ISES 2022 Annual Meeting

From Exposure to Human Health: New Developments and Challenges in a Changing Environment

ANNUAL MEETING LISBON22
INTERNATIONAL SOCIETY of Exposure Science

Abstract Book

INTERNATIONAL SOCIETY OF EXPOSURE SCIENCE ISES

SEPTEMBER 25-29, 2022

2022 MEETING CO-CHAIRS

Marina Almeida-Silva

Dr. Almeida-Silva received the Environmental Health degree from Lisbon School of Health Technology (ESTeSL) in 2010. In 2016, Marina received the Ph.D. degree in Environmental Sciences by TUDelft. She is currently Assistant Professor in Lisbon School of Health Technology (ESTeSL), Lisbon, Portugal and Member of Coordinator Commission from Health and Technology Research Center (H&TRC).

Susana Viegas

Dr. Viegas is professor and researcher in National School of Public Health, Public Health Research Centre from NOVA University of Lisbon. Susana Viegas has a PhD in Public Health (National School of Public Health) and also an academic background in Toxicology (Surrey University), Occupational Health (Lisbon University) and Environmental Health (Lisbon School of Health Technology).

Prof. Viegas lectures on Environmental and Occupational Health and coordinates several research projects on occupational toxicology, exposure assessment (using air and surfaces monitoring and biomonitoring tools) and risk assessment.

Urs Schlüter

Dr. Urs Schlüter is head of the unit Exposure Scenarios at the Federal Institute for Occupational Safety and Health (BAuA) which is the German Competent Authority for the REACH and Biocides regulations. He leads a unit of 20 scientists and engineers who perform the regulatory exposure assessments for workplaces in the framework of the European REACH and the Biocides regulation. Urs Schlüter is a chemist by training who studied at the universities of Dortmund, Münster and Raleigh (NC).

TECHNICAL ORGANIZING COMMITTEE

Miguel Brito | Lisbon School of Health Technology (ESTeSL)

Marlene Dietz | Federal Institute for Occupational Safety and Health (BAuA)

Rima Habre | University of Southern California

Dorothea Koppisch | Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA)

Jessica Meyer | Federal Institute for Occupational Safety and Health (BAuA)

Wouter ter Burg | National Institute for Public Health and the Environment (RIVM)

Devan Campbell | University of Georgia

Christine Ekenga | Emory University

Stefan Hahn | Fraunhofer ITEM

Donghai Liang | Emory University

Andrea Spinazze | Università degli Studi dell'Insubria

Kai Zhang | University at Albany, State University of New York

Alison Connolly | National University of Ireland Galway (NUIG)

Karen Galea | Institute of Occupational Medicine (IOM)

Peng Gao | University of Pittsburgh

James Hanlon | Institute of Occupational Medicine (IOM)

Lisa Melnyk | United States Environmental Protection Agency (EPA)

Jan Urbanus | Shell

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ANNUAL MEETING SEPTEMBER 25TH-29TH, 2022

