investigated in time-to-event analyses using Cox proportional hazards models with time-varying covariates, adjusting for level of urbanization, socio-economic factors, and background ionising radiation.

Results: In time-to-event analyses based on 2,871 cases, the adjusted hazard ratio comparing children with NO2 exposure above the 90th percentile with those below the median was 1.59 for all cancers combined (95%-CI 1.40, 1.81). We observed an increased hazard ratio for leukaemia (HR 1.65; 95%-CI 1.31, 2.09) with indication of a dose-response relationship, in particular for the diagnostic subgroup of acute myeloid leukaemia (AML) (2.51; 1.38, 4.54) and, to a lesser extent, acute lymphoid leukaemia (1.52; 1.17, 1.99). We also found evidence of an increased hazard ratio for lymphoma (1.60; 1.17, 2.18) and CNS tumours (1.42; 1.08, 1.86).

Conclusion: This nationwide study suggests that exposure to high levels of traffic-related air pollution is associated with an increased risk of childhood leukaemia, most notably AML.
Exposure to air pollution and breast cancer risk in the CECILE case-control study.

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim
Some epidemiological studies have suggested that air pollutants may increase breast cancer risk but results remain inconclusive. We investigated the association between breast cancer risk and exposure to air pollution in France.

Methods
We conducted a population-based case-control study on breast cancer in 2005-2007 in two French departments (Ille-et-Vilaine and Côte d’Or) including 1,229 incident cases and 1,316 age-frequency matched control women. All residences occupied by study subjects during the last 10 years were geocoded. Annual concentrations of nitrogen dioxide (NO2), particulate matter ≤10µm and ≤2.5µm (PM10 and PM2.5) at participants’ addresses were assessed using a chemistry-transport model. To take into account different participation rates by place of residence, a Geographical Weighting Score (GWS) was assigned to each subject to make the geographical distribution of the cases and the controls in the study representative (at the 'canton' level) to that of the source population. This score was calculated by comparing the place of residence of the cases to that of all breast cancer patients registered during the study period, and the place of residence of the controls to that of women in the census data. Unconditional logistic regression models with or without GWS were fitted adjusting for potential confounders.

Results
In the model without GWS, the OR for breast cancer associated with mean annual exposure to NO2 was 1.30 (95%CI 1.13-1.51) per 10µg/m³ increase. In the model with GWS, this OR decreased to 1.12 (95%CI 0.97-1.29). For PM10 and PM2.5, GWS adjusted ORs were 1.06 (95%CI 0.95-1.19) and 1.04 (95%CI 0.89-1.20) per 2µg/m³ increase, respectively. Stratification by menopausal status, department of residence, or by breast cancer subtypes showed similar results.

Conclusions
Our results are weakly supportive of an association between exposure to NO2 and breast cancer suggesting a possible effect of traffic-related air pollutants on breast cancer risk.
Children’s lung function result from long-term exposure to PM2.5
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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

A study on the effects of long-term exposure to fine particulate matter with an aerodynamic diameter of 2.5 μm on lung health of children, based on individual exposure dose. We aimed to investigate the associations between long-term exposure to PM2.5 and lung function by the use of ADD in a cross-sectional study. We included 898 participants aged 7-12 years from a typical industrial city Lanzhou, who had spirometric tests and finished questionnaire. We used a spatiotemporal model to estimate the 5-year average ground concentration of PM2.5 (for the year of participant’s lung function examination and for the previous four year) at each participant’s home and school address. We used the multiple linear regression models to examine the associations between average daily dose of PM2.5 and lung function. We use the average daily dose (ADD) instead of concentration to estimate individual exposure level of ambient air pollution. Every 1 mg/d-kg increment in ADD of PM2.5 was associated with a decrease of 32.29ml for forced vital capacity (FVC), 28.67ml for forced expiratory volume in 1 s (FEV1) and 36.25ml for peak expiratory flow (PEF), no significant changes for FEV1/FVC. The dose-response curves also show the decline in FVC, FEV1 and PEF with increments of ADD of PM2.5. Our results revealed it is feasible to use ADD to evaluate the long-term effects of PM2.5 on lung function. Average daily dose to ambient PM2.5 is associated with a reduced lung function of three parameters: FVC, FEV1 and PEF.
The trend of children’s respiratory health and air pollution in a typical northern city over two decades

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

With rapid urbanization and industrialization, environmental situation and people’s life style in china are changing rapidly. To test whether the association between air pollution and children’s respiratory health may change in 20 years, the research team use the similar study protocols to collect data in the current cohort and compared the results with the original cohort. Both two studies were conducted in a typical Northern city in Chinese Lanzhou City. We found the fine particular matter and SO2 level decreased 56% and 90% in urban, 23% and 56% in suburban in comparison with those of 20 years ago. We also found the NO2 level in suburban increased 20% and O3 level in urban increased 35% when compared to 20 years ago. The prevalence of asthma and bronchitis among children significantly reduced than before (Prevalence Ratio <1, P<0.05), but the prevalence rates of tuberculosis increased with multiple stratification (Prevalence Ratio > 1). The prevalence of asthma and bronchitis in urban areas is still higher than suburbs, even though current urban air quality is better than the suburbs. The odds ratios in urban to suburban were narrowed than 20 years ago. We fitted the linear prediction curves of prevalence of respiratory diseases for different pollutants and found different pollutants have different correlation to the disease prevalence rate.
Low-level air pollution and incidence of asthma among adults: pooled analysis of 2 European cohorts in the ELAPSE project

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims: Air pollution has been linked to asthma onset in adults, yet few studies have investigated the effects of low-level pollution below current EU and WHO limit values or guidelines. Within the multicenter ‘Effects of Low-Level Air Pollution: A Study in Europe’ (ELAPSE) study, we examined the association of long-term exposure to fine particulate matter (PM2.5), nitrogen dioxide (NO2), black carbon (BC), and ozone (O3) with incidence of asthma in European adults.

Methods: We pooled data from 2 cohorts from Denmark and Sweden harmonizing individual and area-level variables. Annual mean concentrations of PM2.5, NO2, BC and O3 were centrally modelled for Europe for 2010 by hybrid land use regression models (100 m resolution). We used stratified Cox proportional hazard models to investigate the association between residential pollution (single and multi-pollutant models) and asthma incidence defined as first ever hospital admission, adjusting for sex, smoking (status, duration, intensity), body mass index, marital status, employment, education and income on a neighbourhood level.

Results: Of 50,163 persons, 888 developed asthma during the mean follow-up of 15.6 years. The mean concentrations of PM2.5, NO2 and BC were 10.9 µg/m3, 21.7 µg/m3 and 0.98 10-5/m, respectively. Statistically significant associations were found with NO2 and BC with adjusted hazard ratios and 95% CIs of 1.14 (1.04-1.25) per 10 µg/m3 and 1.15 (1.03-1.28) per 0.5 10-5/m, nonsignificant positive with PM2.5 (1.18; 0.91-1.53) per 5 µg/m3, and none with O3. The NO2 estimate remained unchanged in two-pollutant models with PM2.5, O3, or BC, whereas the BC estimate remained robust in the model with PM2.5 or O3, but attenuated in the model with NO2. The association with PM2.5 attenuated to negative in models with NO2 or BC.

Conclusion: Long-term exposure to NO2 and BC was associated with asthma onset in adults, even at levels below current EU limit values.
Air Pollution Exposure and Infant Lung Function in the MACE Cohort, South Africa

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background
There is little known about the impact of air pollution exposure on lung function among infants (ILF), a notably vulnerable group, particularly in developing countries. Exposure to ambient pollutants may increase risk for poor lung growth.

Aim
To determine the relationship between antenatal exposure to oxides of nitrogen (NOx) and lung function outcomes at different time points, adjusting for maternal and infant risk factors.

Methods
Pregnant females (in the “Mother and Child in the Environment” (MACE) birth cohort) were selected in the first trimester from public sector antenatal clinics in Durban, South Africa, and followed to delivery. NOx exposure was determined by land use regression. ILF were performed at 1.5, 6, 12 and 24 months of age, in unsedated asleep infants, following the ERS/ATS guidelines. Functional residual capacity (FRC) and lung clearance index (LCI) were measured by multiple breath washout using ultrasonic flowmeter with 5% SF6 tracer gas. Measures of tidal breathing were obtained, with analysis of tests performed using Wbreath software.

Results
Mean predicted antenatal NOx was 34.28ug/m3 (13.75-40.86ug/m3). From the 245 tests performed, 215 (88%) valid tests were obtained. For repeated measures mean FRC, LCI and TV showed a significant increase over 1.5, 6, 12 and 24 months (ptrend<0.05). In cross-sectional analyses increasing NOx resulted in a decline in FRC at 24 months, in LCI at 6 and 12 months and in TV across ages. FRC was associated with a 0.6ml (95% CI: -2.12; -0.72) decline with each unit increase in NOx. TV showed a 0.2ml (95%CI: -0.9; 0.67) NOx-related decline, while LCI was not associated with exposure.

Conclusions
Lung development may be associated with maternal NOx exposure during pregnancy. Repeated measures at various time points will provide a better understanding of the influence of NOx exposure as the child ages.
Background: Numerous studies indicated cardiorespiratory effects associated with particulate matters, while evidence for risk estimates on renal diseases is limited.

Objectives: We aimed to estimate the association between mortality from renal failure (RF) and long-term exposures to both respirable suspended particles (PM10) and fine suspended particles (PM2.5).

Methods: In this prospective study, the Chinese Elderly Health Service Cohort enrolled total 66,820 local aged people with over 65 from 1998 to 2001, and followed them up to December 31, 2010. Yearly mean exposures to both PM10 and PM2.5 for individuals were predicted based on satellite data. Cox regression models with attained age as underlying time scale were used to estimate mortality risks of the total RF within all participants and participants with CKD, associated particulate matters (PM10 and PM2.5).

Results: Total 61,447 participants with sufficient information were included in analyses. During an approximate 10-year follow-up, we ascertained 443 deaths of the RF excluding deaths in the first year. The estimated hazard ratios (HR) for RF mortality within all participants per interquartile range (IQR) increase of both PM10 (4.74 µg/m³) and PM2.5 (3.22 µg/m³) were 1.23 (95% confidence interval [CI]: 1.06 to 1.43). The HRs for RF deaths within participants with CKD were 1.43 (1.17 to 1.75) and 1.42 (1.16, 1.74), respectively. Mortality HRs for AKI was associated with PM10 by 2.11 (1.38 to 2.63) and PM2.5 by 2.01 (1.38 to 2.20).

Conclusions: Long-term exposures to PM10 and PM2.5 may increase the risk of RF mortality in Hong Kong elderly population.
Risk of developing malignant pleural mesothelioma in a rural population exposed to Erionite from the State of Guanajuato, Mexico

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Introduction. Malignant pleural mesothelioma (MPM) is a relatively rare cancer, which has been associated with exposure to asbestos. The MPM prognosis is poor approximately 9 to 12 months after diagnosis. In addition, there is another etiology of MPM development, which is related to exposure to a natural fibrous mineral: erionite, this mineral has been associated with MPM cases, the first studies were reported for the first time in the ’70s in Capadocia, Turkey, in the populations of Turkey where erionite was detected, the cause of death in more than 52% of the cases among people of 50 years of these populations was precisely MPM. In México there are natural deposits of erionite, one of them located in the town of Tierra Blanca de Abajo in San Miguel de Allende Guanajuato, with a high rate of lung cancer and reported cases of MPM in a young adult population. In this rural village, the children are highly vulnerable due to several factors: they are far from the services of health, which makes early diagnosis and treatment difficult, and exposure to this mineral in childhood is a risk of early exposure.

Aim. To evaluate the risk of malignant pleural mesothelioma development in population exposure to erionite through the measurement of serum biomarkers.

Materials and methods. Cross-sectional, case-control study. Exposure population: 80 volunteers 40 adults and 40 children habitants from Tierra Blanca de Abajo, San Miguel de Allende, Guanajuato, México. Control group: population without exposure to erionite or asbestos, match by age as the exposure group.

Measurements: mesothelin, osteopontin and microRNA profile (mir-222, mir-126, mir-145, mir-100) levels or expression of miRNAs and compare with the control group, and identified cancer familiar history and asbestos concomitant exposure in exposure group.
Air pollution differential exposure and under-5 mortality in Bogota between 2000 and 2014

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background. Several studies have accounted for the impact of air pollution and mortality in Bogota without considering vulnerable populations as children or differential exposure to air pollution. As annual levels of particulate matter (PM10) are four times higher in the Southwest region compared to Northeast zone, the aim of this study was to examine temporal and spatial associations between air pollution and under-5 mortality from 2000 to 2014 in Bogota.

Methods. A time series analysis was carried out to assess the links between air pollution and under-5 mortality globally and in four different areas of the city. Under-5 daily death counts were used as dependent variable and the main explanatory variable was PM10 daily average. Other covariates were humidity, barometric pressure, ozone and temperature. Environmental data was retrieved from Air-Quality-Monitoring-Network and mortality from vital statistics. Statistical analysis included Poisson regression models to estimate the effect of air pollution on mortality and analysis of variance to compare the mortality differences in the four zones of the city.

Results. Distribution of PM10 levels ranged from 41.9 mcg/m³ in the Northeast to 80.1 mcg/m³ in the Southwest. An association between under-5 mortality and PM10 was observed in Bogota, after adjusting for temperature, relative humidity and barometric pressure (beta=0.003, p<0.05). Such effect persist only in the Southwest and the Southeast after spatial analyses. Having adjusted by high exposure to PM10 (daily average >50mcg/m³), an excess of mortality was observed in the Southwest compared to the Northeast (Mean difference= 0.8, CI 95% 0.75-0.92) and the Northwest (Mean difference=0.34, CI 95% 0.27-0.41). Conclusions. Findings support the hypothesis that under-5 mortality is greater in zones with higher concentration of PM10 in Bogota. As there is a direct gradient between socioeconomic and environmental inequalities in Bogota, future research should include socioeconomic variables to examine these results in more detail.
Long-term Effect of Air Pollution on Hospital Admissions Among Medicare Participants Using a Doubly Robust Additive Hazards Model (DRAHM)

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Background/Aims: Our goal is to look at the relationship between long-term exposure to air pollutants and hospital admissions for cardiovascular and respiratory outcomes among Medicare participants in the United States on an additive scale. The hazard difference obtained from this analysis is of great utility in risk assessment studies as well as in looking at effect modification.

Methods: We used a doubly robust additive hazard model (DRAHM) to assess the effect of long-term exposure to PM2.5 on hospital admissions for stroke, myocardial infarction (MI), lung cancer, heart failure, pneumonia, and chronic obstructive pulmonary disease (COPD) among Medicare fee-for-service participants from 2000 to 2013. This model is unbiased if either the inverse probability weight (IPW) model for exposure or the outcome regression model are correctly specified. It also does not require a proportional hazards assumption. PM2.5 levels were obtained from a previously validated high-resolution prediction models which utilized machine learning algorithms. These predictions were averaged spatio-temporally to obtain annual exposure on a zip code level. Admission information was assessed using discharge diagnosis codes from the Medpar database. Covariates included demographic and socioeconomic variables. Effect measure modification was assessed for sex, age, race, and socioeconomic variables. We then repeated the analyses among observations that were less than the federal standard of 12 mcg/m3 for PM2.5.

Results: Preliminary results from the New England region show an increase in the hazard of admission 0.0025% (-0.0031%, 0.0081%) for MI, 0.00081% (-0.0037%, 0.0053%) for stroke, 0.0090% (0.0058%, 0.012%) for lung cancer, and 0.070% (0.062%, 0.078%) for heart failure for each mcg/m3 increase in PM2.5 levels. Further results are pending.

Conclusions: Long-term exposure to air pollution increases the hazard of admission for cardiovascular and respiratory outcomes on an additive scale.
Long-term Exposure to PM2.5 and Road Traffic Noise and All-cause Natural Mortality: A Danish Nurse Cohort Study

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background/aim: Association between air pollution and mortality is well established, yet studies in areas with low levels of air pollution, below EU limit values, and with data on road traffic noise are sparse. Here we examined the association of long-term exposure to fine particulate matter (PM2.5) and road traffic noise with natural mortality.

Methods: We used data from the Danish Nurse Cohort with 25,038 female nurses who at recruitment in 1993 or 1999 reported information on risk factors, and obtained data on natural mortality from the Danish Register of Causes of Death until end of 2013. Annual mean concentrations of PM2.5 since 1990 were estimated using Danish UBM/AirGIS dispersion model (UBM/AirGIS) whereas 2010 concentration of PM2.5 was estimated using Europe-wide hybrid land-use regression (EW-LUR) model. Road traffic noise levels since 1970 were estimated by Nord2000 model as the annual mean of a weighted 24h average (Lden). We examined associations between PM2.5 and Lden with natural mortality by using time-varying and fixed Cox Regression models, adjusting for all relevant confounders.

Results: 4,331 nurses died during the study time-period. Average levels of PM2.5 in 2010 were 12.9 µg/m³ by UBM/AirGIS and 13.1 µg/m³ by EW-LUR models, respectively, while correlation between the two was 0.43. In the fully adjusted models, we found statistically significant positive association of EW-LUR PM2.5 (hazard ratio; 95% confidence interval: 1.06; 1.02-1.11) per IQR of 2.11 µg/m³ and none with UBM/AirGIS 3-years moving average of PM2.5 (0.96; 0.92-1.11), per IQR of 4.37 µg/m³. We found no association between 1-, 3-, or 23-year running mean of Lden and natural mortality.

Conclusion: We found associations of long-term exposure to PM2.5 with all-cause natural mortality, in a low air pollution setting within nationwide Danish cohort, while no associations were detected with road traffic noise.
Long-term exposure to ambient fine particulate matter and Vitamin D levels: a longitudinal study of the Chinese elderly

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background: Vitamin D deficiency has been implicated in the increased risk of several diseases. Exposure to air pollution has been suggested as a contributor to vitamin D deficiency. We thus examined whether long-term higher exposure of fine particulate matter were associated with vitamin D deficiency in a community-based longitudinal study of Chinese elderly.

Methods: The study included 3,385 Chinese adults aged over 60 years. 1362 participants participated blood test in 2012, 1,362 participants participated blood test in 2014, and 661 participants participated the blood test in 2017. Association between fine particulate matter and Vitamin D levels was analyzed with linear mixed models, adjusting for sociodemographic information, behavior and lifestyle, physical examination.

Results: Characterize the exposure of PM2.5 using estimated average exposures for one year, two years and three years before the test of vitamin D levels. After adjusting for the relevant covariates, for the previous year, previous 2 years and previous 3 years of exposure, the vitamin D level decreased by 1.44 nmol/L, 2.46 nmol/L, 2.77 nmol for every 10μg/m3 increase in PM2.5 concentration. The effect is especially significant in men, older people, those who never participated in outdoor activities, and now smokers.

Conclusions: Long-term PM2.5 exposure was associated with a decline in vitamin D levels among elderly people.
The impact of exposure to coal mine fire smoke in utero and in early childhood on parent-reported indicators of childhood atopic and respiratory illness

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TPS 684: Long-term health effects of air pollutants 1, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims:
In 2014 a coal mine fire exposed an Australian community to high smoke concentrations over six weeks. The longer-term health impacts of such exposure in utero and in early childhood are unknown. Existing evidence suggests that increased risks of respiratory disease and allergies are plausible. We evaluated the association between early life coal mine fire smoke exposure and parent-reported indicators of respiratory and atopic illness 2-4 years later.

Methods:
This prospective cohort study enrolled children in three exposure groups: in utero, early childhood (0-2 years of age) and unexposed (conceived after the fire). We estimated individual average and peak fire-attributable PM2.5 exposures using modelled 12-hourly air quality and time-activity data. Parents reported symptoms, medication use, and doctor attendances relating to respiratory and atopic illness by monthly diary for 29 months 2-4 years after the fire. We used modified mixed-effects Poisson models, adjusted for important confounders including age, season, and tobacco smoke exposure, to separately examine associations between outcomes and exposure to PM2.5 in utero and in early childhood.

Results:
The in utero analysis included 2678 monthly diaries from 160 children, while the early childhood analysis included 3290 diaries from 210 children. Both average and peak PM2.5 exposure in utero were associated with increased reports of multiple outcomes. An increase in average PM2.5 of 10µg/m³ was associated with increased reports of runny nose and/or cough (RR 1.09; 95%CI 1.02-1.17), wheeze (RR 1.56; 95%CI 1.18-2.07), seeking health professional advice (RR 1.17; 95%CI 1.06-1.29), and doctor diagnosis of ‘upper respiratory tract infection, cold or flu’ (RR 1.35; 95%CI 1.14-1.60). Associations with early childhood exposures were less consistent.

Conclusion:
Findings suggest children exposed to coal mine fire smoke in utero had a higher risk of acute respiratory infections 2-4 years later. These findings require confirmation in other studies and settings.
Background: A number of studies have linked long-term exposure to particulate matter with aerodynamic diameter <2.5 µm (PM2.5) with mortality, but evidence on cancer mortality is limited. We evaluated the association of long-term exposure to PM2.5 and all-cause and site-specific cancer mortality in Japan.

Methods: A cohort of 75,531 participants underwent basic health checkups in Okayama City in 2006 or 2007. We followed the participants until the end of 2016. Average PM2.5 levels from 2006 to 2010 were obtained from the Atmospheric Composition Analysis Group at Dalhousie University and assigned to the participants by geographical location. We used the Cox proportional hazard models to estimate hazard ratios for a 5-µg/m³ increase in PM2.5 levels for all-cause and site-specific cancer mortality, adjusting for potential confounders.

Results: PM2.5 exposure was associated with increased risk of cancer mortality; the hazard ratios were 1.37 (95% confidence interval: 1.16, 1.62) for mortality from all causes, 1.83 (1.13, 2.98) for gastric cancer mortality, 2.47 (1.45, 4.20) for liver cancer mortality, and 1.59 (1.11, 2.30) for lung cancer mortality.

Conclusion: Long-term exposure to PM2.5 can increase the risk of all-cause and site-specific cancer mortality in Japan. We will further examine the effects of other pollutants on mortality.
Disinfection by-product haloacetamides show different cytotoxicity to two exposure pathway-related cell lines: human gastric epithelial cell line GES-1 and immortalized human keratinocyte cell line HaCaT

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Background: As an emerging class of nitrogenous disinfection by-products (N-DBPs), haloacetamides (HAcAms) have been found to have significantly higher cytotoxicity than regulated DBPs. Humans are exposed to DBPs mainly through drinking water ingestion and dermal contact. Studies using exposure pathway-related cell lines would be helpful to better recognize the toxicity of DBPs.

Methods: The cytotoxicity of HAcAms on human gastric epithelial GES-1 cells and immortalized keratinocytes HaCaT was investigated by the using of Cell Counting Kit-8 and high content screening.

Results: The ranking order of cytotoxicity of 13 HAcAms was the same in GES-1 and HaCaT cells. The 50% inhibitive concentration (IC50) ranged from $7.29\times10^{-7}$ mol/L to $8.93\times10^{-3}$ mol/L for GES-1 cells and from $1.61\times10^{-6}$ mol/L to $2.36\times10^{-2}$ mol/L for HaCaT cells. And the IC50 for HaCaT cells was 1.01-4.72 times that for GES-1 cells, suggesting the higher sensitivity of GES-1 than HaCaT. HAcAms resulted in $5.83-7.13\times10^{4}$ times higher toxicity than chloroform, a toxicity reference. The novel high-content screening (HCS) analysis results showed that exposure to HAcAms affected nuclear size, membrane permeability, mitochondrial membrane potential and cytochrome c release of both GES-1 and HaCaT, indicating apoptosis as a feasible mechanism of cytotoxicity.

Conclusion: This study brings a new insight on the toxicity of HAcAms and provides more practical toxicity data for health risk assessment.
Differences in the metabolome according to the body mass index in adolescents in the Metropolitan Area of the Valley of Mexico

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TPS 711: The exposome, August 26, 2019, 3:00 PM - 4:30 PM

Background: The fat accumulation could be due to factor different as genetic, metabolic and environmental. Recently metabolomics was recognized as science that allows us identify metabolic alterations that could increase the BMI. Therefore, the objective of this study is to evaluate the metabolome of amino acids and acylcarnitines according to the body mass index (BMI) in Mexican adolescents. Methods: From a follow-up study in adolescents of 10 and 20 years of age conducted in the Hospital Infantil de México was evaluated in 203 participants the metabolome directed to 40 metabolites related to beta oxidation and gluconeogenesis, which were quantified by tandem mass spectrometry. A factor analysis was performed, identifying three indices (one of the amino acids and two acylcarnitines), which were used to estimate their association with the BMI categories through linear regression models, adjusting for metabolic parameters. The BMI categories were generated using the International Obesity Working Group (IOTF) classification. Results: We observed that the acylcarnitine index score was decreased in adolescents with higher BMI compared with adolescents with normal BMI (overweight $\beta$ -1.14, $p = 0.003$, obesity $\beta$ -1.11, $p = 0.004$, morbid obesity $\beta$ -0.80, $p = 0.046$). No statistical association was observed between BMI with the rest of indexes. Conclusion: The negative association with the acylcarnitine index with BMI suggests the relationship between the BMI impulse and the preferential use of fatty acids for energy metabolism.
The Environmental Exposome: Urinary Biomarkers and Asthma Morbidity in a School Inner City Asthma Study

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TPS 711: The exposome, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: To determine whether urinary environmental chemical biomarkers are associated with asthma morbidity.

Methods: This study includes 151 children with physician-diagnosed asthma who participated in the School Inner-City Asthma Intervention Study. Urinary metabolites of phenol, paraben, polycyclic aromatic hydrocarbons, and phthalate analytes were analyzed from samples collected at the baseline visit. Asthma symptom days over the past 2 weeks were dichotomized to no asthma symptom days or any asthma symptom days. Cross-sectional logistic regression models were adjusted for sex, age, colds, household income, prescription control, race, BMI percentile, smoke exposure and specific gravity. Weighted quantile sum regression was used to analyze each chemical class as well as a total mixture effect, controlling for the same covariates. The analyses for this study were conducted with the assistance of the National Institute of Environmental Health Sciences Children’s Health Exposure Analysis Resource.

Results: The population is mostly Hispanic/Latino and low income. The average age was 7.9 years and the average (standard deviation) maximum asthma symptom days over the past 2 weeks were 2.1(3.6). The maximum concentrations indicate extreme values for several chemicals, including benzophenone-3, 2,5-dichlorophenol, propyl and methyl parabens, triclosan, and cotinine. In WQS models, a significant interaction effect for allergen sensitivity was observed; relative contributions of analytes differed between children with and without allergen sensitivity. When biomarker concentrations were deciled, only methyl paraben had borderline significant OR of having any asthma symptoms days compared to having no asthma symptom days for a one natural log unit change in analyte concentration after a Holm-Bonferroni correction. (OR 0.79; 95% CI(0.64-0.97); p=0.03; holm Bonferroni p-value 0.09).

Conclusion: Among a population of inner-city children with asthma, a preliminary cross-sectional negative association of methylparaben and asthma symptoms may be attributed to personal care use; follow-up of this cohort will allow for a longitudinal investigation of this association.
Saliva Metabolome in Detecting Internal Exposure to Traffic Related Air Pollution

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TPS 711: The exposome, August 26, 2019, 3:00 PM - 4:30 PM

Background. High-resolution metabolomics (HRM) is a sensitive tool for measuring complex environmental mixtures and biological responses. However, most HRM applications, to date, have examined blood metabolites, the collection of which is invasive, making it extremely difficult to perform longitudinal biosampling. Saliva, an oral fluid and natural filtrate of blood that contains omics-features worthy of interrogation, may serve as an alternative, non-invasive biospecimen to blood plasma for use in HRM application.

Methods. We conducted the Saliva Metabolome in Traffic-related Health (SMITH) study to examine the feasibility of saliva as an alternative HRM biospecimen for use in detecting exposure to traffic-related air pollution (TRAP). We assessed exposures to several TRAP (e.g., black carbon, nitrogen oxides), and biomonitoring in a panel of 51 students living at various distance to a traffic hotspot. Monthly saliva and plasma samples were collected over four months and analyzed using HRM. We then conducted an untargeted Metabolome Wide Association Study (MWAS) workflow, including biological pathway analysis and chemical identification.

Results. A total of 29,013 metabolic features were reliably extracted from 204 saliva samples and 20,766 metabolic features from 175 plasma samples. 9479 features were shared in both saliva and plasma samples with moderate-to-strong correlation (ρ=0.55, p<0.0001). Using an untargeted MWAS workflow, we detected eight metabolic pathways consistently associated with TRAP in both saliva and plasma samples, including pathways predominantly associated with xenobiotic-mediated oxidative stress and acute inflammatory response, including as leukotriene and vitamin E metabolism.

Conclusions. With moderate-to-strong correlation and similar trends in pathway perturbation associated with TRAP in both biometrics, these results provide initial support for the use of saliva samples as a sensitive, and less invasive biometric for metabolomics analysis. Ongoing cluster analysis and chemical annotation will further clarify saliva metabolic perturbations associated with TRAP exposures to compare with metabolic changes observed in plasma metabolome.
Associations of blood trihalomethanes (THMs) and urinary haloacetic acids (HAAs) with oxidative stress markers among Chinese pregnant women: a repeated measurements analysis

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Background: Toxicological studies have demonstrated that disinfection by-products (DBPs) induce oxidative stress, a proposed mechanism that is relevant to adverse birth outcomes.

Aim: To examine the associations of blood trihalomethanes (THMs) and urinary haloacetic acids (HAAs) with oxidative stress markers among 1760 Chinese pregnant women.

Methods: Blood (n=4304) and urine samples (n=4165) were collected from pregnant women during their early, mid- and late pregnancy, which were separately determined for blood THMs [chloroform (TCM), bromodichloromethane (BDCM), dibromochloromethane (DBCM), and bromoform (TBM)] and urinary HAAs [dichloroacetic acid (DCAA) and trichloroacetic acid (TCAA)]. Concentrations of 8-hydroxy-2-deoxyguanosine (8-OHdG), 8-iso-prostaglandin F2α (8-isoPGF2α) and 4-hydroxy-2-nonenal-mercapturic acid (HNE-MA) in repeated urine samples were quantified to reflect oxidative stress status. The associations between markers of exposure and oxidative stress were assessed using linear mixed models.

Results: Repeated measures of oxidative stress markers exhibited high variability, with intraclass correlation coefficients ranging from 0.01 to 0.11. After adjusting for potential confounders, blood TCM and urinary DCAA and TCAA were positively associated with all 3 oxidative stress markers (all p-values<0.001). Additionally, we found significantly positive associations of blood TTHM (the sum of TCM, BDCM, DBCM and TBM) with urinary 8-OHdG and HNE-MA (both p-values<0.05).

Conclusions: Exposure to DBPs during pregnancy may induce oxidative stress status in pregnant women. These relationships may be particularly relevant to the study of birth outcomes linked to DBP exposure.
Untargeted Metabolomics Analysis of Wood Smoke and Diesel Exhaust Particulate Matter
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TPS 711: The exposome, August 26, 2019, 3:00 PM - 4:30 PM

Background: Untargeted metabolomics analysis is a valuable tool in the field of metabolic profiling of biological samples, but it has been less widely applied to characterization of environmental mixtures. The current study explores using untargeted analysis of environmental samples of air pollution for component analysis and source appointment.

Methods: Particulate matter (PM) in wood smoke and diesel exhaust were collected in laboratory settings at the University of Washington. Total suspended particles were collected using 37 mm Teflon filtration membranes (PALL Corporation, USA) in open-face cassettes attached to air sampling pumps (AirChek XR5000, SKC Inc., USA). After sample extraction (Methanol), concentration and reconstitution (25 μL Methanol and 25 μL 0.4% (v/v) acetic acid), PM samples were analyzed by accurate-mass Q-TOF (Agilent 6500) for separation and qualification. We used MetaboAnalyst (version 4.0) to perform principal component analysis (PCA) to visualize the data and t-tests to compare chemical features between wood smoke and diesel exhaust groups.

Results: We collected and analyzed six wood smoke PM samples (weight = 65 ± 3 μg) and five diesel exhaust PM samples (average weight = 150 ± 1 μg). Using Q-TOF HPLC/MS, we detected 1513 chemical features from the PM samples. In a volcano plot, a total of 112 chemical features were identified that exhibited differences (fold-change > 2, and p-value < 0.05) between PM from the wood smoke and diesel exhaust. PCA showed that 81.3% of the variance was explained when including the 5 most significant principal components (PC). Both the 2-D scores plot and 3-D score plot between selected PCs totally separated wood smoke and diesel exhaust PM samples.

Conclusion: Untargeted metabolomics analysis detected numerous chemical features from wood smoke and diesel exhaust PM samples. The untargeted analysis has the potential to be used in air pollution studies for components analysis and source appointment of PM.
The documented global burden of disease and injury for the occupational sector is appreciable due to a number of important occupational risk factors (carcinogens, asthmagens, gas and particulate matter, noise, injuries, low back pain, etc.). The EXPOSOGAS project uses the integrated approach of the human exposome concept for assessing, managing and communicating information about the overall health risks to workers and the general population. Specific exposures that will be addressed range from multiple chemicals, work shift, noise, high temperatures to ergonomic and psychological factors encountered throughout all oil/gas life cycle stages (design, preparation and infrastructure installation, production, transport, storage, distribution, use and end of life activities). A series of training events, modules and pilot research projects that entail the application of the human exposome framework to characterize exposures and risks for the general population surrounding hydrocarbons operations are laid out.
Functional correlate of CYP2E1 methylation in chronic exposure to VOCs: promoter methylation vs. 5’UTR methylation

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TPS 711: The exposome, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Gene-specific methylation has been considered a surrogate marker for gene expression; also, this kind of epigenetic modification may be highly affected by environmental exposures. In a previous study, CYP2E1 activity in toluene-exposed workers was decreased when compared to controls, however, when studying promoter methylation at this gene, no significant differences were found. The aim of this study was to compare CYP2E1 methylation levels, but this time in the 5’UTR region, instead of promoter region, in a subset of workers already studied in two different studies (toluene-exposed and exposed to a VOC mixture), compared to controls.

Methods: DNA was obtained from whole blood in five different groups: occupationally exposed to a VOC mixture (high levels, n= 19; low levels, n= 19 and very low levels, n=17), toluene-exposed workers (n= 19) and a control group (n=19). We performed PCR-pyrosequencing in the 5’UTR region from CYP2E1, IL6, SOD1, TNF-α and TOP2A genes.

Results: In participants exposed to high levels of a VOC mixture, we found significant differences: methylation levels for IL6 and TOP2A (lower methylation levels) as well as for TNF-α (higher methylation levels) when compared to controls. In toluene-exposed workers, we found significant, lower methylation levels for CYP2E1 compared to controls.

Conclusions: Lower methylation levels in the 5’UTR region from CYP2E1 in toluene exposed-workers, whom previously had shown a decreased activity in this enzyme, suggests that this epigenetic modification could represent a functional correlate in enzymatic activity as a response to toluene biotransformation. 5’UTR region could be more prone to be epigenetically affected, compared to promoter region.
Background/Aim: Studies on childhood adiposity have mostly assessed the risks of single or few exposures. We used an exposome approach to assess the associations of several lifestyle and environmental prenatal exposures with child general, visceral and liver fat.

Methods: In a population-based prospective cohort study among 3,223 mother-child pairs, we assessed 46 lifestyle and environmental prenatal exposures and fat mass index by dual-energy X-ray absorptiometry, and visceral fat index and liver fat fraction by magnetic resonance imaging at 10 years. We used an exposure-wide association study (ExWAS) considering exposures individually in linear regression models, and a variable selection method, the deletion-substitution-addition (DSA) algorithm, considering all exposures simultaneously to build a final multi-exposure model.

Results: In ExWAS, 21 exposures (including maternal body mass index (BMI), smoking habits, alcohol consumption, dietary intake and air pollutants) were associated with at least one of the child fat outcomes, but only the associations of maternal BMI, alcohol consumption and vitamin D levels remained significant after multiple testing correction (p<0.002). In the final DSA multi-exposure model, maternal BMI was positively associated whereas alcohol consumption was negatively associated with all child fat outcomes. Positive associations were observed for linoleic acid levels with fat mass index, for smoking habits and γ-linolenic acid levels with fat mass and visceral fat indices, and for caffeine intake and overall psychological distress with visceral fat index and liver fat fraction. Negative associations were observed for overall diet quality and elemental potassium concentration with fat mass index, for vitamin D levels with fat mass and visceral fat indices and for nitrogen dioxide concentration with liver fat fraction.

Conclusions: Our exposome approach identified mainly lifestyle prenatal exposures that are associated with child general, visceral and liver fat.
The First Cycle of China National Human Biomonitoring Program Has Been Launched: Plan and Operation

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TPS 711: The exposome, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: China now faces many environmental challenges that are seriously affecting human health and quality of life. The biomonitoring for environmental chemicals and health risk assessment on national level are required to understand what environmental chemicals Chinese people are exposing to and their mechanisms. In 2017, China National Biomonitoring Program (China-NHBP) was launched to acquire the baseline exposure level of environmental chemicals in general population and build biospecimen biobank for future study.

Methods: China-NHBP used a three-stages sampling design to recruit nationally representative samples of general population aged 3-79 years in China. The anticipated sample size was 21,888, participants aged 3-, 6-, 12-, 19-, 40- and 60-79 were equally selected. Information on demographic, economic, medical and health service data and source of industrial and agriculture pollutant of counties, districts and communities were collected by local organizations. Personal and family information related to environmental chemicals exposure were collected by trained interviewers. Medical examination was performed for all participants, biospecimens of blood and urine were also collected during the examination. For biospecimens, metal/metalloid was detected using inductively coupled plasma mass spectrometry, phthalate esters, bisphenol A and perfluorochemicals were detected using high-performance liquid chromatography-tandem mass spectrometry.

Results: Totally, 21,745 participants have been investigated from 2017 to 2018, of whom 49.90% were male and 54.40% were living in cities, all age groups were almost equally investigated. Until now, the exposure level of 13 metals/metalloids including Pb, Cr, Hg, As and Cd, etc. have been detected in 20,432 blood and 20,350 urine samples; 18 perfluorochemicals including perfluorooctanoic acid, perfluorooctane acid, etc. have been detected in 483 blood samples.

Conclusions: China-NHBP has completed its goals on schedule, which will provide a national exposure data of environmental chemicals for Chinese people. Questionnaires and biospecimens need to be further analyzed to support decision making of Chinese government.
Associations between PBDEs exposure during pregnancy, fetal growth and aberrant DNA methylation of human placenta

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TPS 711: The exposome, August 26, 2019, 3:00 PM - 4:30 PM

Aim: To evaluated the association between in utero PBDEs exposure and fetal growth and examined the potential role of altered DNA methylation of growth regulatory genes in these associations.