INTERNATIONAL SOCIETY OF EXPOSURE SCIENCE

SUNDAY 9.25 SCHEDULE-AT-A-GLANCE

8:30AM – 12:30PM	**Pre-Conference Workshop** **Auditorium II** Techniques of Sample and Analysis of Biological Aerosols *Additional Fee Required*
8:30AM – 12:30PM	**Pre-Conference Workshop** **Auditorium III** Improving Task-Based Exposure Assesment Accuracy Using The Structured Deterministic Model (SDM) 2.0 – Session 1 *Additional Fee Required*
8:30AM – 12:30PM	**Pre-Conference Workshop** **Sala 1** Modeling Of Consumer Aggregate Exposure Using ConsExpo and PACEM *Additional Fee Required*
12:30PM – 5:00PM	**Presentation Preparation** **Sala 5** *Speakers can visit the presentation preparation location to test and submit their presentations. Please have final presentations prepared and ready to submit. You can submit your presentations online.*
1:00PM – 4:00PM	**ISES Board of Directors Meeting** **Sala 4** INVITE ONLY
1:30PM – 5:30PM	**Pre-Conference Workshop** **Auditorium II** Stoffenmanager®: A Validated and Regulatory Accepted Chemical Workplace Exposure Management Tool Combining Latest Exposure Intelligence and Smart It *Additional Fee Required*
1:30PM – 5:30PM	**Pre-Conference Workshop** **Auditorium III** Improving Task-based Exposure Assessment Accuracy Using The Structured Deterministic Model (Sdm) 2.0 – Session 2 *Additional Fee Required*
1:30PM – 5:30PM	**Pre-Conference Workshop** **Sala 1** Strategies For Enhancing Peer Review From An Editor's Perspective *Additional Fee Required*
6:00PM – 7:00PM	**Welcome & Opening Plenary** **Auditorium I**
7:00PM – 8:30PM	**Welcome Reception** **Entrance Canopy** *Join your fellow attendees to kick off the 2022 Annual Meeting. We will host a short reception to include light food and drinks. Entertainment will also be included. We look forward to networking with everyone to start the beginning of a great meeting.No cost to participate, included in your registration fee.*

View the full program schedule and stay up to date throughout the event here!

SCAN ME

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ANNUAL MEETING SEPTEMBER 25TH-29TH, 2022

MONDAY 9.26 SCHEDULE-AT-A-GLANCE

8:00AM – 9:00AM **Coffee Service** Auditorium I

8:00AM – 9:00AM **New Attendee Gathering** Sala 4
It's Monday morning and the start of a great meeting! Join other new attendees to network and ask questions. Mentors and other tenured ISES members will be present to guide and answer questions.

9:00AM – 9:50AM **General Session** Auditorium I

10:00AM – 11:00AM **Oral Presentations**

Biomonitoring Of Plasticisers • **Auditorium I**
Household Air Pollution Intervention Network (HAPIN) • **Auditorium II**
Occupational Metal Exposure • **Auditorium III**
Indoor Exposure By Dust • **Sala 1**
Occupational Exposure Modeling – Session 1 • **Sala 2**
Exposure To Biological Agents • **Sala 3**
Open Forum: Global Positioning System Use In Human Health Studies • **Sala 5**

Poster Viewing and Break 11:00 – 11:30 AM

11:30AM – 12:30PM **Oral Presentations**

Occupational Biomonitoring – Session 1 • **Auditorium I**
PM2.5 In Households • **Auditorium II**
Environmental Health and Meals • **Auditorium III**
COVID-19 • **Sala 1**
Tobacco Smoking • **Sala 3**

12:30PM – 2:00PM **Lunch** Entrance Canopy

12:30PM – 2:00PM **Diversity, Equity and Inclusion Gathering** Sala 4
Diversity, Equity and Inclusion Gathering: The ISES Diversity Committee is hosting an informal discussion regarding the topics of diversity, equity and inclusion related to the field of exposure science. This will be a friendly and welcoming environment for anyone interested in joining this discussion.

2:00PM – 3:30PM **Symposiums**

The Results Of HBM4EU – Science To Support Policy – Part 1 • **Auditorium I**

Inhalational Exposures From Novel Nicotine and Cannabis E-Cigarette/Vape Devices – Part 1: Overview and Product Analysis/Emissions • **Auditorium II**

Chronic Kidney Disease Of Non-traditional Etiology: Risk Factors, Exposures, and Outcomes Across The Life Course • **Auditorium III**

Challenges Related To The New European Occupational Exposure Limit Values For Nickel – Sampling, Analysis and Exposure Assessment • **Sala 1**

The Use Of Low-Cost Sensors For Occupational Exposure: Making Sense Of Sensor Data • **Sala 2**

Meaningful Health Risk Communication To Improve Safe Working With Hazardous Substances • **Sala 3**

Poster Viewing and Break 3:30 – 4:00 PM

SEE BACK FOR MORE TIMES, SESSIONS AND INFORMATION »

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ANNUAL MEETING SEPTEMBER 25TH-29TH, 2022

MONDAY 9.26 SCHEDULE-AT-A-GLANCE

3:30PM – 4:00PM — **Soapbox Meeting** **Sala 4**

4:00PM – 5:30PM — **Symposiums**

The Results Of HBM4EU – Science To Support Policy – Part 2 • **Auditorium I**

Inhalational Exposures From Novel Nicotine and Cannabis E-Cigarette/Vape Device – Part 2: Biomarkers Of Exposure • **Auditorium II**

Cefic-LRI Programme On Exposure Research and Implementation Under Chemicals Control Legislation • **Auditorium III**

Biological Agents Risk Assessment: How To Close The Gap Between Science, Policy Making and Occupational Health and Safety Practice? • **Sala 1**

Exposure To Poor Air Quality On Global Subway and Metro Systems – Understanding Sources, Quantifying Health Impacts, Developing Solutions & Transferring Knowledge • **Sala 2**

Evaluation Of Indoor Exposome: From Exposure Assessment and Source Identification To Health Effects • **Sala 3**

5:30PM – 7:00PM — **Women's Networking Event** **Off Site**

5:30PM – 6:30PM — **Presentation Preparation** **Sala 5**

Speakers can visit the presentation preparation location to test and submit their presentations. Please have final presentations prepared and ready to submit. You can submit your presentations online.

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INTERNATIONAL SOCIETY OF EXPOSURE SCIENCE

TUESDAY 9.27 SCHEDULE-AT-A-GLANCE

8:00AM – 8:30AM	**Coffee Service** Auditorium I
8:30AM – 9:20AM	**General Session** Auditorium I
9:30AM – 11:00AM	**Symposiums** HBM4EU Occupational Studies • Auditorium I Working Together To Improve Sampling In Workplace Aerosol Exposure Assessment Methodologies • Auditorium II Applying A Scientific Workflow To Estimate Exposure To Emerging Contaminant Scenarios • Auditorium III Data As Essential Elements For Developing, Calibrating and Evaluating Dermal and Oral Occupational Exposure Models • Sala 1 European Exposure Science Strategy 2020–2030: From Education, Data and Methods To Informing Stakeholders – Part 1 • Sala 2 Air Pollution Due To Traffic – Session 1 • Sala 3 *Poster Viewing and Break 11:00 – 11:30 AM*
11:00AM – 11:30AM	**Soapbox Meetings** Sala 4
11:30AM – 12:30PM	**Oral Presentations** Influence Of Exposure To Specific Diseases • Auditorium I Biomonitoring Of Children's Exposure • Auditorium II Urban PM2.5 Exposure • Auditorium III Multiple Occupational Exposures • Sala 1 Consumer Biomonitoring Of Organic Pollutants – Session 1 • Sala 2 New and Emerging Environmental Exposures – Session 1 • Sala 3 *Poster Viewing and Break 11:00 – 11:30 AM*
12:30PM – 2:00PM	**ISES i-HBM Working Group** Sala 5 INVITE ONLY
12:30PM – 2:00PM	**European WG Education, Training and Communication** Sala 4 INVITE ONLY
1:00PM – 2:00PM	**Oral Presentations** Citizen Science and Community-Engaged Research • Auditorium I PM2.5 Modeling For Household Exposures • Auditorium II Nutrition Exposure • Auditorium III Application Of Sensors In Occupational Exposure Assessment • Sala 1 Consumer Biomonitoring Of Organic Pollutants – Session 2 • Sala 2 New and Emerging Environmental Exposures – Session 2 • Sala 3
2:00PM – 3:00PM	**Presentation Preparation** Sala 5 *Speakers can visit the presentation preparation location to test and submit their presentations. Please have final presentations prepared and ready to submit. You can submit your presentations online.*
3:00PM – 9:00PM	**Lisbon Tour & Dinner** Off Site – *Pre-Registration & Fee Required*

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WEDNESDAY 9.28 SCHEDULE-AT-A-GLANCE