Methods: A total of 249 mother-newborn pairs comprising of 124 fetal growth restriction (FGR) cases and 125 controls within the Wenzhou Birth Cohort were enrolled in this nested case–control study. In utero exposure of 19 PBDEs congeners, including thirteen lower PBDE congeners (BDE-17~190) and six higher brominate BDE congeners (BDE-196~209), were determined by gas chromatography tandem mass spectrometry in umbilical cord blood. Placental DNA methylation of LINE1, HSD11B2 and IGF2 was measured by quantitative polymerase chain reaction-pyrosequencing at differentially methylated regions (DMRs). Multiple linear regression and logistic regressions models were used to examine associations among PBDEs exposure, fetal growth indicators and DMR methylation fractions.

Results: Concentrations of BDE-49, BDE-206, BDE-209, BDE-17~190 and Σ19PBDEs were significantly higher in FGR cases than those in normal controls. Meanwhile, DNA methylation of IGF2 and HSD11B2 showed significant differences between FGR group and control group, respectively. BDE-206 (OR: 1.569, 95% CIs: 1.053-2.338), BDE-17~190 (OR: 2.860, 95% CIs: 1.233-6.634), BDE-196~209 (OR: 1.688, 95% CIs: 1.024-2.783) and Σ19PBDEs (OR: 2.387, 95% CIs: 1.220-4.668) concentrations were associated with increased risk of FGR. Being FGR birth were also associated with increasing DNA methylation of HSD11B2 (OR: 1.145, 95% CIs: 1.032-1.270) and decreasing DNA methylation of IGF2 (OR: 0.892, 95% CIs: 0.845, 0.941). In addition, BDE-17~190 showed significant associations with placental DNA methylation of HSD11B2 and IGF2 (β: 1.127, 95% CIs: 0.069-2.186; β: -3.452, 95% CIs: -5.512--1.392). These results were consistent with the expected direction relating PBDEs exposure, fetal growth and placental DNA methylation.

Conclusion: We report an inverse association between in utero exposures to PBDEs and fetal growth and provide evidence supporting epigenetic gene plasticity in these associations.
Impact of prenatal maternal stress on birth anthropometrics and pregnancy outcomes in rural Ghana

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Background/Aim
In developed countries, prenatal maternal stress has been associated with impaired fetal growth, however this has not been evaluated in rural sub-Saharan Africa. We evaluated the effect of prenatal maternal stress on fetal growth and birth outcomes in rural Ghana.

Methods
Leveraging a prospective, rural Ghanaian birth cohort, we ascertained prenatal maternal negative life events, categorized scores as 0-2 (low stress; referent), 3-5 (moderate), and >5 (high) among 353 pregnant women in the Kintampo North Municipality and Kintampo South District located within the middle belt of Ghana. We employed linear regression to determine associations between prenatal maternal stress and infant birth weight, head circumference, and length measured within 24 hours of birth. We additionally examined associations between prenatal maternal stress and adverse birth outcomes, including low birth weight, small for gestational age, and stillbirth using logistic regression. Models were adjusted for maternal age, weight, height, socioeconomic status, marital status, ethnicity, infant sex, and intervention cluster. Effect modification by infant sex was examined.

Results
Compared with low prenatal maternal stress, high stress was associated with reduced birth length ($\beta=-0.91$ cm, $p=0.04$; $p$-value for trend=0.04) for all infants. Among female infants, moderate and high prenatal maternal stress were both associated with reduced birth weight ($\beta=-0.16$ kg, $p=0.02$; $\beta=-0.18$, $p=0.04$ respectively; $p$-value for trend=0.04) and head circumference ($\beta=-0.66$ cm, $p=0.05$; $\beta=-1.02$, $p=0.01$ respectively; $p$-value for trend=0.01). In female infants, high prenatal stress increased odds of a composite of adverse birth outcomes (OR 2.41, 95% CI 1.01-5.75; $p$ for interaction=0.04).

Conclusions
In this rural Ghanaian cohort, our data suggests that prenatal maternal stress may negatively impact fetal growth and pregnancy outcomes in all infants, especially for female infants. Understanding risk factors for impaired fetal growth may help develop preventative health strategies for future public health interventions.
Associations between oxidative stress and inflammation and preterm birth in Puerto Rico

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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Preterm birth (PTB; gestational age <37 weeks) is the leading cause of infant morbidity and mortality worldwide. Oxidative stress and inflammation have been implicated as contributors to PTB; however, these pathways are difficult to distinguish in human populations. Using data from the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) cohort (N=469), we examined associations between urinary 8-iso-prostaglandin F2α (8-iso-PGF2α) concentrations and PTB, and applied a novel approach to identify whether the association was attributable to oxidative stress or inflammation.

Methods: 8-iso-prostaglandin F2α (8-iso-PGF2α) and prostaglandin F2α (PGF2α) were measured in urine samples collected at up to 3 timepoints across pregnancy (median 18, 24, 28 weeks gestation) and averaged. Logistic regression models were used to calculate adjusted odds ratios (OR) for the associations between average concentrations and PTB. We quantified the proportion of 8-iso-PGF2α originating from oxidative stress and inflammation pathways with a formula based on the ratio of 8-iso-PGF2α to PGF2α. Finally, we examined associations between 8-iso-PGF2α fractions and PTB.

Results: The geometric means of 8-iso-PGF2α and PGF2α were higher among women who delivered preterm compared to term. An interquartile range (IQR) difference in 8-iso-PGF2α was associated with increased odds of PTB (OR=1.64, 95% confidence interval [CI]=1.07-2.54). This association appeared to be driven by associations with inflammation. An IQR increase in the fraction of 8-iso-PGF2α derived from inflammation was associated with PTB (OR=1.56, 95% CI=1.01, 2.53), the fraction of 8-iso-PGF2α derived from oxidative stress was not associated with PTB (OR=1.05, 95% CI=0.72, 1.54).

Conclusions: Our results indicate an association between 8-iso-PGF2α, a traditional oxidative stress biomarker, and PTB. Our additional interrogation of that association indicates that the relationship is likely attributable to elevated inflammation. Further research is needed to improve our understanding of the role these biomarkers may play in the causal pathway between environmental factors and PTB.
Socio-demographic profile in pregnant women of a birth cohort study of environmental pollutant exposure at a urban area – Project PIPA pilot study

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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims: The project children and environmental pollutants (PIPA) is a longitudinal study which aims to investigate the individual and combined effects of environmental pollutants, on the health and development of children in Municipality of Rio de Janeiro (MRJ) - Brazil. The study population will be all children born at the School Maternity of Federal University of Rio de Janeiro (SM/UFRJ) for 12 months. The estimated population is 2,500 children. Between the months September 2017 and August 2018 was done a pilot study (PS) with 142 women-pregnant enrolled. This study describes the socio-demographic profile of pregnant who have agreed to participate in the PS, compared with the profile of pregnant who refused and with existing data for MRJ. Methods: A 10-month cohort study. Population composed of pregnant women and their children born in SM/UFRJ. The study protocol included investigations in the third trimester of gestation at birth and follow-up until the 6th month. Collecting biological samples from the mother and the baby, inquiry into the socio-demographic health and behavioral profile of the mother and clinical evaluations in children. Results: Of 209 eligible pregnant women, 142 (67.5%) accepted to participate. The mean age was 27.5 years (SD 8.05), a result similar to that observed in refusals. Among pregnant participants 24.4% (34) were white, among the refusals 12.9% (10). Schooling was higher among the participants, where 22% (30) had more than 12 years of study, among refusals 14.8% (11). Among the participants 58.9% (86) are in the labor market, among the refusals 47.2% (35). In MRJ, 35.0% are white, mean age is 27 years, and 20% are at least 12 years of study. Conclusions: The results of the study allow you to know better the profile of pregnant women who are part of the target population and plot strategies for the development of the Cohort.
Impact of improved cook stove intervention on reduction of exposure to PM2.5 among rural women and children in Andhra Pradesh, India

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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background
Due to inefficient designs and use, traditional biomass stoves emit fine particulates, and other toxics causing additional burden of diseases for a major population in developing countries. Keeping this fact in mind, this study was conducted in a few villages of Andhra Pradesh, India providing with a cost effective intervention. PM2.5 was adopted as the surrogate exposure burden and compared its concentration with pre- and post-intervention measurements.

Methods
This study was a cluster-randomized with 2 groups of 24 households each and was randomized to a traditional wood stove (control) and an efficient wood burning stove (intervention). However, the present study represents PM2.5 concentration in 24 intervention households between pre- and post-intervention periods. Area and personal measurements were done using standard protocols. Area samplings were conducted during dinner and breakfast cooking (3 hrs.; N=24), non-cooking (6 hrs. after dinner and breakfast cooking; N=12) and kitchen-living room (24 hrs.; N=6), whereas personal sampling with 6 participants for 3 hours during dinner cooking.

Results
Pre- and post- PM2.5 concentrations (Mean ± SD) during dinner cooking periods were 376.07±366.50 and 152.64±106.86 µg/m3, whereas, for breakfast were 725.40±980.64 µg/m3 & 335.84±404.48 µg/m3, respectively. However, for post dinner and post breakfast non-cooking periods, concentrations were 86.54±38.71 & 55.42±37.60 µg/m3 and 116.44±68.70 & 119.30±194.76 µg/m3, respectively. Mothers and Children personal PM2.5 concentrations were 350.18±282.89 & 142.52±123.82 µg/m3 and 476.98±811.43 & 426.13±741.59 µg/m3, respectively. For 24-hours pre- & post- kitchen and living area, values were 397.71±671.04 & 114.39±134.07 µg/m3 and 157.04±235.49 & 47.35±39.91 µg/m3, respectively.

Conclusion
The study showed clear reduction of PM2.5 exposure concentration in intervention period might be due to comparatively lesser amount of fuel use and higher efficiency of the improved stoves. As per users’ perception, they could save some cooking time and felt better cooking environment in intervention period.
Spatial Epidemiology of Vitamin D Status in Mongolia

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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background

Most Mongolians are known to have low vitamin D levels because of low availability and lack of dietary habit of vitamin D-rich foods, including fish and mushrooms. Moreover, solar radiation is inadequate to induce cutaneous synthesis of pre-vitamin D in winters because of Mongolia’s high latitude and highland location. This study aims to determine the spatial status of vitamin D in Mongolians.

Methods

Serum 25-hydroxyvitamin D [25(OH)D], the most abundant vitamin D metabolite in circulation, was measured in 541 healthy subjects (age: 10–64 years) living in six Mongolian provinces and capital, Ulaanbaatar. Furthermore, blood samples were collected between September and December 2016.

Results

The mean (± standard deviation) serum 25(OH)D concentration was 16.6 (± 7.0) ng/mL (recommended value, ≥30.0 ng/mL); furthermore, 70.1% of subjects had “deficient” (<20 ng/mL) and 24.2% had “insufficient” (20≤, <30 ng/mL) levels. The 25(OH)D levels were significantly lower in females (14.9 ± 5.9 ng/mL) than in males (19.5 ± 7.8 ng/mL), although no differentiation was noted by age. Subjects from Ulaanbaatar exhibited the lowest levels of 25(OH)D (7.9 ± 2.6 ng/mL) compared with all provinces, with significant differences even if seasonal sampling blood was considered. Furthermore, the 25(OH)D levels were relatively high in provinces in southern Mongolia.

Conclusions

Mongolians have deficient vitamin D levels, especially in Ulaanbaatar, which could be partly attributed to the impact of air pollution; Ulaanbaatar is the most air polluted area in Mongolia (annual mean: PM2.5, 6–10 times higher than the safety level), which decreases the amount of ultraviolet-B radiation required for the synthesis of pre-vitamin D. Therefore, a comprehensive policy, including dietary modification and the remedy for air pollution, is warranted.
Trend analysis of colorectal cancer incidence in Latin American
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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background: Colorectal cancer burden increased in Latin America in the past 15 years. Aim: to determine trends of colorectal cancer incidence rates in four LA countries.

Methods: A trend study was performed using data series of Cancer Incidence in Five Continents (CI-5) published by International Agency for Research on Cancer (IARC), 1983-2012 for Cali (n=5.528), 1983-2011 for Costa Rica (n=8.585), and 1988-2012 for Goiania (n=3.856) and Quito (n=2.2463). Jeopardized populations were obtained in CI-5/IARC, with size corrections in Goiania by the Brazilian Institute of Geography and Statistics. Incidence rates were standardized by age using truncated method, and world population proposed by Segi modified by Doll as standard. Trends were evaluated by estimated annual percent change (EAPC) for entire period, annual percent change (APC) for each segment, significant level of 5%. Selection of best model was based on Monte Carlo permutation test and Joinpoint Regression Program used to analyze.

Results: Increases Colorectal cancer rates were observed in Costa Rica men and women (3.1%, 2.1%), and Quito (2.6%, 1.2%), Cali men (2.8%), and Goiania women (3.3%). Cali women presented increased rates during 1983-1992 (7.2%), with smaller magnitude during 1992-2012 (1.4%), Goiania men presented decreased rates during 1988-1991 (-17.6%), with later increase during 1991-2005 (8.9%), and another drop during 2005-2012 (-1.7%). There was an increased EAPC for colon cancer for Cali men and women (3.1%, 2.9%), Costa Rica (3.9%, 2.8%) and Quito (2.9%, 1.8%), and Goiania women (2.4%). Increased APC was observed in Goiania men during 1991-2005 (9.5%), with reduction during 2005-2012 (-2.8%). Increased rectal cancer rates were observed in Cali men and women (2.5%, 2.6%), Costa Rica (2.2%, 1.0%) and Goiania (5.5%, 4.6%), and in Quito men (2.8%).

Conclusions: In Latin America, increased colorectal cancer incidence rates were observed. Greater magnitudes were found in Goiania, especially for rectal cancer in both genders.
Cancer mortality among indigenous people in western Amazon
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Aim: to estimate the cancer mortality and cancer Standardized Mortality Ratio (SMR) in western Amazon indigenous population.

Methods: A cancer mortality descriptive study was accomplished among indigenous people in the state of Acre, Brazil, located in the western Amazon region. Cancer deaths diagnosed from January 1, 2000 to December 31, 2012 were obtained from Death Certificate Information System. Population at risk was obtained from the Brazilian Institute of Geography and Statistics. Cancer deaths distributions stratified by sex, age, and ethnic group were proceeded according to anatomic sites. The SMR, with 95% confidence intervals, were estimated using the cancer-mortality rates of Goiania, Acre state, and Brazilian North region as references.

Results: A total of 81 cancer-deaths among indigenous people were recorded from 2000-2012, mostly among men (59.3%), those aged 70+ (37%), and Huni Kuin/Kaxinawá ethnic group (38.8%). Among men, the main cancer sites were stomach (27.1%), liver (18.7%), colorectal (8.3%), leukemia (8.3%), and prostate (8.3%); while among women were cervix (36.4%), stomach (12.1%), liver (6.1%), leukemia (6.1%), and uterus (6.1%). In men, cancer deaths excess were observed for stomach as compared to men from Goiânia (SMR = 2.72; 95%CI: 2.58-2.87), Acre state (SMR = 2.05; 95%CI: 1.94-2.16), and North region (SMR = 3.10; 95%CI: 2.93-3.27); and also for liver comparing to Goiânia (SMR = 3.89; 95%CI: 3.66-4.14), Acre state (SMR = 1.79; 95%CI: 1.68-1.91), and North region (SMR = 4.04; 95%CI: 3.77-4.30). In women, cancer deaths excess were observed for cervix as compared to cervical cancer rates from Goiânia (SMR = 4.67; 95%CI: 4.41-4.93), Acre state (SMR = 2.12; 95%CI: 2.00-2.24), and North region (SMR = 2.60; 95%CI: 2.45-2.75). Conclusion: Cancer mortality among indigenous people from western Amazon affected mainly men, elderly people (aged 70+), and Huni Kuin/Kaxinawá ethnic group. In men, stomach and liver cancer-deaths excess were observed among indigenous people comparing to non-indigenous population from Goiania, Acre state, and North region. In women, a cervical cancer-death excess were observed among indigenous people comparing to non-indigenous population from the same areas. It suggest that indigenous people in western Amazon have lack of cancer prevention, diagnosis and treatment access, as compared to non-indigenous population in the same area.
Aim: to estimate the cancer incidence and cancer Standardized Incidence Ratio (SIR) in western Amazon indigenous population. Methods: A cancer incidence descriptive study was accomplished among indigenous people in the state of Acre, Brazil, located in the western Amazon region. Cancer cases diagnosed from 2000 to 2012 were obtained from cancer hospitals of Acre, Goiânia, and Rondônia; Acre-DSEI (Indigenous Health Special Sanitary District), and Acre-CASAI (Primary Health Care for Indigenous People), Goiânia-DSEI/CASAI, and São Paulo-DSEI/CASAI; histopathological reports in all public and private laboratory of Acre. Population at risk was obtained from the Brazilian Institute of Geography and Statistics. Cancer incidence cases distributions stratified by sex, age, and ethnic group were proceeded according to anatomic sites. The SIR, with 95% confidence intervals, were estimated using the cancer-incidence rates of Goiânia in 2006 as reference. Results: A total of 137 new cancer cases among indigenous people were recorded from 2000-2012. Most cases were women (51.8%), and those aged 70+ (32.1%). Among men, the main cancer sites were stomach (25.8%), liver (15.1%), colorectal (7.6%), leukemia (7.6%), and prostate (6.1%); while among women were cervix (50.7%), stomach (8.5%), leukemia (5.6%), liver (4.3%), and breast (4.3%). In men, cancer cancer excess were observed for stomach (SIR=1.75;95%CI:1.67-1.83), liver (SIR=1.77;95%CI:1.66-1.88), and leukemia (SIR=1.64;95%CI:1.49-1.78); with lower incidence for prostate (SIR=0.06;95%CI:0.05-0.07). In women, cancer excess were observed for cervix (SIR=4.49;95%CI:4.34-4.64), and liver (SIR=2.11;95%CI:1.88-2.34); with lower incidence for breast (SIR=0.12;95%CI:0.11-0.14). Conclusion: Among indigenous people in western Amazon, women and elderly people were mostly cancer-affected groups. Comparing to Goiânia population, a cancer cases excess were observed for stomach, liver, and leukemia in men; and for cervix and leukemia in women. It suggests that infection-related cancer were more frequent among indigenous people as compared to non-indigenous people, reflecting environmental exposures related to socioeconomic vulnerability and lack of healthcare system access.
Incidence of colon and rectal cancer in selected countries in Latin America: the analysis of the age-period-cohort effect
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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background. Over the past decades, incidence trends of colorectal cancer increased in Latin America. Aim. To estimate the effects of Age-Period-Cohort(APC) over the colorectal cancer incidence rates in Latin American countries covered by high-quality population-based cancer registries. Methods. A trend study using Cancer Incidence in Five Continents(CI-5) published by International Agency for Research on Cancer(IARC) of 1983-2012 in Cali(n=5.528), 1983-2007 in Costa Rica(n=8.585), of 1988-2012 in Goiania(n=3.856) and Quito(n=2463) was performed. APC effects were estimated including people aged 20-79, using Poisson regression model, with 5% significance level. Models adjustment were evaluated by statistics deviance. Results: Age effects for both sexes across every region and anatomic sites were observed. Curves inclination reached peaks in older groups(70-74 and 75-79 years). Cohort effects were observed in all regions, with increased RR for the more recent cohorts. For colorectal cancer increases were observed in men and women in Cali(RR=4.16;CI95%:2.29-7.55 and RR=3.77;CI95%:2.12-6.69), Costa Rica(RR=2.51;CI95%:1.50-4.20 and RR=2.17;CI95%:1.30-3.61), Goiania(RR=4.68;CI95%:2.18-10.02 and RR=2.65;CI95%:1.31-5.36) and for men from Quito(RR=2.61;CI95%:1.10-6.16). For colon cancer effects were observed in men and women of Cali(RR=4.26;CI95%:1.89-9.63 and RR=3.62;CI95%:1.68-7.80), Costa Rica(RR=2.66;CI95%:1.37-5.18 and RR=3.41;CI95%:1.79-6.50), Goiania(RR=1.26;CI95%:1.15-1.38 and RR=1.23;CI95%:1.25-1.34) and Quito(RR=3.19,CI95%:1.04-9.77 and RR=1.86;CI95%:1.06-3.26). For rectal cancer, there were increases in men and women in Cali(RR=4.03;CI95%:1.67-9.73 and RR=3.40;CI95%:1.49-7.76), Goiania(RR=3.25;CI95%:1.04-10.18 and RR=4.60;CI95%:1.61-13.09) and in men from Costa Rica(RR=2.41;CI95%:1.07-5.44) and Quito(RR=1.71,CI95%:1.05-2.77). Increased period effects was observed for colorectal cancer in 2003-2007 among men and women of Goiania(RR=1.26;CI95%:1.17-1.35 and RR=1.24;CI95%:1.16-1.32), colon cancer(RR=1.26;CI95%:1.15-1.38 and RR=1.23;CI95%:1.25-1.34), and rectal cancer(RR=1.27;CI95%:1.14-1.42, and RR=1.25;CI95%:1.13-1.38). Conclusions: In Latin America, an age effect was observed in the increased incidence rates for every anatomic site. Birth cohort effects were verified for recent cohorts in both gender for all site in Cali and Goiania; while in Costa Rica was observed for colorectal cancer in both genders and in Quito. Goiania city presented a period effect with increased RR for 2003-2007.
Type of sanitation and drinking water source in relation to stunting among children in Madagascar

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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim:
Stunting affects 155 million children globally. Environmental enteric dysfunction (EED), an inflammatory intestinal disorder, has been linked to stunting through chronic microbial contamination exposure. Recent investigations suggest that mitigating stunting requires the highest threshold of sanitation, defined as use of toilets with sewer or septic systems, piped drinking water into household, and high-quality flooring materials. We report on a population-level analysis on these sanitation indicators as proxies for microbial exposures and stunting in Madagascar.

Methods:
We analyzed 4,861 mother-child pairs from the cross-sectional 2008-2009 Madagascar Demographic and Health Surveys using logistic regression to assess child stunting outcome in relation to whether or not a child’s household had three main sanitation factors, i.e., advanced toilet system, piped water to premises of the household, and high-quality flooring. We also stratified by whether or not households reported treating their drinking water. We adjusted for potential confounders including wealth index, mother’s education, urban/rural location, and child’s age.

Results:
Nearly half of Malagasy children were stunted (48.6%). Associations between advanced flush toilets and stunting were not suggested after adjusting for confounders. Lack of piped water access in the household (aOR=2.28, 95%CI: 1.19, 4.36) and not having finished flooring was associated with increased odds for stunting (aOR=1.53, 95%CI: 1.27, 1.85). Potential effect measure modification was suggested between piped water use and stunting among households that did not treat their water (aOR=5.07, 95%CI: 1.47, 17.54) compared to those that treated their water (aOR=1.41, 95%CI: 0.63, 3.15).

Conclusion:
The overall stunting prevalence in this DHS study sample was much higher than the global child stunting rate of 23%. Our population-level findings support the notion of association between type of sanitation and stunting with those with the most improved types of sanitation having lower odds for stunting.
Emerging Chronic Kidney Disease of uncertain aetiology (CKDu) among rural farming communities in Southern and Uva Provinces of Sri Lanka

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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Chronic Kidney Disease of uncertain aetiology (CKDu) is an endemic disease occurring in clustered farming communities in Sri Lanka. The current study used an environmental and clinical approach to find the causative factors responsible for CKDu development and discover potential biomarkers for early detection of CKDu in emerging provinces. Dissolved Oxygen, Salinity, Temperature, Conductivity, Total Dissolved Solids (TDS), pH, fluoride, nitrates, Orthophosphates and total hardness, heavy metals analysis and herbicide (i.e. glyphosate) residue analysis were performed. Diagnosis of CKDu using WHO guidelines and early detection of kidney injury using novel urine biomarkers KIM-1 and NGAL were also performed following standard methods. Water hardness was high in all study locations except controls. In most wells, fluoride levels were within limits however, certain wells were exceeded WHO drinking water standards for fluorides. Cadmium levels were within the national and WHO standards in all locations but detectable levels of cadmium were reported in CKDu emerging locations. Measureable levels of Glyphosate were detected in water samples. Albumin to Creatinine Ratio (ACR) and eGFR revealed three cases from Angunakolapelessa were at stage-3 kidney disease. Six cases from Matara, 52 cases from Angunakolapelessa and 77 cases from Bandagiriya were at stage-2 kidney disease. Whereas, 32 cases from Matara, 56 cases from Angunakolapelessa and 65 cases from Bandagiriya were at stage-1 kidney disease. Tubular damage predicted by urinary KIM-1 and NGAL were significantly correlated with high urinary ACR levels. Strikingly, early tubular damage as seen by higher urinary KIM-1 and NGAL was also observed in healthy farmers despite normal ACR levels (< 30 mg/g). Urinary tubular markers reconfirm tubulointerstitial disease with repeated tubular injury in farming communities. It is recommended that clean and safe water should be supplied to CKDu emerging provinces and relevant diagnosing methods should be implemented immediately for disease diagnosis and patient management.
Spatio-temporal Analyses for Dengue Outbreak in Tarawa, Kiribati

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TPS 723: Low and middle income countries: sanitation, infections and other health effects, August 26, 2019, 3:00 PM - 4:30 PM

Background:
The Republic of Kiribati is a Pacific Island country comprised of atoll. It has a population density of 152 people per square kilometers, confined in a narrow strip of small atolls connected with causeway, which provides an advantageous environment for the spreading of the vector borne diseases. The purpose of this study was to investigate the propagation pattern of dengue in Kiribati through its outbreak in 2018.

Method:
This study utilized reported data to the government. The index case was reported on 10 February, and last case was reported on 19 September. Based on the geographic and land use characteristics of Kiribati, the cases’ residence were categorized into the western, central, eastern, and northern region. The date of onset of each region was compared. Temporal and spatial correlations were used and generalized additive model was utilized for the analyses. The attack rates were estimated by region. Spatio-temporal patterns were analyzed in relation to the geographic characteristics and climate variables.

Results:
During this period, a total of 1,802 cases of dengue were reported, among which 1,699 cases used for the analysis. Dengue of Kiribati in 2018 started in the eastern area, Bonriki, the area in which an international airport is located. The first case of each region was; 21 March in the central, 5 April on the western, and 8 May on the northern area. The attack rates per 1,000 persons was 48.98 in the eastern, 25.73 in the central, 27.24 in the western, and 17.81 in the northern area, respectively.

Conclusions:
Dengue spread from the east to westward through the central area, and from the east to the north. This study provided the evidence of the pattern of propagation of mosquito-borne infection and can be applied for the prevention of the vector borne disease
Perinatal Phthalates exposure decreases fine-motor functions in 11-year-old girls: results from Weighted Quantile Sum regression


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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Phthalates are a group of chemicals, generally used as plasticizers and odor enhancers. Phthalates cross the blood-placenta barrier and are associated with deficits in cognitive functions and behavior problems in offspring. We previously reported sex-specific associations with motor function when phthalates are considered singly. Because exposure to phthalates usually occurs as a mixture, here we assess these associations between a mixture of phthalates and motor function at age 11 years.

Methods: Data come from the prospective cohort study of mothers and offspring who participated in the Columbia Center for Children’s Environmental Health birth cohort (CCCEH). Seven phthalate metabolites were measured in maternal spot urine and motor function was evaluated using the short form of the Bruininks-Oseretsky Test (BOT-2) at the age of 11 years. We used Weighted Quartile Sum (WQS) regression models to examine the effect of phthalate mixture, adjusting for child age in months, child BMI, maternal race (African-American vs. Dominican), alcohol consumption, maternal demoralization and HOME scores, and urine specific gravity.

Results: 209 mother-child pairs were eligible for this analysis. A significant decrease in fine-motor functions was observed among females, but not among males, following exposure to high levels of phthalate metabolites (Covariates-adjusted coefficient B=-2.7 with 95%Confidence Interval [CI] -4.64 to -0.75, p =0.01 for females and B=-1.63 95%CI -3.94 to 0.69, p =0.16 for males). The most highly weighted phthalate metabolites, associated with fine-motor functions among females, were MBP, MBZP, and MIBP. No significant associations were found between exposure to phthalates and gross-motor functions for both females and males. Significant associations were found between the mean concentrations of non-DEHP phthalates and both gross and fine motor functions among females (B=-1.58 95%CI -2.75 to -0.47 and B=-1.05 95%CI -1.81 to -0.29 respectively).

Conclusions: Phthalate exposure during pregnancy was associated with decreased fine motor functions among 11-year-old girls.
Smoking during pregnancy and cognitive and psychomotor development at 1 year and in preschool age
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Aim: The aim of the study was to analyse the association between smoking during pregnancy and neurodevelopment at 1 year and in preschool age in children from the Spanish INMA Project. Methods: Maternal smoking during pregnancy was measured throughout a questionnaire at the 3rd trimester of pregnancy assessing the timing and dose of maternal smoking before and during pregnancy. Mothers (N=1822) were classified according to their smoking status during pregnancy (women who did not smoke, even at the beginning of the pregnancy; those who smoked during the first and second trimesters but not later; and those who smoked throughout their pregnancy, continuing the habit during the 3rd trimester). Cotinine levels were measured in urine samples collected in the same interview. Child cognitive and psychomotor development was assessed at 1 year of age throughout the Bayley Scales of Infant Development (N=1822) and at age 4-5 years throughout the McCarthy Scales of Children Abilities (N=1807) and the Conners Kiddie Continuous Performance Test (N=1338). Models were built using multivariate linear regression or negative binomial regression. Effect modification by sex was also analysed. Results: Adjusted regression models showed that maternal smoking throughout the pregnancy and higher levels of cotinine were negatively associated with non-verbal cognition, omissions errors and reaction time standard error in the whole sample. Overall, we did not find effect modification by sex. Conclusion: This study shows a negative effect of smoking throughout the pregnancy on children non-verbal cognition and attentional function at 4 years of age even after adjusting by maternal IQ. No strong pattern of interaction effect with sex was found.
Indoor and outdoor PM2.5 exposure, and anxiety in schoolchildren, Korea: a panel study

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Aim: To evaluate children’s anxiety according to PM2.5 exposure in a panel study. Methods: During the 3 waves (Mar, Jul, and Nov in 2018), 52 children were assessed indoor PM2.5 exposure at their home and 3 classrooms in two elementary schools, a city in Korea: for 7 days in each wave. Indoor exposure was calculated daily median, mean, and maximum using 30-minute mean of their own home and classroom in same time. Outdoor PM2.5 data was obtained from AirKorea, national ambient measurement of city spot near the school. Low (< 75 percentile) and high exposed group (≥ 75 percentile) were classified in daily statistic of indoor and outdoor PM2.5 level. Children’s anxiety was assessed via State Anxiety Inventory for children (SAIC) for 7 days in each wave. Gender and household income were assessed via questionnaire, and were used as covariates. Generalized estimated equation model was used to analyze for repeated measured data. Results: Using mean of PM2.5 concentration, SAIC were 4.5 point higher (p=0.02) in low-indoor and high-outdoor group, and 2.7 point lower (p=0.002) in high-indoor and low-outdoor group than in low-indoor and low-outdoor group. Using median and maximum of PM2.5 concentration, SAIC were 3.1 point (p<0.0001) and 1.8 point lower (p=0.04) in high-indoor and low-outdoor group than in low-indoor and low-outdoor group, respectively. Conclusions: We found controversial results Indoor and outdoor exposure to PM2.5 on children’s anxiety. The results imply that social environment arouse anxiety rather than current exposure level of PM2.5 per se.

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Prenatal Sex Hormones and Behavioral Outcomes in Children

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Background/Aim: Exposures resulting in abnormal sex hormone levels in utero have been associated with later-life child behavior, but it is unclear if normal variation in prenatal sex hormones is associated with subsequent behavior in childhood.

Methods: We assessed maternal sex hormones, including serum estrone (E1), estradiol (E2), estriol (E3), free testosterone (FT), and total testosterone (TT), during early pregnancy and evaluated child behavior at ages 4-6 using the Behavioral Assessment System for Children (BASC) and Social Responsiveness Scale (SRS) in 404 mother/child pairs (211 girls, 193 boys) within The Infant Development and Environment Study, a multi-site pregnancy cohort study. Associations were evaluated using linear regression and spline generalized additive models adjusting for demographic and biological covariates, and effect modification by sex was assessed.

Results: A 10-fold increase in maternal FT was associated with a 4.3-point (95% CI: 0.3, 8.4) higher BASC internalizing composite T score in both sexes. In girls, E1 was associated with a 4.3-point (1.1, 7.5) worse adaptive skills composite T score (interaction p=0.03). In sub-scale score analyses in all children, there were significant linear associations between E1 and worse social withdrawal and social motivation as well as between E2 and worse social skills, in addition to curvilinear associations between E2 and worse social skills at a threshold of about 3000 pg/mL. In models with significant sex interactions, there were significant linear associations between E1 and worse social skills and social cognition, as well as curvilinear associations between E3 and poorer functional communication and TT and worse attention problems in girls. In boys, higher FT was significantly associated with worse social communication.

Conclusions: In utero hormone concentrations may have sex-specific and threshold-based associations with child behavior and development. The role of environmental influences on hormone concentrations, such as endocrine-disrupting chemicals, in subsequent child behavior should be further investigated.
Phthalate Mixtures in Pregnancy and Childhood Behavioral Outcomes

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Prenatal exposure to phthalate plasticizers has previously been associated with changes in child behavior, but the typical approach of evaluating each compound independently has led to inconsistent results.

Methods: We examined the relationship between a mixture of 11 specific gravity-adjusted urinary phthalate metabolites, averaged across the first and third trimesters of pregnancy, and child behavior at ages 4-6 using the Behavioral Assessment System for Children (BASC) and Social Responsiveness Scale (SRS). Analyses included 499 mother/child pairs (252 girls, 247 boys) participating in The Infant Development and Environment Study, a multi-site pregnancy cohort. We evaluated associations using weighted quantile sum (WQS) regression, which weights individual compound contributions to combined exposure mixture associations, adjusting for demographic and biological covariates.

Results: A one quintile increase in the log10-transformed phthalate mixture was significantly associated with 0.7-1.3 point adverse differences in BASC composite externalizing, behavioral symptoms index (BSI), and adaptive skills T scores, as well as SRS total T score. MBP and MIBP accounted for 76% and 74% of the total weighted mixture sum for the externalizing and BSI scores, respectively; MBP and MCPP accounted for 77% for adaptive skills; and the sum of DEHP metabolites (SumDEHP), MCPP, and MBzP accounted for 56% for the total SRS score. Stratifying by sex revealed female-specific adverse associations in externalizing and BSI composite scores highly weighted for MIBP and MBP (88% and 78%, respectively). For adaptive skills, WQS coefficients were similar between sexes, but the most highly weighted phthalates were MBP and MBzP (74%) for females and MCPP and SumDEHP (56%) for males.

Conclusions: Our results suggest adverse associations between prenatal phthalate mixtures and childhood behavior with sex-specific impacts, particularly MBP for females and DEHP for males. Further investigation into the potential sex-specific effects of mixtures will improve our understanding of endocrine-disrupting chemical effects on neurobehavioral development.
Perinatal exposure to air pollution and childhood autism spectrum disorder in Taiwan
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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Exposure to air pollutants is associated with various diseases in humans, including those of the respiratory and cardiovascular systems. However, their effects on the nervous system were less frequently evaluated. Autism spectrum disorders (ASD) is a group of neurodevelopmental disorders of which the etiology is still unknown. We conducted a study in Taiwan to evaluate the possible associations between perinatal exposure to air pollutants and ASD. Methods: From the one million people in the Taiwan National Insurance Research Database, which is a random sample of the general population, we identified all the infants born between 1996 and 2000. We followed them till the end of 2013 and identified cases of ASD. We traced back the mother’s residence and assess exposures to air pollutants using the data obtained from the air quality monitoring database maintained by the government, which included ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), and particles with diameter less than 10 μm (PM10). The associations between exposures to pollutants during the month of birth and childhood ASD were evaluated by using Cox proportional hazard models. Results: We identified a total of 29,282 newborns during the study period. After adjusting for other risk factors, we found an increase of 1 μg/m3 in PM10 during the month of birth was associated with a hazard ratio of 0.99 (95% confidence interval CI: 0.98-0.99). None of the associations with other pollutants reached statistical significance. Conclusions: In conclusion, we found that perinatal exposure level of PM10 had a small but stable negative association with the risk of developing childhood ASD, but not the exposure levels to O3, CO, NO2, or SO2.
Prenatal air pollution exposure and child’s attentional function at 7 years old: exploring windows of susceptibility

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim. Previous studies have shown that prenatal air pollution exposure is associated with an impaired child neuropsychological development including attentional function. However, little is known about the critical windows of susceptibility to air pollution.

Methods. About 1,599 mother-child pairs from the Spanish INMA Project were included. Temporally adjusted land use regression models were used to estimate individual weekly residential exposures to NO2 from conception to birth. Attentional function was assessed at 7 years old using the Attentional Network Test. Distributed lag non-linear models were used to explore critical windows of susceptibility. Lag response relationship was defined by cubic B-spline functions with the optimal number of equal spaced interval knots from 2 to 8 selected by minimizing AIC (i.e. 3 knots placed at weeks 5, 15, and 30).

Results. Higher NO2 exposure at weeks 6 to 14 of gestation was associated with an increase of hit reaction time (standard error) (HRT(SE)) (0.54ms (95%CI 0.26;0.81) per each increase of 10μg/m3 of NO2), with a peak at week 9. Higher NO2 exposure at weeks 32 to 35 of gestation was also associated with an increase of HRT(SE) (0.25ms (95%CI 0.03;0.48) per each increase of 10μg/m3 of NO2), with a peak at week 32. But higher NO2 exposure at weeks 1 to 4 of gestation was associated with a decrease of HRT(SE) (-0.83ms (95%CI -1.27;-0.39) per each increase of 10μg/m3 of NO2).

Conclusions. Critical windows of susceptibility to air pollution in relationship with impaired attentional function in children at 7 years of age were identified at weeks 6 to 14 and 32 to 35 of gestation. The unexpected improved attentional function observed at weeks 1 to 4 of gestation might be explained by a live birth bias or due to an artifact commonly observed in this type of statistical models in the tails.
Air Pollution and Academic Performance in School Children: Preliminary Results from a Longitudinal Study in Chile

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Air pollution has been consistently linked to detrimental impacts on children’s health, nevertheless, evidence on the impact of air pollution on academic performance is limited. This study presents preliminary results from a project that analyzes the impact of exposure to ambient particulate matter 2.5 (PM2.5), one of the most harmful constituents of air pollution, on academic performance in school children in Chile.

Methods: We combined 1-km estimates from a global PM2.5 model developed by van Donkelaar et al. (2016) with administrative data on the universe of results from a standardized test taken by fourth, eight and tenth graders between 2002 and 2016 in all schools in Chile to study the association between school-level PM2.5 concentration and individual-level academic performance. Annual means of PM2.5 and surrounding vegetation were estimated for 250m buffers around each school. We used a panel structure to control for school and individual time-invariant characteristics. We also exploit the variation provided by children that attended different schools when taking the standardized test at different grades.

Results: The total number of observations (test results) were 8,984,359 corresponding to 4,823,847 individuals in 8,759 schools for the 15-year study period. Annual PM2.5 in schools varied between 8 ug/m\(^3\) to 34 ug/m\(^3\), with significant differences between schools in urban versus rural areas. We detected a small, non-significant negative impact of air pollution exposure on mathematics standardized test scores (-0.4 score points, \(p<0.89\)), and a small negative significant effect of air pollution on language test scores (-0.23 score points, \(p<0.001\)), per 1 ug/m\(^3\) increase in annual PM2.5 concentrations.

Conclusions: Air pollution exposure has a detrimental impact on academic performance in school children.
Exposure to endocrine disrupting chemicals and behaviors associated with ADHD in adolescents
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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Phthalates and parabens are endocrine disrupting chemicals (EDCs) commonly found in personal care products. Studies suggest that exposure to EDCs may influence childhood behaviors associated with attention deficit/hyperactivity disorder (ADHD), but the relationship during adolescence has not been studied.

Methods: Urinary biomarker concentrations of phthalates and parabens commonly found in personal care products were quantified in 152 adolescents (age ~15 yrs) in the New Bedford Cohort, a birth cohort study among residents near the New Bedford Harbor Superfund site, Massachusetts. ADHD-associated behavior was assessed with multiple indices from self, parent, and teacher completed behavioral checklists using the Conners’ Attention Deficit Scale and the Behavior Assessment System for Children, 2nd ed., where higher scores indicate more problem behaviors. We used a repeated measures analysis with negative binomial models to estimate the adjusted association of each analyte with these multiple measures of ADHD-related behavior.

Results: In this racially diverse (38% non-white or Hispanic) and socioeconomically disadvantaged (31% in low income households, 43% had unmarried mothers, 59% had mothers with a high school education or less) population, a doubling in urinary concentration of the molar sum of paraben biomarkers was associated with an 2% increase in behavior score associated with ADHD in girls (95% CI: 1.01, 1.04), but not boys; this association appeared to be driven by propyl and methyl paraben. We also observed a 3% increase in the ADHD-related behavior score in both sexes with a doubling of the molar sum of urinary phthalate biomarkers commonly found in personal care products (95% CI: 1.01, 1.04); this association was predominantly driven by monobutyl phthalate (%diff: 1.04, 95% CI: 1.02, 1.07), although we observed a smaller significant association with mono-iso-butyl phthalate.

Conclusion: Our findings suggest that exposure to some parabens and phthalates during adolescence may be associated with behaviors characteristic of ADHD.
Assessing the impact of school socioeconomic status (SES) and school building conditions on student performance among upstate New York public schools: Does it mediate by the students’ respiratory health?

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: In previous studies, low socioeconomic status (SES) and poor school building conditions (SBCs) have been associated with poor school outcomes such as low attendance and academic achievements. While a few attempts were made to understand the potential causal framework, the indirect effect of school SES and SBCs on student performance mediated by students’ respiratory health has not been tested.

Methods: The mediating effects of students’ respiratory health on the relationships between school SES, SBCs and school outcomes were assessed using the counterfactual based mediation approach. Records of respiratory visits among children aged 4-18 were extracted from statewide hospital discharge data and school level hospital visit rates were calculated. Information on SBCs was collected from the 2010 school building condition survey for all public schools in upstate New York. School SES, attendance rate, and students’ scores in the standard test were obtained from school report cards. The associations between the mediator (students’ respiratory health) and outcomes (attendance/performance) were first assessed. Natural indirect and direct effects were then calculated for the outcomes showed significant associations with the mediator.

Results: Schools with higher respiratory visits among students reported consistently lower attendance. Suggestive associations were also found between poor respiratory health and standard test scores but not with Regents exam scores. About a 7% decrease in school attendance due to low school SES, as indicated by the free lunch eligibility, was mediate through students’ respiratory health. While strong total effects were observed between school SES/SBCs and standard test scores, the mediating effect of respiratory health was insignificant.

Conclusion: Poor respiratory health may be one of the most crucial issues to address in improving student attendance and academic performance. Future studies should further explore the mediating effect of other social or parental factors on the path from school SES/SBCs to school outcomes.
Early life exposure to outdoor air pollution and child behavior in the Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE) Study

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims: Previous epidemiological studies suggest that exposure to ambient air pollution impairs healthy neurodevelopment and increases risk of behavior problems in early childhood. However, it is difficult to disentangle effects of prenatal versus postnatal exposure.

Methods: We included mother-child dyads who completed a preschool visit in the CANDLE study. Primary outcomes were internalizing and externalizing behavior scores from the Child Behavior Checklist. Detailed addresses histories from enrollment to outcome assessment were available. We estimated pre- and postnatal exposures to nitrogen dioxide (NO2) and particulate matter less than 10 microns (PM10) at participant residences using a national annual average universal kriging model (land-use regression with spatial smoothing), and distance to nearest major roadway as a proxy for traffic-related pollution. In regression models, we adjusted for multiple measures of individual and neighborhood socioeconomic status, maternal IQ, child sleep health and several other determinants of child neurodevelopment.

Results: The study population (N=975) was predominantly low-income and 69% African American and 31% White. The mean child age at assessment was 4.4 years. Mean NO2 and PM10 exposures were 12.9 ppb and 20.9 μg/m3, respectively. In fully adjusted models, a 5 ppb increase in prenatal NO2 was associated with 13% higher externalizing behavior score (95% CI: 0.5, 28%). A 5 ppb increase in childhood NO2 was associated with more externalizing and internalizing behaviors: differences of 25% (95% CI: 2, 53%) and 26% (95% CI: 5, 50%), respectively. Notably, significant postnatal associations persisted even with adjustment for prenatal exposures, but the converse was not true. Neither PM10 nor road proximity was associated with outcomes.

Conclusions: In a large and richly characterized pregnancy cohort in the ECHO PATHWAYS Consortium, we observed associations supporting the hypothesis that air pollution leads to adverse behavioral outcomes. Postnatal associations were stronger than prenatal effects for both externalizing and internalizing problems.
Number of words at 2.5 years predicts neurocognitive performance at age 7 years. A sensitive measure for assessing effects of EDC exposure? Results from the SELMA study.

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background
Language development is routinely assessed in Sweden when children are 2.5 years of age. The assessment includes a parental questionnaire consisting of questions about the child’s language development. One of the questions regards the number of words the child uses; less than 25, 25–50 or more than 50 words. Number of words has been used in the Swedish Environmental Longitudinal, Mother and child, Asthma and allergy study (SELMA) as an outcome indicating language development.

Aim
The aim of the present study has been to examine number of words as an outcome to validate it as a measure of early neurocognition. We studied whether number of words could predict neurocognitive performance at age 7 years.

Methods
Thirty-eight children that used less than 50 words were compared with 547 children with more than 50 words at age 2.5 as regards intellectual functioning (IQ), verbal concept formation (VC), perceptual reasoning (PR), working memory (WM) and processing speed (PS) at age 7 years using the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV). All scores had a mean of 100 with a standard deviation of 15. Multiple linear regression was used to examine the association between number of words at 2.5 years with scores for IQ, VC, PR, WM, and PS at age 7, adjusted for sex, parental IQ, maternal education level, maternal weight, smoking and prematurity.

Results
Children using less than 50 words at 2.5 years displayed 4.5-7.5 lower index scores for cognitive function at age 7 for IQ ($\beta = -7.27$, $p=0.001$), VC ($\beta = - 7.37$, $p<.001$), PR ($\beta = -4.76$, $p=.027$), and WM ($\beta=-7.46$, $p=.001$), but not for PSI, in comparison to children with more than 50 words.

Conclusions
Number of words at 2½ years seems to be an early signal of cognitive function.
Air Pollution and cognitive impairment in 5 years old children from Chile

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Atmospheric pollution is present in most of the countries independent of its development. Children may be more susceptible to the harmful effects of toxins that are present in air pollution. The main objective of this research is to analyze the possible influence of air pollution on the diagnosis of psychomotor development according to region and sex, adjusted by sociodemographic variables, in Chile.

Methods: Results of psychomotor development evaluation in 5 years old children were extracted from health statistics records according region in 2014. Air databases were obtained of the annual average of the concentrations of MP 2.5 and MP10 in μg/m³ at the national level in 2015. We determine odds ratio values and confidence intervals for the variable state of psychomotor development according to region, for MP 2.5, MP 10 through the STATA version 14 program.

Results: A total of 24,849 minors were included, 96.58% had a normal development status and a 3.43% delay. In relation to the air pollution levels of PM10, concentration ranged from 85 μg/m³ in Aysén to 35 μg/m³ in Antofagasta, and 66.5 μg/m³ in Aysén to 5 μg/m³ in Magallanes. The risk of retardation of psychomotor development in relation to atmospheric pollution for each region of the country was determined. We found detrimental association between air pollution and psychomotor development. The associations were stronger for PM10 than PM2.5 in Aysén region we found OR 21 (IC 95% 6-70) for PM10 and OR 4 (IC95% 2-9).

Conclusion: Our preliminary findings suggest than air pollution due to particulate matter is related with less performance in psychomotor development in children of five years old in Chile.
Early Life PM2.5 Exposure and Behavioral Development in Children from Mexico City

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Poor adaptive skills are a behavioral phenotype that often tracks with later life health issues such as obesity and poor executive function. Early life air pollution exposure has been linked with maladaptive cognitive development; however, less is known about air pollution and childhood behavior or the critical exposure windows during the pre- and postnatal period that may vary by time.

Methods: We used data from 582 mother-child pairs from a prospective birth cohort in Mexico City. Daily PM₂.₅ was estimated using a 1km² satellite-based exposure model and averaged over trimesters, entire pregnancy, and the first year of life. We assessed associations between PM₂.₅ and the Behavioral Assessment Scale for Children (BASC-2) composite scores and subscales measured at 48 months. Linear regression models were used to estimate change in BASC-2 T-scores with interquartile range increases in PM₂.₅. Trimester-specific models were mutually adjusted for the other trimesters. Bayesian distributed lag interaction models (BDLIM) were used to identify critical exposure windows and assess sex interactions. All models adjusted for maternal education, maternal age, child’s age at testing, child sex, and season of conception.

Results: We observed inverse associations between PM₂.₅ and the composite adaptive skills score (β=-0.94, 95%CI: -1.70, -0.17) and among the subscales within the adaptive composite including adaptability (β=-1.09, 95%CI: -1.91, -0.28), social skills (β=-1.04, 95%CI: -1.88, -0.20), and functional communication (β=-0.69, 95%CI: -1.35, -0.04) for PM₂.₅ during the first trimester. A lower adaptive score indicates poorer adaptability. Using the BDLIM, we identified a possible critical window during the 7-15 week of gestation for girls, but not boys.

Conclusions: Exposure to PM₂.₅ during early pregnancy may be associated with worse adaptive skills in children (practical, everyday skills needed to function and develop appropriately). These results suggest that air pollution impacts behavioral domains as well as cognition.
Pre- and Postnatal Air Pollution Exposure and Autism Spectrum Disorder: Findings from the Study to Explore Early Development

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Epidemiologic studies have reported associations between prenatal and early postnatal air pollution exposure and autism spectrum disorder (ASD); however, few studies to date have assessed associations between air pollution and ASD across different geographic locations using uniform exposure and outcome assessment methods.

Methods: We examined associations between early life exposure to PM₂.₅ and ozone in association with ASD across multiple U.S. regions. Our study participants included 674 children with clinically confirmed ASD and 855 population controls from the Study to Explore Early Development, a multi-site case-control study of children born from 2003 to 2006 in the United States. We used a satellite-based model to assign air pollutant exposure averages during several critical periods of neurodevelopment: three months before pregnancy, each trimester of pregnancy, the entire pregnancy, and the first year of life. Logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CIs), adjusting for study site, maternal age, maternal education, maternal race/ethnicity, maternal smoking, and month and year of birth.

Results: The association between air pollution and ASD appeared to vary by exposure time period. PM₂.₅ exposure during the first year of life was associated with ASD, with an OR of 1.26 (95% CI: 1.02, 1.57) per 1.6 µg/m³ increase in PM₂.₅. We additionally observed an association with ozone exposure during the third trimester [OR = 1.22 (95% CI: 1.05, 1.42) per 6.6 ppb increase in ozone].

Conclusions: Our study provides evidence for a positive association between early life air pollution exposure and ASD, and identifies a potential critical window of exposure during the late prenatal and early postnatal periods. This abstract does not necessarily represent the official positions of the Centers for Disease Control and Prevention or the Environmental Protection Agency.
Background: Fetal exposure to tobacco is linked to impaired cognitive ability in the offspring. It is not clear whether these associations persist in the absence of other known risk factors, such as pre-term delivery and low birth weight. We aimed to explore the associations between fetal exposure to tobacco with cognitive function, independent of pre-term delivery or low birth weight. Methods: We followed 246 mother-child pairs enrolled in the Healthy Start cohort through age 4.5 years, who were born full-term (≥37 weeks gestation) and with a birth weight>2,500-g. Maternal urinary cotinine was measured at 27 weeks gestation. At age 4.5 year, parents completed the Third Edition Ages and Stages Questionnaire (ASQ-3) and children completed the National Institutes of Health (NIH) Toolbox Cognition Battery. The five domains of the ASQ-3 were dichotomized as fail/monitor and pass. Logistic regression models examined the association between cotinine categories (below limit of detection (LOD) or ≥LOD) and the five ASQ-3 domains as separate outcomes. Linear regression models examined the association between cotinine categories and fully-adjusted T-scores for inhibitory control (Flanker test), cognitive flexibility (Dimensional Change Card Sort test), and receptive language (Picture Vocabulary test). Our models adjusted for sex, race/ethnicity, maternal age, maternal education, and maternal psychiatric diagnosis. Results: Approximately 65 of the 246 children were exposed to some level of tobacco during pregnancy. Compared to non-exposed offspring, those prenatally exposure to tobacco were more likely to have a fail/monitor score for fine motor skills (adjusted odds ratio: 3.9, 95% CI: 1.6, 9.9) and to exhibit decreased inhibitory control (adjusted beta coefficient: -3.5, 95% CI: -6.5, -0.4). Conclusions: Any exposure to tobacco in utero may have long-lasting effects on cognitive ability, independent of other known risk factors. Increased developmental screening may be warranted for children prenatally exposed to tobacco.
Attention deficit/hyperactivity disorder in Catalonia, Spain: a New Population-Based Case-Control Study to Investigate Environmental Factors

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Attention deficit/hyperactivity disorder (ADHD) is one of the most common behavioral disorders in childhood characterized by a persistent pattern of inattention, hyperactivity and/or impulsivity. According to a recent systematic review, the worldwide estimate of ADHD prevalence is 7.2% in children. This study aims to assess the ADHD prevalence in 2017 and the ADHD incidence in 2009-2017 among children in Catalonia, Spain, as well as their temporal and geographical variability.

Methods: We set up a population-based cohort that included all children aged 4-17 years old insured in the public Catalan Health System in 2009-2017. We identified all ADHD cases diagnosed in 2009-2017 with the ICD-9 codes 314.0, 314.1, 314.2, 314.8, and 314.9. We estimated the ADHD prevalence in 2017 and the yearly ADHD incidence in 2009-2017. We used Poisson regression models to assess the temporal trend of the incidence and mixed-effects Poisson regression models to assess the geographical variability.

Results: We estimated an ADHD prevalence of 4.06% (95%CI 4.03, 4.10) in children in 2017, being 5.81% (95%CI 5.75, 5.87) in boys and 2.20% (95%CI 2.16, 2.24) in girls, and higher in the age group of 13-17 years old (7.28% (95%CI 7.20, 7.36)). ADHD incidence increased slightly from 0.51% (95%CI 0.50, 0.52) in 2009 to 0.58% (95%CI 0.57, 0.59) in 2017, with a higher increase in girls, and in children diagnosed at older ages. Geographical differences were observed only in the 2017 prevalence.

Conclusions: The estimated ADHD prevalence of 4.06% was lower than the estimates reported in previous systematic reviews. The prevalence was higher in boys than girls, with a sex ratio similar to previous studies. We also observed a slight increasing temporal trend of the ADHD incidence in recent years. This new population-based case-control study on ADHD will allow investigating the role of environmental factors in the origins of ADHD.
Impact of lifetime exposure to air pollution on cognitive development in young children: findings from the UK Millennium Cohort Study

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim
Previously we have reported cross-sectional associations between long-term exposure to air pollution and cognitive test performance among children of the UK Millennium Cohort Study (MCS). Here, we report the impact of lifetime exposure to air pollution on cognitive ability at age 3, 5 and 7 and its trajectory.

Methods
Longitudinal study of 13,000+ singleton births, 2000-2002, analysed to examine associations between lifetime exposure to selected air pollutants (NO₂, PM₂.⁵, PM₁₀, SO₂, O₃, CO) modelled at 1×1 km resolution and cognitive scores and changes in scores (Naming Vocabulary, Picture Similarity, Pattern Construction, Word Reading, School Readiness and Number Skills) at age 3, 5 and 7. Multivariable regression models took account of sampling and attrition weights with adjustment for other major risk factors.

Results
Inter Quartile Range (IQR) increases in lifetime exposure to NO₂, PM₂.₅, PM₁₀, SO₂ and CO were associated with decreases in percentile of the standard test score of Naming Vocabulary at age 5: -0.18 [95%CI: -0.29, -0.07], -1.06 [-1.57, -0.55], -0.71 [-1.02, -0.41], -0.53 [-0.92, -0.14] and -3.65 [-5.68, -1.62], respectively. At age 7, PM₂.₅ and PM₁₀ showed detrimental impact on Pattern Construction (-0.67 [-1.31, -0.03] and -0.44 [-0.84, -0.04]) and SO₂ on Number skills (-0.83 [-1.40, -0.27]). These effect sizes were much smaller than those of other major risk factors including ethnicity, household income, mother’s education, language, siblings, environmental tobacco smoke and breast feeding. Little effect on cognitive ability at age 3. Children with higher lifetime exposure had lower development in Naming Vocabulary at age 3-5 for all pollutants investigated (percentile decrease in standardised test score ranged from -3.9 to -1.2) except O₃ (opposite direction).

Conclusions
Lifetime exposure to air pollution showed negative association with selected cognitive ability at age 5-7 years and its development, but no clear association at younger ages.
Hyperactivity disorder in children was related to traffic-related air pollutant during pregnancy

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Attention-deficit/hyperactivity disorder (ADHD) is one of the most common neurobehavioral disorders globally. Although some investigations implied a relationship between ADHD and air pollution exposure during pregnancy, evidence is limited and controversial. This study aimed to investigate the association between air pollution exposure during pregnancy and offspring hyperactivity, one of the key early symptoms of children ADHD.

Methods: Taiwan Birth Cohort Study recruited representative mother-infant pairs, as a result of approximately 12% of all deliveries in 2005 using multistage stratified sampling. Ever having hyperactivity syndrome as evaluated by physicians, psychologists, or special educators was inquire at year of eight years. Exposure to air pollutants were estimated by interpolation based on the 66 air-quality-monitoring stations. The participants with prematurity, low birth weight, intrauterine growth restriction, fetal distress, multiple gestations, maternal alcohol drinking or tobacco smoking were excluded. Odds ratios (ORs) of hyperactivity as a factor of air pollutants were calculated using logistic regression, adjusting for gender, urban/rural residence, birth season, household income, and temperature. For air pollutants with significant effects, two- and multiple-pollutant models in different pregnant period were further applied to confirm the relationship.

Results: 16,686 mother-infant pairs were included in the final analysis, where 374 (2.3%) of children had been diagnosed as having hyperactivity before 8 years of age. The occurrence of hyperactivity was significantly related to prenatal nitrogen oxide (NOx), but not particulate matter 10 micrometers or less in diameter or sulfur dioxide. Further analysis to separate effects by nitrogen dioxide (NO2) and/or nitrogen monoxide (NO) showed that NO was the significant factor for hyperactivity (adjusted OR per interquartile range (3.14 ppb): 1.27, 95% confidence interval: 1.07–1.51).

Conclusions: This study found hyperactivity occurrence in childhood to be positively associated with prenatal NO exposure. Further confirmation on potential hazardous effects of NO and investigation on potential mechanisms are warranted.
Background: The number of children diagnosed with autism spectrum disorder (ASD) has increased. This systematic review and meta-analysis aimed to summarize the association between maternal exposure to outdoor air pollution and ASD in children.

Methods: A systematic literature search in three databases (Medline, Embase, and Web of Science) was performed using subject headings related to ASD and maternal exposure to air pollution. Eligible studies were screened based on predetermined criteria, and risk of bias was assessed by the Newcastle-Ottawa Scale. For meta-analyses, the studies were grouped by air pollutant and exposure time (prenatal period and trimesters). Within-group studies were standardized by log odds ratio (OR) and then combined by three meta-analysis methods: frequentist fixed and random effects models, and Bayesian random effects model due to the small number of studies.

Results: The initial search identified 1,302 papers, of which 20 studies remained for final analysis after duplicates and ineligible studies were removed. Of the 20 studies, 9, 11, 10, and 6 studies, respectively, investigated the association of ASD with PM2.5, PM10, NO2, and ozone. The frequentist and Bayesian random effects models resulted in different statistical significance. For prenatal period, frequentist meta-analysis returned significant pooled ORs for PM2.5 (1.073 with 95% confidence interval (1.008, 1.142)) and ozone (1.010: (1.002, 1.017)), but Bayesian meta-analysis showed ORs with wider uncertainty for PM2.5 (1.075 with 95% posterior interval (0.966, 1.222)) and ozone (1.010: (0.907, 1.133)). Trimester 3 appeared to have higher pooled ORs for PM2.5, PM10, NO2, and ozone. Patterns in the time-varying associations over the trimester were inconsistent, as between-study differences were apparent.

Conclusions: There is marginal evidence for positive associations between maternal exposure to PM2.5, but not PM10, NO2, and ozone, and ASD development in children during pregnancy. However, trends in associations over trimesters were inconsistent between studies and between air pollutants.
Background: Preschool is a critical time for neurological growth and development in children. Few studies have attempted to measure personal air pollution exposure simultaneously with family and home characteristics such as verbal language exposure, important predictors of future educational outcomes. The Cumulative Risks, Early Development and Academic Trajectories (CREATE) pilot study aims to assess personal, home and school exposure with growth and development data among 3-4 year old preschool children.

Methods: Small backpacks were equipped with personal air monitors and t-shirts designed with Language EnviroNment Analysis system (LENA) technology to collect air and language data for two consecutive 24-hour periods. Plug-in air pollution monitors were also stationed in each child’s home and school. Collection time, percent missing, and percent of time fine particulate matter (PM2.5) > 35 µg/m$^3$ along with minimum, maximum, and average PM2.5 were calculated in R version 3.5.2 for each location, timepoint, day, and child combination and compared across location and day graphically and statistically. A urine collection protocol was also tested.

Results: Missing data arose from unintentional unplugging of air monitors. However, few significant differences in air pollution summary measures across location or day were observed ($p > .05$). Technical challenges in the school environment suggest home and personal measurement may be more valid and reliable metrics of child personal exposures compared to school. Maternal, paternal and other adult language also varied by location and time of day. Over 85% of 3-4 year olds were compliant with the first 24 hours of air monitoring and day one urine collection, which dropped to 50% on day two.

Conclusions: It is possible to collect personal air exposure and language environment data in preschool children’s home and school environments. Future studies may not require multi-location or multi-day collection for establishing a baseline, rather repeat measurement should occur at longer intervals.
Acetylcholinesterase inhibition and symptoms of depression and anxiety among adolescents in agricultural communities in Ecuador: transient effects on mood.

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background:
The cholinergic system has an important roles in mood regulation. Cholinesterase inhibitor pesticides (e.g. organophosphates) appear to increase depression and anxiety symptoms in the few existing animal and human studies. As growing evidence also suggests that pesticide exposures may induce short-term neurobehavioral alterations in children, in the present study we aimed to assess whether acetylcholinesterase (AChE) inhibition (reflecting greater exposure to cholinesterase inhibitors) between 2 time periods within the same year would be associated with mental health alterations.

Methods:
Methods: We analyzed data of 310 adolescents (ages 11-17y, 51% female) living in agricultural communities in the Ecuadorian Andes (ESPINA study). Participants were examined twice: in April 2016 and July-October 2019. Acetylcholinesterase (AChE) activity was measured in a finger-stick sample at both time points. Anxiety and depression symptoms were assessed using the CDI-2 and MASC-2 (greater scores reflect greater internalizing symptoms). Models adjusted for age, gender, anthropometrics, hemoglobin, parental education, among others.

Results:
The mean (SD) of the following parameters were: AChE change -13% (0.48), depression T-score 52.9 (9.5) and anxiety T-score: 58.1 (9.7). Greater AChE inhibition (reflecting greater cholinesterase inhibitor exposure) was associated with higher depression symptoms (difference per 10% decrease of AChE, β [95% CI]: 0.92 [0.07, 1.77]). These associations were stronger in girls (1.10 [0.15, 2.04]) than boys (0.40 [-1.30, 2.09]). No associations were observed with anxiety scores.

Discussion:
We observed that inhibition of AChE between 2 agricultural seasons was associated with greater depression symptoms in adolescents. This is the first study to describe associations between change of a biomarker of pesticide exposure and depression symptoms among children and is among the largest studies of its kind. These findings concur with previous cross-sectional findings and suggest that AChE inhibition may transiently affect the mood of adolescents.
Exposure to fungicides and attention in 6-year old children from the Infants’ Environmental Health Study (ISA)

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: Several fungicides are suspected endocrine disruptors and may impair children’s neurodevelopment, but data from prospective studies are lacking. In Costa Rica, fungicides are aerially sprayed and used postharvest on bananas. We examined whether exposure to fungicides was associated with poor attention in children from the Infants Environmental Health Study (ISA).

Methods: To evaluate attention, we applied the Conners Continuous Performance Test (K-CPT-II) in 6-year old children (mean 6.4 ± 0.4 years) (n=268) using T-scores of omissions, commissions and Hit Reaction Time (HRT). To assess exposure to the fungicides mancozeb, pyrimethanil, and thiabendazole, we measured ethylenethiourea (ETU), hydroxy pyrimethanil (OHP), and 5-hydroxythiabendazole (5-OHT), respectively, in repeated urine samples collected during pregnancy and 5-6 years of age. We ran separate linear regression models for log-10 transformed mean prenatal, and mean child metabolite concentrations and CPT-II, adjusting for child age, child sex, HOME score, and maternal education. We examined effect-modification by sex.

Results: Median (p25-p75) prenatal specific gravity-adjusted ETU, OHP and 5-OHT were 3.40 (2.38-4.79), 0.50 (0.21-1.28) and 0.10 (0.03-0.53) µg/L, and current ETU, OHP and 5-OHT were 2.66 (1.90-3.63), 0.86 (0.34-2.32) and 0.12 (0.04-0.49) µg/L, respectively. Higher current ETU concentrations were associated with increased omissions (β=8.4 95%CI 3.5-13.4, per ten-fold increase in exposure). The association was stronger for girls (β=7.3, 95%CI 0.6-13.9) as compared to boys (β=5.5, 95%CI 0.6-12.6). For girls, both higher prenatal and current OHP concentrations were associated with increased omissions (β=3.1, 95%CI 0.6-5.6 and β=4.0, 95%CI 0.9-7.0, respectively), and current OHP concentrations were also associated with slower responses (β=2.1, 95%CI 0.2-2.9). OHT and prenatal ETU were not associated with measures of attention.

Conclusion: Six-year old children with higher current exposure to mancozeb and higher prenatal and current exposure to pyrimethanil had poorer attention as compared to children with lower exposures, the effect was stronger for girls.
Associations between in utero phthalate exposure and non-nutritive suck: a measure of early neurodevelopment


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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Infant non-nutritive suck (NNS), or sucking on a pacifier with no nutrient being delivered, has been linked to childhood language, motor, IQ and overall neurodevelopment and is considered an index of early brain development. However, it remains unknown if an infant’s NNS pattern is a sensitive indicator of neurotoxicity induced by exposure to environmental contaminants. Our aim was to examine associations between in utero exposure to phthalates, chemicals widely used in plastics and personal care products, and infant NNS.

Methods: The Center for Research on Early Childhood Exposure and Development (CRECE) examines how environmental exposures impact the health and development of infants and children living on the heavily-contaminated island of Puerto Rico. In this ongoing birth cohort, we measure maternal urinary concentrations of phthalate metabolites throughout pregnancy as measures of intrauterine exposure to their child. NNS is then measured in infants at 4-6 weeks of age using a custom research pacifier, yielding NNS amplitude (CmH2O), frequency, bursts/min, cycles/min, and cycles/burst.

Results: Thus far, we have NNS and in utero phthalate measures on 88 full-term infants (47 males) in this ongoing study. Linear models, controlling for sex, birthweight, and specific gravity reveal that the phthalate metabolites MCNP, MEHHP, and MEOHP were significantly associated with slower NNS frequencies, while MECPP, MEHHP, MEOHP, MONP, and MEHHTP were associated with higher NNS amplitudes (all p<0.05). In addition, MEHHP and MEOHP were also associated with fewer NNS cycles/min (p<0.05).

Conclusions: These preliminary data suggest that certain features of infant suck, particularly NNS frequency and amplitude, are associated with in utero exposure to several phthalates, particularly di(2-ethylhexyl) phthalate. Results from this study will be the first to prospectively determine the sensitivity of NNS as an early indicator of exposure-related changes in neurodevelopment.
Organochlorine pesticides (OCPs) are environmental contaminants that persist in the environment, and previous studies have shown associations between prenatal OCP exposure and subsequent neurodevelopment. However, it is still not clear how long this association could be prolonged. A prospective birth cohort study was conducted to examine the associations between prenatal OCP exposure and intelligence at 7 years children. Blood samples were analyzed using gas chromatography/mass spectrometry techniques to quantify 29 OCPs. The Wechsler Intelligence Scale for Children 3rd edition (WISC-III) was used to assess intelligence of children, which provided Verbal IQ (VIQ), Performance IQ (PIQ), and Full Scale IQ (FIQ). The test also has four subscales to represent more narrow domains of cognitive functions. We analyzed data from 95 singleton children without congenital anomalies, and who had both maternal OCP levels and WISC-III data. After multiple regression analysis adjusted by maternal age, education, parity, blood sampling period, children sex, we found OCPs had negative association with FIQ and PIQ, and positive association with VIQ. When prenatal total dioxin TEQ level was added to adjustment, however, positive associations between OCPs and VIQ disappeared, and negative association between FIQ and p.p′-DDD (β= -10.8: 95% Confidence Interval: -18.6 -2.9), p.p′-DDT (-19.26: -31.4 -7.1), and between PIQ and p.p′-DDD (-10.8: -18.6 -2.9), p.p′-DDT (-19.3: -31.4 -7.1) were remained. In the same analysis for subscale, the Perceptual Organization Index decreased with p.p′-DDD (-12.2: -20.2 -4.3), p.p′-DDT (-22.4: -34.6 -10.2), and Parlar-26 (-11.2: -21.7 -0.7). Additionally, Freedom from Distractibility Index, which reflects attention or working memory, decreased with p.p′-DDD level (-8.8: -16.8 -0.8). Although careful consideration is needed regarding other influential factors, and causal relationship between prenatal exposure to low-level OCPs and cognitive function of school aged children, prenatal OCP level may have prolonged effect on the children’s intelligence, especially perception, and attention or working memory.
Prenatal exposure to arsenic and neurobehavioral development of newborns in China

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TPS 731: Neurological effects in children, August 26, 2019, 3:00 PM - 4:30 PM

Background: The link between arsenic exposure and deficits in children’s neurodevelopment has been well documented, but it remains unclear that whether prenatal arsenic exposure can affect early neurobehavioral development in infancy. Methods: To assess the associations of in utero arsenic exposure with neurobehavioral outcomes in newborns, we conducted a cross-sectional study of 892 mother-infant pairs from 10 hospitals in Shanghai, China. The concentrations of arsenic were determined in cord blood samples. Neurobehavioral measures were administered at 3 days postpartum in full-term newborns using the neonatal behavioral neurological assessment (NBNA). Logistic regression models were used to estimate odds ratios for dichotomous NBNA outcomes. Results: After adjusting for potential confounders, a natural log unit (ln-unit) increase in cord blood arsenic was associated with 90% increased odds of low NBNA score (95% confidence interval [CI]: 1.62, 2.23). As for clusters, each ln-unit arsenic increase was associated with 47% increased odds of low score for behavior (95% CI: 1.31, 1.66) and 36% increased odds of low score for passive muscle tone (95% CI: 1.23, 1.51). Odds ratios comparing extreme tertiles were 8.62 (95% CI: 4.19, 17.8) for total scale, 3.69 (95% CI: 2.35, 5.82) for behavior, and 3.32 (95% CI: 2.21, 4.97) for passive tone (all p-trend < 0.001). Stratified analyses showed more evident associations in newborns of mothers ≥ 29 versus < 29 years of age. Conclusions: Our results provide evidence for an inverse association between low-level prenatal arsenic exposure and neonatal neurobehavioral performance, particularly among newborns born to older mothers. Further studies are warranted to confirm arsenic-related neurodevelopmental deficits in early life.
TPS 743: Health effects in pregnancy
Endocrine disrupting chemicals mixture and pregnancy glucose levels among women from a fertility clinic
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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Endocrine disrupting chemicals (EDCs) have been linked to pregnancy complications such as gestational diabetes (GDM). As individuals are exposed to multiple chemicals simultaneously, investigating EDCs as a mixture is required to provide a more realistic assessment. We evaluated the association between pregnancy exposure to EDC mixture and glucose levels in the late second trimester of pregnancy, an established risk factor of GDM.

Methods: We used data from 295 women in the Environment and Reproductive Health (EARTH) Study who had data available on 1st and/or 2nd trimester urinary concentrations of 19 EDCs, as well as late 2nd trimester glucose levels. Several methods were used to evaluate chemical mixtures including: weighted quantile sum (WQS) regression, for estimating exposures' weights in contributing to the mixture-outcome association; shrinkage procedures (LASSO/elastic net) and Bayesian Kernel Machine Regression (BKMR), for variable selection. The 19 chemicals (3 parabens, triclosan, 11 phthalate metabolites, bisphenol A, benzophenone-3, 2,4-dichlorophenol, 2,5-dichlorophenol) concentrations were adjusted for specific gravity and log transformed. All analyses were adjusted for race, education, BMI, age, physical activity, smoking, and infertility diagnosis. A final linear regression model mutually including the selected exposures was further estimated.

Results: Focusing on early 2nd trimester exposures, the following chemicals were identified as potential predictors of higher glucose by at least 2 statistical approaches: bisphenol-A, 2,4-dichlorophenol (2,4D), monoethyl phthalate (MEP), and the molar sum of four di(2-ethylhexyl) phthalate metabolites (∑DEHP). When fitting a final model that included these chemicals, suggestive positive associations were observed (e.g., β=2.2 mg/dL for (a unit increase in) log(2,4D), β=5.4 mg/dL for log(MEP), β=3.5 mg/dL for log(∑DEHP)). Analyses on 1st trimester exposures showed similar results.

Conclusion: By evaluating EDCs as an environmental mixture, we identified relevant potential risk factors providing important insights in understanding the relationship between this class of chemicals and pregnancy glucose levels.
Individual and joint effects of phthalate metabolites on oxidative stress among pregnant women in Puerto Rico
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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background: Exposures to phthalate compounds have been linked to adverse birth outcomes, potentially through oxidative stress mechanisms. Oxidative stress has typically been explored by measuring the biomarker 8-iso-prostaglandin-F2a (8-iso-PGF2), which can be generated via both oxidative stress and inflammatory pathways, indicating that it may not be a reliable biomarker of oxidative stress.

Methods: We explored associations between biomarkers of phthalate and phthalate replacement metabolites and oxidative stress using a novel method of calculating the ratio of 8-iso-PGF2a/prostaglandin F2a to disentangle contributions of oxidative stress from inflammation. Urinary biomarker measurements were taken from 477 pregnant women in the PROTECT longitudinal birth cohort at up to three time points during gestation. Linear mixed effects (LME) models were used to test for longitudinal associations between phthalate biomarker concentrations and overall 8-iso-PGF2a and contributions from oxidative stress. We used Bayesian kernel machine regression (BKMR) analyses to test for joint effects of different phthalate metabolites on oxidative stress.

Results: Most phthalate metabolites were positively associated with overall 8-iso-PGF2a, and this association remained for most metabolites with oxidative stress derived 8-iso-PGF2a. Interquartile range (IQR) increases in monoethylhexyl phthalic acid (mEHP) and monocarboxynonyl phthalate (mCNP) concentrations were associated with 11.4% (95% CI: 4.53, 18.7) and 5.62% (95% CI: 2.30, 9.05) increases in oxidative stress derived 8-iso-PGF2a, respectively. BKMR analyses suggested three phthalate metabolites (mEHP, mCNP, MHiBP) were important for predicting changes in oxidative stress derived 8-iso-PGF2a. BKMR analyses suggested that as the concentrations of MHiBP and mCNP increased from their 25th to 75th percentile, the effect of mEHP on oxidative stress derived 8-iso-PGF2a decreased. A similar pattern was observed with mCNP.

Conclusions: Phthalate metabolites are widely associated with total 8-iso-PGF2a, and these associations appear to be driven by oxidative stress derived 8-iso-PGF2a. There is additional evidence for potential antagonistic behavior of different phthalate metabolites on oxidative stress.
Prenatal Mixtures of Environmental Exposures and Associations with Subsequent Teen Births

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background: The impacts of exposure mixtures on adolescent risk-taking behaviors are not well understood. We examined associations between prenatal exposure to environmental mixtures and subsequent teen births, a manifestation of high-risk sexual activity, in a socioeconomically and racially diverse community surrounding the New Bedford Harbor (NBH) Superfund site in Massachusetts, USA.

Methods: Birth records for female infants born in the study area (1992-1998, n=5,865) were linked to subsequent birth records (2005-2017) to identify those who gave birth as teenagers (<20yrs). Exposures of interest included modeled prenatal levels of polychlorinated biphenyls (PCBs), ρ,ρ′-dichlorodiphenyl dichloroethylene (DDE), hexachlorobenzene (HCB), lead (Pb), and mercury, and GIS-calculated distances from birth address to the nearest major roadway and the NBH. We fit generalized additive models (GAMs) with multivariate smooths of exposure mixtures and mapped predicted odds of teen birth as a function of joint exposures. We adjusted for potential confounding by maternal and infant characteristics, including maternal age, race, parental educational attainment, marital status, household income, insurance status, prenatal alcohol/tobacco use, adequacy of prenatal care, breastfeeding status, and parity. We utilized permutation tests to assess the significance of each smoothed exposure mixture.