8:00AM – 8:30AM	**Coffee Service** Auditorium I
8:00AM – 9:20AM	**EHP's Meet The Editors Morning Coffee** Sala 4 INVITE ONLY
8:30AM – 9:20AM	**General Session** Auditorium I
9:20AM – 11:00AM	**European Chapter Board Meeting** Sala 4 INVITE ONLY
9:30AM – 11:00AM	**Symposiums** Integrating Exposure Science and Human Health Data Amidst Disasters and A Changing Climate: Application To Wildfires • **Auditorium I** ISES i-HBM Working Group Symposium: Strategy For Translating Human Biomonitoring Data To Policy Making • **Auditorium II** The Urban Exposome and Climate Change • **Auditorium III** What The F? Implications Of PFAS Definitions For Exposure Science and Regulation • **Sala 1**
9:30AM – 11:00AM	**Oral Presentations** Indoor Exposure Of Children Session • **Sala 2** Air Pollution Due To Traffic – Session 2 • **Sala 3** *Poster Viewing and Break 11:00 – 11:30 AM*
11:00AM – 11:30AM	**Soapbox Meeting** Sala 4
11:30AM – 12:30PM	**Symposiums** European Exposure Science Strategy 2020–2030: From Education, Data and Methods To Informing Stakeholders – Part 2 • **Auditorium I** Equity In Exposure Sciences: Just The Beginning • **Auditorium II** Methods In Heat Exposure Assessment In Community and Occupational Based Research • **Auditorium III**
11:30AM – 12:30PM	**Oral Presentations** PM2.5 Exposure • **Sala 1** Prenatal Exposure • **Sala 2** Occupational Exposure Modeling – Session 2 • **Sala 3**
12:30PM – 2:00PM	**Lunch** Entrance Canopy
2:00PM – 3:30PM	**Oral Presentations** Environmental Justice • **Auditorium I** Indoor Exposure • **Auditorium III** Exposure Assessment For Agricultural Settings • **Sala 1** Biomonitoring For Metals • **Sala 2** Statistical Methods In Biomonitoring • **Sala 3** Use Of "Big Data" In Exposure Science • **Sala 5**
2:00PM – 3:30PM	**ART Consortium** Sala 4 INVITE ONLY *Poster Viewing and Break 3:30 – 4:00 PM*
4:00PM – 5:00PM	**ISES Membership Meeting** Auditorium I *All members of ISES are encouraged to attend and participate in this annual meeting to hear about updates and new initiatives related to the future of ISES. Beverages will be provided! Join us!*
5:00PM – 6:00PM	**Sensor Technology Fair** Auditorium II
5:00PM – 6:00PM	**Committee Fair** Auditorium III
5:00PM – 6:00PM	**Presentation Preparation** Sala 5 *Speakers can visit the presentation preparation location to test and submit their presentations. Please have final presentations prepared and ready to submit. You can submit your presentations online.*
6:00PM – 7:00PM	**Europe Chapter Social** Entrance Canopy

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ANNUAL MEETING SEPTEMBER 25TH-29TH, 2022

THURSDAY 9.29 SCHEDULE-AT-A-GLANCE

8:00AM – 8:30AM	**Coffee Service** Auditorium I
8:30AM – 9:20AM	**General Session** Auditorium I
9:30AM – 10:30AM	**Sensor Technology Fair** Auditorium II
9:30AM – 10:30AM	**Oral Presentations** Results From Biomonitoring Cohorts • Auditorium I PFAS Exposure – Session 1 • Auditorium III Application Of Sensors • Sala 1 Silicone Samplers • Sala 2 Multiple Exposures and Interactions For Health – Session 1 • Sala 3 Urban Air Pollution – Session 1 • Sala 5
9:30AM – 11:00AM	**European WG Exposure Modelling** Sala 4 INVITE ONLY *Poster Viewing and Break 10:30 – 11:00 AM*
11:00AM – 12:00PM	**Sensor Technology Fair** Auditorium II
11:00AM – 12:00PM	**Oral Presentations** Exposure Data In Policy Action • Auditorium I PFAS Exposure – Session 2 • Auditorium III Occupational Biomonitoring – Session 2 • Sala 1 Multiple Exposures and Interactions For Environmental Health – Session 2 • Sala 2 Urban Air Pollution – Session 2 • Sala 3
11:00AM – 12:30PM	**European WG Human Biomonitoring** Sala 4 INVITE ONLY *Poster Viewing and Break 12:00 – 12:30 PM*
12:30PM – 2:00PM	**Annual Award Ceremony** Auditorium I

View the full program schedule and stay up to date throughout the event here!