Results: Approximately 5% (n=291) of female infants had subsequent teen births. Prenatal exposure combinations associated with teen births included a mixture of DDE, Pb, and HCB (p<0.001), and a mixture of PCBs and distances to the nearest major roadway and the NBH (p<0.001). Higher levels of HCB and Pb resulted in a 4-fold greater risk of teen birth, and risk was even greater for female infants born to teen mothers. Closer proximity to a major roadway and the NBH yielded a 3-fold increased risk of teen birth.

Conclusions: Prenatal environmental exposures may interact to increase risk of teen births. Characterization of complex mixtures of environmental factors using GAMs may help inform targeted community interventions.
Urinary phenols exposure in early to mid-pregnancy and gestational diabetes mellitus: A multi-racial/ethnic longitudinal study

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Certain phenols as endocrine disruptors have been linked to type 2 diabetes among non-pregnant populations, but their roles in gestational diabetes (GDM) remain elusive due to scarce data. We investigated the associations of urinary phenols during early-to-mid pregnancy with GDM risk.

Methods: Within the prospective Pregnancy Environment and Lifestyle Study, we conducted a nested case-control study of 111 GDM cases at gestational weeks (GW) 24-28 and 222 non-GDM controls, matched on age, GW at urine collection, and race/ethnicity (Asian/non-Asian, given high proportion of Asian cases). Urinary bisphenols A, F, S (BPA, BPF, BPS), benzophenone-3, and triclosan were assessed at GW 10-13 and 16-19. Conditional logistic regression estimated adjusted odds ratios (aOR) of GDM in relation to phenols, adjusting for pre-pregnancy body mass index, urinary creatinine, and race/ethnicity (White/Black/Hispanic/Asian).

Results: Women with versus without GDM had higher levels of BPF and BPS at GW 10-13 and triclosan at GW 10-13 and 16-19 (all P <0.05). BPS in the middle and highest tertiles versus lowest tertile at GW 10-13 had a 2.10-fold (95% CI 1.08-4.10) and 1.96-fold (0.96-4.03) increased risk of GDM, respectively, after adjusting for covariates, with no association at GW 16-19; no associations were observed for other phenols. Effect modification by race/ethnicity was observed for BPA, BPS, and TCS (all P-for-interaction <0.10). We observed only among non-Asians associations of GDM with BPA in the highest tertile at GW 10-13 (aOR 2.69; 95% CI 1.00-7.19) and in the middle tertile at GW 16-19 (4.71; 1.31-17.0), BPS in the highest tertile at GW 10-13 (3.90; 1.41-10.8), and triclosan in the highest tertile at GW 10-13 (3.26; 1.27-8.35).

Conclusions: Elevated urinary BPA, BPS, and triclosan levels, as early as in the first trimester, were associated with increased risk of GDM, only among non-Asians. Further investigations are needed to understand these racial/ethnic differences.
Exposure to organochlorine compounds during pregnancy and thyroid hormone levels in mothers and newborns

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Organochlorine compounds (OCs) such as some PBCs and pesticides can impair the endocrine functions causing adverse health effects. The present work aims to study the association of OC levels during pregnancy with thyroid hormone levels in mothers and newborns in INMA-Gipuzkoa cohort.

Methods: Blood free T4 (fmol/L), T3 (pmol/L) and TSH (μU/ml) levels were determined in pregnant women from the INMA-Gipuzkoa cohort (N=577) in the first trimester of pregnancy; in newborns (N=311), blood TSH (μU/ml) and total T4 (ng/dl) levels were measured. OC levels (PCB28, PCB118, PCB138, PCB153, PCB180, HCB, β-HCH, g-HCH, pp-DDE, pp-DDT) were determined in blood from the first trimester of pregnancy in mothers and in cord blood in newborns, and adjusted for serum lipid concentration (ng/g lipid). Linear regression models were built only for the OCs detected in more than 50% of samples.

Results: PCB153, PCB138, PCB180, HCB, pp-DDE and β-HCH were detected in more than 50% of samples. Linear regression models were built only for the OCs detected in more than 50% of samples. HCB concentrations were higher in cord blood than in mothers. In mothers, an increase of 1 ng/g lipid PCBs was associated with an increment of 2.61 fmol/L of free T4 levels (96%CI:0.29-4.94), and with a decrease of 1.22 pmol/L T3 (95%CI: -1.96-(-0.47)). An increase of 1 ng/g lipid HCB in mothers was associated with a decrease of 1.98 pmol/L T3 (95%CI: -3.94-(0.02)), and in newborns an increase of 1 ng/g lipid of HCB was associated with an increase of 8.17 ng/dl of total T4 (95%CI:0.52-15.82).

Conclusions: The association of PCBs and HCB and hormone levels during pregnancy in mothers and newborns indicate that exposure to OCs could impair thyroid function of pregnant women and their children.
Exploring effects of polybrominated diphenyl ether and hydroxylated brominated diphenyl ether exposure among women undergoing in vitro fertilization

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background: Most polybrominated diphenyl ethers (PBDEs) have been phased out of production in the US and EU due to their toxicity to humans and ecosystems. Exposure to PBDEs has been associated with implantation failure among women undergoing in vitro fertilization (IVF), yet some animal studies suggest greater toxicity from their hydroxylated metabolites (OH-BDEs).

Methods: A subset of 215 women (contributing 330 IVF cycles) from an existing longitudinal cohort were recruited from Massachusetts General Hospital fertility clinic between 2005 and 2015. At cycle 1, women provided a serum sample where PBDEs: PBDE-47, PBDE-99, PBDE-100, PBDE153, and PBDE154 and OH-BDEs: 3’OH-BDE47, 5’OH-BDE47, 6’OH-BDE47, and 4’OH-BDE49 were measured. Associations among PBDEs, OH-BDEs, and IVF outcomes were assessed using multivariable generalized mixed models adjusted for lipids, age, BMI, year, IVF protocol, and follicle stimulating hormone levels.

Results: Detection rates of OH-BDEs (60-98%) were higher than PBDEs (53-93%). Correlations for all PBDEs were moderate-to-strong (0.27≤r≤0.78; p<0.001) except for BDE154. Metabolites of PBDE47 (3’OH-BDE47, 5’OH-BDE47, 6’OH-BDE47) were strongly correlated to its parent compound (0.43≤r≤0.75; p<0.001). All PBDEs and OH-BDEs, except 6’OH-BDE47, were inversely associated with year of sample collection (p<0.05). Overall, early stages of IVF (prior to implantation) were negatively associated with PBDEs (none statistically significant). However, there was a 41-42% increase in the odds of successful implantation, clinical pregnancy, and live birth with increasing levels of PBDE153 (Odds ratio (OR)) =1.41-1.42; p=0.01). Results for OH-BDEs were less conclusive, yet higher 6’OH-BDE47 concentrations resulted in an increase in odds of successful implantation, clinical pregnancy, and live birth (OR:3.13-3.5; p=0.01).

Conclusion: Detection rates of PBDEs and OH-BDEs remain elevated. Although PBDE-47 and its metabolites were correlated, associations were divergent and stronger between OH-BDEs and clinical outcomes. Thus, OH-BDEs may have a stronger impact on IVF compared to PBDEs
Background/Aim: Prevalence of infertility has increased in recent years. In parallel, a decrease in sperm quality has been observed among men. Sperm quality is associated with several chronic diseases, lifestyle, and environmental factors. Among them, air pollution is a growing problem, but the study results are inconsistent due to differences in study design and exposure measures.

The objective of this study is to evaluate the association between air pollution exposure and sperm quality.

Methods: A prospective study was conducted in a fertility clinic in Barcelona between 2015 and 2018, recruiting males from infertile couples. At inclusion, the participant completed a questionnaire including demographic and lifestyle data (including education, drugs consumption, dietetics, and physical activity). Volume, concentration, motility, morphology, and DNA fragmentation from multiple semenograms were collected for each participant, including previous semen samples. Long-term exposure to NO2, NOx, PM10, PMcoarse, PM2.5, and PM2.5-absorbance at the participant's home address was assessed using LUR ESCAPE models. Association between long-term air pollution exposure and the averaged sperm quality parameters by participant was studied using linear regressions adjusted on age, body mass index, study level, and smoking status.

Results: 322 men were included, contributing with 1009 (from 1 to 20 samples per participant). Mean age at semen samples was 37.7 years. A third of participants were non-smokers (34%), more than half were overweight or obese (55%), and half of them had at least a graduate degree (52%). No associations were found between long-term exposure to any of the air pollutants included and any of the sperm parameters studied.

Conclusions: Our study does not reveal an association between pollution and sperm quality. Our results are coherent with the existing literature that has shown inconsistent results. There is a need for further research using specific windows of exposure.
Effects of prenatal exposure to triclosan and parabens on thyroid hormones levels during pregnancy and birth outcomes: from the Mother And Kids Environmental health (MAKE) Study

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Triclosan and parabens are widely used in some personal care products and other consumer products. These chemicals are associated with poor birth outcomes and may impact thyroid hormone regulation and homeostasis. Relevant epidemiologic studies are limited and results are inconsistent. Therefore, we investigated the effects of prenatal exposure to triclosan and parabens on thyroid hormones during pregnancy and birth outcomes, including gestational age, birth weight, body length, head circumference and abdominal circumference.

Methods: We recruit more than 300 women during 3rd stage pregnancy between 2017 and 2019 in Korean pregnant women, called The Mother And Kids Environmental health(MAKE) Study. We measured triclosan(TCS) and parabens (Methyl-paraben(MeP), Ethyl-paraben(EtP), Propyl-paraben(PrP)) concentrations in maternal urine samples, also collected information on birth outcomes, socio-economic status, and consumption habits of consumer products. We analyzed the association between thyroid hormone levels and birth outcomes according to triclosan and parabens levels using multivariate linear regression.

Results: The adjusted geometric means for urinary concentrations of TCS, MeP, EtP, and PrP were 0.24, 13.96, 9.45, and 1.70 ng/mL, respectively. We found positive associations between TSH and birth length in high TCS exposure group (β=0.496, p=0.04). Also, both birth weight and length were significantly increased with TSH in high EtP exposure (weight, β=0.114, p=0.024, length, β=0.659, p=0.008).

Conclusions: This study found associations between thyroid hormones during pregnancy and birth outcomes such as birth weight and birth length in high exposure group of TCS and parabens. Further study is required to more fully elaborate this relation between prenatal exposure to triclosan and parabens and thyroid hormones during pregnancy on birth outcomes.

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Prenatal exposure to parabens affects birth outcomes through maternal Glutathione S-Transferase (GST) Polymorphisms: from the Mother And Kids Environmental health (MAKE) Study

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Background/Aim: Human exposure to parabens is very common in daily life by using personal care products. These chemicals are associated with poor birth outcomes. However, modifying effects of polymorphism in glutathione S-transferases (GST) gene remain unexplored. Therefore, the aim of this study was to investigate the effect of genetic polymorphisms on the association of prenatal exposure to parabens with birth outcomes.

Methods: We plan to recruit more than 300 women during 3rd stage pregnancy between 2017 and 2019 in Korean pregnant women, called The Mother And Kids Environmental health (MAKE) Study. We measured parabens (Methyl-paraben (MeP), Ethyl-paraben (EtP), Propyl-paraben (PrP)) concentrations in maternal urine samples, also collected information on birth outcome, socio-economic status, and consumption habits of consumer products. Multivariate linear regression was used to examine whether the association between prenatal exposure to parabens and birth outcomes (gestational age, birth weight, body length, head circumference and abdominal circumference) varied by maternal GST genes.

Results: The adjusted geometric means for urinary concentrations of MeP, EtP, and PrP were 13.96, 9.45, and 1.70 ng/mL, respectively. Parabens were positively associated with weight and abdominal circumference at birth. In particular, MeP and PrP showed significant association with an increase in abdominal circumference (MeP, β=0.355, p=0.02; PrP, β=0.376, p=0.02) adjusting for potential confounders. Prenatal exposure to parabens showed significantly positive association with abdominal circumference in mother of GST null genotype (MeP, β=0.634, p=0.02; EtP, β=0.546, p=0.05; PrP, β=0.618, p=0.04).

Conclusions: This study reported the association between prenatal parabens exposure and birth outcomes. We also found that GST polymorphism might affect the association between prenatal parabens exposure and abdominal circumference, suggesting the effect of genetic susceptibility on the relation between prenatal parabens exposure and abdominal circumference.
Perfluoroalkyl Substances and thyroid hormones in early pregnancy: findings in the Danish National Birth Cohort (DNBC)


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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

BACKGROUND: Thyroid hormones (THs) during pregnancy are essential for fetal brain development. Perfluoroalkyl substances (PFASs), synthetic chemicals widely applied in a variety of industrial and consumer products, have been demonstrated to interfere with thyroid function in adults. We evaluated the associations between six types of PFASs and thyroid function in early pregnancy using samples collected in the Danish National Birth Cohort (DNBC) during 1996-2002.

METHODS: A cross-sectional analysis was conducted using 1,366 maternal blood samples collected in the DNBC during week 5 to 19 of gestation (median 8.3 week). We estimated changes of serum thyrotropin (TSH) and free thyroxine (fT4) levels according to each of the six PFASs plasma concentrations (ng/mL) analyzed per inter-quartile range (IQR) increase or by exposure quartiles, adjusting for gestational week of blood sampling and other potential confounders. We also estimated the gestational-week-specific relationship between PFASs and TSH or fT4. Binary outcomes for hyper- or hypo-thyroid profiles were also evaluated.

RESULTS: Overall, there was no apparent association between each of the PFASs and the TSH or fT4 levels or the risk for subclinical hyper- or hypo-thyroid status. However, the gestational-week-specific analyses suggested possible dynamic differences in TSH comparing the highest quartile for several PFASs to the lower quartiles; the TSH values were higher for PFOS, PFOA, PFHxS and PFHpS from gestational week 5 to 10 but the trend reversed after gestational week 10.

CONCLUSIONS: We did not find strong associations between PFASs and TSH or fT4 values among women enrolled in the DNBC most of whom were healthy and without thyroid disorders. We observed possible gestational-week-specific relationships for high PFASs exposures and TSH in early gestation, but replication is needed for these results that were less precise and unexpected a priori.
Pesticides consumption in the middle west region of Brazil and risk of fetal death from central nervous system abnormalities

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Introduction: Brazil is one of the top pesticides consumers in the world. Pesticides have harmful effects on reproductive system and it is important to know if exposure leads to infant death related to malformation abnormalities. Middle West region is one of the most pesticides consumers’ areas in Brazil. It alone accounted for about 30% of pesticide consumption in the country. This study was performed to understand and investigate associations between pesticides exposure and infant death caused by central nervous system (CNS) abnormalities in the Middle West region of Brazil.

Methods

The study design was performed using an ecological approach. Mortality data were collected from the National Mortality Information System in the period of 1996-2016. Indexes used to assess exposure variables included pesticides expenditure, number of agricultural workers and number of crop establishments that use pesticides. For every state, each exposure variable was sorted to separate groups in tertiles. Comparisons were then made using first tertile as the reference group and second and third tertiles were respectively defined as medium and high exposure groups.

Results: Results showed that there was a greater risk for infant death in cities that had medium and high exposure when compared with the low exposure group. Mortality rate ratios varied from 1.64 to 2.87 using different exposure variables and all of them showed statistical significance at the 95% confidence level.

Conclusions: Our results suggest that cities in the Brazil’s Middle West region that have high exposure to pesticides are at higher risk of infant death from central nervous system abnormalities. Despite the limitations associated with ecological studies, this is an important first step to take the initiative to establish field studies in order to show reproductive health adverse effects related to high pesticide exposure in agricultural areas such as middle west region from Brazil.
Maternal exposure to ambient air pollution and risk of preeclampsia: a population-based cohort study in Scania, Sweden

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background
There is a mounting literature on the association between low-level air pollution exposure and the risk for preeclampsia (PE); however, how air pollution affects the health of pregnant women and fetal development is still unknown.

Aim
To investigate the spatiotemporal associations for the risk of developing PE and to determine the risk thresholds for maternal exposure to ambient black carbon (BC), PM2.5 and PM10 during pregnancy.

Methods
Maternal Air Pollution in Southern Sweden (MAPSS) consists of 48777 singleton pregnancies and monthly exposure levels of BC, as well as local and total PM2.5 and PM10 at maternal residential address estimated by Gaussian dispersion modeling in Scania, Sweden during 2000 to 2009. Employing IBM SPSS Statistics version 25, we used binary logistic regression models to estimate the association between particle exposures and total PE, early- and late-onset PE, PE with small-for-gestational age (SGA) and PE without SGA, adjusted for obstetrical risk factors and socioeconomic predictors.

Results
The number of PE cases was 2.9%. The effect estimates for each 1 µg/m3 increase of BC on the risk for PE are adjusted odds ratio (AOR) of 1.89 (95% CI 1.34, 2.65) in the first trimester, 2.08 (1.45, 2.98) in the second semester, 1.77 (1.28, 2.45) in the third semester and 2.14 (1.48, 3.09) in whole pregnancy. Similar patterns were observed for each 5 µg/m3 increment in locally emitted PM2.5 and PM10 at all exposure windows. Effect estimates appeared to be more prominent in pregnancies complicated by SGA.

Conclusions
There is a significant positive association between maternal exposure to ambient air pollution during gestation and the risk of developing PE with SGA in a setting with low-level air pollution. Lowering the limit values would not only benefit the more vulnerable pregnant woman and their unborn children, but also the population as a whole.
Influence of residential exposure to traffic-related fine particulate matter on umbilical cord blood cytokine levels: a birth cohort study

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Prenatal exposure to traffic-related air pollution (TRAP) is known to influence fetal programming and development. The impact of TRAP on the developing immune system has poorly been investigated. We aimed to examine the association between exposure to traffic-related fine particulate matter (PM2.5) in utero and immune cytokine profiles in the umbilical cord blood of newborns.

Methods: Data came from 239 mother-newborn pairs embedded in the NELA study, a population-based birth cohort set up in a south-eastern Mediterranean region of Spain (2015-2018). In utero residential exposure to traffic-related PM2.5 was assessed by using WRF-Chem modelling. Umbilical cord blood samples were incubated in the presence of specific immune stimulants: Lypopolisaccharide (LPS), Concanavalin A (ConA), Phytohemagglutinin (PHA), Peptidoglycan (PG), Polyinosinic-polycytidylic acid (pi:C), Immunostimulatory CpG oligonucleotides (ODN), Dermatophagoides pteronyssinus and Olea europaea extracts. Immune stimulants were selected according to their capacity to induce innate (IL-6, IFN-alpha, IL1-beta, TNF-alpha) and/or Th1 (IFN-gamma, IL-2), Th2 (IL-4, IL-5, IL-13), Th9 (IL-9), Th17 (IL-17, IL-23) or Treg (IL-10) cytokines. Cytokine responses in relation to prenatal PM2.5 concentration were analyzed using robust linear regression models.

Results: Median PM2.5 concentration during pregnancy was 13.2 microg/m3 (inter-quantile range 10.9-14.4). Higher PM2.5 exposure in utero was positively associated with: increased response of TNF-alpha, IL-5, IL-6, IL1-beta and IL-23 after PHA stimulation (p<0.05); increased response of IL-9 after Con A stimulation (p<0.05); increased response of IL-6 and IL-13 after PG stimulation (p<0.05); and increased response of IL-13 after LPS stimulation (p<0.05). Cytokine responses for other immune stimulants did not differ according to prenatal PM2.5 levels.

Conclusions: These preliminary findings suggest that effects of prenatal exposure to traffic-related PM2.5 may influence cytokine response in newborns, which could have a predisposition to innate and adaptative immune system related disorders.

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Host and environmental determinants of placental iodine concentrations

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background/aims

Iodine is an essential trace element, used in the production of thyroid hormones, and plays a key role during the gestational period for optimal foetal growth and (neuro-)development. To this day, Europe still faces the public health problems of iodine deficiency. Previous studies indicate that the placental iodine levels are representative of the gestational diet. We aim to investigate the host and environmental determinants of placental iodine concentrations.

Methods

For 473 women, selected from the ENVIRONAGE birth cohort, the placenta was sampled at three standardized locations. Pooled samples were digested, and the iodine concentrations were determined using an inductively coupled plasma mass spectrometer. Lifestyle and environmental variables were obtained using questionnaires and medical files. A high-resolution air pollution model estimated exposure to particulate matter (PM2.5), based on maternal address. Determinants of placental iodine concentration were identified using stepwise regression procedures, with a p-value of 0.15 for the independent variables to enter/stay in the model.

Results

Median iodine concentration was 25.9 ppb. Nineteen explanatory variables were a priori selected, of which nine reached the 0.15 threshold. The following determinants were positively associated with iodine concentrations: date of delivery, gestational age, usage of vitamins, use of anti-inflammatory medication, and the concentration of iodine was highest in children born during the winter season. Variables associated with an adverse outcome were: women with gestational diabetes, an excess amount of weight gain during the pregnancy, and women exposed to indoor SHS. Additionally, exposure to PM2.5 during the last trimester of pregnancy was associated with lower iodine levels in the placenta.

Conclusions

We observe various host and environmental factors that alter the gestational iodine concentrations. These findings indicate several risk factors for iodine deficiency, and hence adequate actions should be taken to achieve iodine sufficiency during gestation in order to safeguard the neonates optimal (neuro-)development.
Racial/ethnic disparities in critical periods of vulnerability to fine particulate matter during pregnancy

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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background
Exposure to ambient fine particulate matter (PM2.5) during pregnancy is associated with preterm birth (PTB), a leading cause of infant morbidity and mortality. Recent studies have attempted to identify periods of susceptibility to PM2.5 during pregnancy. This study aims to identify racial/ethnic disparities in critical periods of susceptibility to PM2.5 during pregnancy.

Methods
We linked all live singleton births in California from 2005 – 2010 with weekly average PM2.5 (μg/m3) exposure during pregnancy. Associations between PM2.5 and preterm birth were assessed using multi-level distributed lag Cox proportional hazard models and a distributed lag model. We also assessed effect measure modification by non-Hispanic White, non-Hispanic Black and Hispanic race/ethnicity by calculating the weekly relative excess risk due to interaction (RERI).

Results
Gestational weeks 17-24 and 36 were associated with increased vulnerability to PM2.5 exposure across all pregnancies. We find that non-Hispanic Black mothers may be more susceptible to PM2.5 exposure effects when compared with non-Hispanic White mothers, particularly during weeks 28-33 of pregnancy.

Conclusions
These findings extend our knowledge about the existence of specific susceptibility exposure periods during pregnancy that may differ across race/ethnic groups which can help to inform targeted prevention efforts among racial/ethnic subgroups.
Association of Ambient PM2.5 Air Pollution with Maternal Bone Strength in a Cohort of Pregnant Women from Mexico City


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TPS 743: Health effects in pregnancy, August 26, 2019, 3:00 PM - 4:30 PM

Background
Pregnancy is associated with increased bone remodeling and can lead to deteriorations in maternal bone strength and susceptibility to bone fractures and osteoporosis. No study to date has examined whether ambient PM2.5 levels are associated with bone strength during pregnancy and early postpartum period.

Methods
The PROGRESS cohort recruited mother-child pairs from 948 singleton pregnancies from Mexico City. Daily ambient PM2.5 exposure levels were estimated from a satellite remote sensing spatio-temporal model based on the individuals’ address from conception through six months postpartum. Bone strength of the radius and proximal phalanx of the middle finger, reflecting trabecular and cortical bones, respectively, were quantified using quantitative ultrasound during the second & third trimester and one & six months postpartum. Linear piecewise growth curve mixed models and distributed lag models were used to estimate the relations of mean PM2.5 levels with bone strength.

Results
In models accounting for multiple exposure windows and other relevant factors including expected pregnancy-associated changes in bone strength, first and second trimesters PM2.5 levels are associated with steeper pregnancy-associated decline in trabecular and cortical bone strength (effect estimate: additional decline of 0.23 to 0.29 standard deviations in bone strength per 10 µg/m3 increase in PM2.5). This short-term decline appears to be non-permanent; greater postpartum bone strength recovery also associated with first and second trimesters PM2.5 levels. Third trimester and early postpartum exposures are associated with diminished postpartum recovery of bone strength.

Discussion
In this analysis, ambient PM2.5 exposures both during and after pregnancy were associated with diminished trabecular and cortical bone strength. Early-mid pregnancy PM2.5 exposures were associated with greater bone strength decline during pregnancy while late pregnancy and early postpartum exposures adversely affected the postpartum bone strength recovery. However, the results also suggest that the adverse effects may be transient if later exposures can be mitigated.
Background: Chronic exposure to sub-lethal concentrations of antibiotic is mostly ignored. The rural environment receives antibiotics and their residues from agriculture, livestock and human that may persist for long-time. Hence public exposure in rural world to antibiotics is multifaceted and need health risk assessment.

Aims: This study aimed to (i) quantify ethical and unethical antibiotic usage, their concentrations and residues in rural environment (ii) assess chronic exposure of rural population to antibiotics and consequent health risks among rural population.

Methods: Field soil, fecal and irrigation water samples were analyzed for fluoroquinolones and quinolone antibiotics. Target rural population (n=234) were surveyed which includes livestock handlers, agricultural farmers, field workers, female households and children, to assess extent of exposure to antibiotic persist in their immediate environment and epidemiological symptoms.

Results: Significant use of ciprofloxacin as self-medication (unethical) was strongly correlated with flu and gastrointestinal infections. Among females gastro (OR=1.51; 95% CI=1.16–1.95) whereas in livestock workers both flu (OR=1.39; 95% CI=1.07–1.80) and gastro (OR=2.11; 95% CI=1.62–2.74) incidences were recorded as consequent impact of chronic exposure to antibiotics. In feces wide range of ciprofloxacin was detected (97.5–188.2 mg kg–1) whereas amount of levofloxacin and ofloxacin were within the WHO regulatory limits. Wastewater channels from rural dwellings and livestock farms were identified as potential hotspots for chronic exposure. Indiscriminate use of antibiotics to enhance dairy produce has forced rural people to indulge in unethical drug administration which has increased their susceptibility to further exposure to antibiotics and their residues in rural environment.

Conclusions: We conclude that chronic exposure of rural population to antibiotics and their residues provoke health risks and this exposure is on rise due to continuous add-up of sub-lethal levels linked with self-administrated usage which must be strictly checked to minimize their release in environment.
Morbidity rates in livestock dense areas: Recent findings from two registry-based studies in the Netherlands

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Background:
There is ongoing debate and public concern regarding the possible effects of livestock density on human health. Two studies were performed based on longitudinal health data, to investigate the prevalence of infections/symptoms, chronic illnesses and medication among residents of livestock dense areas.

Methods:
In the first study prevalence of health outcomes was assessed for seven consecutive years (2010-2016), based on a sample of ±100000 individuals. Data were obtained from electronic health records registered in 26 general practices located in areas with intensive livestock farming in the Netherlands (provinces of North-Brabant and Limburg) (“study area”). These were compared with data from 22 general practices in rural regions with a low density of livestock farms or other major environmental exposures (“control area”). In the second study, a different “study area” was used (Gelderland, Overijssel and Utrecht) and analyses were repeated for the period 2014-2017 based on a sample of ±70000 residents.

Results:
The first study suggested a significantly higher prevalence of pneumonia, which was consistent over the years (2013: OR=1.5, 99% CI 1.03 – 2.17; 2014: OR=1.45, 99% CI 1.00 – 2.1; 2015: OR=1.58, 99% CI 1.09 – 2.3; 2016: OR=1.6, 99% CI 1.13 – 2.28). Lower respiratory tract infections, respiratory symptoms and vertigo were also consistently more common compared to the control area. Significant results were also observed for subgroups with respiratory conditions, children and the elderly. The second study verified the previous findings on respiratory outcomes, showing a consistently higher prevalence of pneumonia and acute respiratory symptoms in other livestock dense area(s). Both studies showed no significant differences in chronic conditions such as asthma and COPD.

Conclusions:
Respiratory infections and symptoms are more common in livestock dense areas. Assessment of temporal associations including individual exposure estimates and identification of causal pathogens based on serological analyses may shed further light.
The use of fixed-effects regression to assess work activities and protective measures associated with changes in respiratory function in a prospective industrial hog worker cohort, North Carolina, USA

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TPS 751: Farms, antibiotics, infections, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Prior research quantifying health impacts from industrial hog operation (IHO) work has suffered from an inability to control for between-person confounders due to a vast number of variables, small sample size, and/or lack of access to IHO sites. Further, prior longitudinal studies have used months or years between follow-up, reducing recall accuracy. By employing an underutilized statistical method in which time-invariant confounders are omitted from models, we aimed to quantify changes in IHO worker lung function resulting from variations in occupational activities and personal protective equipment (PPE) use during the prior week.

Methods: IHO employees (n=101) were followed for up to eight bi-weekly visits. At each visit, lung function measurements were collected using inexpensive portable spirometers and work activities self-reported via questionnaire. Fixed-effects regression was employed to identify activities and protective measures associated with within-person spirometric changes.

Results: Reported exposure activities showed limited changes in respiratory function, while any PPE use (coveralls, facemasks, or eye protection) was associated with diminished forced expiratory volume in the first second (FEV₁) (β:-0.33 L; 95% confidence interval (CI):-0.59, -0.08) and peak expiratory flow rate (PEFr) (β:-1.06 L/s; 95% CI:-1.74, -0.39) versus no PPE use, associations not previously hypothesized. In subsequent analyses, we found that while workers increasingly wore coveralls during weeks they performed more and dirtier activities, they were less likely to wear face PPE, which may explain the spirometry findings. We also identified the potential for use of handheld, battery-operated spirometers to obtain reliable data (R²=0.79 for portable versus gold standard devices).

Conclusions: Workers increasingly wore body protection but less consistently wore face PPE as barn conditions and tasks intensified. The novel use of fixed-effects regression helped elucidate this relationship. On-the-job training should be conducted to bolster adherence to PPE use among the ~33,000 IHO workers in the United States.
Piloting the use of mobile devices in community-driven research to assess occupational and environmental exposures from industrial hog operations in rural eastern North Carolina, USA

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Background/Aim: Industrial hog operation (IHO) workers and community residents want to know how airborne hog waste impacts their household environment and health. Such questions can be answered with state-of-the-art molecular source tracking technology measuring hog-specific fecal markers (e.g., Pig-2-Bac) and livestock-associated bacteria (e.g., scn-negative Staphylococcus aureus) in the air, on household surfaces, and in nasal swab samples linked with electronic survey questions. Our objective was to describe the feasibility, practicability, capacity-building potential, and data completeness and quality when using this technology in a community-driven research study.

Methods: From November 2017 to April 2018, community organizers collected air, surface, and nasal swab samples, as well as questionnaires via tablet computer at IHO-employed and community-referent households located at varying distances from IHOs. Data were assessed for completeness and quality, defined as missingness, correct data type, and within an expected range.

Results: Of the 49 households enrolled, only 38 (78%) were deemed eligible after data review. Among eligible households, 14,322 of 14,675 (97.6%) required electronic survey questions were complete and 14,307 of 14,322 (99.9%) were the correct data type and were within the expected range. Compared to prior work using the same questions but on paper surveys, completeness was improved for key covariates, including smoking (0% missing versus 24%), education (0% versus 4%), and sex (0% versus 2%). Nasal swabs and novel air samples were 100% complete while novel environmental swabs were 95% (431 of 455) complete.

Conclusions: Community and academicians were able to design a pilot study to appropriately address local questions of differences in at-home exposure to airborne hog waste relative to distance from IHOs and build capacity for effective citizen science. While eligibility criteria were often unmet, necessitating electronic survey recoding and further staff training, data collected were complete and of high-quality.
West Nile virus (WNV) is the most widespread cause of arboviral neurological disease in the world; however, there is considerable inter-annual variation in the number of human cases. As a consequence, effective allocation of public health resources is challenging and often reactive, a circumstance that highlights the need for accurate, real-time forecasts of the burden of disease. Recently, we showed that accurate and reliable predictions of seasonal WNV outbreaks can be made using a mathematical model representing WNV transmission dynamics among mosquitoes and birds, as well as spillover to humans. We then expanded the core model to include environmental forcing (average daily temperature [i.e. climatology] for the region) by accounting for temperature modulation of the extrinsic incubation period. The mathematical model is optimized using a data assimilation method and two observed data streams: mosquito infection rates and reported human WNV cases. These retrospective forecasts were then used to calibrate estimation of real-time forecast expected accuracies for various predicted features: outbreak peak timing, peak magnitude, and total number of infected mosquitoes for the season and the number of human cases in the next 4 weeks and over the season. Weekly forecasts of WNV were generated in real time using this calibrated system for 4 California Counties during the 2018 outbreak season. Overall, the real-time forecasts were able to estimate accurately the peak timing, peak magnitude, and total number of infected mosquitoes for the season in real-time prior to the peak of infected mosquitoes. Forecasts of human WNV cases over the next 4-weeks were able to provide accurate prediction intervals of future observations: the 4-week ahead 50% prediction interval captured 55% of observations. Here we present the models and evaluation of the real-time forecasts.
Antimicrobial resistance to Enterobacteriaceae in feral pigeons from urban and rural areas

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TPS 751: Farms, antibiotics, infections, August 26, 2019, 3:00 PM - 4:30 PM

Background
The antimicrobial drug-resistant (AMR) bacteria in wild animals reflects AMR in water, soil, and agricultural areas. However, AMR surveillance on wild animals in Japan has been insufficient to maintain proper level of alertness. In this study, we analyzed the AMR of Enterobacteriaceae in feral pigeons (Columba livia) inhabiting urban and rural environments, to confirm whether the feral pigeon can be a useful proxy to measure the environmental AMR index.

Methods
In May and June 2014, we collected feces from 20 pigeons each, from an urban region (Taito ward, Tokyo) and a rural region (Asahi and Choshi, Chiba) in Japan. Using the agar plate dilution method issued by the Clinical and Laboratory Standards Institute M100-S24 criteria, we performed a drug sensitivity test to detect Enterobacteriaceae. Antimicrobial sensitivity tests were performed using the following antibiotics: ampicillin (ABPC), cephalothin (CET), cefotaxime (CTX), ceftazidime (CAZ), imipenem (IPM), tetracycline (TC), gentamicin (GM), amikacin (AMK), chloramphenicol (CP), and ciprofloxacin (CPFX).

Results
In both regions, the most common Enterobacteriaceae detected was Escherichia sp., which comprised 47% and 77% of total detected bacteria in urban and rural area, respectively. In the urban area, drug sensitivity tests revealed that most pigeons (10) harbored ABPC-resistant bacteria, followed by CET- (8), TC- (4), CTX- (3), CAZ- (3), GM- (3), CPFX- (3), and CP-resistant bacteria (1); while four pigeons harbored no drug-resistant bacteria. In the rural region, TC-resistant bacteria were found in as many as 16 pigeons, followed by ABPC- (13), CP- (13), CET- (4), GM- (3), CPFX- (2), and CTX-resistant bacteria (1); and as above, four pigeons harbored no resistant bacteria.

Conclusions
Thus, the pigeon populations in each area distinctly harbor different patterns of AMR Enterobacteriaceae, which may reflect the regional use of particular antimicrobial compounds, and are potential indicators of an outbreak of specific drug-resistant bacteria.
Associations between medication use for asthma and COPD and proximity of livestock farms in the Netherlands

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TPS 751: Farms, antibiotics, infections, August 26, 2019, 3:00 PM - 4:30 PM

Background
Inverse associations between asthma and chronic obstructive pulmonary disease (COPD) and proximity to livestock farms were found in previous studies in the southeast of the Netherlands. We aimed to study the association with asthma or COPD medication dispenses, using nation-wide registry data and additional measures of exposure.

Methods
We conducted a cross-sectional study among 5,426,044 Dutch residents older than 17, living at least two years at the same address, not working in the livestock-sector and not living in large cities, in residential care or close to the Dutch border, using data on medication dispenses for treatment of asthma/COPD in 2016. We defined exposure based on distances to livestock farms and on modelled livestock-related particulate matter-concentrations (PM10), using an atmospheric dispersion model. Pooled results for different regions were obtained by meta-analyses, adjusting for several personal-level variables.

Results
Persons living within 500 m from livestock farms, particularly cattle farms, were less likely to receive medication for asthma/COPD than persons living further away (meta-analysis-odds-ratio, 95% confidence interval: 0.96, 0.94-0.99, I²=67% for any livestock farm; 0.96, 0.93-0.98, I²=45% for cattle farms). Contribution of cattle farms to local PM10-concentration was generally negatively associated with medication use as well (meta-analysis-odds-ratio for 10-90 percentile increase in exposure: 0.93, 95% confidence interval: 0.87-0.98, I²=88%), after adjustment for PM from other sources. The latter was positively associated with medication use. Associations with exposure related to other animals than cattle were less evident.

Conclusions
Cattle farm proximity was associated with lower asthma/COPD medication dispenses. Results are in accordance with the hygiene hypothesis, suggesting a reduction of allergies and atopy with exposure to higher microbial diversity. This hypothesis does not explain associations with COPD, which we could not analyze separately from asthma. Our findings add to the societal debate on, otherwise mainly adverse, effects of animal husbandry on human health.
Transmission dynamics and community compliance of containing nipah virus transmission in Kerala, India

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TPS 751: Farms, antibiotics, infections, August 26, 2019, 3:00 PM - 4:30 PM

Background
Nipah virus case of recent outbreak in India was in Kerala where the first victim died on May 5th 2018, following which there was death toll of 17. A Phased methodology was applied combining survey and interview method to identify the factors that experienced sustained nipah transmission.

Methods
A phased study was performed using cross-sectional survey (Phase 1) and semi-structured interviews (phase 2).

Phase 1- cross-sectional survey data were used to reconstruct the dynamics of transmission
Phase 2- Semi-structured interviews were conducted with key community informants and selected households to document community perception, resistance, and adaptation to response strategies. Cox proportional hazards regression models were fitted to estimate hazard ratios (HRs) and 95% confidence intervals (95% CI) for the association between nipah (probable and confirmed cases) and covariates previously documented, including household size, sex, and age.

Transmission dynamics were obtained using contact history. Relationship between infected individual was categorized as immediate family, extended family, and social neighbors and friends.

Results
All households (n = 300; 1200 individuals) participated in the survey. 17 of 19 nipah probable/confirmed cases died (89•5% case fatality rate).
Nipah transmission was understood after public awareness was given through media and various social workers. The identification of index case took some time and barrier methods were not followed initially leading to its transmission. After diagnosis and better nursing protocols the transmission could be contained. Two of the affected individuals responded to ribavirin.

Conclusions
Transmission was maintained by a small number of large households; the outbreak was controlled in this community only after prolonged transmission and a high death toll. A key recommendation emerging from these findings is to ensure that large households and immediate family members are prioritized in control and prevention activities. Community based strategy of social mobilization and community engagement was effective in case detection.
Antimicrobial chemicals are contained in various household and personal care products. This study examined relationships between the use of antimicrobial household products and allergic rhinitis in children in South Korea. In total, 1,538 elementary school students in Seoul were tracked from 2012 to 2017 (first to sixth grade). Among these, 917 children (mean age 7 years) who did not have allergic rhinitis were included in the final analysis. Data on demographic characteristics and frequency of antimicrobial household product use were collected using questionnaires completed by the parents of the children. Antimicrobial exposure (AE) scores were calculated for each child by summing their exposure to three antimicrobial household products. During the follow up, we estimated the cumulative incidence of doctor-diagnosed allergic rhinitis based on International Study of Asthma and Allergies in Childhood questionnaires. During follow up, the cumulative incidence of allergic rhinitis was 25.6%. A multivariable logistic analysis adjusted for demographic factors revealed that the children with AE scores ≥ median value were more likely to have allergic rhinitis than those with AE scores < median value (adjusted odds ratios, aOR = 1.37, 95% CI = 1.01–1.87). About 1 of 4 children developed allergic rhinitis during the 5-year follow-up and AE score groups were significantly associated with the incidence of allergic rhinitis. Parental use of AHPs may be associated with development of allergic rhinitis.
Background/Aim: campylobacter species have emerged as leading bacterial causes of gastroenteritis and foodborne infections in developed countries. the incidence-rate in israel, one of the highest world-wide, increased from 31:100,000 to 91 during 1999–2010. We aimed to explore the effect of spatio-ecological factors (e.g. socio-economic-status (ses)) and time-spatial factors (e.g. ambient temperature) on the infection incidence in israel; and to pinpoint areas with increased risks.

Methods: data on 35,542 incident cases was provided by the reference laboratories of the israeli ministry of health for the period 1999-2010. case characteristics included isolate date, species identification (c. jejuni or c. coli), age and street-address that was geo-coded into spatial areas. the spatio-temporal study unit was region (1,824 units)* season (48 seasons). we calculated the standardized incidence ratio, adjusted for age-group and nationality, for each study unit and applied bayesian hierarchical spatio-temporal models to estimate relative risk (rr) and 95%ci for the ecological determinants (ses, temperature, population-density and altitude) and for mapping disease risk.

Results: we found significant effects of ses, altitude, population-density and temperature on campylobacter infection risk. for ses, rr was 1.107 (95%ci=1.062-1.153, standardized values -3 to +3), for altitude rr was 1.14 (95%ci=1.11-1.15 for 100 meters), for population-density rr was 0.881 (95%ci=0.860-0.904, log), and for temperature rr was 1.025 (95%ci=1.013-1.038, for 10c). Across seasons, the higher risk was found in the spring (rr=1.150, 95%ci=1.061, 1.241, compared to winter). among the six israeli districts, the highest risk was found in the southern district showing increased risk in many regions throughout the year. in haifa district (northern-israel), unlike other districts, there were a few regions with very high risks and the rest without an increased risk.

Conclusions: campylobacter infection in israel is multifactorial and associated with environmental factors. the finding of a spatio-temporal ambient-temperature effect should be considered in climate-change adaptation strategies.
Campylobacter and Laboratory Analysis Type: A Case-Case Analysis to Determine Differences in Risk Factors

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TPS 751: Farms, antibiotics, infections, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aims: Campylobacter bacteria is estimated to be responsible for over a million illnesses in the U.S each year and is regarded as the most common bacterial cause of gastroenteritis worldwide. Campylobacter infection is identified by collecting a biospecimen from the individual and testing for Campylobacter bacteria by culture isolation or by rapid non-culture diagnostic assessments. To better understand the differences between culture and culture-independent diagnostic tests (CIDTs), we conducted a case-case analysis to determine differences in disease presentation, demographic characteristics, healthcare utilization, and individual exposures between cases identified via two different diagnostic tests (culture vs. CIDTs).

Methods: This secondary data analysis included Campylobacter cases reported to public health agencies between 2013-2017 in Maricopa County, Arizona that also completed the University of Arizona Campylobacter interview. Variable classes for demographics, disease characteristics, healthcare utilization, and individual risk factors from the University of Arizona Campylobacter interview and Maricopa County Public Health Department were included in the analysis. Descriptive statistics, univariate logistic regression, and multivariable logistic regression with stepwise backwards selection of variables were performed on the different classes of risk factors.

Results: In general, there were fewer infants, children, and non-Hispanic cases identified via culture than CIDT. After adjusting for age and gender, cases identified via culture were significantly more likely to report diarrhea and have had their stool sample analyzed at a laboratory. Additionally, culture-identified cases were significantly more likely to have consumed raw cheese and nuts in the week leading up to the illness, after adjusting for age and gender. Finally, culture-identified cases were significantly more likely to have consumed cantaloupe and sprouts than non-culture identified cases.

Conclusions: This study expanded the knowledge of differences in case risk factors by Campylobacter diagnostic test using a large dataset. Future investigations should include rural counties and region-specific strains of Campylobacter.
TPS 771: Diet and lifestyle
E-cigarette Use Patterns and Device Characteristics of Daily E-cigarette Users in Maryland

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background
Approximately 10.8 million American adults use e-cigarettes, with more than half under 35 years old. Currently, there is limited literature on daily e-cigarette users, which make up 1% of prevalence. This study describes the use patterns and e-cigarette device characteristics of daily e-cigarette users in Maryland.

Methods
From December 2015 to October 2017, we recruited 164 participants: 100 daily sole e-cigarette users, 14 daily dual users (use e-cigarettes and combustible tobacco cigarettes), 50 non-smokers/non-e-cigarette users. Data on health status, e-cigarette use patterns, device characteristics, sociodemographic factors were collected by interview.

Results
Sole e-cigarette users, dual users, and non-users were similar in sociodemographic characteristics; participants were mostly male (64%), caucasian (82.3%), aged 30.4 years (SD: 10 years). On average, e-cigarette users used 2 devices (SD: 1 device), vaped 365 puffs/day (SD: 720 puffs) at 4.25 volts (SD: 1.2 volts) with either a kanthal (44%), stainless steel (17%) or nichrome heating coil (16%); users tended to consume 52.1 ml of e-liquid/week (SD: 47.2 ml) with a nicotine concentration of 5.4 mg/ml (SD: 5.3 mg/ml). Compared to non-users, e-cigarette users reported more symptoms of wheezing, shortness of breath, coughing in the morning and in the evening, and having hypertension. Majority of e-cigarette users intended to reduce e-liquid nicotine levels, but less than half planned to quit e-cigarette use altogether. In regression models, older aged individuals tended to vape at a higher nicotine concentration but at fewer puffs per day. Women and individuals of higher education tended to vape at a lower voltage and consume less e-liquid/week.

Conclusion
With chronic use and no intention to quit vaping, e-cigarette users may be at risk for increased toxic exposures, particularly among men and individuals with lower education levels. Further research is needed to characterize the long-term health effects of daily e-cigarette use.
Smoking-induced risk of future cardiovascular disease is partly mediated by cadmium in tobacco: Malmö Diet and Cancer Study
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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background
Smoking is a strong risk factor for cardiovascular disease (CVD) and causes exposure to cadmium, which is a pro-atherosclerotic metal. Cadmium exposure has also been shown to increase the risk of CVD, even after adjustment for smoking. Our hypothesis was that part of the risk of CVD in smokers may be mediated by cadmium exposure from tobacco smoke. We examined this hypothesis in a mediation analysis, trying to assess how much of the smoking-induced CVD risk could be explained via cadmium.

Methods
We used prospective data on CVD (incidence and mortality) in a Swedish population-based cohort of 4304 middle-aged men and women (the Malmö Diet and Cancer Study). Blood cadmium was analyzed in baseline samples from 1991 - 1994, and clinical events were followed up for 16–19 years based on registry data. Mediation analysis was conducted to evaluate the indirect effect (via cadmium) of smoking on CVD. Survival was analyzed by the accelerated failure time (AFT) model and the Aalen additive hazard model.

Results
The mean blood cadmium level in the study population was 0.43 μg/L (median 0.24 μg/L) and increased with recent and current smoking. As expected, shorter survival time (AFT model) and higher incidence rate (Aalen model) were found in current smokers for all CVD outcomes and this effect seemed to be partly mediated by cadmium. For the sum of acute myocardial infarction, bypass grafts and percutaneous coronary intervention, and death in ischemic heart disease, about half of the increased risk of such events in current smokers was mediated via cadmium, with similar results for the AFT and Aalen models.

Conclusion Cadmium plays an important role in smoking-induced CVDs.
Exposure to polycyclic aromatic hydrocarbons (PAHs) in adults differ by tobacco product type and frequency of use: Data from the U.S. Population Assessment of Tobacco and Health (PATH) Study

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1CDC

TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background:
Polycyclic aromatic hydrocarbons (PAHs) are environmental pollutants formed from incomplete combustion of organic matter. PAHs are known carcinogens and exposure can occur through smoking. Information about PAHs exposure by tobacco product type and frequency of use is limited.

Methods:
To address this gap, we evaluated exposure to PAHs among 11,519 adult participants in Wave 1 (2013–2014) of the Population Assessment of Tobacco and Health (PATH) Study. From self-reported information, we categorized participants based on their use of tobacco products as never-tobacco user, exclusive current established combustible products user (e.g. cigarette smoker), and exclusive current established non-combustible products user (e.g., e-cigarette user). We further classified tobacco users as exclusive cigarette user, exclusive smokeless product user, and exclusive e-cigarette user. Last, we categorized frequency of product use (everyday vs some days) and time since use. We evaluated associations between tobacco product user categories and PAHs urinary biomarkers geometric mean concentrations determined by liquid chromatography tandem mass spectrometry.

Results:
Combustible products users had significantly higher concentrations of all biomarkers than non-combustible products users and never users; non-combustible products users had significantly higher concentrations than never users for most biomarkers. Everyday cigarette and smokeless product users had significantly higher concentrations for most biomarkers than some days’ users; cigarette and smokeless product users who used the product in the last hour had significantly higher concentrations of most biomarkers than other occasional cigarette or smokeless product users, respectively. By contrast, everyday e-cigarette users’ concentrations of most biomarkers did not differ significantly from those in some days’ e-cigarette users; we did not observe clear trends by time of last use among e-cigarette users.

Conclusion:
These data showed that users of tobacco products had higher PAHs urinary biomarker concentrations compared to never users, and concentrations differed by type and frequency of tobacco product used.

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Background/Aim: Folic acid is critical to fetal neurodevelopment. Bioavailable folate is affected by both folic acid intake and folate processing genetics. We tested whether maternal prenatal vitamin use or folic acid intake during the first month of pregnancy was associated with autism spectrum disorder (ASD) risk, and whether this association differed by maternal folate metabolism genotype.

Methods: The Early Autism Risk Longitudinal Investigation is an enriched risk pregnancy cohort. Supplement use was reported prospectively by month during pregnancy. Total folic acid intake in pregnancy month one was calculated from supplement use (prenatal vitamins, multivitamins, folic acid). Clinical ASD diagnosis was made at 36-months (37 cases, 139 controls). Using logistic regression, we examined associations of maternal prenatal vitamin use or maternal folic acid intake (low (<400mcg), adequate (400-1000mcg), and high (>1000mcg)) on child’s ASD diagnosis (n=176 mother-child pairs), adjusting for child’s sex and maternal education. We tested for effect modification by methylene tetrahydrofolate reductase (MTHFR) variant A1298C.

Results: Prenatal vitamin use (60.8%), compared to no use, was associated with non-significantly reduced risk of ASD (OR: 0.71, 95%CI: 0.32–1.59), congruent with previous findings in other cohorts. High total folic acid (from any supplement combination, 10.2% of mothers) compared to adequate (46.0%) was not associated with increased odds ASD (OR: 1.49, 95%CI: 0.43–5.16). Low folic total folic acid (43.8%) also was not associated with odds ASD (OR: 0.72, 95%CI: 0.31–1.68). There was no evidence supporting gene-environment interaction, although statistical power was quite limited.

Conclusions: We interpret these results of this modestly sized study cautiously. We confirm prenatal vitamin use in pregnancy month one appears protective against ASD. Future work will harmonize with other studies to obtain sufficient MTHFR C677T variant carriers for study and to investigate exposure timing.
Smoking habit in parents and exposure to environmental tobacco smoke in elementary school children of Milan

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Environmental Tobacco Smoke (ETS) has been classified as carcinogenic to humans by the International Agency on Research on Cancer. Children with smoking parents are potentially exposed to ETS. The aim of the present study was the assessment of exposure to ETS in Milan schoolchildren, using biological monitoring.

Methods: Eighty-two third grade elementary school children and their parents were recruited for the study. A questionnaire was submitted to parents to collect information about smoking habit in the house, and the possible exposure to ETS of their children. For each child a spot urine sample was collected in the morning, before school, and urinary cotinine was measured by LC-MS/MS.

Results: Twenty-nine children had at least one smoking parent, and 3 of them had two smoking parents. Children, divided in ETS exposed and not-exposed according to their parents opinion, had median urinary cotinine of 0.37 µg/L (up to 14.1 µg/L, n = 14) and < 0.1 µg/L (up to 1.9 µg/L, n = 68), respectively. Interestingly, when children were divided according to their parents’ smoking habit, median urinary cotinine was 0.66 µg/L (up to 14.1 µg/L, n = 29) vs. < 0.1 µg/L (up to 1.7 µg/L, n = 53) in those with smoking and non-smoking parents, respectively. Median urinary cotinine was 3.4 (n = 6), 0.37 (n = 30), and <0.1 µg/L (n = 43) in children living in houses where smoking was allowed in some rooms, allowed only on the balcony, and completely banned, respectively.

Conclusions: ETS exposure resulted in measurable urinary cotinine in children. Milan smoking parents tend to underestimate exposure to ETS of their children. Widening the smoking ban to indoor environments of the house is effective in diminishing ETS exposure of children.
Effects of environmental and lifestyle exposure on urinary polycyclic aromatic hydrocarbon metabolites: a cross-sectional study of urban adults in China

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Background: Urinary polycyclic aromatic hydrocarbons (PAHs) metabolites which reflect internal level of PAH are commonly used to evaluate exposure-response relationship between PAH exposure and adverse health effects on multiple organ systems. However, potential association of environment PAH exposure and lifestyle to urinary PAH metabolites is unclear. Hence, in this study, we evaluated the effect of four common PAH sources, including cigarette smoking, cooking status, traffic exposure and diet, on the level of urinary monohydroxylated PAH metabolites (OH-PAHs) among residents of urban community in China.

Methods: Urinary OH-PAHs were measured among 4092 participants from the Wuhan-Zhuhai cohort. Variables of lifestyle were collected using questionnaire by trained investigators. Linear mixed models were conducted to explore the association between PAH sources and urinary OH-PAHs. Standardized regression coefficients were used to assess the relative importance of PAH sources.

Results: The levels of total urinary OH-PAHs (ΣOH-PAHs), 1-, 2-hydroxynaphthalene and 2-hydroxyfluorene were significantly positively related to tobacco smoking (P<0.01). The concentrations of ΣOH-PAHs, 1-, 2-hydroxynaphthalene and 9-hydroxyfluorene were significantly positively correlated with dietary intake (P<0.05). Elevated levels of 9-hydroxyfluorene and 1-hydroxyphenanthrene were found among the participants with long traffic time exposure (P<0.05). And 1-hydroxyprpyrene (1-OHP) was significantly associated with self-cooking (P<0.05). Moreover, urinary total OH-PAHs and hydroxynaphthalene were primarily affected by cigarette smoking, poor ventilation and dietary intake. Poor ventilation in kitchen, traffic exposure and dietary intake contributed most to urinary total hydroxyfluorene and hydroxyphenanthrene. And the most important sources to urinary 1-OHP were self-cooking and traffic exposure.

Conclusions: The relationship and contribution to the species of urinary OH-PAHs varied from diverse exposure sources. And secondary ventilation could eliminate PAHs effectively.
Associations of dietary factors and oral health behaviors with plasma fluoride concentrations in children and adolescents aged 6 to 19 years

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim

Municipal water fluoridation is common in the US; however, fluoridation remains a contentious public health issue in some areas. In addition, non-drinking water sources of fluoride exposure in children and adolescents are poorly understood. We sought to describe the association between dietary factors and oral health behaviors with plasma fluoride concentrations using a nationally representative survey from the US.

Methods

We used data from 3,929 respondents aged 6-19 years old from the 2013—2016 National Health and Nutrition Examination Survey. We identified dietary factors using a 24-hour dietary recall and categorized types of foods and beverages consumed using US Department of Agriculture food group definitions. We characterized oral health behaviors using information on the timing of last dental visit, the number of tooth brushings per day, and amount of toothpaste used per brushing. We estimated associations between these factors and ln-transformed plasma fluoride concentrations after adjusting for sociodemographic factors and measured tap water fluoride, accounting for the complex survey design.

Results

The geometric mean plasma fluoride concentration was 0.36 µmol/L (95% confidence interval (CI): 0.34, 0.38). Children who drank tea (N=534, 14.1%; any variety) versus those who did not had 34% higher plasma fluoride concentrations (95% CI: 16, 54). Intake of other foods that may contain fluoride, including coffee, chicken nuggets, and grapes/raisins, were not associated with plasma fluoride concentrations, nor were oral health behaviors. For each 0.10 mg/L increase in tap water fluoride (median: 0.5 mg/L; interquartile range: 0.18-0.72), plasma fluoride was 4.9% higher (95% CI: 3.8, 6.0).

Conclusions

Our findings suggest tea consumption in children and adolescents may increase plasma fluoride concentrations substantially. Future studies should continue to investigate the contribution of diet and other behaviors to total fluoride exposure, which is critical to establishing safe levels of municipal water fluoridation.
Breastfeeding is associated to mitochondrial DNA content of adolescents


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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Several studies emphasized the benefits of breastfeeding on the child's health, including improvement of the development of the immune system, brain and cognitive function. We hypothesized that besides these beneficial effects, breastfeeding is also associated with mitochondrial DNA (mtDNA) content at adolescent age.

Methods: This study was part of the third cycle of the Flemish Environment and Health study (FLEHS III) cohort and included 306 adolescents aged 14-15 years. DNA was extracted from peripheral blood and the relative mtDNA content was determined using quantitative PCR. Data on breastfeeding was retrieved by a questionnaire filled out by the mother. Multiple linear regression models, adjusted for important confounding variables, were used to associate breastfeeding and mtDNA content in adolescents.

Results: Breastfeeding was positively associated with mtDNA content. mtDNA content was 23.1% (95% CI 4.6-44.9; p = 0.013) higher in breastfed adolescents. When infants were breastfed for 1-10 weeks, and over 20 weeks, mtDNA content was increased with 15.1% (95% CI -7.6-43.6; p = 0.208), 23.9% (95% CI 1.4-51.3; p = 0.036), and 31.7% (95% CI 4.7-65.5; p = 0.019), respectively. In sensitivity analyses, we observed that breastfeeding is independently associated to mtDNA content in non-smoking adolescents and that the association was stronger in boys than in girls.

Conclusions: In addition to the well-known long-term effects of breastfeeding, this study shows a positive association between breastfeeding and mtDNA content in adolescents. mtDNA content gradually increased with longer periods of breastfeeding. An increase in mtDNA may be a underlying mechanism of the beneficial effects of breastfeeding.
The impact of military actions on hospitalization rates due to coronary heart disease and psychiatric disorders

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Abstract

Background: In years 2008-2014 the Israeli population has been exposed to three military operations which may have had an effect on the public’s physical and mental health especially in areas in close geographic proximity to the conflicts.

Aim: To assess the effects of military operations Cast Lead, Pillar of Defense and Protective Edge on hospitalizations and emergency room visits due to coronary heart disease (CHD) and psychiatric disorders (PD).

Methods: Hospitalization files, meteorological data, were used. We built a multivariate logistic regression model to examine the association between hospitalization rates due to CHD/PD during operation and peaceful periods. We built the logistic regression model to examine the association between ED visits due to CHD/PD. We used applications of time series technique (Cosinor model) for negative binomial regression, as well we examined LAG effects (1d, 2d, one week, 14d and 30d after the military operations) on hospitalizations due to CHD.

Results: We did not find an association between exposure to military operations and hospitalizations due to CHD hospital admissions after adjusting for age, gender, air temperature and distance from place of operation. However, we did find an association between exposure to military operations and ED visits due to PD (OR=3.608, 95% CI=3.060-4.2540) with the highest risk with adjusted OR of 6.647, 95% CI=4.791-9.211.

Conclusion: In this study we found an association between exposure to military emergency and ED visits due to PD. No short-term associations were found between exposure to military emergency and hospitalization rates due to CHD in BMC.
Short-term Exposures to Particulate Matter Gamma Radiation Activities and Biomarkers of Systemic Inflammation and Endothelial Activation in COPD Patients

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background: Inhalation of radionuclides attached to particulate matter (PM) is an important route of ionizing radiation exposure. We examined short-term relationships between PM-gamma radiation activities and biomarkers of systemic inflammation and endothelial activation in chronic obstructive pulmonary disease (COPD) patients.

Methods: We assessed biomarkers of systemic inflammation and endothelial activation seasonally up to four times over a year in 85 COPD patients from Eastern Massachusetts, USA from 2012 to 2014. Ambient gross gamma count data measured on TSP in Boston (gamma energy channels 3-9) were from U.S. EPA’s RadNet system, a national radiation monitoring network. We adjusted for background terrestrial and cosmic radiation to estimate daily ambient PM-gamma activities and estimated indoor exposures by using the indoor-to-ambient sulfur ratio as a measure of home infiltration. Mixed effects models were used, adjusting for potential confounders.

Results: We found positive associations between ambient and indoor PM gamma activities with plasma CRP and IL-6. For ambient exposure averaged over 6 days before phlebotomy, gamma activities were associated with an increase in CRP from 8.75% (95%CI: -0.57, 18.95; p=0.068) to 14.8% (95%CI: 4.5, 26.0; p=0.004) that varied slightly by channel. Indoor exposures were associated with a similar increase, from 7.45% (95%CI: 2.77, 12.4; p=0.002) to 13.4% (95%CI: 5.82, 21.4; p<0.001). For IL-6, indoor exposures over same time period were associated with increases from 3.56% (95%CI: 0.31, 6.91; p=0.033) to 6.46% (95%CI:1.33, 11.85; p=0.014) per IQR; ambient exposures had a similar effect. There were no associations with sVCAM-1, nor effects of weekly PM2.5; findings were similar adjusting for weekly black carbon.

Conclusions: Our results suggest there are systemic effects attributable to ambient and indoor PM-gamma radiation in COPD patients. Since gamma activity is a surrogate for the decay of alpha- and beta-emitting radionuclides, our findings have implications for understanding the health effects of environmental radiation.
Prevalence and use frequency of personal care product of female students in elementary school in South Korea

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Concern about exposure to harmful substances of personal care products (PCPs) are increasing among children. Information on use of PCPs is important for consumer exposure assessment. A purpose of the present study was to investigate distributions of use frequency for personal care products among female students in elementary schools in Korea. A population based samples of 1,599 elementary school girls aged 6-13 years in Korea was collected through web-based questionnaires in July, 2018. Information on demographic factors and use frequency of 34 PCPs, including rinse-off, leave-on, hairstyle, cosmetic, and general hygiene products, were examined using questionnaires filled out by the mother of the girls. Use percent of PCPs were varied by age, region, pocket money, whether to diagnosis of contact dermatitis of girls and education levels of mother. In the class of cosmetic products, use percent in 8 of the 12 cosmetic products were significantly increased as age groups were increased. Only few PCPs were significant differed by use frequency among users according to demographic characteristics, suggesting that use frequency of PCPs were similar among users. Use frequency of most PCPs was correlated each other. Particularly, correlation coefficient of class of hairstyle and cosmetic products was higher than other type of product classes, which might impact aggregate exposures. Present study provides data on usage patterns of PCPs in elementary schools girls in Korea by several demographic characteristics. The information of present study might be useful for exposure assessment in a risk assessment.
Does the dietary pattern at age four affect attention deficit / hyperactivity symptoms at age 6?

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Attention deficit hyperactivity disorder (ADHD) is one of the most commonly diagnosed neurobehavioral disorders in childhood. The effect of diet or dietary supplements on ADHD is controversial, although some evidence suggests that dietary factors are associated with development of ADHD. Recently, several studies used dietary pattern for evaluation of dietary factors associated with ADHD. As nutrients are consumed in combination and nutrients are usually highly interrelated, the study of dietary patterns is useful to further understand the overall role of dietary factors in ADHD. This study aims to determine the association between dietary patterns at 4 years old and ADHD in 6-year-old children. We obtained data from the children around 4 years and 6 years old. Dietary intake was estimated using a food frequency questionnaire (FFQ) to assess dietary intake in 4 years old children and 33 defined food groups were considered in principal components analysis (PCA). PCA identified four major dietary patterns: the “Sweets” pattern, the “Vegetables” pattern, the “Meats” pattern, and the “Carbohydrates” pattern. The parents of the participating children at 6 year-old assessed the ADHD symptoms of their children by responding to the Korean version of the ADHD rating scale (K-ARS).

The ‘Sweets’ pattern showed a higher risk of AD, HD and ADHD in the higher quartile group than the lower quartile group (AD [Relative risk (RR) =1.35(confidence interval (CI): 1.17, 1.56) at Q4 vs. Q1]; HD [RR= 1.44(CI: 1.22, 1.69) at Q4 vs. Q1]; ADHD [RR= 1.39(CI: 1.25, 1.54) at Q4 vs. Q1]). For food item analysis for the sweets group, the score of chocolate, snack of chips and fruit Jams intakes were positively significant with AD, HD and ADHD. In this study, sweets dietary pattern was positivity associated with ADHD in childhood.
The association between sleep duration and cognitive function in 6-year-old children

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background:
Sufficient sleep during childhood is needed for imperative component of cognitive functions such as learning and successful school performance. We aim to investigate the effects of sleep duration on cognitive performance in 6-year-old children.

Methods:
Among the 645 children recruited the study which was conducted as part of a cohort named “The Environment and Development of Children”, and collected the socioeconomic and environment factors including sleep duration for children from their parents’ questionnaire. Cognitive function included measures of childhood intelligence quotient (IQ) scores (FSIQ) and Social Impairment using the Korean version of the Social Communication Questionnaire (K-SCQ) in children aged 6 years. We examined to investigate the relationship between exposure to sleep duration with continuous variables of IQ scores and social impairment (KSCQ) scores adjusting maternal age, maternal educational level, maternal occupation, maternal IQ, exposure to second-hand smoking, season, Children BMI Z-score, Gestational age, Children’s age. After sex stratified, we compared to the effect the sleep duration on IQ score and Social impairment.

Results:
We found that longer sleep duration in participants was associated with better performance on measures of full IQ and social impairment. The relative risk of full IQ score and K-SCQ score under 8 hours for meanly sleep duration are 0.95(95% CI: 0.91-0.99, p= 0.037) and 1.46(95% CI: 1.12-1.90) compared to more than 10 hours for sleep duration. After sex stratified, only boys were significantly associated between sleep duration and Full IQ (p=0.007), but not girls (p=0.639). However, among girls were only significant the association between sleep duration and social impairment (p=0.002), but not boys (p=0.467).

Conclusions
These findings support the hypothesis that sleep duration is differentially related to some components of cognitive function by sex difference. Future studies should be needed that assess children’s sleep duration pattern and children’ health outcome for prospective cohort.
Evaluating the impact of criminalizing drunk driving on years of life lost of road traffic deaths in one megacity, China
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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Abstract: Aim: Road safety is an important public health issue worldwide. However, few studies analyse the association between criminalizing drunk driving and Years of Life Lost (YLL) of Road Traffic Deaths (RTD). There are still countries which do not have the law preventing drunk driving. Our study can provide useful information about this. Methods: We used interrupted time-series analysis to find the changes of YLL before and after the law enforcement using RTD data from 2008 to 2014 in Tianjin. We also examined RTD risk change related to the law. Results: Simple comparisons of the median of RTD and the YLL in all subgroups except the >=65 age group showed reductions after enactment of the new law in May 2011. Results: The overall RTD and YLL decreased by 9.6% (125 vs 113) and 16.11% (5786 vs 4854) after the law. In regression analyses with adjustment for seasonality, months, holidays and the number of people in each district, the RTD and YLL declined significantly after the new traffic law, especially obvious in the middle age group. However, the upgrade of the law in 2013 does not have any effect on the YLL and the RTD. Conclusions: YLL provides a complementary measure for examining the effect of criminalization on drunk driving RTD. Conclusion: This study highlights that the law can lead to reduction in RTD and YLL in Tianjin, China. Large, immediate public health benefits resulted from the new road traffic law in China. However, the first issue of the law is more effective than the upgrade of the law later.
Associations between shift work and empty calorie food/beverage consumption
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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background
Unhealthy eating behaviors may be a pathway by which shift work increases risk of chronic diseases. Recent studies have shown that people’s empty calorie food/beverage consumption can vary day-to-day based on their daily experiences. Yet, the majority of evidence focused on the between-person associations.

Aim
To examine within-person associations between shift work and daily empty calorie food/beverage consumption.

Methods
A 14-day intensive longitudinal study design with ecological momentary assessment (EMA) was employed to collect information on empty calorie food/beverage consumption. During study period, participants were prompted to complete surveys on a smartphone four times daily. Daily empty calorie food/beverage consumption was assessed with a 21-item food checklist based on the top sources of empty calorie foods and beverages reported in the 2003-2006 National Health and Nutrition Examination Survey and the Nutrition and the 2005-2008 Health Survey in Taiwan. The registry-based work schedule was employed as the primary approach to measure shift work. Person fixed-effect negative binomial regression models were used to examine within-person associations between shift work and empty calorie food/beverage consumption.

Results
A total of 2,448 observations from 77 Taiwanese registered nurses were included in the final analysis. On days when working an evening shift (Adj. Coeff.: 0.18, 95% CI: 0.01, 0.35) or a night shift (Adj. Coeff.: 0.24, 95% CI: 0.06, 0.41), nurses’ empty calorie food/beverage consumptions were higher compared to days when working a day shift. However, shift work on a day was insignificantly associated with empty calorie food/beverage consumption on the following day.

Conclusions
Findings in this study showed that shift work is concurrently associated with shift workers’ daily empty calorie food/beverage consumption. Shift work is unavoidable for certain types of industries (e.g., healthcare). Thus, strategies to improve shift workers’ eating behaviors on days when working on an evening or a night shift are warranted.

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: To assess the relationship between acute and intermittent secondhand tobacco smoke (SHS) exposure with child and adolescent blood pressure (BP).

Methods: We analyzed data from 3579 children and adolescents participating in the United States National Health and Nutrition Examination Survey (NHANES) between 2007 and 2012, with SHS exposure assessed via serum cotinine (biomarker for acute exposures) and urine NNAL (4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol, biomarker for intermittent exposures). BP measures were calculated as percentiles (adjusted for age, sex, height) according to the 2017 guidelines established by the American Academy of Pediatrics. We used weighted linear regression accounting for the complex sampling weights from NHANES and adjusting for socio-demographic and clinical characteristics.

Results: Overall, participants were predominantly non-Hispanic white with a mean age of 12.6 years. There was approximately equal representation of boys and girls. Approximately 15.9% of participants lived in homes where smoking is present. In adjusted models, an interquartile range (IQR) increase in urinary NNAL was associated with a 2.93 (95% CI: 1.00-4.87) point increase in diastolic blood pressure (DBP) percentiles, and with a 2.76 (95% CI: 0.29-5.22) point increase in systolic blood pressure (SBP) percentiles. The association of NNAL and BP differed by sex. Among boys, an IQR increase in NNAL was associated with a 4.77 (95% CI: 2.50-7.06) point increase in DBP percentiles, but was not associated with SBP percentiles. Meanwhile, among girls, an IQR increase in NNAL was not associated with DBP percentiles, but was associated with a 4.30 (95% CI: 0.56-8.03) point increase in SBP percentiles. An IQR increase in serum cotinine was associated with a 2.73 (95% CI: 0.42-5.05) point increase in DBP percentiles, but was not associated with SBP percentiles.

Conclusions: Our findings provide strong evidence for the relationship between acute and intermittent SHS and increased BP percentiles among children and adolescents in the United States.
Assessing Risk Factors for the Increased Risk of Pulmonary Cancer in Salento Area (Southern Apulia): first results from the “PROTOS” Case-control Study
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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim

Data from the Cancer Registry of the ASL of Lecce show how the incidence of pulmonary neoplasms in the male population in the years between 2003 and 2006 exceeded that of central and northern Italy, despite the absence of major industrial plants. A well-defined incidence cluster has also been found by National Institute of Health (ISS) including 16 municipalities in the central Salento area. Local Health Authority ASL Lecce, has activated an inter-institutional network (Oncological Prevention Network of Lecce, REPOL) and performed the PROTOS case control study, aimed at assessing the possible association between the excesses of lung cancer incidence and possible exposures (professional/environmental or life-style-related) or familiarity for neoplasms.

Methods

Patients suffering from pulmonary cancer (with diagnosis from 07/01/2015 to 12/31/2016) were interviewed on a voluntary basis with a specific questionnaire while entering healthcare services. Exclusion criteria for controls were the presence of respiratory diseases (asthma, emphysema, COPD), any previous neoplasia, myocardial infarction and cerebral stroke.

Results

442 cases were interviewed (351 males, 91 females) and 1541 controls (1111 males, 430 females). The most represented pulmonary neoplasm was adenocarcinoma (39.82% of cases). Only 8.82% of cases were non-smokers. Cases showed a statistically significant association with cigarette smoking (P <0.0001) and had significantly lower education level than controls (P = 0.001); the cases differed significantly from controls also for less physical activity (P<0.0001), higher consumption of alcohol (P<0.0001) and positive family history for cancer (P<0.0001). Professional history of jobs with possible exposure to carcinogens was statistically significant (P=0.022) as well as the use of pesticides in agriculture (P<0.001). Possible associations with environmental pollutants are currently under assessment by multiple modeling.

Conclusion

This study aims to clarify the epidemiological scenario in the province of Lecce concerning the historical data showing a higher incidence and mortality for lung cancer in males.
Dietary and socio-demographic factors among pregnant women and newborns exposed to environmental pollutants: Results from a birth cohort (PIPA Longitudinal Study) in Rio de Janeiro, Brazil.

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Background/Aims: Exposure to environmental pollutants during early life stages has been associated with several health outcomes. However, few studies addressed how these exposures affect the early gut microbial profile. We investigated the relationship between maternal diet, sociodemographic factors, BMI before pregnancy, and early feeding patterns in a birth cohort exposed to metals and pesticides, in Rio de Janeiro, Brazil. These results will collaborate with future studies of the association of environmental chemical exposure on colonization of newborn’s gut microbiome. Methods: Maternal diet and pollutant exposure were accessed during pregnancy, and during the first six months of life for the newborns. Samples of maternal blood and urine, newborn’s urine and meconium, and cord blood were collected, along with questionnaire interviews to obtain information on sociodemographic, existing maternal diseases, diet, smoking, alcohol consumption, use of medication, and environmental exposure information. Results: A total of 142 pregnant women were enrolled, in October and November of 2018, in the Federal University of Rio de Janeiro Birthing Center. The average age was 28 (SD = 6.9), black and brown-skinned were more prevalent (76%), and 61 (43%) were overweight or obese before pregnancy. Weekly consumption of at least one ultra-processed food was reported by 33% the women. At the ages of one, three and six months, 70%, 52% and 9% of the infants, respectively, were fully breastfed. During the first month, 32% of the infants were introduced to formula or solid foods. This proportion increased to 71% at the 6th month. Only 7% of the infants didn’t receive formula during the first 6 months of life. Conclusions: Most of mothers didn’t exclusively breastfeed their babies until the 6th month of life, as World Health Organization recommends. Besides, 33% of women regularly consumed ultra-processed food during pregnancy. Both infant and maternal diet impact infant’s microbiota colonization.
Suicide in young people, an exploratory analysis involving data of young people: 15 and 19 years old from cities in Brazil and the United States. 2012 -2017

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Suicide in young people worldwide is treated as a public health factor by the World Health Organization -WHO. Brazil has high levels of inequalities, as well as the United States. Worldwide, suicide affects more than 800,000 people, according to the World Health Organization (WHO). It is the second cause of death on the planet among young people aged 15 to 29 years - the first is violence. In Brazil, in 2015, suicide was the fourth cause of death in this same age group. In the United States, in 2008 the hospitalization rate of children and adolescents in American hospitals due to suicide attempt or suicidal thoughts was 0.66%. By 2015, that rate had reached 1.82%. The world has presented various environmental changes and we do not know if these factors may be influencing this picture. It is important to address the issue in this environment by exploring likely environmental issues. This project aims to know the profile of young people of the High school in some cities of Brazil and the United States, with a comparative analysis of data from the WHO. Data were collected on health information systems, considering hospitalizations and death of 15 to 18-year old by psychiatric conditions and suicides. Period 2012 to 2017. Analyzed by states of Brazil and United States. SPSS were used. Data reveal a higher incidence in women and a growing increase in specific states, especially in the southeastern region of Brazil. Conclusion: the data reveal the need for further studies and analyzes, especially for etiological analyzes of this phenomenon, and may contribute to the establishment of public policies.
Prenatal Caffeine Exposure and Social Responsiveness Scores in Early Childhood

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Maternal nutrition during gestation may modify the effect of toxicants on child neurodevelopment. Caffeine, most notable for its stimulation of the central nervous system, may affect offspring neurodevelopment. However, little is known about the relationship between gestational caffeine intake and autistic behaviors. We aimed to assess the relation between daily maternal caffeine intake and children’s behavior traits associated with Autism Spectrum Disorders (ASD), measured by the Social Responsiveness Scale (SRS).

Methods: We harmonized data from two pregnancy cohorts, the Health Outcomes and Measures of the Environment (HOME) (n=269), a general population cohort, and Early Autism Risk Longitudinal Investigation (EARLI) (n=120), an enriched-risk autism cohort of mothers who previously had child with autism. Caffeine-containing food and beverage intake was assessed twice during pregnancy via maternal report. Parent-reported SRS scores were ascertained when children were ages 3-8 years, with higher scores indicating greater ASD severity. We estimated changes in continuous SRS scores per interquartile range increase in maternal caffeine intake, adjusting for sociodemographic and perinatal factors.

Results: Median maternal caffeine intake during pregnancy was 18 mg/day (25th and 75th quartiles: 44, 56) in the pooled and individual cohorts (HOME 25th, 75th percentile: 44, 56; EARLI 25th, 75th percentile: 43, 55). In the pooled sample there was a positive association between caffeine intake and SRS scores (β: 1.1; 95%CI: 0.5, 2.2). However, the association was significantly different in each cohort (cohort x caffeine interaction p-value<0.05), where increasing caffeine intake was associated with increased SRS scores in EARLI (β: 2.7; 95%CI: 1.2, 4.2), but not in HOME (β: 0.3; 95%CI: -0.8, 1.3).