SCAN ME

THANK YOU FOR ATTENDING THE ISES 2022 ANNUAL MEETING!

PLENARY SPEAKERS

Dr. Andrea Baccarelli

Leon Hess Professor, Chair of Environmental Health Sciences, Columbia University

Presented: Tuesday 27th

Topic: Development of New Epigenomic Biomarkers to Aid in Identifying the Impact of Environmental Exposures on our Bodies

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Dr. Mary Schubauer-Berigan

Head, Monographs Programme, International Agency for Research on Cancer

Presented: Wednesday 28th

Topic: The IARC Monographs Programme of Cancer Hazard Identification

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Dr. Yuri Bruinen de Bruin

Project Manager, EU-OSHA

Presented: Monday 26th

Topic: The European Exposure Science Strategy with a roadmap 2020-2030

Dr. Annette Guiseppi-Elie

Action National Program Director for Chemical Safety and Sustainability

Presented: Tuesday 27th

Topic: Opportunities for Exposure Science to Inform Decisions at the Nexus of Climate Change and Environmental Justice

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Dr. Mai Anh Luong

Associate Professor, Deputy Director, Health Environment Management Agency, Ministry of Health of Viet Nam

Presented: Wednesday 28th

Topic: Occupational Health in Vietnam, Challenges & Opportunities for Collaboration

Dr. Paul Scheepers
Associate Professor, Radboudumc

Presented: Monday 26th
Topic: The European Exposure Science Strategy with a roadmap 2020-2030

Dr. Elke Schneider
Senior OSH and Policy Expert, Directorate, EU-OSHA

Presented: Monday 26th
Topic: EU-OSHA¬Worker exposure survey on cancer risk factors at work

Dr. Carla Viegas
Professor and Researcher

Presented: Sunday 25th
Topic: Microbiologic exposure assessment in different occupational and indoor settings

Dr. Athanasios Gkrillas
Risk Assessor for Dow Chemical Company

Presented: Sunday 25th
Topic: Microbiologic exposure assessment in different occupational and indoor settings

ISES 2022 Excellence in Exposure Science Award

Dr. Dana Barr
Professor, Department of Environmental Health
Rollins School of Public Health, Emory University, Atlanta, GA

The ISES Board has established a new award to recognize individuals who have left an indelible mark in the field of exposure science. This award is inspired by the work of visionary individuals who have helped shape the field of exposure science and who supported the origins and growth of the ISES and have now passed on but left a strong legacy.

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Conjoint application of phosphate and vermicompost under alternate wet and drying reduces arsenic loading in rice grain

Rahul Mishra[1,2], Siba Prasad Datta[3], Debasis Golui[4,5], M. C. Meena[6], B. S. Dwivedi[7]
[1]ICAR-Indian Agricultural Research Institute, New Delhi, India, Student. [2]ICAR- Indian institute of Soil science, Bhopal, India, Scientist. [3]ICAR-Indian Agricultural Research Institute, Professor. [4]ICAR-Indian Agricultural Research Institute, New Delhi, India, Scientist. [5]North Dakota State University, Fargo, ND, USA, Scientist. [6]ICAR-Indian Agricultural Research Institute, New Delhi, India, Senior Scientist. [7]ICAR- National Bureau of Soil Survey and Land Use Planning, Nagpur, India, Director