Conclusion: Higher levels of maternal caffeine intake during pregnancy were associated with increases in ASD-related traits among children in EARLI, but not in HOME. We speculate differences between these two cohorts could be due to underlying genetic susceptibilities.
Background. Micronutrients status during pregnancy is recognized as one of the environmental factors that can have an impact on maternal and children’s health. The study aims at evaluating socio-demographic, lifestyle, environmental, and pregnancy-related determinants of maternal micronutrients status during pregnancy.

Methods. The analysis was based on data from the Polish Mother and Child Cohort (REPRO_PL). During the second trimester of pregnancy, 1306 women filled in a modified version of the validated food frequency questionnaire (FFQ) based on which the intake of the following micronutrients was estimated: calcium, magnesium, zinc, copper, selenium, folate, vitamin D, vitamin A and vitamin E. In addition, copper, zinc and selenium levels were measured in the blood collected during the first trimester of pregnancy.

Results. About 95% of the women took dietary supplements during pregnancy. Despite such supplementation in the case of a high proportion of the women the intake of majority of the analyzed micronutrients was below recommendations for the pregnancy period (based on the Estimated Average Requirement). The mean plasma zinc, copper and selenium concentrations were 0.9±0.3 mg/l, 2.0±0.6 mg/l and 48.4±10.5 ug/l, respectively. The chance to reach the recommended intake for vitamin A, vitamin D and selenium was higher among the multiparous women (OR= 1.53 p=0.007; OR= 1.44 p=0.02; OR=1.48 p=0.009) and for zinc among the women with a higher socio-economic status (SES) (OR=1.43 p=0.04). For other variables the results were not statistically significant. A higher selenium level in the plasma was observed among the older women (p=0.01) and those with a higher SES (p=0.03). Conclusions. The current study presents evidence on specific factors influencing the micronutrients intake. They need to be accounted for in educational programs and interventions that focus on healthy diet recommendations during pregnancy.
**Comparison of Nasal Biomarkers of Inflammation and Immune Status in Former Smokers with COPD and Healthy Adults with and without Tobacco Exposure: A Pilot Study**

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**Background:** Tobacco exposure has both inflammatory and immunosuppressive effects in the upper and lower respiratory tract. Chronic obstructive pulmonary disease (COPD) is a smoking-related disease characterized by greater susceptibility to infection and abnormal inflammatory responses to noxious particles. We hypothesized that the upper respiratory cytokine milieu of former smokers with COPD would differ from healthy adults with and without tobacco exposure.

**Methods:** We recruited 18 former smokers with moderate to severe COPD, 14 smokers, and 20 non-smokers. We sampled each participant’s nasal epithelial lining fluid using an absorbent fibrous Leukosorb matrix. Soluble immune mediators were eluted and analyzed by multiplex ELISA. We examined 29 inflammatory mediators with relevance to airway disease. Mean concentrations were compared across groups by one-way ANOVA, followed by pair-wise comparisons when differences were found.

**Results:** The concentrations of most biomarkers were similar among former smokers with COPD compared with smokers and non-smokers. However, several biomarkers (IL-7, IL-10, IL-13, IL-12p70, IL-15) differed among the groups (global p<0.05) and all were lower among former smokers with COPD compared to non-smokers. There were no differences between current smokers and former smokers with COPD, but many of these biomarkers were similarly lower among current smokers compared to non-smokers. For example, mean±SD concentration of IL-13 (in pg/mL) was 26.8±17.8 in former smokers with COPD, 32.1±21.3 in smokers, and 70.7±36.9 in non-smokers (global p<0.0001).

**Conclusions:** Certain biomarkers of inflammation and immune status were lower in the nasal epithelial lining fluid of former smokers with COPD compared to non-smokers, but not compared to current smokers. Several biomarkers that differed between the COPD group and non-smokers also differed between current smokers and non-smokers. These findings suggest that alterations in upper respiratory immune defenses in the setting of ongoing smoking may be similar to the sequelae of smoking-related airway disease even after smoking cessation.
Association between anthropometry and lifestyle factors and future risk of B cell lymphoma; an exposome wide analyses

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Background/Aim
The etiology of B-cell lymphomas (BCL) remains mostly unknown, and only a few risk factors have been clearly established which explain a small proportion of the cases in general population. Moreover, epidemiological studies have suggested differences in risks among BCL subtypes for a wide range of risk factors. To better understand the role of different exposures in human disease, it would be preferable to study a representation of the exposome in a single study. We aimed to create a model Exposome-Wide Association Study, to search for anthropometry, socioeconomic status, and lifestyle factors associated with lymphoma on a broad scale.

Methods
476,160 subjects (aged 30-70 years) including 2257 BCL cases (newly diagnosed after cohort inception) participated in the European Prospective Investigation into Nutrition and Cancer cohort with data on lifestyle, demography, and anthropometry were included in current study. Cox regression model adjusted for age, sex, and country and multivariable penalized cox regression model were used to identify associated exposures. Moreover, we used principal component analysis coupled with a Cox-regression to look at clusters of exposures in relation to lymphoma risk.

Results
Several anthropometry measures were associated with the development of BCL, DLBCL, MM, and CLL. We found significant associations between consumption of dairy products and calcium and BCL and DLBCL, between fat and lower risk of CLL, between sugar and confectionary and FL, and between Mediterranean diet score, fish/shellfish, and Vit D and lower risk of DLBCL. Current smoking>25/day was related to CLL, DLBCL. Moreover, manual work activity and high physical activity were associated with incidence of BCL and DLBCL.

Conclusions
Using a novel EWAS approach, several exposures were found to be associated with BCL and its subtypes. Some of these were previously unknown, providing new insight in the development of BCL and highlighting the value of exposome-wide association studies.
A dietary intervention with nuts or olestra to enhance the excretion of persistent organic pollutants in healthy adults: The NO-POPs Trial.

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Introduction: Persistent organic pollutants (POPs), including organochlorine pesticides (OCP), PCBs and PBDEs, are mostly fat-soluble chemicals with long half-lives and associated with adverse health outcomes. Because POPs accumulate in humans with age, there is need to identify ways to enhance their excretion from human tissues. We hypothesized that consumption of nuts that have incomplete intestinal absorption or the fat-substitute olestra can enhance the excretion of POPs in 50-70-year-old adults within a randomized controlled trial.

Methods: We randomized 47 men and women to 3 treatment arms: A) whole or diced almonds and walnuts (110g/day), B) olestra from fat free potato chips (18g of olestra/day), or C) vegetable oil from standard potato chips (17.4g of oil/day, control group). We assessed change from baseline of the concentrations of 9 POPs that were detectable in >75% of participants in plasma after 6 months of treatment. Models adjusted for age, gender, cholesterol and triglyceride concentrations at baseline and follow-up.

Results: All treatment groups resulted in lower values for all 3 classes of POPs after the 6-month trial. The relative differences of POPs 6-month changes of participants receiving nuts or olestra (vs controls) were: \( \sum \text{PBDEs:} \) -56.7% (-95.0%, -18.5%) and -29.9% (-66.4%, 6.6%), respectively; \( \sum \text{PCBs:} \) -7.5% (-23.6%, 8.6%) and 2.9% (-12.4%, 18.2%), respectively; \( \sum \text{OCPs:} \) 27.4% (-17.6%, 72.4%) and -29.6% (-72.6%, 13.3%).

Discussion: Supplementation with nuts or olestra were associated with substantial decreases in POPs levels. Olestra resulted in substantial reductions in PBDE and OCP concentrations whereas nut treatment resulted in reductions in PBDE and PCB concentrations but was not as effective in reducing OCP concentrations as the control group. This trial shows promising results of 2 dietary interventions to enhance the excretion of some POPs.
Dietary Inflammatory Index of mothers during pregnancy and ADHD symptoms in the child at preschool age: A prospective investigation in the INMA and RHEA cohorts

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Inflammation is one potential pathway underlying the association of maternal diet during pregnancy with ADHD symptoms in the child. However, no previous study has quantified the proinflammatory potential of maternal diet. Thus, we evaluated the association between the dietary inflammatory index (DII) of the mothers during pregnancy and ADHD symptoms in their children at the age of 4 years in two Mediterranean regions (Spain and Greece).

Methods: The study population consisted the population-based birth cohort studies- INMA (Environment and Childhood) in Spain and RHEA study in Crete (Greece). A total 2097 children and their mothers participated. The DII of maternal diet was calculated using a previously validated method based on dietary data collected during pregnancy (12th and/or 32nd week of gestation) through validated food frequency questionnaires. ADHD symptoms were assessed by ADHD-DSM-IV in INMA cohort and by ADHDT test in RHEA cohort, with questionnaires filled-out by teachers. The association between maternal DII and ADHD was analysed using multivariable-adjusted zero-inflated negative binomial regression models.

Results: The DII score was higher (i.e., pro-inflammatory), on average, in the RHEA cohort (DII = 2.37 vs. the INMA cohort DII = -1.34). In models adjusted for children’s age, region, gestational diabetes, parity and maternal covariates, we observed no association between maternal DII score and inattention symptoms in their children. We observed an inverse association of maternal DII with hyperactivity (IRR [CI 95%] = 0.80 [0.67-0.94]), as well as with total ADHD (IRR [CI 95%] = 0.84 [0.74-0.9]) but these associations were seen only in boys in Spanish cohort. Conclusions: Findings from this study do not suggest an association between a more proinflammatory maternal diet during pregnant and ADHD symptomatology. In fact, we found a region- and sex-specific inverse association in boys of the Spanish cohort that requires replication.
The associations of geomagnetic storms, fast solar wind, and stream interaction regions with cardiovascular characteristic in patients with acute coronary syndrome

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TPS 771: Diet and lifestyle, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Solar activity and other space weather events affect the Earth’s atmosphere by causing geomagnetic activity and change in weather pattern. A lot of publications have confirmed that geomagnetic activity affects humans’ health. The main goal of this research is to evaluate geomagnetic storms (GS), high-speed solar wind (HSSW), solar proton event (SPE) (daily mean of proton flow >10 MeV flux was over 10), and stream interaction regions (SIR) influence for patient characteristics during hospital admission for acute coronary syndromes (ACS) (myocardial infarct (MI) or unstable angina).

Methods: The study was conducted during the 2000-2005-year period and data of 4076 randomly selected patients, who were hospitalized at the Hospital of Lithuanian University of Health Sciences, were used. Data analysis was performed using multivariate logistic regression.

Results: It was found, that the risk of ACS in men was higher on days of HSSW (OR=1.32, 95% CI 1.09-1.61) and a lower on days of GS and 1-3 days after GS (OR=0.77, 95% CI 0.66-0.90). The risk of ACS in older than 70 years patient was increased on days of SPE and 1-3 days after the event, which coincided with 1-3 days before the event (OR=1.33, 95% CI 1.02-1.74) and decreased on 1-3 days after SIR event (OR=0.84, 95% CI 0.72-0.97).

The risk of MI in diagnosis was on days of GS and 1-3 days after that coincident with SPE (OR=1.56, 95% CI 1.16-2.10). On days of GS with a lag of 0-3 days without SPE was the risk of unstable angina (OR=1.28, 95% CI 1.09-1.51).

Conclusions: Our results showed that different space weather events may have a different effect on men and woman, also the types to ACS may be depending on heliogeophysical conditions during admission.
Association between Marijuana Use and Serum Gamma-Glutamyltransferase in US Adults

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Background/Aim: Several epidemiological studies have reported positive associations between marijuana use and adverse cardiovascular effects, yet there is insufficient evidence to draw definitive conclusions. Few studies have been performed to examine the possible biological mechanisms responsible for this observation. In this study, we examined whether current marijuana use is associated with elevated serum levels of gamma glutamyl transferase (GGT), a biomarker of oxidative stress that is linked to cardiovascular disease risk.

Methods: We combined questionnaire data with laboratory measurements (GGT and cotinine) in serum samples available for adults aged ≥ 18 years participating in the US National Health and Nutrition Examination Survey during 2005 to 2014. We categorized the participants into 496 exclusive current cigarette smokers (self-reported cigarette smoking within the five days prior to examination, but neither used marijuana nor any other tobacco products), 105 recent exclusive marijuana users (self-reported use of marijuana within the five days prior to examination but never used any tobacco products) and 2524 nonusers (neither used any tobacco nor marijuana products in life). We performed comparative analyses of the adjusted geometric means (aGMs) of GGT among those groups using multiple regression models, adjusted for age, gender, race/ethnicity, body mass index, education, poverty-income ratio, fasting length, serum cotinine and average alcohol drinks/day.

Results: Recent exclusive marijuana users had a small but significantly higher aGM of GGT (23.4 u/L, 95% confidence interval, CI: 20.3, 27.0 u/L) compared to nonusers (20.0 u/L, CI: 19.0, 21.1 u/L) (p=0.046). Cigarette smokers had the highest aGM of GGT (30.2 u/L, CI: 24.3, 37.6 u/L) among these groups.

Conclusions: The findings suggest a plausible biological pathway for effects of exclusive marijuana use on cardiovascular disease risk. Future studies are needed to confirm these findings and to better examine the health effects of marijuana in the environment of liberalized use.
Exploring risk factors for prostate cancer: A cross-sectional study

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Background/Aim

Although the age-adjusted mortality rate for prostate cancer in Japan is declining after peaking in 2005, the age-adjusted incidence per 100,000 people was 39.9 in 2014, and prostate cancer is expected to become the second highest leading cause of death in Japan after lung cancer in 2020. While many risk factors have been reported for prostate cancer, including gene polymorphisms and Western-style diets, few risk factors have been confirmed by sufficient evidence. We conducted a cross-sectional study to identify and explore the risk factors associated with prostate cancer.

Methods

Data from 1066 cases and 992 controls were examined. Lifestyle, family history and food frequency data were obtained using a questionnaire, and nutritional intake was estimated by food frequency. Additionally, gene polymorphisms was investigated on in 307 cases and 296 controls. To explore the risk factors, a decision tree or random forest algorithm was applied to trained data including 307 cases and 296 controls, and the same models were applied to test data (total 2058 subjects including trained data).

Results

After trying several patterns, we found that intake of 2-amino-3,8-dimethylimidazo[4,5-f]quinoxaline, total energy, alcohol and vegetables was highly associated with the onset of prostate cancer. Sensitivity, specificity and positive predictive values for decision tree-applied data were 0.84, 0.57, and 0.68, respectively. The respective values for random forest-applied data were 0.84, 0.67, and 0.76, although there were a large number of missing values.

Conclusions

Our study using a machine learning model that does not assume a linear combination suggests that intake of heterocyclic amines is a risk factor for prostate cancer. However, because this was a cross-sectional study, further evidence is needed to determine causality. Further, we did not consider data such as gene polymorphism and intake of individual food groups, and such analysis should be performed in the future.
Background/Aim
Early life diet is a major determinant of lifelong health trajectories. However, studies of the long term health outcomes of breastfeeding are difficult to study due to cost and time restraints in collecting data prospectively and the inherent limitations of questionnaires. A biomarker that can retrospectively measure the dose and duration of breastmilk and formula feeding would be a major advancement in the study of health trajectories associated with infant diet, particularly for health outcomes measured much later in life, years after the cessation of breastfeeding. We show that chemical signals in baby teeth can reconstruct breastfeeding histories.

Methods
We measure chemical signatures in aged dentine layers to generate weekly estimates of biomarkers of infant diet. Using reversed distributed lag models (DLM) we identified chemical signatures in teeth associated with breastmilk or formula intake and developed an index of breastmilk intake using a lagged weighted quantile sum (WQS) regression approach. Biomarkers of milk intake were developed in a non-human primate model and refined in a human cohort. We tested the index against prospectively collected breastfeeding histories in a human cohort based in Mexico (n=225) and a replication cohort from the US (n=100).

Results
Preliminary studies identified barium as a sensitive marker of infant diet transition from breastmilk to infant formula, identifying the timing of infant formula introduction in 70% of teeth. Reversed DLMs indicated strontium as a sensitive marker to infant formula intake and lithium as a marker for breastfeeding after 6 months. Using WQS, lithium and strontium were found to be the strongest contributors within a mixture to differentiate breastfed and formula fed infants.

Conclusions
Breastmilk intake during childhood can be reconstructed using chemical signatures in teeth. This method can be applied to more accurately investigate associations of breastfeeding dose and duration with long term health outcomes.
Personal exposure to PM2.5 and its inflammatory effect on local residents in urban and rural Beijing, China: results of the AIRLESS project

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Introduction
Owing to diverse air pollution sources, socio-economic and personal activity patterns, residents in urban and rural areas may be exposed to varying concentrations of fine particulate matter (PM2.5), resulting in distinct health responses. Here, we compare personal exposure of PM2.5 from urban and rural setting using data from AIRLESS project and investigate the associations between PM2.5 and respiratory and systemic inflammatory biomarkers.

Methods
In total, 123 urban and 128 rural non-smoking subjects aged 40-70 years were recruited from two well-established cohorts in Beijing to allow a panel-study design. During Nov-Dec 2016 and May-Jun 2017, each subject was instructed to carry a validated personal air monitor (PAM) to measure PM2.5 concentration at high spatiotemporal resolution for consecutive seven days in each campaign. During the participated week, each subject completed two clinical measurements of exhaled NO (FeNO) and blood monocytes counts on Day3 and Day7. The associations between personal exposure to PM2.5 and health outcomes were examined with linear mixed-effect models with adjustment for demographic, socio-economic, lifestyle and meteorological variables.

Results
The weekly mean concentrations (standard deviation [SD]) of personal exposure to PM2.5 during the winter and summer campaign were 64.1(35.4) and 34.3(12.3) μg/m3 in rural subjects, higher than those of 33.8(18.9) and 28.7(9.9) μg/m3 experienced by the urban subjects. An IQR increase in previous 1-day personal exposure to PM2.5 (26.1 μg/m3) was significantly associated with elevated FeNO [7.8%(95% confidence interval (CI): 5.0-10.8%)] and monocyte counts [0.6%(CI: 0.3-0.9%)] (p<0.05). The PM2.5-associated changes in FeNO and monocyte counts were 6.0% and 0.2% in rural subjects, lower than those of 9.3% and 0.7% in urban subjects, respectively.

Conclusions
Compared with urban residents, rural residents in Beijing have a higher personal exposure to PM2.5 in both winter and summer, but lower PM2.5-associated respiratory and systemic inflammatory responses.
Correlation and temporal variability of urinary biomarkers of chemicals among couples: Implications for reproductive epidemiological studies
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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Exposure to some environmental chemicals is ubiquitous and linked to several adverse outcomes, including children's health. Only a few studies have assessed the contribution of both male and female exposures to children's health. Therefore, understanding the patterns of couple's exposure is warranted to understand their joint effects. We aimed to assess the correlation patterns between the concentrations of 37 environmental chemical biomarkers between male and female partners. We also assessed the temporal reliability of the biomarkers within the couples.

Methods: We calculated the Spearman pairwise correlations between the concentrations of the urinary biomarkers (specific gravity adjusted) and hair mercury among 380 couples enrolled in the Environment and Reproductive Health (EARTH) study at the Massachusetts General Hospital Fertility Center (2004-2017). We also calculated the intra-class correlation coefficients (ICCs) for couple's biomarkers to assess the temporal variability of these biomarkers within a couple using multiple paired-samples from couples.

Results: All measured biomarkers were positively correlated within couples (range: 0.05 for tert-butylphenyl phenyl phosphate to 0.66 for triclosan). In general, biomarkers with the highest correlations within couple were for chemicals that diet (e.g., di(2-ethylhexyl) phthalate (DEHP)), personal care products use (e.g., triclosan and benzophenone-3), and the indoor environment (e.g., 2,5-dichlorophenol) are considered primary exposure sources. Most other biomarkers were moderately correlated (0.3 to <0.6). Similar patterns of temporal reliability (ICCs) were observed across biomarkers.

Conclusions: Urinary concentrations of several biomarkers as well as hair mercury were mostly moderately correlated within couples, suggesting similar exposure sources. Future epidemiological studies need to consider collecting samples from both partners to be able to accurately determine the contributions of maternal and/ or paternal exposures to health outcomes of the offspring.
Maternal cigarette smoking affects DNA methylation in imprinting control regions and enhancer regions in placenta

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Background/aim
Exposure to cigarette smoking during pregnancy has been robustly associated with cord blood DNA methylation. However, little is known about such effects on the placenta; in particular, whether cigarette smoking before pregnancy could also induce epigenetic alterations in the placenta of former smokers is unknown.

Methods
Placental DNA methylation levels were measured in 568 women and compared among non-smokers and women either smoking during their pregnancy or who had ceased smoking before pregnancy.

Results
Among the 344 genomic regions identified as differentially methylated as a result of maternal exposure to cigarette smoking, 44 presented a transmissible “epigenetic memory” of past exposure to cigarette-smoking. Additionally, an analysis of the encode placental histone marks associated with most of the 344 differentially methylated loci presented characteristics of gene enhancer regions.

Conclusions
Finally, a number of imprinting control regions was also among the 344 differentially methylated regions, suggesting mechanisms by which tobacco could directly impact fetal development.
The alternation of LINE-1 DNA methylation may mediate the effects of air particulate matters on the risk of preterm birth in Guangzhou, China

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Aim: We aimed to prospectively estimate the effects of maternal exposure to PMs (particulate matters) with different sizes (PM10, PM2.5 and PM1) on risk of preterm birth (PTB), identify the susceptible exposure windows, and illustrate the roles of LINE-1 DNA methylation in the associations of PMs with PTB.

Methods: We have conducted a Birth Cohort Study on Prenatal Environment and Offspring Health (PEOH Cohort) since 2016 in Guangzhou, China. Weekly average concentrations of PM10 and PM2.5 were predicted using a spatio-temporal land use regression (LUR) model. Weekly PM1 concentrations were estimated using a generalized additive model (GAM). Maternal and cord blood LINE-1 methylation was assessed by bisulfite-PCR pyrosequencing. A distributed lag non-linear model (DLNM) incorporating a Cox proportional hazard model was applied to assess the exposure-lag-response between PMs and PTB.

Results: The risk of PTB was positively associated with PM2.5 and PM1 during the 12th to 18th gestational weeks. The strongest association were observed during the 16th gestational week (HRPM2.5=1.058, 95%CI: 1.008-1.110; HRPM1=1.070, 95%CI: 1.013-1.130). Each 10µg/m3 increment in PM10, PM2.5 and PM1 concentrations was associated with an average of 0.51%5mC, 0.66%5mC and 0.67%5mC respectively decrease in the cord blood LINE-1 methylation level, and each 10µg/m3 increment in PM1 was associated with 0.86%5mC (P=0.034) decrease in maternal LINE-1 methylation. The risk of preterm birth was negatively associated with maternal LINE-1 methylation (OR=0.93, 95%CI: 0.83-1.06), but positively correlated with cord blood LINE-1 methylation (OR=0.94, 95%CI: 0.94-1.15).

Conclusions: Higher maternal exposures to PMs were associated with increased risk of PTB, and PMs with smaller sizes had more pronounced effects. The period from the 12th to 20th gestational weeks might be the susceptible exposure window of PMs. Maternal and fetal LINE-1 methylation might be an underlying mechanism of PMs inducing PTB.
Comparison of smoking related DNA methylation in newborns from maternal smoking exposure in pregnancy, and in adults from personal smoking
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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Background: Cigarette smoke has genome-wide impacts on blood DNA methylation in newborns exposed to maternal smoking during pregnancy and in adults from their own smoking. However, it is not known whether there is a unique methylation signature for in utero exposure in newborns compared with personal smoking in adults.

Methods: We meta-analyzed blood DNA methylation, assessed with the Illumina450K array, in relation to sustained maternal smoking during pregnancy from 5,648 newborns (897 exposed) from the PACE (Pregnancy And Childhood Epigenetics) consortium. For adult blood DNA methylation and personal smoking, we meta-analyzed Illumina450K data from 15,907 participants (2,433 current smokers) in the CHARGE (Cohorts for Heart and Aging Research in Genomic Epidemiology) consortium. Cytosine-phosphate-Guanine (CpG) sites significantly (False Discovery Rate<5%) differentially methylated in relation to the relevant smoking exposure were compared to identify potentially unique methylation in newborns related to maternal smoking during pregnancy not seen for personal smoking in adults.

Results: There were 5,547 significantly differentially methylated CpG sites in relation to maternal smoking during pregnancy among the newborns. In adults, 34,541 CpG sites were significantly differentially methylated in relation to current smoking, reflecting the larger sample size and higher exposure proportion and thus higher power in the CHARGE data. We found 3,838 CpG sites that were significantly differentially methylated among the newborns only and 1,709 CpG sites overlapped between newborn and adult analyses. There were 743 genes with at least one significantly differentially methylated CpG site among the newborns but none among the adults. The unique smoking associated genes in newborns were enriched in pathways and processes related to metabolism of xenobiotics.

Conclusion: In addition to many shared signatures, we identified numerous signals specific to newborns. Our findings may provide new insights about the specific impacts on offspring of maternal smoking during pregnancy.
Association between prenatal exposure to air pollution and inflammatory markers in children

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: Early-life exposure to ambient air pollution has been associated with adverse health effects in children but little is known about its potential effects on cytokine levels. We evaluated the association of pregnancy exposure to particulate matter with child inflammatory biomarkers in 500 mother-child pairs from the RHEA pregnancy cohort in Crete, Greece.

Methods: Mean concentrations of particulate matter with an aerodynamic diameter of less than 2.5 µm (PM2.5) and less than 10 µm (PM10) during pregnancy were estimated at maternal home addresses with temporally adjusted land-use regression models. Levels of several inflammatory biomarkers were determined in child serum at 4 years of age via immunoassay. Exposure-outcome associations were assessed using log-binomial or Poisson regression with robust variances, in cases of non-convergence. Potential effect modification from maternal and offspring characteristics was examined by introducing interaction terms in multivariate models.

Results: A 5 µg/m³ increase in concentration of PM2.5 and PM10 during pregnancy was associated with an increased risk of high levels (in the 5th quantile) of child interleukin-6 (IL-6) levels at 4 years (RR=2.68, 95%CI: 1.38, 5.20 and 1.28, 95%CI: 1.04, 1.57, respectively). Effects of prenatal exposure to both PM2.5 and PM10 remained significant only for non-smoking mothers in stratified analysis by maternal smoking status (p-interaction: 0.037 and 0.071, respectively). Child overweight/obesity (p-interaction: 0.013 and 0.001) and asthma status (p-interaction: 0.007 and 0.001) more than doubled the effects of maternal exposure to PM2.5 and PM10 on IL-6 at 4 years. Similar effects were found with other inflammatory biomarkers under study.

Conclusions: Our results indicate alterations in systemic inflammatory markers in 4-y-old children in relation to prenatal exposure to traffic-related air pollution. Further work is needed to examine the underlying mechanisms and interactions between cytokines in the inflammatory response following air pollution exposure.
Associations of Annual Ambient PM2.5 Components with DNA methylation age (PhenoAge) in Elderly Men: the Normative Aging Study

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Aim: We aimed to identify which particulate matter with aerodynamic diameter less than or equal to 2.5 µm (PM2.5) species were associated with DNA methylation age in a one-year exposure. Methods: We collected whole blood samples from 683 elderly men in the Normative Aging Study. DNA methylation age was calculated using 513 cytosine-phosphate-guanine (CpGs) retrieved from the Illumina Infinium HumanMethylation450 BeadChip. Ambient particulate species were measured daily at a fixed monitoring station. Linear mixed-effect (LME) regression and Bayesian kernel machine regression were used to estimate the associations. Results: Only lead, iron, and calcium were significantly associated with DNA methylation age in LME. Bayesian kernel machine regression showed that only lead had significant effect. Conclusions: Our results demonstrate that lead contained in PM2.5 was robustly associated with DNA methylation age.
Exposure to ambient air pollution and blood levels of gamma-glutamyl transferase (GGT) in a large Austrian cohort

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: The liver enzyme gamma-glutamyl-transferase (GGT) is involved in detoxification, reflects oxidative stress and is linked to several health outcomes and mortality. A German study showed an association of particulate matter <2.5µm (PM2.5) with GGT. We evaluated the association between long-term exposure to air pollution with GGT in the largest cohort of the European study of cohorts on air pollution effects (ESCAPE), the Austrian VHM&PP-cohort.

Methods: Baseline addresses of individuals were geocoded and annual average concentrations of air pollution assessed by land-use regression models for particulate matter below 10 µm (PM10), between 2.5 and 10 µm (PMcoarse), PM2.5, PM2.5absorbance, nitrogen oxides (NOx) and nitrogen dioxide (NO2). Linear regression models for log-transformed GGT, adjusted for potential confounders, were calculated.

Results: In the study population of 116,109 participants, GGT had a median of 12 mg/dl (1st and 3rd quartile: 9;20). PM2.5, PM10, PM2.5absorbance and NOx had means and standard deviation of 13.6 (1.2) µg/m3, 20.7 (2.4) µg/m3, 1.66 (0.22) 1*10^-5/m and 40.0 (9.5) µg/m3, respectively.

All pollutants, except for PMcoarse showed a statistically significant positive association with change in GGT (%) e.g. 3.90 (95% confidence interval (CI) 2.35;5.48) per 5 µg/m3, 3.09 (95%-CI:1.36;4.84) per 1*10^-5/m and 1.57 (95%-CI:0.83;2.32) per 20 µg/m3 for PM2.5, PM2.5 abs and NOx, respectively. In two-pollutant-models, effect estimates for PM2.5 and NOx were robust to adjustment with a any of the other pollutants. For PM2.5 and PM2.5absorbance there was an indication for effect modification by sex with women showing a change in GGT of 5.50 (95%-CI:3.45;7.46) for PM2.5 vs 1.80 (95%-CI:-0.37;3.97) in men.

Conclusions: This large study shows an association of several air pollutants on GGT, suggesting that long-term air pollution could lead to elevated levels of GGT which has been shown to be linked to adverse health outcomes. Women may be more susceptible for these effects.
Exposure to ambient particulate matter elements and blood levels of gamma-glutamyl transferase (GGT) in a large Austrian cohort.

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Background/Aim: The liver enzyme gamma-glutamyl-transferase (GGT) is involved in detoxification, reflects oxidative stress and is linked to several health outcomes and mortality. Furthermore, an association of particulate matter (PM) with GGT has been found but it is unclear which components of PM are most relevant. We evaluated the association between long-term exposure to PM-components with GGT in the largest cohort of the European study of cohorts on air pollution effects (ESCAPE), the Austrian VHM&PP-cohort.

Methods: Baseline addresses of individuals were geocoded and exposure assessed by land-use regression models for copper (Cu), iron (Fe) and zinc (Zn) representing non-tailpipe traffic emissions; sulphur (S) indicating long-range transport; nickel (Ni) and vanadium (V) for mixed oil-burning and industry; silica (Si) for crustal material and potassium (K) for biomass burning. Linear regression models for log-transformed GGT, adjusted for potential confounders, were calculated. Two pollutant models were calculated where the pearson correlation coefficient (rho) was <0.7.

Results: In the study population of 116,109 participants, total PM below 2.5 μm (PM2.5) was strongest correlated with PM2.5_K (rho=0.87) and total PM below 10 μm (PM10) with PM10_S (rho=0.83). Statistically significant positive associations for components in PM2.5 and PM10 were observed for Cu, K, S and Zn with a change in GGT (%) of 3.36 (95%-confidence-interval (CI):1.52;5.25) per 5ng/m3, 0.71 (95%-CI:0.14;1.28) per 50ng/m3, 6.27 (95%-CI:3.77;8.82) per 200ng/m3 and 1.27 (95%-CI:0.21;2.35) per 10ng/m3, respectively, in the PM2.5 fraction. Si showed a statistically significant negative association of -4.89 (95%-CI:-9.39;-0.17) per 100ng/m3 in PM2.5 but not PM10.

In two-pollutant models, S was the element reducing most the change in GGT for total PM2.5, and K for total PM10. S was robust to adjustment for the metals, which may occur in sulphate complexes.

Conclusion: Change in GGT was associated with indicators of non-tail pipe traffic emissions, long-range transport and biomass burning.
Increased Risk of Trisomy 18 Observed after a Fertilizer Warehouse Fire in Brazos County, TX
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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Trisomy 18 (T18) is the second most common autosomal chromosomal disorder due to the presence of extra chromosome 18 after trisomy 21 (T21). However, the causes of T18 remain unknown. In 2009, a fire accident occurred in a fertilizer warehouse in Brazos County, Texas. It caused extensive flames and smokes, which resulted in evacuating the south of town. The potential impacts of this accident-related pollution on birth outcomes (or congenital malformations) has rarely been studied. In this study, we assessed the effects of exposure to pollution from this fire accident on Trisomy 21 (T21) and Trisomy (T18), two of the most common chromosome abnormalities, using Texas birth defect data and live birth data. The changes in prevalence of T18 and T21 before (2005-2008), during the impacted years (2009-2010, i.e. current year and one year after the accident) and after the accident (2011-2014) were analyzed, respectively. Standardized Morbidity Ratio (SMR) was applied to examine the elevated risk of chromosomal anomalies as compared to the statewide risk after adjusting for maternal race and age. The prevalence of T18 was significantly higher during the impacted years (2.5%-5.7%) than those in the years before and after the accident (0%-1.3%). Comparing to the statewide risk, the risk of T18 during the impacted years in Brazos county was significantly higher (SMR=5.0, 95% CI: 2.19-9.89) while there was no significant difference before (SMR=0.77, 0.13-2.54) and after the accident (SMR=0.71, 0.12-2.36). However, the prevalence of T21 during the impacted years was not significantly different from those before or after the accident. No elevated risk of T21 during the impacted years was observed as compared to the statewide level. This study suggested that this fertilizer fire may be related to the increased risk of T18 in Brazos County, TX. The findings warrant further investigation.
Multi-omic profiling of Metabolome and Epigenome Signature Related with OP Exposure
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Background: Organophosphates (OP) are widely used insecticides that have been associated with a wide range of adverse health outcomes. There is great interest in improving the understanding of molecular mechanisms related to chronic OP exposure induced toxicity. We aim to integrate metabolomics and epigenomics to investigate the pathophysiologic response related with OP exposure on system biology level.

Methods: In a population-based case control study of Parkinson's disease (PD), we assessed ambient OP exposure via residential and workplace proximity to commercial applications. We investigated associations between OP exposure and serum metabolome (LC/MS) as well as genome-wide DNA methylation (Illumina 450 k) in 99 blood samples (79 PD patients, 20 controls). Weighted gene coexpression network analysis (WGCNA) was used to identify modules of correlated CpG sites and metabolites. A partial correlation network was constructed from the modules and the relations between the module network and the OP exposure were investigated.

Results: Epigenomic modules associated with OP exposure were enriched in pathways related with acetylcholine and other neurotransmitters’ activity. The associations between OP exposure and oxidative stress and inflammation were observed in both metabolomic and epigenomic profiles. The epigenomic and metabolomic modules were interrelated and showed cross-sectional associations with OP exposure.

Conclusion: Long-term OP exposure associates with both metabolome and epigenome. By integrating metabolomics and epigenomics, we illustrated that OP exposure could disrupt neurotransmission, and induce oxidative stress and inflammation, which could then increase the risk of adverse health outcomes.
Short-term ambient ozone exposure and inflammatory biomarkers in adolescents: Results of the GINIplus and LISA birth cohorts
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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Background: Ambient air pollution is considered to be associated with many diseases via inflammatory response, though this mechanism is still not fully illustrated.

Aim: We analyzed associations between short-term exposure to ozone, an oxidative pollutant, and inflammatory biomarkers among healthy adolescents.

Methods: These cross-sectional analyses were based on 1243 10-year-old and 1557 15-year-old participants from Munich and Wesel areas of the GINIplus and LISA German birth cohorts. Maximum 8-hour averages of ozone and daily average concentrations of nitrogen dioxide (NO2) and particulate matter with an aerodynamic diameter < 10 µm (PM10) were adopted from two background monitoring stations 0 (same day), 1, 2, 3, 5, 7, 10 and 14 days prior to blood sampling. Fractional exhaled nitric oxide (FeNO) and highsensitivity - C reactive protein (hs-CRP) were available for two age groups while interleukin-6 (IL-6) was measured at 10 years only. To assess associations between ozone exposure and biomarkers, generalized additive models were utilized for FeNO, and logistic regressions were adopted for hs-CRP and IL-6, adjusted for potential confounders as well as co-pollutants NO2 and PM10.

Results: We found that ozone exposure was robustly positively associated with FeNO in adolescents at the age of 15 years, with the most significant association 4.08%, 95% confidence interval 2.02 – 5.13, but not at age 10. Ozone was neither associated with hs-CRP levels at age 10 nor age 15 years if region-specific effects were combined. No consistent associations were observed between ozone exposure and IL-6 in children aged 10 years.

Conclusions: Our study demonstrates significant associations between ozone exposure and FeNO at 15 years of age. This finding indicates that acute ozone exposure may cause inflammatory responses in adolescents, which is especially visible for lung inflammation. Further research with more inflammatory markers is warranted.
Effects of different PM2.5 pollution processes on inflammatory stress in Shanghai area

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TPS 911: Air pollution, epigenetics, biomarkers, August 26, 2019, 3:00 PM - 4:30 PM

Objective To explore the different anti-oxidant and inflammation effects of short-time high-dose and long-time low-dose fine particular matter (PM2.5) on rats. Methods: Forty-eight healthy male C57BL/6 rats were randomly divided into six groups, eight in each. Low-dose group, moderate-dose group and high-dose group were exposed to PM2.5 at 100μg/m3, 150μg/m3 and 250μg/m3 on average, respectively, using the artificial climate environment expose cabinet. Meanwhile, three blank groups were also set. After exposure, C-reactive protein (CRP), constitutive nitric oxide synthase (cNOS), homocysteine (HCY), interleukin-8 were analyzed. Results: The levels of CRP, HCY and IL-8 in long-term low-dose group were significant higher than those in the short-term high-dose group (P<0.05, P<0.01). The inhibition level of cNOS in the low-dose group were also significant higher than that in the short-term high-dose group (P<0.05, P<0.01). Conclusion: The ranking of PM2.5 exposure to health damage effect was low-dose 72h, moderate-dose 24h and high-dose 28.8h, when the PM2.5 exposure dose were same.
Background/Aim: Epidemiological studies use long-period air temperature series to quantify health risks related to heat. Typically, temperature is measured from meteorological stations, which have limitations in characterising its spatial patterns, due to landscape heterogeneity and sparseness of monitors. Analyses of satellites-remote sensing observations using machine learning methods (ML-methods) can overcome such limitations, but while several different models have been explored, little evidence exists about their individual and relative performance under the same study area. This study aims to compare alternative ML-methods to produce spatio-temporal predictions of maximum temperature (Tmax).