Abstract

Arsenic (As) contamination of soil and subsequent entry into the food chain affect human health in Nadia, India. As a result, developing a low-cost, labor-intensive, and simply implementable strategy to prevent As entering into human food chain is critical to protecting human health from As exposure. In this study, effect of flooding (W1), alternate wet and drying (W2) in combination with phosphate (P1: 0 kg ha-1, P2: 60 kg ha-1 and P3: 120 kg ha-1) and vermicompost (C1: 0 t ha-1, C2: 5.0 t ha-1 and C3: 10.0 t ha-1) application on the rice grain As accumulation were evaluated. The W2 reduced As in pore water and redistributed into less labile fractions. Arsenic content in rice grain under P1, P2 and P3 were 0.38, 0.23 and 0.25 mg kg-1, respectively, whereas under C1, C2 and C3 were 0.32, 0.28 and 0.27 mg kg-1, respectively. Lowest value of grain As was observed under W2 with a treatment combination of C2P2. Uptake of As in plant was 77.7 and 23.4 µg pot-1 under W1 and W2, respectively while under graded dose of phosphate and vermicompost range from 58.2 to 37.4 µg pot-1 and 47.4 to 52.7µg pot-1, respectively. Risk to human health in terms of hazard quotient (HQ) for the dietary intake of As through the consumption of grain was assessed and HQ ranged from 0.30 to 1.50. This experiment showed that lower HQ was observed in W2. In nutshell, combined application of P2 and C2 under W2 reduced grain As content.

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Precision environmental health monitoring by longitudinal exposome and multi-omics profiling

Peng Gao[1,2], Xiaotao Shen[1], Xinyue Zhang[1], Chao Jiang[3], Michael Snyder[4]
[1]Stanford University School of Medicine, Postdoctoral Scholar. [2]University of Pittsburgh School of Public Health, Assistant Professor. [3]Zhejiang University, Principal Investigator. [4]Stanford University School of Medicine, Chairman and Professor

Abstract

Conventional environmental health studies primarily focused on limited environmental stressors at the population level, which lacks the power to dissect the complexity and heterogeneity of individualized environmental exposures. Here we integrated deep-profiled longitudinal personal exposome and internal multi-omics to systematically investigate how the exposome shapes a single individual's phenome as a pilot case study. We annotated thousands of chemical and biological components in the personal exposome cloud and found they were significantly correlated with thousands of internal biomolecules, which was further cross validated using corresponding clinical data. Our results showed that agrochemicals and fungi predominated in the highly diverse and dynamic personal exposome, and the biomolecules and pathways related to the individual's immune system, kidneys, and liver were highly associated with the personal external exposome. Overall, this data-driven longitudinal monitoring study demonstrates the potential dynamic interactions between the personal exposome and internal multi-omics, and the impact of the exposome on precision health by producing abundant testable hypotheses.

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DIETARY SUPLEMENTS BASED ON MACA (*LEPIDIUM MEYENII*) THE SOURCE OF MYCOTOXINS

Iwona Ałtyn[1], Magdalena Twarużek[2]
[1]Kazimierz Wielki University, M.Sc.. [2]Kazimierz Wielki University, Professor

Abstract

Maca (*Lepidium meyenii*) is a biennial plant of the crucifer family (*Brassicaceae*). The analysis showed that is a source of polyunsaturated fatty acids, sterols (β-sitosterol, campesterol, stigmasterol), glucosinolates and macamines - ingredients that improve sexual function. The results of the research have confirmed its effect on fertility, physical fitness and improvement of animal and human health. This plant also shows anticancerogenic, anti-osteoporotic and neuroprotective properties.

The aim of this study was to evaluate mycotoxins contamination of dietary supplements based on maca, available in Poland. The material consisted of 29 samples from various manufacturers and different stores. OTA and AF was determinated using HPLC-FLD method. Trichotecenes and ZEN were determined using HPLC-MS/MS method .

The most frequently detected mycotoxins were OTA and T-2 - 45% and 10%, respectively. 7% of the samples contained DON, MAS and ZEN. The toxin HT-2 was found only in one of 29 tested samples. NIV, DAS, AF were not detected in any of the samples.

The results confirm contamination of mycotoxins in maca.Ingestion of food items contaminated with mycotoxins causes mycotoxicoses. These poisonings, as a result of lifelong accumulation of toxins in human organs, tissues or cells, can not only cause serious and chronic diseases but also lead to death.

Based on our results, it is recommended that producers of dietary supplements should include mycotoxicological analysis in product quality control.

This study was supported by the Polish Minister of Education and Science, under the program "Regional Initiative of Excellence" in 2019 - 2022 (Grant No. 008/RID/2018/19)

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PROFILE OF MOLDS AND CYTOTOXIC EVALUATION OF USED CARS' DUST FILTERS

Magdalena Twarużek[1], Ewelina Soszczyńska[2], Jan Grajewski[1]
[1]Kazimierz Wielki University, Professor. [2]Kazimierz Wielki University, M.Sc.

Abstract

The growth of bacteria and mold or clogging filters may be indicated by steamed windows and unpleasant smell from the conditioning system. Prolonged exposure to mold spores can develop cough, chronic sneezing, acute breathing problems and allergic diseases.

The study material included 57 used dust filters. Prior to the mycological evaluation the filters were divided into 3 groups depending on the time of use: less than 1 year (n=12), 1 to 2 years (n=23) and more than 2 years (n=20).

Mycological examination was carried out on YGC agar medium. The results are expressed as the number of colony forming units per gram of a sample. Identification of molds was done to genus. The average contamination of molds in the filters was: in the first group 1.2 x 105 cfu/g, in the second group - 3.1 x 105 cfu/g, and in the third - 7.5 x 105 cfu/g.

Cytotoxicity of the samples was evaluated using the MTT cytotoxicity test, with swine kidney cells (SK). The MTT test results showed 43% of samples with low cytotoxicity, 14% of the samples of medium cytotoxicity and 4% of the samples with a high cytotoxicity.

The results of this study demonstrated that vehicle cabin dust filter are environments favourable to the bioaccumulation of several molds genera, including toxigenic Stachybotrys spp. and the genus Aspergillus that cause pulmonary diseases

This study was supported by the Polish Minister of Education and Science, under the program "Regional Initiative of Excellence" in 2019 - 2022 (Grant No. 008/RID/2018/19)

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Using databases for assessing the link between occupationnal hearing loss and co-exposure to noise and chemical substances

Frédéric Clerc[1], Benoît Pouyatos[2]
[1]INRS, Statistician. [2]INRS, ototoxicity and neurotoxicity laboratory head

Abstract

Evaluating risks associated with multiple occupational exposures is no easy task, especially when chemical and physical nuisances are combined. For this purpose, an attempt to join and exploit different existing databases for multiple exposure assessment is described. This case study joins three French databases for the analysis of co-exposure to noise and ototoxic chemicals (i.e. toxic to the ear). The goals were (1) to assess whether this approach could confirm the toxicological data showing that this co- exposure increases the risk of developing hearing loss; and (2) to highlight occupational sectors where the workers are the most exposed. The results present data per occupational sector exposing workers to noise only, ototoxic chemicals only, noise and ototoxic chemicals, and none of these two nuisances. The ten sectors in which the proportion of exposed workers is the highest are listed. This analysis showed that the rate of hearing loss in these sectors is high but did not show an increased incidence of hearing loss in co-exposed sectors.

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The concentration of BTEX compounds and health risk assessment in municipal solid waste facilities and urban areas

Fatemeh Yousefian[1,2], Kamyar Yaghmaeian[3]
[1]Kashan university of medical sciences, Asisstant profesor. [2]Tehran university of medical sciences, Researcher. [3]Tehran university of medical sciences, Profesor

Abstract

In this study, human exposure to benzene, toluene, ethylbenzene, xylenes (BTEX), along with their respective risk assessment is studied in four major units (n = 14-point sources) of the largest municipal solid waste management facilities (MSWF) in Iran. The results were compared with four urban sites in Tehran, the capital of Iran. Workers at the pre-processing unit are exposed to the highest total BTEX (151 μg m− 3). In specific, they were exposed to benzene concentrations of 11 μg m− 3. Moreover, the total BTEX (t-BTEX) concentrations measured over the conveyor belt were 198 μg m− 3 at most, followed by trommel (104), and active landfills (43). The mean concentration of ambient t-BTEX in Tehran is 100 μg m− 3. On average, xylenes and toluene have the highest concentrations in both on-site and urban environments, with mean values of 24 and 21, and 41 and 37 μg m− 3, respectively. Even though the non-carcinogenic risk of occupational exposure is