Methods: Five ML-methods (Decision Tree (DT), Random Forest (RF), Gradient Boosting (GB), Support Vector Machine (SVM), and Neural Network (NN)) were investigated to predict London’s Tmax, using a data set from 12 summers (2006–2017) based on meteorological variables and temporal, spatial, and spatio-temporal predictors. The predictors’ rank-order was performed by Stepwise Linear (SL) regression, and the best group of predictors was split into 70:30 training/testing samples to validate each ML-method.

Results: The optimal set of predictors was identified as land surface temperature, Julian day, elevation, normalised difference vegetation index, solar-zenith angle, distance from the coast, and longitude. The comparison across ML-methods indicated that the GB model performed the best, with R2=0.65 and root-mean-square error (RMSE) of 2.43°C. The RF, SVM, and NN had comparatively good performances, with R2 and RMSE ranging in 0.61–0.59 and 2.56°C–2.64°C, respectively. All these models improved the prediction obtained by the standard SL method. The DT model showed instead much lower predictive ability, with R2=0.30 and RMSE=3.44°C.

Conclusion: This comparative analysis demonstrated the predictive power of ML-methods over SL-method. The GB model showed the best predictive ability, followed by RF, SVM, and NN, while the performance of the DT method is sub-optimal. Further research will assess the properties of alternative ML-methods in more general settings.
A Machine Learning Approach to Model Community-Level Ultrafine Particle Emissions from Arriving Aircraft

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OPS 03: Machine learning in environmental epidemiology, Room 315, Floor 3, August 26, 2019, 16:30 - 17:30

Background: Ultrafine particles (UFP; <100 nm diameter) are highly variable in space and time leading to challenges in accurate exposure assessment. Recent studies have shown that airports are contributors to local air pollution, but research is needed to understand the impact from commercial aircraft during landing and take-off and how far from flight paths these impacts are observed. Our aim was to use a machine-learning approach to characterize UFP from aircraft exhaust during landings at Boston Logan International Airport (MA, USA).

Methods: Particle number concentration (PNC; a proxy for UFP) was measured continuously on selected weeks at six sites along an arrival path between April and September 2017 at 1-sec resolution. For this same monitoring period, flight activity data were acquired from the U.S. Federal Aviation Administration, which included three-dimensional positions of aircraft at ~5-sec resolution, and meteorology was acquired from the U.S. National Weather Service station at Logan Airport at a 1-min resolution. We used random forest regression to identify key covariates and optimize prediction of PNC. Each tree was grown by a bootstrap sample with random subsets of predictors selected at each split. Final models were based on the average results of all trees.

Results: Preliminary models explained >55% of 1-hr PNC variance. Models explained more of the hourly 95th and 99th percentile PNC variance than models of the 50th percentile with no change in variables included. While meteorological variables were still ranked most important, the explanatory power was reduced when modeling the 95th and 99th percentiles. Flight frequency had the largest percent gain in model importance when comparing the 95th and 99th percentile models to the 50th percentile.

Conclusions: Our results suggest that landing aircraft can help explain peak ambient UFP exposures. Machine learning can be a tool to understand how these aircraft contribute to community-level PNC.
Multi-media biomarkers: Improving the accuracy of metal exposure assessments

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OPS 03: Machine learning in environmental epidemiology, Room 315, Floor 3, August 26, 2019, 16:30 - 17:30

Background/Aim: Exposure assessment traditionally relies on measured chemical concentrations in a single biological medium. Toxicokinetic properties cause chemicals to distribute unevenly among different media, thus each medium provides incomplete information about body burden. We propose that machine learning and statistical approaches developed for mixtures can create aggregated exposure estimates, which we term multi-media biomarkers (MMBs), for a given chemical that outperform exposure estimates from individual media.

Methods: We measured lead (Pb) in blood, hair, nails, and urine to derive aggregated MMBs and then tested their association with Wechsler Intelligence Scale for Children (WISC) total IQ scores in the Public Health Impact of Metals Exposure (PHIME) project, a study of Italian adolescents aged 10-14 years (N~720). We used a supervised learning technique, weighted quantile sum regression (WQS), and an unsupervised learning technique, independent component analysis (ICA) to create the Pb MMB. Since the MMB produced using ICA is not normally distributed, we measured adjusted associations between Pb and IQ using Spearman correlation and residuals generated from a model where sex and age are predictors of IQ.

Results: Total IQ was associated with the Pb MMB for ICA (r=-0.14; p=0.03) and for WQS (r=-0.16; p=0.01). Total IQ was not associated with Pb measured using the individual exposure biomarkers (blood: r=-0.10; p=0.11, urine: r=0.09; p=0.13, hair: r=-0.10; p=0.11, nails: r=-0.06; p=0.35). Weights highlighting the contributions to each MMB indicate that nails (59%) and hair (23%) contributed most for WQS, whereas blood (51%) and nails (21%) contributed most for ICA.

Conclusions: These results indicate that MMBs can be more effective measures of exposure than individual biomarkers. Though MMBs have increased assay costs, they may increase statistical power when the choice of exposure medium is unclear. Future work will need to validate these methods for other toxicants and evaluate the associations with WISC subscales.
Assessing NO₂ Exposures with High Spatiotemporal Resolution across the Contiguous United States Using Ensemble Model
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OPS 03: Machine learning in environmental epidemiology, Room 315, Floor 3, August 26, 2019, 16:30 - 17:30

Background
NO₂ is an air pollutant that leads to multiple adverse health outcomes. Various modeling approaches have been proposed to estimate NO₂, using statistical regressions, machine learning algorithms, hybrid models and other approaches, with predictor variables ranging from land-use terms, satellite-derived column NO₂ concentration, and meteorological variables. Those complementary fitting methods and predictor variables have the potential to improve model performance. However, few studies have been proposed to integrate multiple fitting methods to estimate NO₂.

Methods
We propose an ensemble model to integrate multiple machine learning algorithms, including neural network, random forest, and gradient boosting, with a variety of predictor variables as input variables. This NO₂ model covers the entire contiguous United States from 2000 to 2016. After model training, we predicted daily NO₂ levels at 1 km × 1 km grid cells, as well as associated monthly uncertainty level. We also downscaled the 1-km-level prediction to 100-meter-level.

Results
After cross-validation, this ensemble-based model produced good $R^2$, with mean $R^2 0.788$, and mean spatial $R^2 0.844$. The relationship between daily monitored NO₂ and predicted NO₂ is almost linear. The distribution of NO₂ exhibits clear spatial clustering, with high concentration clustering around urban areas, especially major cities, and along highways. Temporally, NO₂ level underwent a profound decline over the study area, with annual level in 2016 about 50% of the 2000 level.

Conclusion
This NO₂ estimation has very high spatiotemporal resolution (daily and 1 km × 1 km), covers a large spatial area (contiguous United States), and provides good exposure assessment to epidemiologists to analyze the long-term and short-term health effect of NO₂. We also conclude that the most appropriate predictor variables and fitting algorithm are context-based. It is time to consider how to integrate different predictor variables and fitting algorithms together and achieve an optimized modeling for air pollution estimation.
OPS 08: Biological contaminants and respiratory health

Risk of respiratory hospital admission associated with modelled concentrations of Aspergillus fumigatus from composting facilities in England

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OPS 08: Biological contaminants and respiratory health, Room 117, Floor 1, August 26, 2019, 16:30 - 17:30

Background
Bioaerosols have been associated with adverse respiratory-related health effects and are emitted in elevated concentrations from composting facilities. We use a newly developed dispersion model of Aspergillus fumigatus concentrations to assess associations with respiratory-related hospital admissions.

Methods
Averaged modelled daily Aspergillus fumigatus concentrations were estimated for all 2011 Census Output Area (COA, average of 300 inhabitants) with a population-weighted centroid located within 4km of a composting facility in England. Exposure was defined as quartiles of modelled concentration around each composting facility. We fitted a hierarchical generalized mixed models to examine the risk of hospital admission with a primary diagnosis of (i) any respiratory condition, (ii) respiratory infections, (iii) asthma, (iv) COPD, and (v) cystic fibrosis, in relation to quartiles of exposure. The models included a random intercept for each COA to account for over-dispersion, nested within a random intercept on composting facility to account for spatial structure of the data, and were adjusted for age, sex, ethnicity, deprivation, tobacco sales (smoking proxy) and background air pollution.

Results
A total of 76 large scale open windrow composting facilities were included. Overall, 252,911 respiratory-related hospital admissions in 9,606 COAs were included in the analyses. We did not find any associations with respiratory-related hospitalisation with exposure, even after models were fully-adjusted. The relative risk of hospitalization for any respiratory disease was 0.98 (95% CI 0.96–1.01) for COAs in the highest quartile of exposure. Similar results were observed across all disease sub-groups.

Conclusions
This study does not provide evidence for increased risks of respiratory-related hospitalisations in those living within 4 km of a composting facility. Hospital admissions represent severe respiratory episodes, and further research would be needed to investigate associations with symptoms or mild respiratory disease.
Respiratory health effects and atopic sensitization in non-farming residents associated with particulate matter and endotoxin emitted by livestock farms

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OPS 08: Biological contaminants and respiratory health, Room 117, Floor 1, August 26, 2019, 16:30 - 17:30

Background

Living in livestock-dense areas has been associated with health effects, suggesting airborne exposures to livestock farm emissions to be relevant for public health. Livestock farm emissions involve complex mixtures of various gases and particles. Endotoxin, a pro-inflammatory agent of microbial origin, is a constituent of livestock farm emitted particulate matter (PM) that is potentially related to the observed health effects. Quantification of livestock associated endotoxin exposure at residential addresses has not been performed earlier. We aimed to assess exposure-response relations for a range of respiratory endpoints and atopic sensitization in relation to modelled livestock farm emitted PM10 and endotoxin.

Methods

Self-reported respiratory symptoms and health information of 12,117 persons participating in a population based cross-sectional study was used. For 2,494 persons, also data on lung function (spirometry) and serologically assessed atopic sensitization was available. Annual-average PM10 and endotoxin concentrations at home addresses were predicted by dispersion modelling and land-use regression (LUR) modelling. Exposure-response relations were analysed with generalized additive models.

Results

Health outcomes were generally more strongly associated with exposure to livestock farm emitted endotoxin compared to PM10. An inverse association was observed for dispersion modelled exposure with atopic sensitization (endotoxin: p=.004, PM10: p=.07) and asthma (endotoxin: p=.029, PM10: p=.022). Prevalence of respiratory symptoms decreased with increasing endotoxin concentration at the lower range, at the higher range prevalence increased with increasing concentration (p<.05). Associations between lung function parameters with exposure to PM10 and endotoxin were not statistically significant (p>.05).

Conclusions

Exposure to livestock farm emitted particulate matter is associated with respiratory health effects and atopic sensitization in non-farming residents. Results indicate endotoxin to be a potentially plausible etiologic agent, suggesting non-infectious aspects of microbial emissions from livestock farms to be important with respect to public health.
Airborne pollen: trends in season onset, duration and intensity and the importance for environmental epidemiology

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OPS 08: Biological contaminants and respiratory health, Room 117, Floor 1, August 26, 2019, 16:30 - 17:30

**Background/Aim**
As allergies to airborne pollen are increasingly common in Europe, our exposure to this kind of pollen is gradually changing as a result of climate change. Pollen is a barely recognized, but increasingly relevant environmental pollutant which affects 15-20% of the European population, yet the long-term trends in their exposure are not well understood.

**Methods**
We looked at pollen concentration data for 14 stations in Switzerland for the years 1993-2018 for Hazel, Alder, Birch, Oak, Beech, Grasses, Sweet Chestnut, Mugwort and Ragweed. For all 10 species, we analysed trends in the onset of each pollen season (the day of the year when it first starts), its duration (days from start to end) and its intensity (seasonal pollen index (SPI): the total sum of daily pollen concentrations over the season).

**Results**
The timing of the onset, the duration and the intensity of the pollen season are importantly determined by local presence of species and weather-dependent variations between years. Whereas the onset of the season for early flowering tree species has become earlier between 1969 (the start of pollen counts) and 2000, no substantial further trend in the timing of the onset was observed in recent decades for these species. However, the intensity of the tree pollen season (occurring in the early springtime) is increasing, with a clear rise in the pollen number count each season over the period 1993-2018, especially for Hazel (SPI increase from 920 to 2500 season-1) and Birch (SPI increase from 4800 to 6900 season-1).

**Conclusions**
In light of the high prevalence of allergies in the Swiss and European population, the increasing trend in seasonal pollen index of some highly allergenic species is important for public health. Health effects related to these increasing exposures may be a thus-far unrecognized adverse health effect of climate change.
Sensitization to Pets and Pet Ownership Modify the Association Endotoxin with Asthma and Wheeze

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OPS 08: Biological contaminants and respiratory health, Room 117, Floor 1, August 26, 2019, 16:30 - 17:30

Background: Pets are important sources of endotoxin. Exposure to endotoxin as well as exposure to dog and cat allergens have each been associated with asthma and wheeze. However, it has been difficult to separate the impact of these exposures and whether they interact with each other to affect respiratory outcomes. Methods: We examined whether exposure and sensitization to dog and cat influence the association of house dust endotoxin with asthma and wheeze in 6051 children and adults in the U.S. National Health and Nutrition Examination Survey. Exposure to pets was assessed using both pet ownership and pet allergens measured in bedroom dust. Endotoxin was quantified using the LAL assay. Allergic sensitization status was determined from serum levels of specific immunoglobulin-E. Administered questionnaires assessed current asthma and wheeze and associated morbidities. Results: The study confirmed the prevalence of dog (48.3%) and cat (37.5%) ownership and endotoxin concentration in dust was significantly greater in homes with pets. Exposure to endotoxin as well as exposure and sensitization to dog and cat allergens were each independently associated with a higher prevalence of current asthma and/or wheeze, especially in adults. The association of endotoxin with the respiratory outcomes was significantly altered by exposure to pet allergens and sensitization status. In participants not sensitized to dog, exposure to high levels of dog allergen enhanced the association of endotoxin with wheeze, while in participants sensitized to cat, exposure to high levels of cat allergen heightened the odds of current asthma associated with endotoxin. The concurrent exposure to high levels of both dog and cat allergens augmented the association of endotoxin with both current asthma and wheeze in the past 12 months. Conclusions: We conclude that measures to reduce the levels of endotoxin as well as dog and cat allergens may help prevent active asthma and wheeze.
OPS 14: Temperature variation associated with suicide and violence

Suicide risk associated with season and temperature in Japan, 1972-2015; the role of climate, demographic, and socioeconomic factors

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OPS 14: Temperature variation associated with suicide and violence, Room 412, Floor 4, August 26, 2019, 16:30 - 17:30

Background/Aim: Previous literature suggested that suicide is associated with season and temperature. However, no study comprehensively investigated spatial heterogeneity and temporal change in the season- and temperature-related suicide risks, and the factors that may underlie the varying risks. We examined the spatio-temporal variations in the risk of suicide associated with season and temperature, and the role of climate, demographic, and socioeconomic factors in 47 prefectures in Japan during 1972-2015.

Methods: We used two-stage meta-analysis. Firstly, we used Poisson time-series regression with splines to estimate the seasonality of suicide and a short-term association with temperature for each prefecture. Next, we pooled the prefecture-specific estimates using multivariate meta-analysis. We used meta-regression to identify the underlying factors that may explain the varying risks of suicide. We explored the temporal change in seasonality and temperature association via year-specific analysis.

Results: We found a bimodal pattern of the total seasonality of suicide showing primary and secondary peaks in April (spring) and October (fall) and a trough in December (winter). The seasonality changed into a different shape with a peak in March and a trough in August after adjusting for temperature. The temperature-suicide association was shown as nonlinear in which the risk increased as temperature increased but leveled off above 25 oC. The total seasonality and the association with temperature were larger for rural prefectures characterized by smaller population, higher proportions of the elderly and females, and lower levels of financial capability and air conditioning prevalence and for colder and more humid prefectures, whereas the residual seasonality was larger for urban and warmer prefectures. Both of the seasonality and temperature association slowly decreased over time.

Conclusions: Seasonality of suicide and short-term association with temperature vary across locations and time, which seems to be explained by climate, demographic, and socioeconomic factors.
Background/Aim
Criminology research has traditionally examined sociodemographic predictors of crime, such as sex, race, age, and socioeconomic status. However, evidence suggests that short-term fluctuations in crime vary more than long-term trends, which sociodemographic factors often cannot explain. This has redirected researchers to explore how environmental factors, such as meteorological variables, influence criminal behavior. However, current evidence on the relationship between temperature and homicide is still relatively limited and uncertain. This study investigates the association between ambient temperature and homicide incidence in South Africa, a country with one of the highest homicide rates in the world.

Methods
We applied a case-crossover study design using mortality data derived from a dataset of all recorded deaths in South Africa between 1997 and 2013, linked to a dataset of daily ambient temperature. Cases (n=205,932) were defined as deaths with homicide as the underlying cause (ICD-10 codes X85-Y09), as well as violent deaths of undetermined intent but likely to be homicides (ICD-10 codes Y22-Y25, Y28-Y29). We linked mortality data to daily temperature data (minimum, maximum, and mean) at the level of the district municipality, and performed analyses using conditional logistic regression.

Results
Preliminary results indicate a positive association between homicide and same-day maximum temperature, with an odds ratio of 1.013 (1.012, 1.015) per °C increase in temperature. In sensitivity analyses, significant (<0.05) positive associations remained when applying other temperature metrics (minimum/mean), when stratifying by definite vs. probable homicides, and for short lags (lag 1 and lag 0-1). There was no evidence of interaction by district municipality.

Conclusions
This study suggests an association between ambient temperature and homicide in South Africa and may aid in developing crime prevention efforts and related policy. The temperature-homicide relationship may be of increasing relevance in the context of climate change.
Acute air pollution exposure, temperature, and the risk of violent behavior in the United States

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OPS 14: Temperature variation associated with suicide and violence, Room 412, Floor 4, August 26, 2019, 16:30 - 17:30

Background: Violence is a significant public health threat leading to social harm, injuries, and mortality. While violence research emphasizes social and individual behavior, associations with short-term environmental conditions are poorly understood. Emerging evidence suggests that acute air pollution and increased daily temperature may promote aggressive or impulsive reactions in people.

Methods: We applied a two-stage hierarchical time series model to estimate the change in risk of violent and non-violent criminal behavior associated with short-term air pollution and daily temperature in U.S. counties (2000-2013). We used monitoring data from the Environmental Protection Agency for ozone and fine particulate matter (PM2.5), daily temperature from the National Climatic Data Center, and daily crime counts from the Federal Bureau of Investigation. We evaluated differences in risk by community characteristics of poverty, urbanicity, race, and age and estimated a non-linear exposure-response relationship.

Results: Our analysis over 300 counties in 34 states, representing 86.1 million people and 721,674 days. We found each 10µg/m³ change in daily PM2.5 and 10ppb change in ozone is associated with a 1.17% (95% CI: 0.90, 1.43) and a 0.59% (95% CI: 0.41, 0.78) relative risk increase (RRI) for violent crime. However, we observed no risk increase for non-violent property crime due to daily PM2.5 or ozone. Our results were robust across all community types, except rural regions. Exposure-response curves indicated increased violent crime risk at concentrations below regulatory standards. Violent crime and temperature showed a linear association with increasing temperature, but this trend flattened with non-violent crimes.

Conclusions: Our results suggest that short-term changes in ambient air pollution and temperature may be associated with greater risk of violent behavior, regardless of community type.

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OPS 14: Temperature variation associated with suicide and violence, Room 412, Floor 4, August 26, 2019, 16:30 - 17:30

Background: Extreme heat events can trigger a variety of heat stress. In a temperate climate, we evaluate whether hot temperatures trigger suicide.

Methods: In a bidirectional time-stratified case-crossover design, 20,533 suicide deaths among individuals aged 5 years or older registered between January 1st 2002 and December 31st 2011 in Belgium were matched by day of the week with control days from the same month and year. Here, we focus on 1,096 suicide deaths occurring during the last day of a “hot week”, defined as a period of 7 days including the event day and its preceding 6 days during which the average daily temperature exceeded or was equal to 24°C at least once, i.e. the 95th percentile of values observed during the warm season in Belgium (June–August) in the study period. We applied conditional logistic regression models adjusted for PM10 to obtain odds ratios (OR) and their 95%CI for an increase of 1°C over different lag periods (lag 0, 0-1, 0-2, 0-3, 0-4, 0-5, 0-6 days). Other potential confounders (e.g. duration of sunshine and holiday) and effect modification by suicidal method (violent vs non-violent) were considered.

Results: The average (±SD) temperature on event days was 21°C (±3.5), and the average difference with control days was 3.4°C (±2.2). In weeks with at least one day with average temperature above or equal to 24°C, we observed significant associations of temperature with suicide mortality for lag 0-5 (OR=1.08 per 1 °C increment 95%CI:1.01-1.15) and lag 0-6 (OR=1.10 per 1 °C increment 95%CI:1.03-1.19). Suicidal method significantly modified the associations with significant associations observed only among violent events (n=925; lag0-4: OR=1.08; 95%CI:1.01-1.15, lag0-5 OR=1.12; 95%CI:1.04-1.20, lag0-6 OR=1.14; 95%CI:1.05-1.24).

Conclusions: Temperature related stress might be a trigger for suicide, particularly violent suicide events.
Background: The potential health effects of acrylamide have drawn worldwide attention due to lifelong exposure of human. However, the association of acrylamide exposure with lung function and the underlying mechanisms remain unknown. We aimed to investigate the exposure-response relationships and potential mechanisms between urinary acrylamide metabolites and lung function alteration in a general Chinese adult population.

Methods: In the Wuhan-Zhuhai cohort, lung function and urinary acrylamide metabolites including N-Acetyl-S-(2-carbamoylethyl)-L-cysteine (AAMA) and N-Acetyl-S-(2-carbamoyl-2-hydroxyethyl)-L-cysteine (GAMA) were measured in 3271 participants, of whom 2557 subjects had an assay for C-reactive protein (CRP) as a systemic inflammatory marker. Relationships among urinary acrylamide metabolites, CRP and lung function were assessed by linear mixed models. The mediating role of CRP was further investigated by mediation analysis.

Results: After adjustment for potential confounders, each 1-unit increase in log-transformed value of AAMA, GAMA, or total urinary acrylamide metabolites (ΣUAAM) was associated with a 61.56-, 65.99-, or 66.16-ml decrease in forced vital capacity (FVC), and a 55.41-, 61.04-, or 60.08-ml decline in forced expiratory volume in 1 second (FEV1), respectively (all P<0.05). Such associations were independent of smoking and were significant in the participants of physical inactivity rather than physical activity. Each 1-unit increase in log-transformed value of CRP was related to a 72.96- and 59.99-ml decrease in FVC and FEV1, respectively (all P<0.05). GAMA (β=0.10, P<0.05) rather than AAMA (β=0.03, P>0.05) was significantly associated with CRP. Mediation analysis suggested that increased CRP significantly mediated 9.30% and 9.84% of the GAMA related FVC and FEV1 reduction, respectively.

Conclusions: Exposure to acrylamide may impair lung function independently of cigarette smoking, and systemic inflammation may be one of the underlying mechanisms. Physical activity may prevent lung function decline caused by acrylamide exposure.
Multiple Pollutant Exposure during Pregnancy on Atopic Dermatitis in infants at age of 12 month: the Mothers and Children’s Environmental Health (MOCEH) Study

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OPS 17: Chemical exposures and respiratory outcomes, Room 110, Floor 1, August 26, 2019, 16:30 - 17:30

Background/Aims
Prenatal exposure to various environmental pollutants has been associated with increased risk of infantile atopic dermatitis (AD). However, few studies have examined the combined effects of multiple pollutants on AD. We aimed to investigate the multiple pollutant exposures during pregnancy on AD in 12-month-old children.

Methods
This study used prospective data from 520 participants of the Mothers and Children’s Environmental Health study. Three heavy metal (mercury, lead, cadmium) were measured in maternal blood samples. Three phthalate metabolites (mono(2-ethyl-5-hydroxyhexyl) phthalate, mono(2-ethyl-5-oxohexyl) phthalate, and mono-n-butyl phthalate) and bisphenol A were measured in maternal urine samples. Exposure to nitrogen dioxide (NO2) and particulate matter (PM10) were estimated based on the residence address by land use regression, and PM2.5 were estimated by community multiscale air quality model. Information on infantile AD was obtained by using a questionnaire administered to the guardians of the children. To assess the effect of multiple pollutants, we applied the elastic-net regression (ENET) and principal component regression (PCR). In addition, we performed a logistic regression with the inverse probability of treatment weight (IPTW) to identify population causal relationships.

Results
In the late pregnancy model using the ENET, five pollutants (lead, cadmium, bisphenol A, mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP), and PM10) were selected, and lead and MEHHP were significantly associated with risk of AD (Adjusted odds ratio(OR): 1.52, 95% CI: 1.01-2.30, and OR: 1.01, 95% CI: 1.00-1.01), respectively. In addition, PCR model using selected five pollutants showed positive association between the first component score and risk of AD (OR: 1.42, 95% CI: 1.01-2.01). Further, MEHHP and the first component score were also significantly associated with AD in the IPTW model.

Conclusion
Our finding suggests that the effect of multiple pollutants was associated with increased risk of AD. These results highlight the need of further study to clarify causality between multiple pollutants and AD.
Association between early life exposure to phthalates and the development of childhood asthma

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OPS 17: Chemical exposures and respiratory outcomes, Room 110, Floor 1, August 26, 2019, 16:30 - 17:30

Background/Aim:

Epidemiological studies have reported an association between phthalate exposure, particularly DEHP and BzBP, and the development of childhood asthma. However, results have been inconsistent. One reason for the inconsistency could be that few studies have examined early life exposure, including infancy. Our goal was to examine the association between early life exposure to phthalates measured in house dust and the development of asthma at 5 years within the Canadian Healthy Infant Longitudinal Development (CHILD) Study, a population-based birth cohort.

Methods:

Pregnant mothers were enrolled in the CHILD study between 2009-2012 from 4 cities and 1 rural area in Canada. House dust samples were collected from the floor of the child’s bedroom and the next most used room at 3 months. Children underwent clinical assessments at 1, 3 and 5 years. From the eligible study population, a case-cohort study was designed by selecting a random sample of 450 children (sub-cohort) and adding all cases with physician diagnosed definite asthma at 5 years. House dust samples were analyzed for 6 phthalates. Differences in median concentration between cases and the sub-cohort were examined using the Mann-Whitney U-test.

Results:

Based on results from the first 183 subjects, concentrations of all phthalates varied widely in the dust. The highest concentration was observed for DEHP (median: 187 µg/g dust), followed by BzBP (median: 26.9 µg/g dust). Statistically significant differences in median concentration of DEHP were observed between asthma cases (n=80) and the sub-cohort (n=103): median(cases) = 365 vs median(sub-cohort) = 85.3 µg/g dust, p<0.0001. Significant differences in median BzBP concentrations were also observed between cases and the sub-cohort: median(cases) = 44.0 vs median(sub-cohort) = 22.2 µg/g dust, p=0.007.

Conclusions:

Preliminary results suggest concentrations two to three times higher of DEHP and BzBP in floor dust from homes of children with asthma compared to those without.
Background/Aim: Asthma during childhood is associated with substantial morbidity. We investigated whether higher prenatal exposure to phthalates, ubiquitous chemicals commonly used as plasticizers, is associated with child asthma and examined sex-specific associations.

Methods: We studied dyads enrolled in two prenatal cohorts from the ECHO-PATHWAYS consortium: Conditions Affecting Neurocognitive Development and Learning in Early Childhood (CANDLE, recruited 2006-2011) and The Infant Development and the Environment Study (TiDES, 2011-2013). Our outcome was current asthma at age 4-6 years, based on parent report of child asthma (ever), asthma-specific medication use, and/or wheeze in past 12 months. We quantified 11 phthalate metabolites in 3rd trimester urine and estimated associations with child asthma using Weighted Quantile Sum (WQS) logistic regression, including separate models to estimate protective and adverse associations in accord with WQS assumptions. Models were adjusted for maternal race, age, education, smoking, parity, asthma history, birth year, study site, and child sex. We examined sex specific associations in stratified models.

Results: Of 1486 women, 45% were black, 7.4% reported prenatal smoking, and 17% reported an asthma history. Among children, 12.4% had asthma. Overall, a modest protective association was observed between the WQS phthalate index and asthma (adjusted odds ratio per 1 quintile increase in WQS weighted metabolite exposure (AOR); 95% confidence interval (CI): 0.85; 0.72, 1.01), with mono-ethyl hexyl phthalate (MEHP) having the strongest individual weight (w=0.49). In stratified models, a higher WQS index was associated with asthma in boys (AOR; 95% CI: 1.45; 1.10-1.90) with mono-ethyl (MEP) [w=0.35] and monocarboxy-isononyl (MCNP) [w=0.26] phthalates having the strongest individual weights. In girls, there was a protective association (AOR; 95% CI: 0.68; 0.51, 0.91) with MCNP [w=0.34] and mono-isobutyl phthalates (MiBP) [w=0.21] having the strongest individual weights.

Conclusions: Results suggest effect modification by sex between prenatal phthalate mixture exposure and child asthma.
Epidemiologic studies of non-persistent chemicals typically rely on urinary biomarker measurements to assess exposure. However, determining a sampling strategy that allows one to adequately capture exposure is challenging because intra-individual levels of urinary biomarkers can have large temporal variability. A recent review of the literature on non-persistent chemicals reported that published intraclass correlation coefficients (ICCs) were mostly below 0.4, representing poor reliability of spot sample measurements. Thus, sampling strategies including one or only a few samples can result in exposure misclassification. To help epidemiologists and exposure scientists establish optimal urine sampling strategies, we developed a user-friendly tool based on pharmacokinetic modeling and Monte Carlo simulations. The tool allows the user to create exposure scenarios for which they can select exposure patterns (e.g., once a day at a random time, three times a day during meals), exposure route (i.e., oral, dermal, inhalation), inter- and intra-individual variability in external exposure (i.e., low, medium, high), chemical biological half-life, absorption half-life, maximum number of samples that can realistically be collected, and sampling strategy (e.g., random, first morning voids). The tool also accommodates urinary dilution adjustments based on creatinine or specific gravity. Based on this information, the model simulates a population from which precision and classification statistics are calculated by comparing “true” to “measured” exposure. Namely, the tool evaluates the relationship between internal exposure over the exposure period (i.e., area under the curve) and measured biomarker levels through linear regression, and estimates exposure misclassification for tertile and quartile classification schemes. This tool will not only assist researchers but also research sponsors by highlighting the need for sufficient resources to properly characterize exposures when studying non-persistent chemicals.
Exposure to Polybrominated Diphenyl Ethers and Risk of Thyroid Cancer in Women: Single and Multi-Pollutant Approaches

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OPS 21: Methodological progress in chemicals health effects research, Room 210, Floor 2, August 26, 2019, 16:30 - 17:30

Background: Thyroid cancer incidence is the most rapidly increasing malignancy, and rates are three times higher in women compared to men. Polybrominated diphenyl ethers (PBDEs), flame retardant chemicals associated with thyroid hormone disruption, have been hypothesized to contribute to this trend. Methods: We investigated the relationship between PBDE exposure and papillary thyroid cancer (PTC) in 250 incident female papillary thyroid cancer cases and 250 female controls frequency-matched on age, all residing in Connecticut. Interviews and serum samples were collected from 2010-2013. Samples were analyzed for 11 congeners using gas chromatography with isotope dilution high resolution mass spectrometry; serum concentrations were adjusted for lipids. We calculated odds ratios (OR) and 95% confidence intervals (95% CI) using single pollutant logistic regression models for continuous and categorical lipid-adjusted serum concentrations of individual PBDEs, adjusted for age, alcohol consumption, and educational attainment. We also applied three multi-pollutant approaches (standard multi-pollutant regression models, hierarchical Bayesian modeling, principal components analysis [PCA]) to investigate associations with exposures to mixtures of PBDEs. Results: No individual PBDEs were positively associated with PTC risk. Some statistically significant protective relationships were observed when comparing the highest to lowest exposure categories for congeners BDE-47 and BDE-99. In the standard multi-pollutant regression modeling, BDE-100 was statistically significantly associated with PTC risk. The other multi-pollutant analyses did not yield any statistically significant associations. Conclusions: Our results do not support an association between PBDE exposure and increased PTC risk. Multi-pollutant models were generally consistent with single pollutant models. Application of more advanced statistical approaches to analyze mixtures, incorporation of genetic polymorphisms, and investigations in populations with higher exposure levels could reveal new insights.
Chemicals associated with spontaneous abortion in the Comparative Toxicogenomics Database (CTD): Implications for birth cohort research

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OPS 21: Methodological progress in chemicals health effects research, Room 210, Floor 2, August 26, 2019, 16:30 - 17:30

Background: In epidemiologic research, failure to account for a toxicant’s impact on spontaneous abortion (SA) can bias toxicant-birth outcome associations. We lack a comprehensive understanding of high-risk SA chemicals, as many events occur before women are aware of their pregnancy. Our goal was to test chemicals for overlap with SA, based on toxicogenomic responses.

Methods: We used reference SA (MeSH: D000022) and chemical gene lists from the Comparative Toxicogenomics Database in three species (human, mouse, and rat). We prioritized chemicals (n=25) on US maternal exposure levels. For exposure-disease gene sets of sufficient size (n=13 chemicals, n=20 comparisons), chi-squared enrichment tests and proportional reporting ratios (PRR) were calculated. We cross-validated results and assessed enrichment in gene ontology biological processes.

Results: Number of unique genes annotated to a chemical ranged from 59 (diethyl phthalate) to atrazine (5,607), and 121 genes were SA annotated. In humans, all chemicals tested were highly enriched for SA gene overlap (all p<0.001; ethyl parathion PRR=7, cadmium PRR=6.5, lead PRR=3.9, arsenic PRR=3.5, atrazine PRR=2.8). In mice, highest enrichment (p<0.001) was observed for naphthalene (PRR=16.1), cadmium (PRR=12.8), arsenic (PRR=11.6), and carbon tetrachloride (PRR=7.7). In rats, we observed highest enrichment (p<0.001) for cadmium (PRR=8.7), carbon tetrachloride (PRR=8.3), and dieldrin (PRR=5.3). Our findings were robust to 1,000 permutations each of gene sets ranging in size from 100 to 10,000. SA genes were overrepresented in biological processes: inflammatory response (q=0.001), collagen metabolic process (q=1x10^-13), cell death (q=0.02), and vascular development (q=0.005).

Conclusion: We observed chemical gene sets (ethyl parathion, cadmium, naphthalene, carbon tetrachloride, arsenic, lead, dieldrin, and atrazine) were highly enriched for SA genes. Exposures to chemicals linked to SA, thus linked to probability of live birth, may deplete fetuses susceptible to adverse birth outcomes. Our findings have critical implications for the design and interpretation of pregnancy cohort analyses with environmental exposures.
An Overview of Methods to Address Distinct Research Questions on Environmental Mixtures: An Application to Persistent Organic Pollutants and Leukocyte Telomere Length

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OPS 21: Methodological progress in chemicals health effects research, Room 210, Floor 2, August 26, 2019, 16:30 - 17:30

Background. Multiple methods exist to analyze environmental mixtures in health studies. To illustrate the differences among methods based on the research question each answer, we employed methods geared toward distinct research questions in a sample concerning persistent organic pollutants (POPs) as a mixture and leukocyte telomere length (LTL) as an outcome.

Methods. With information on 18 POPs and LTL among 1,003 U.S. adults (NHANES, 2001–2002), we used unsupervised methods including clustering, to identify profiles of similarly exposed participants, and Principle Component Analysis (PCA) and Exploratory Factor Analysis (EFA), to identify common exposure patterns. We also applied supervised learning techniques including penalized, weighted quantile sum (WQS), and Bayesian kernel machine (BKMR) regressions, to identify potentially toxic agents and characterize nonlinear associations, interactions, and the overall mixture effect.

Results. Clustering separated participants into high, medium, and low POP exposure groups; longer log-LTL was found among those with high exposure. The first PCA component represented overall POP exposure and was positively associated with log-LTL. Two EFA factors, one representing furans and the other PCBs 126 and 118, were positively associated with log-LTL. Penalized regression methods selected three congeners in common (PCB 126, PCB 118, and furan 2,3,4,7,8-pncdf) as potentially toxic agents. WQS found a positive overall effect of the POP mixture and identified six POPs as potentially toxic agents (furans 1,2,3,4,6,7,8-hxcdf, 2,3,4,7,8-pncdf, and 1,2,3,6,7,8-hxcdf, and PCBs 99, 126, 169). BKMR found a positive linear association with furan 2,3,4,7,8-pncdf, suggestive evidence of linear associations with PCBs 126 and 169, and a positive overall effect of the mixture, but no interactions among congeners.

Discussion. Using different methods, we identified patterns of POP exposure, potentially toxic agents, the absence of interaction, and estimated the overall mixture effect. These applications and results may serve as a guide for mixture method selection based on specific research questions.
OPS 41: Metals and birth outcomes

Early life exposure to inorganic arsenic and children atopic allergy in a birth cohort follow-up study

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OPS 41: Metals and birth outcomes, Room 411, Floor 4, August 26, 2019, 16:30 - 17:30

Background/Aim
Early life exposure to inorganic arsenic, through water, air, or food, have been found associated with impaired immune function and decreased lung function in children. We aimed to evaluate prenatal and childhood exposure to inorganic arsenic and their associations with atopic diseases in a 15-year follow-up birth cohort study in central Taiwan.

Methods
A total of 261 children born to original 485 recruited pregnant women, were successfully followed at 2, 5, 8, 11, and 14 years for arsenic and serum immunoglobulin E (IgE) measurements. Arsenic species levels were quantified using high performance liquid chromatography / Inductively Coupled Plasma Mass Spectrometry with urinary creatinine adjusted. Atopic allergic diseases were based on clinician diagnosis using ISSAC questionnaire.

Results
The allergic children have higher percentage of maternal atopy (50%) as compared to those without (27%). Children with any allergic symptom of dermatitis, asthma, or rhinitis tended to have higher blood IgE along the follow-up period. Boys had the higher arsenic exposure level than girls at 2 and 5 years. Children with total inorganic arsenic over the median at 2-11 years had significantly higher Odds Ratio (OR) for allergic rhinitis aged 8-14 years than those below the median (OR= 2.72, 95% confidence interval, 1.21-5.69), adjusted for sex, parental allergy, breast feeding, Environmental Tobacco Smoke (ETS), prenatal arsenic exposure, and postnatal phthalate exposure. The increased prenatal arsenic exposure was associated with increased OR of asthma in children (OR=5.93, p=0.04 for maternal exposure less than the median as compared to the over group) adjusted for sex, parental allergy, breast feeding, ETS, and prenatal phthalate exposure.

Conclusions
Children postnatal arsenic exposure was associated with allergic rhinitis disregarding parental allergic status. Prenatal exposure was associated with children asthma incidence. There appeared different mechanism and prevention strategies for prevention of the atopic diseases.
Early Pregnancy Metal(loid) Mixtures and Second Trimester Glucose Levels
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OPS 41: Metals and birth outcomes, Room 411, Floor 4, August 26, 2019, 16:30 - 17:30

Background/Aim: Previous studies suggested that a number of essential metal(loid)s are required in normal glucose metabolism, while certain non-essential metal(loid)s are associated with risk of diabetes. However, the effects of these metal(loid)s on glycemia during pregnancy, either individually or jointly, are unclear. We aimed to explore associations of early pregnancy essential (chromium, copper, magnesium, manganese, selenium, vanadium, zinc) and non-essential (arsenic, barium, cadmium, cesium, mercury, lead) metal(loid)s, individually and as a mixture, with second trimester glucose levels.

Methods: We studied 1382 pregnant women enrolled in Project Viva, a prospective pre-birth cohort in eastern Massachusetts. Red blood cell (RBC) concentrations of metal(loid)s were quantified in early pregnancy blood samples (median: 10 weeks gestation) using Direct Mercury Analyzer 80 (for mercury) and Inductively Coupled Plasma Mass Spectrometry (for all others). Glucose levels were abstracted from the 50-gram, non-fasting glucose challenge test for screening gestational diabetes (median: 28 weeks gestation). We conducted linear regression analyses with all metal(loid)s mutually adjusted in addition to other confounders. Bayesian Kernel Machine Regression (BKMR) was then applied to flexibly model the dose-response relationships between the metal(loid) mixtures and glucose levels and qualitatively investigate interactions.

Results: In adjusted linear regression analyses, 1 standard deviation higher ln-transformed mercury was associated with 2.0 mg/dL lower glucose levels (95% confidence interval: -3.7, -0.2). The individual associations of metal(loid)s were consistent in BKMR accounting for joint effects, with smaller estimated effect sizes and greater variations. Bivariate analyses in BKMR suggested sub-additive interactions between chromium and barium, and between chromium and selenium.

Conclusions: We found suggestive evidences that early pregnancy higher mercury was associated with lower glucose levels. The potential hyperglycemic effect of chromium may be dependent on barium and selenium concentrations. Future work is needed to better understand the joint effects of these metal(loid)s in the context of glucose regulation in pregnancy.
Prenatal exposure to mercury and effects on birth outcomes of women from Suriname's interior

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OPS 41: Metals and birth outcomes, Room 411, Floor 4, August 26, 2019, 16:30 - 17:30

Background/Aim:
Mercury (Hg) is an environmental pollutant with high toxic potential especially for developing children. Hg is widely used in Suriname’s interior in gold mining activities. We aimed to determine prenatal Hg exposure and to explore the potential association of Hg exposure and birth outcomes in pregnant women living in Suriname’s interior. The study population is a subset of the Caribbean Consortium of Environmental and Occupational Health environmental epidemiologic cohort study designed to examine the effects of chemical and non-chemical stressors on birth outcomes and pediatric neurodevelopment.

Methods:
Data on birth weight (BW), categorized as low birth weight (LBW<2,500g) and preterm birth (PTB<37 weeks) was collected from pregnant women seeking care at the Medical Mission health centers and recruited from April 2017-December 2018 in a prospective study. Among 79 singleton births of women living in the interior of Suriname, there was 76 live births, two stillbirths and 1 miscarriage were not included. Hg concentration was measured in maternal hair. We conducted a correlation analysis between hair-Hg and BW treating both as continuous variables. We categorized exposures as below or above the median and used the Fisher’s exact test and odds ratios to evaluate associations with LBW and PTB.

Results:
The median hair-Hg concentration was 2.42 ug/g, 8.6% had LBW and 15.2% PTB. There was no significant correlation between hair-Hg and BW (r=0.02, p<0.85.) or between hair-Hg and LBW (Fisher’s exact test, p<0.43, OR=0.45 95%CI--0.08-2.04) or PTB (Fisher’s exact test, p<0.51, OR=0.59 95%CI--0.18-2.12).

Conclusions:
Our results were consistent with what others have found regarding exposure to Hg during pregnancy at these concentrations and birth outcomes. The mercury exposure is predominantly from consumption of Hg-contaminated fish. The findings related to birth outcomes in this sub-cohort will be confirmed by ongoing analyses of the larger study cohort (N=1000).
Early-life exposure to selenium and metals and neuropsychological development at 2 years

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OPS 41: Metals and birth outcomes, Room 411, Floor 4, August 26, 2019, 16:30 - 17:30

Background: Humans are exposed to non-essential and essential trace elements primarily through food and groundwater. Exposure occurs during critical periods of early-life development via transplacental and lactational transfer. While there is moderate-to-high evidence of neurotoxicity for certain metals, little is known about mixture effects. Further, micronutrients such as selenium can influence the metabolism and thereby toxicity of metal exposures. We investigated if infant exposure to ubiquitous trace elements was associated with later neuropsychological impairment.

Methods: In a prospective Norwegian birth cohort (HUMIS), we measured concentrations of arsenic (As), cadmium (Cd), cobalt (Co), lead (Pb), mercury (Hg), and selenium (Se) in breastmilk collected 1 month postpartum using inductively coupled plasma-mass spectrometry (n=298). Child behavior and development was ascertained by maternal completion of the Ages and Stages Questionnaires (ASQ-II) and infant-toddler symptom checklist (ITSC) when children were 2 years of age. We assessed associations and interactions between metals and neuropsychological development scores.

Results: Selenium and arsenic were present in the highest concentrations in breastmilk (median: 9.7 and 0.33 µg/kg, respectively), and metals exhibited low inter-correlations. Fish intake was strongly associated with arsenic concentrations in breastmilk. There were indications that co-exposure to the metal mixture was jointly, albeit weakly, associated with increased odds of a high total ITSC score, reflecting an unfavorable ability to self-regulate. Selenium was associated with a decreased odds of a high ITSC score: OR = 0.69 (95% CI: 0.50, 0.96) per SD increase in breastmilk levels, and there were indications of an arsenic–selenium interaction. There were no robust associations between exposures and developmental delay, as assessed by an abnormal ASQ-II score.

Conclusions: We found evidence of a protective main effect of selenium status on neuropsychological development. The potential neuro-protective effects of selenium in mitigating the neuro-toxic effects of metal mixtures warrants further attention.
OPS 42: Cardiometabolic effects of noise exposure

Long-Term Aircraft Noise Exposure and Incident Hypertension in the Women’s Health Initiative

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OPS 42: Cardiometabolic effects of noise exposure, Room 217, Floor 2, August 26, 2019, 16:30 - 17:30

Background: Aircraft noise is a persistent concern for communities surrounding airports. Studies report associations with hypertension, yet establishing causation is difficult as few were longitudinal; to date, no prospective cohort studies have been conducted in the U.S. We aim to evaluate the association between long-term aircraft noise exposure and hypertension risk among post-menopausal participants in the Women’s Health Initiative (WHI) Clinical Trials (CT) cohort, a large ongoing U.S. prospective study.

Methods: Day-night average sound levels (DNL) 45-75 decibels (dB) were modeled for 90 U.S. airports from 1995-2015 in 5-year intervals using the Federal Aviation Administration’s Aviation Environmental Design Tool and linked to WHI-participant geocoded addresses. Subjects were followed from 1993-2010. Hypertension was defined as annual systolic/diastolic blood pressure measurements ≥140/90 mmHg or inventoried/self-reported anti-hypertensive medication use. Using time-varying Cox regression, we estimated hazard ratios (HR) for incident hypertension per 10 dB increase and for ≥45 dB vs. <45 dB, ≥55 dB vs. <55 dB, and ≥65 dB vs. <65 dB, controlling for participant sociodemographic, behavioral, and environmental/contextual factors (e.g. body mass index, neighborhood socioeconomic status) with further stratification by U.S. Census region.

Results: The 45,504 women free of hypertension at baseline had a median follow-up time of 6.7 years. Of these, 21.9% were exposed to ≥45 dB, 3.8% to ≥55 dB, and 0.2% to ≥65 dB, and 26,718 developed hypertension. Multivariate models did not show statistically significant associations between DNL noise exposure and incident hypertension; however stratified analyses suggested higher risk for those exposed to ≥45 dB in the Northeast region (HR: 1.04, 95%CI: 0.97-1.12). Adjustment for concomitant air pollutant (NO2, PM2.5) concentrations did not alter effect estimates.

Conclusions: This is among the first U.S.-based studies investigating the longitudinal relationship between aircraft noise exposure and incident hypertension using a national cohort. Investigations of nighttime aircraft noise-incident hypertension relationships are ongoing.
Long-term Wind Turbine Noise Exposure and Risk of Incident Atrial Fibrillation and Stroke in the Danish Nurse Cohort

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OPS 42: Cardiometabolic effects of noise exposure, Room 217, Floor 2, August 26, 2019, 16:30 - 17:30

Background: The potential health effects related to wind-turbine noise have received increased focus during the past decades, but evidence is sparse. We examined the association between long-term exposure to wind turbine noise and incidence of atrial fibrillation (AF) and stroke.

Methods: First ever hospital admission of AF and stroke amongst 28,731 female nurses in the Danish Nurse Cohort were identified in the Danish National Patient register until ultimo 2013. Wind turbine noise levels at residential addresses between 1982 and 2013 were estimated using the Nord2000 noise propagation model, as the annual means of Lden, Lday, Levening and Lnight at the most exposed façade. Time-varying Cox proportional hazard regression models were used to examine the association between the 11-, 5- and 1-year rolling means of wind turbine noise levels and AF and stroke incidence.

Results: 1,430 nurses developed AF and 1,097 developed stroke by end of follow-up in 2013. Mean (standard deviation) baseline residential noise levels among exposed nurses were 26.3 (6.7) dB and higher in those who developed AF (27.3 (7.31) dB), than those who didn’t (26.2 (6.6)). We observed a 30% statistically significant increased risk (95% CI: 1.05-1.61) of AF amongst nurses exposed to long-term (11-year running mean) wind-turbine noise levels ≥ 20 dB(A) at night compared to nurses exposed to levels <20 dB(A), and similar effects with day (HR 1.25; 95% CI:1.01-1.54), and evening (HR 1.25; 95% CI:1.01-1.54) noise levels. No association between long-term wind turbine noise exposure and stroke incidence was found.

Conclusions: We found suggestive evidence of an association between long-term exposure to wind turbine noise and AF amongst female nurses, while we found no support of an increased risk of stroke development.
Background/Aim
Environmental factors such as road traffic noise and air pollution can negatively affect human health but are often studied separately. This project aims to study the associations between road traffic noise, air pollution and diabetes in three European cohorts.

Methods
Cross-sectional data were available from LifeLines (n=61,032 collected during 2007-2013 in the Netherlands), UKBiobank (n=405,817 collected during 2006-2010 in the UK), and HUNT3 (n=25,459 collected during 2006-2008 in Norway). Residential road traffic noise exposure (Lden) for 2009 was assessed using a European noise model based on the Common Noise Assessment Methods in Europe framework (CNOSSOS-EU) and residential ambient air pollution exposure (PM10 and NO2) for 2007 was estimated using land use regression models. Prevalence of type 2 diabetes was obtained with questionnaires. Regression analyses were adjusted for self-reported demographic and lifestyle factors.

Results
Across the three participating cohorts, mean age ranged between 43-56 years, mean Lden between 49-56 dB(A), and type 2 diabetes prevalence ranged between 1.5-5.3%. Adjusted regressions showed that a 10 dB(A) increase in Lden was associated with higher odds of diabetes type 2 prevalence in the UKBiobank (odds ratio 1.086, 95% CI 1.051-1.121). Adjustments for PM10, NO2 attenuated associations between noise and type 2 diabetes, but remained statistically significant. Associations were stronger in men. Air pollutants (while adjusted for noise) were also associated with type 2 diabetes prevalence (OR 1.468, 95%CI: 1.397-1.543 per 10µg/m³ of PM10). No associations were found between noise, air pollution and diabetes in the LifeLines and HUNT3 cohorts.

Conclusions
We observed that higher exposure to road traffic noise and air pollution was significantly associated with higher prevalence of type 2 diabetes in the UKBiobank. No evidence of such associations was observed in the Dutch LifeLines and Norwegian HUNT3 cohorts. Longitudinal analyses are currently conducted to further evaluate these findings.
Long-term transportation noise exposure and incidence of ischaemic heart disease and stroke – a cohort study

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OPS 42: Cardiometabolic effects of noise exposure, Room 217, Floor 2, August 26, 2019, 16:30 - 17:30

Background
There is limited evidence from longitudinal studies on transportation noise from different sources and development of ischemic heart disease (IHD) and stroke.

Objectives
This cohort study assessed associations between exposure to noise from road traffic, railway or aircraft and incidence of IHD and stroke.

Methods
In a cohort of 20,012 individuals from Stockholm County, we estimated long-term residential exposure to road traffic, railway and aircraft noise. National Patient and Cause-of-Death Registers were used to identify IHD and stroke events. Information on risk factors was obtained from questionnaires and registers. Adjusted HR for cardiovascular outcomes related to source-specific noise exposure were computed using Cox proportional hazards regression.

Results
No clear or consistent associations were observed between transportation noise and incidence of IHD or stroke. However, noise exposure from road traffic and aircraft was related to IHD incidence in women, with HR of 1.11 (95% CI 1.00-1.22) and 1.25 (95% CI 1.09-1.44) per 10 dB Lden, respectively. For both sexes taken together, we observed a particularly high risk of IHD in those exposed to all three transportation noise sources at ≥45 dB Lden, with a HR of 1.57 (95% CI 1.06-2.32), and a similar tendency for stroke (HR 1.42; 95% CI 0.87-2.32).

Conclusion
No overall associations were observed between transportation noise exposure and incidence of IHD or stroke. However, there appeared to be an increased risk of IHD in women exposed to road traffic or aircraft noise as well as in those exposed to multiple sources of transportation noise.
OPS 48: Air pollution and epigenetics
Newborn histone modifications and gestational exposure to particulate matter air pollution: the ENVIRONAGE Cohort Study

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OPS 48: Air pollution and epigenetics, Room 417, Floor 4, August 26, 2019, 16:30 - 17:30

Background:
Exposure to particulate air pollution has been linked with risk of disease in later life. Changes in DNA histone modifications might have long-term adverse health effects. We aimed to investigate the association between prenatal exposure to air pollution and levels of total histone H3 and specific trimethylation marks in cord blood.

Methods:
We measured cord plasma total histone H3, H3k4me3 and H3K36me3 in 614 samples from the ENVironmental Influence ON early AGEing (ENVIRONAGE) birth cohort. We used a high-resolution air pollution model to estimate exposure to particulate matter with a diameter less than 2.5 μm (PM2.5) and black carbon (BC), and NO2 over the different trimesters of pregnancy and the entire pregnancy on the basis of maternal address. The association between prenatal air pollution exposure and specific methylation marks was analysed with a linear regression model, while accounting for covariates and potential confounders.

Findings:
PM2.5 exposure averaged (SD) 13.4 μg/m3 (2.6) for the duration of pregnancy, black carbon exposure 1.29 μg/m3 (0.31) and NO2 exposure 17.98 μg/m3 (4.57). H3K4me3 was positively associated with gestational PM2.5 exposure, a 24.1% (p=0.0007) was observed for each 5 μg/m3 increase in PM2.5 exposure. Cord blood H3K36me3 levels were inversely associated with entire pregnancy exposure with a 18.3% (p=0.03) decrease in association with a 5 μg/m3 increment in PM2.5 exposure. For the entire pregnancy a 14.7% (p<0.001) increase in total histone H3 levels was associated with a 5 μg/m3 increment in exposure. Results for other exposures were similar.

In conclusion, exposure to particulate air pollution during pregnancy is significantly associated with levels of cord plasma histone H3 modifications at birth. Particulate air pollution induced changes in cord plasma histone H3 modifications during early life and might be a risk factor in the development of air-pollution related disease, later in life.
Integration of whole blood genome-wide DNA methylation and gene expression identifies epigenetically controlled modules in relation to NO2 air pollution exposure

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Background: Air pollution exposure has been associated with adverse health effects, including pregnancy outcomes, childhood airway disease, and neurodevelopmental disorders. Although underlying mechanisms are unclear, several studies have suggested pollutant-induced changes in gene expression profiles. Our aim was to investigate the association of nitrogen dioxide (NO2) exposure with transcriptome-wide gene expression patterns along with integration of expression data with DNA methylation in children and adolescents.

Methods: We meta-analyzed the associations between current NO2 exposure (estimated via ESCAPE LUR) at the time of biosampling and gene expression data measured with the Human Transcriptome Array 2.0 in peripheral blood of 575 subjects from three MeDALL European birth cohorts of children (INMA 4-year-olds) and adolescents (GINI and BAMSE 15-16-year-olds). In addition, an integration analysis of genome-wide DNA methylation with matched gene expression data available in INMA and BAMSE was conducted using Functional Epigenetic Modules (FEM R-package).

Results: Single-cohort transcriptome-wide analyses showed two (RP11-158A14.1 and ZBTB16) and one (FLJ46363) 5% FDR-significant differentially expressed gene (DEG) in BAMSE and INMA, respectively, in relation to NO2 exposure at the time of biosampling, but none in GINI. No DEGs in relation to NO2 exposure at 5% FDR were found in meta-analysis of the three cohorts. An integration of methylation and expression data revealed 6 and 13 FDR-significant hubs with correlated differential methylation and gene expression patterns in BAMSE and INMA, respectively, one of which, HSPG2 (representing 26 genes in common), was identified in both cohorts. HSPG2 (Heparan Sulfate Proteoglycan 2) is known to play an important role in the proinflammatory function of fibrocytes.

Conclusions: By integrating methylation and gene expression data we identified a significant interactome hotspot of epigenetic deregulation, HSPG2, in relation to air pollution exposure. Our study shows the added value of integrating environmental exposure data with multi-omics information to understand biologic responses of exposure.
Effects of Prenatal Air Pollution on Family-Specific, Genome-Wide, Repetitive Element Methylation in Cord Blood

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OPS 48: Air pollution and epigenetics, Room 417, Floor 4, August 26, 2019, 16:30 - 17:30

Background/Objective: Repetitive elements (REs) comprise more than 50% of the genome and methylation suppresses their transpositions (insertions into other genomic regions) that can damage DNA. Global average RE methylation is inversely associated with particulate matter ≤2.5µm (PM2.5) exposure, however, averaging all RE methylation may overlook their biological activity, as RE subfamilies and individual REs vary in methylation. We employed a method predicting genome-wide, RE subfamily-specific, methylation in cord blood and investigated their associations with prenatal PM2.5 exposure.

Methods: Trimester average PM2.5 was estimated using a satellite-based spatio-temporally resolved prediction model and residence location of 443 women from the PROGRESS birth-cohort in Mexico City. We measured cord blood DNA methylation with the Illumina EPICArray using a random forest-based algorithm to predict genome-wide, locus-specific CpG methylation of long interspersed elements-1 (L1) and a short interspersed element (Alu) using nearby CpG sites. We modeled associations between PM2.5 with: 1) methylation of subfamilies within the most recent L1PA and L1PB lineages averaged across the genome; and 2) genomic locus-specific aggregates of 2 or more adjacent RE CpGs from these subfamilies.

Results: We imputed methylation of 1,183 CpG aggregates and 25 subfamilies within the L1PA and L1PB lineages and 69,596 aggregates and 36 Alu subfamilies with mean methylation of 92%. Average methylation of 20 L1 and 35 Alu subfamilies was inversely associated with 2nd trimester PM2.5. Restricting analysis to full-length L1, methylation of L1PA2, L1PA3, L1PA5, and the active element, L1HS, were inversely associated with PM2.5 in the 2nd and 3rd trimester. Investigations of individual CpGs yielded two aggregates associated with PM2.5 after multiple comparison corrections.

Conclusions: Reduced RE subfamily methylation may promote transpositions and cell toxicity that could be related to health endpoints such as cancer. Future work will investigate RE expression and whether RE methylation/expression mediate relationships between PM2.5 exposure and health.
Background. Air pollution is associated with numerous adverse health outcomes. Advanced epigenetic age, estimated using DNA methylation, may be a marker of biological consequences of prolonged air pollution exposure.

Methods. In a sample of non-Hispanic white women ages 35-74 living in the contiguous U.S. (n=2,764), we estimated annual average ambient residential levels of PM2.5, PM10 and NO2 using a model combining land-use regression and kriging fit to regulatory monitoring data. Predictive k-means was used to assign participants to one of 7 clusters that corresponded to different relative combinations of PM2.5 components. We measured DNA methylation (DNAm) in blood samples using the Illumina’s Infinium HumanMethylation450 BeadChip and calculated DNAm age using the Levine/PhenoAge clock. Age acceleration was derived by regressing DNAm age on chronological age and calculating the residuals. Using linear regression models accounting for blood cell composition, we estimated adjusted associations between an interquartile range (IQR) increase in pollutants and age acceleration. We stratified the associations for PM2.5 by component cluster membership.

Results. Higher age acceleration was observed for PM10 (β=0.24, 95% CI: 0.03, 0.46) but not for NO2. For PM2.5, we observed heterogeneity by component cluster membership (p for interaction=0.001). PM2.5 was associated with an almost 4-year higher age acceleration in a cluster characterized by higher relative fractions of crustal elements Si, Ca, K and Al (β=3.96, 95% CI: 0.72, 7.20), and an almost 2-year higher age acceleration in a cluster characterized by low sulfur fractions relative to overall PM2.5 (β=1.94, 95% CI: 0.41, 3.46). In contrast, PM2.5 was inversely associated with age acceleration in a cluster distinguished by low relative nitrite concentrations (β=-1.84, 95% CI: -3.19, -0.48).

Conclusions. Air pollution was associated with epigenetic age, a marker of mortality and disease risk, with heterogeneity in the association between PM2.5 and epigenetic age acceleration by particulate matter composition.
OPS 51: Air pollution and mortality: what’s new?
Natural and cause-specific mortality and low-level air pollution in a pooled cohort of 392,826 participants in Europe: the ELAPSE project

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OPS 51: Air pollution and mortality: what’s new?, Beatrix theater, August 26, 2019, 16:30 - 17:30

Background/Aim
Cohort studies have consistently found associations between long-term exposure to outdoor air pollution and morbidity and mortality endpoints. Recent evaluations by WHO and GBD suggest these associations may be non-linear and persist at very low concentrations. The aim of this study was to investigate the associations between low-level air pollution and mortality in a pooled European cohort.

Methods
We pooled data from nine ongoing European cohorts with 392,826 participants. We assessed residential exposure to air pollution as annual 2010 mean concentrations of PM2.5, NO₂, O₃ and BC, based on Europe-wide hybrid land use regression models at 100 m spatial scale. After harmonizing individual and area-level variables between cohorts, we applied Cox proportional hazard models with increasing adjustment for potential confounders to investigate the association between long-term air pollution exposure and natural and cause-specific mortality. We applied splines to assess the shape of the concentration-response relationship.

Results
The total study population contributed 7,518,024 person-year at risk (average follow-up 19 years). Average air pollution exposure was 15.4 (SD 3.5) µg/m³ for PM2.5, 25.3 (8.2) µg/m³ for NO₂, 1.6 (0.4) *10⁻⁵/m for BC, and 86.2 (9.4) µg/m³ for O₃. A 5 µg/m³ increase in PM2.5 was associated with an HR of 1.13 (95% CI: 1.11, 1.16) for natural mortality and 1.14 (95% CI: 1.10, 1.18) for cardiovascular mortality. A 10 µg/m³ increase in NO2 was associated with an HR of 1.09 (95% CI: 1.07, 1.12) for natural mortality, 1.10 (95% CI: 1.04, 1.17) for respiratory mortality. Associations of PM2.5 and NO₂ with natural and cardiovascular mortality were stable in two-pollutant models.Splines did not indicate strong deviation from linearity.

Conclusions
Long-term exposure to PM2.5 and NO₂ was associated with natural and cause-specific mortality, even at low concentrations in Europe.
Nonlinear associations between low levels of fine particulate matter and mortality across three cycles of the Canadian Census Health and Environment Cohort

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OPS 51: Air pollution and mortality: what’s new?, Beatrix theater, August 26, 2019, 16:30 - 17:30

Background: Ambient fine particulate matter (PM2.5) is an important contributor to the global burden of disease. An element critical to these estimates, and to air quality standards, is information on the shape of concentration-response relationships at low concentrations. In the largest population-based air pollution cohort ever constructed, we examined the concentration-response relationship between PM2.5 and non-accidental mortality in a new Canadian Census Health and Environment Cohort that combines the 1991, 1996, and 2001 Canadian census cycles linked to mobility and mortality data.

Methods: We linked individual census responses with death records through 2016, resulting in a cohort of approximately 8.5 million adults who contributed 151 million person-years, and 1.5 million deaths. Using annual place of residence, we assigned time-varying contextual variables and annual average exposures to ambient PM2.5 at a 1 km x 1 km spatial resolution from 1981 to 2016. We ran log-linear Cox proportional hazards models for PM2.5 with eight subject-level indicators of socioeconomic status, seven contextual covariates, and O\textsubscript{3} and NO\textsubscript{2}. We ran a nonlinear model-fitting routine (the shape constrained health impact function, SCHIF) to examine the shape of the concentration-response relationship at PM2.5 levels below 20 \textmu g/m\textsuperscript{3}.

Results: The mean three-year annual average PM2.5 concentration was 7.4 \textmu g/m\textsuperscript{3} over all person-years of follow-up. We estimated an ensemble hazard ratio for non-accidental mortality of 1.045 (95% CI: 1.037-1.054) for a 10 \textmu g/m\textsuperscript{3} change in PM2.5. We observed a sublinear concentration-mortality curve predicted by the SCHIF model that results in a 1.063 (95% CI: 1.052-1.073) hazard ratio for a change in concentration from 5 to 15 \textmu g/m\textsuperscript{3}. We found little increase in risk below 5 \textmu g/m\textsuperscript{3}.

Conclusions: In this very large population-based cohort with up to 25 years of follow-up, PM2.5 was associated with non-accidental mortality at concentrations as low as 5 \textmu g/m\textsuperscript{3}.
Background and Aims:
Latin America is one of the most urbanized areas of the world with nearly 80% of the population living in cities. Despite its benefits, this concentration of population in cities also increases exposures to pollutants related to urban activity. We examined levels and trends of PM2.5; patterns of population exposure by age, gender and socioeconomic status; disparities in exposure; and association of PM2.5 concentration with city characteristics and effects on mortality.

Methods:
Ground level annual PM2.5 from satellite-based observations was available in 2015 for 371 cities with greater than 100,000 residents and 1436 sub-city units across 11 countries in Latin America that comprise the SALURBAL Project (https://drexel.edu/lac/salurbal/overview/). Mortality, socio-demographic and built environment variables (patch density, intersection density, travel delay, density of subway, Bus Rapid Transit or other public transit, and area greenness) were examined using simple descriptive statistics and hierarchical linear mixed models.

Results:
Together, the included cities have approximately 300 million residents. Nearly 40% of the cities have mean PM2.5 concentration above the World Health Organization Air Quality Guidelines (AQG) (62% in Chile and 13% in Central America). Approximately 172 million people (including 12 million children aged 0-4) are potentially at risk for developing health problems due to AQG violations. There were no differences in exposure by gender and only small differences by SES. The elderly were proportionally more exposed. Levels of air pollution were associated with some built and socioenvironmental variables. From adjusted models we observed an increase of 1.5 (0.3 to 2.6) and 0.4 (0.1 to 0.8) in the mortality rate per 1.000.000 people for cardiovascular and respiratory diseases, for 1µg/m3 increase in mean PM2.5.

Conclusions:
High levels of air pollution exist in Latin America, are associated with city-level built and social environment characteristics, with detectable effects on mortality.
Long-term exposure to ultrafine particles and cause-specific mortality in the Rome Longitudinal Study

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OPS 51: Air pollution and mortality: what’s new?, Beatrix theater, August 26, 2019, 16:30 - 17:30

Background/Aim
Few studies evaluated the association between long-term exposure to ultrafine particles (UFP) and mortality. We aimed to study the association between UFP and mortality in a large administrative cohort (Rome Longitudinal Study, RoLS) and to evaluate whether the role of UFP is independent of other exposures.

Methods
We selected 1,009,434 30+ year olds living in the Rome urban area, and we followed them from 2001 to 2013. We used land use regression models for PNC (particle number concentrations) as proxy for UFP, NO2, PM2.5, PM2.5 absorbance (as proxy for soot), and zinc component of PM2.5 (as proxy for non-tail-pipe emissions). We used the acoustic model SoundPLAN7.4 to assess road traffic noise indicators (Lden, Lnight). All exposures were attributed to the residential address of each subject. We analyzed non-accidental, cardiovascular, and ischemic heart disease (IHD) mortality. We applied Cox proportional hazard models adjusted for age, sex, education, place of birth, marital status, occupation, area-level socioeconomic position. We performed single-pollutant and two-pollutant models.

Results
The average population exposure was 16,014 (interquartile range, iqr=2,659) \( n/cm^3 \) PNC, 47 (iqr=8) \( \mu g/m^3 \) NO2, 20 (iqr=2) \( \mu g/m^3 \) PM2.5, 2.8 (iqr=0.3) 10−5/m PM2.5-absorbance, 25 (iqr=3.4) ng/m3 PM2.5-Zn, 61 (iqr=11) dB. The correlation between UFP and the other exposures ranged from 0.45 (UFP-noise) to 0.61 (UFP-PM2.5). We observed 166,787 deaths for non-accidental causes, 69,034 for cardiovascular causes, and 25,092 for ischemic heart disease. We estimated an increase in non-accidental (Hazard Ratio [HR]=1.010, 95%CI:1.004-1.016), cardiovascular (HR=1.029, 95%CI:1.020-1.038), and IHD (HR=1.032, 95%CI:1.016-1.047) mortality, per iqr increments in PNC. Results were robust to adjustment for all other exposures for cardiovascular and IHD mortality. For non-accidental mortality, adjustment for NO2 and PM2.5-absorbance substantially decreased the PNC effect estimates.

Conclusions
We found an effect of UFP exposure on cardiovascular mortality independent of the concomitant exposure to other air pollutants and traffic noise.
Although much is known about the radiation-related risk of thyroid cancer in those exposed at young ages, less is known about the risk due to adult exposure. Among Japanese atomic bomb survivors and in some other higher dose groups there is little or no statistical evidence of a radiation dose-response for thyroid cancer among those exposed in adulthood. In contrast, a strong and significant dose-response was found in a case-control study of Belarusian, Russian and Baltic clean-up workers exposed as a result of the 1986 Chernobyl nuclear power plant accident. To improve the characterization of thyroid cancer risk following adult exposure, we conducted a nested case-control study (149 cases; 458 controls) in Ukrainian clean-up workers. Individual thyroid doses due to external irradiation, inhalation during the cleanup mission, and intake of I-131 during residence in contaminated settlements were calculated for all study subjects (total dose mean 199 mGy; range 0.15 mg to 9 Gy). Our preliminary findings suggest a non-significantly increased total radiation dose-response for thyroid cancer (excess relative risk [ERR]=0.40; 95% confidence interval: -0.05, 1.48; p=0.12). Time since exposure significantly modified this association so that less time since exposure was associated with a higher ERR/Gy. Further analyses are being conducted to characterize the dose-response relationships according to source of exposure and histological subtype.
Brain tumor risk after exposure to medical ionizing radiation: results from the MOBI-kids study

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OPS 26: Radiation, EMF, cancer and mortality, Room 114, Floor 1, August 26, 2019, 16:30 - 17:45

Background/Aim
We explored the association of cumulative ionizing radiation (IR) exposure from medical procedures during prenatal and postnatal life with brain cancer risk in the MOBI-kids study.

Methods
MOBI-kids is an international (Australia, Austria, Canada, France, Germany, Greece, India, Israel, Italy, Japan, Korea, New-Zealand, Spain, The-Netherlands) case-control study of 899 brain tumour cases and 1910 controls, 10 to 25 years. Medical radiological history was collected through a personal interview, including exposure of the mother during pregnancy. In radiation epidemiology, the exposure measure is the absorbed dose to the target organ. Through a literature review, we collected values of the brain absorbed dose during each examination by age and time-period. We calculated the cumulative IR dose to the brain for each subject by summing over the dose assigned to each procedure. Conditional logistic regression models were used for risk estimation with a lag-period of two years to exclude procedures due to the current cancer. Presence of neurological, mental and genetic condition was taken into account as confounders. Analyses were conducted on 645 neuroepithelial cases and 1700 matched controls (sex, age, country).

Results
Overall, the doses were very low (median 0.02 mGy). We did not observe an increase of risk for postnatal exposure of 5-30 mGy, 30-50 mGy, and 50-100 mGy categories (totally 44, 117, 37 subjects respectively) when compared to the 2110 subjects in the 0-5 mGy category. The Odds Ratio for a postnatal exposure above 100 mGy was 1.63 (CI: 0.44; 6.00; 11 subjects) and for a prenatal exposure above 5 mGy was 1.55 (CI: 0.57, 4.23; 20 subjects).

Conclusions
The majority of participants were exposed to very low dose, thus the statistical power was low. We found little evidence of an association between prenatal and postnatal exposure to medical IR and neuroepithelial brain cancer risk in children and adolescents.
Residential radon exposure and all-cause mortality risk among Medicare beneficiaries

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OPS 26: Radiation, EMF, cancer and mortality, Room 114, Floor 1, August 26, 2019, 16:30 - 17:45

Background: Radon is an inert gas formed from the decay of naturally-occurring materials in the earth’s crust. It infiltrates into homes from soil, water, and construction materials. Its decay products are radionuclides, which attach to ambient particles. Residential radon is one of the leading risk factors for lung cancer. An association between radon exposure and other mortality causes is biologically plausible and may be related to inflammatory and oxidative damage. Although radon exposure has been found to be related to non-respiratory malignant and nonmalignant mortality, the evidence is scarce and inconsistent.

Methods: In a cohort study with 14 years of follow-up (2000-2013), we evaluated the association between chronic radon exposure and all-cause mortality, and explored whether there are subpopulations who are more vulnerable to radon effects. We included 87,296,195 person-years of follow-up from all Medicare beneficiaries in the Mid-Atlantic and Northeastern U.S. states. We obtained county mean radon levels, modeled by the Lawrence Berkeley National Laboratory (LBL). We examined the association between the natural logarithm of county-averaged radon (ln(Rn)) and mortality and assessed effect modification by chronic conditions. We adjusted the models for race, sex, age, chronic conditions, neighborhood socioeconomic characteristics and percent smokers, and fine particulate matter.

Results: An interquartile range increase in the ln(Rn) was associated with a 2.62% increase (95%CI 2.52%;2.73%) in mortality, independent of PM2.5 exposure. Larger mortality risks were observed among individuals with respiratory, cardiovascular and metabolic diseases, with the highest associations observed among those with diabetes (4.98% increase), heart failure (4.58% increase), and chronic obstructive pulmonary disease (4.49% increase).

Conclusion: We found an increased risk for all-cause mortality associated with increased radon exposure. The risk was enhanced among susceptible individuals with chronic conditions. We believe this is the first cohort study to identify populations at higher risk for non-malignant health consequences of radon exposure.
Modelling the cumulative effective dose to a population after a nuclear power plant accident under different scenarios

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OPS 26: Radiation, EMF, cancer and mortality, Room 114, Floor 1, August 26, 2019, 16:30 - 17:45

Background/Aim: The radiological consequences of a large radionuclide release from a nuclear power plant (NPP) accident will depend on the mitigating actions applied soon after the fallout. The aim was to develop a model for the prediction of the cumulative effective dose 50 years post-accident (CED50), including both external and internal dose, primarily using the ground deposition of 137Cs (Aesd) immediately after fallout. The Aesd can relatively easy be quantified by airborne surveys and therefore useful for early forecasts of CED50.

Methods: Swedish data were used from: a) several time series measurements of the ambient dose equivalent rate 1 meter above ground, b) air filter measurements from fixed continuous air gamma rate monitoring stations, c) high-resolution gamma spectrometry, d) an aerial survey of ground deposition of 137Cs, and e) radioecological transfer factors based on whole body monitoring of the general population and hunters, respectively.

Results: Compared to the standard scenario with an average Aesd of 15 kBq m\textsuperscript{-2} and a transfer factor of 11.0 Bq kg\textsuperscript{-1} per (kBq m\textsuperscript{-2}) a total of 12 different scenarios were calculated. The scenarios include different combinations of outdoor occupancy, shielding factors, radioecological transfer, relocation and food restrictions. The CED50 per unit 137Cs deposited ranged from 0.14 mSv per kBq m\textsuperscript{-2} to 1.5 mSv per kBq m\textsuperscript{-2}, depending on the mitigating actions applied. The sensitivity analysis showed that the most important parameters for the CED50 were the correlation factor between the local areal deposition of 137Cs and the maximum initial ambient dose rate, the maximum transfer from local fallout on the ground to body burden, the local areal deposition of 137Cs, and the county average 137Cs deposition.

Conclusions: This model allows quantification of CED50, both the external and the internal effective dose, using only Aesd after a NPP accident under different mitigation strategies.
EMF exposure and non-specific physical symptoms: a new approach of studying ‘electrosensitivity’

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Background/Aim
Some people attribute non-specific physical symptoms (NSPS) such as headache and fatigue to exposure to radiofrequency electromagnetic fields (RF-EMF). Most studies into exposure-response associations in electrosensitivity were short-term laboratory studies, only suitable to detect symptoms elicited by acute exposure. We will present the results from two studies with an ambulatory design using body worn exposimeters and electronic diaries that aimed to analyse exposure-response relationships in self-declared electrosensitive persons both at a group and individual level.

Methods
In study 1, seven participants registered NSPS and perceived RF-EMF exposure in an electronic diary daily at three set times for a period of three weeks. During the same period personal exposure was monitored using exposimeters. A second study including 57 participants used a similar design but the study period was five days and diaries were completed at quasi-random times with 2-3 hour intervals. Associations between EMF exposure and NSPS were analysed using ARIMA and (linear) mixed models.

Results
In study 1, we found statistically significant associations between perceived and actual exposure to WiFi and base stations for mobile telecommunications and NSPS scores in four participants. In two persons a higher EMF exposure was statistically significantly associated with higher symptom scores, and in two other persons it was associated with lower scores. Strengths of the associations were in the order of a 0.4 to 0.9 increase or decrease in symptom scores (on a five-point scale) for an increase of 2 standard deviations in EMF exposure. In study 2, at group level, there was no statistically significant association between EMF exposure and NSPS. Analyses at an individual level are ongoing and will be presented at the conference.

Conclusions
RF-EMF exposure was associated either positively or negatively with NSPS in some but not all of the selected self-declared electrohypersensitive persons.