negligible, BTEX is likely to increase the chance of carcinogenic risks (1.7E-05) for workers at the pre-processing unit. A definite carcinogenic risk of 1.3E-04, and non-carcinogenic effect, of HI = 1.6 were observed in one urban site. With the exception of the pre-processing unit, the citizens of Tehran had higher exposure to BTEX. Overall, BTEX concentrations in the largest MSWF of Iran remain an issue of public health concern.

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Long-term exposure to ambient air pollution and autism spectrum disorder in children: A case-control study in Tehran, Iran

Fatemeh Yousefian[1], Kamyar Yaghmaeian[2], Masud Yunesian[2]
[1]Kashan univesity of medical sciences, asisstant profesor. [2]Tehran univesity of medical sciences, Profesor

Abstract

Some recent human and animal studies have suggested that air pollution may affect the central nervous system and contribute to neurodevelopmental outcomes, such as autism spectrum disorder (ASD). We aimed to investigate the association between long-term exposure to ambient air pollution and increased odds of ASD among 2 to 10-year-old children. We conducted a case-control study in Tehran, Iran. Cases were 134 children born between 2004 and 2012 diagnosed with ASD whose mothers were residents in Tehran during their pregnancy, and the controls were 388 children without ASD randomly selected from public schools and kindergartens. Landuse regression models were used to estimate their annual mean exposure to ambient particulate matter with aerodynamic diameter ≤10 μm (PM10), sulfur dioxide (SO2), benzene, toluene, ethylbenzene, p-xylene, oxylene, m-xylene (BTEX), and total BTEX. Logistic regression was used for the analyses and adjusted for possible confounding variables. The odds ratios per 1 unit increase in pollutants in the adjusted models were 1.00 (95% CI: 0.99, 1.01) for PM10, 0.99 (95% CI: 0.99, 1.00) for SO2, 0.96 (0.83, 1.11) for benzene, 1.00 (0.96, 1.04) for toluene, 0.95 (0.79, 1.16) for ethylbenzene, 1.00 (0.78, 1.27) for p-xylene, 1.09 (0.94, 1.27) for o-xylene, 1.01 (0.92, 1.12) for m- xylene, and 0.99 (0.97, 1.01) for total BTEX. We did not find evidence of an association between estimated annual mean exposure to the abovementioned ambient air pollutants and increased odds of ASD in children

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Characterization and validation of a carbon monoxide sampling method in remote locations. Application to emergency situations

Béatrice Le Roy[1], Lucien Valente[2], Gérald Provini[2], Jean-Ulrich Mullot[3]
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Abstract

Carbon monoxide (CO) is a lethal gas, present during incomplete combustion of carbonaceous materials. Colorless and odorless, its quantification with satisfying accuracy requires analytical devices. Currently, the main CO quantitative instruments are infrared detectors (relatively expensive) or electrochemical detectors (presenting interferences with other gases). These devices are not adapted to certain military operational situations, nor to CO measurements in remote locations, poorly equipped. It was therefore necessary, for a French research project, to develop a solution to measure instantaneous CO concentrations in aircraft cabins, as a possible fume events marker.

An alternative to in situ measurements is to take samples on field and analyze them in a laboratory. Tedlar® bags or canisters can be used for this purpose but are relatively cumbersome. Thus, we validated a method for spot carbon monoxide sampling using 50cc polypropylene syringes. The method was validated over a concentration range of 2 to 40 ppm, with recoveries between 101 and 102% and variation coefficients below 2%. Samples are stable for up to 2 weeks in the dark and at room temperature. I It can also be used for a higher concentration range, a dilutor being then required before the analyzer.

This sampling method is inexpensive, easy to implement and energy-independent. Coupled with a laboratory infrared analysis, it allows a better sensitivity and avoids potential interferences compared to electrochemical sensors. It is an interesting tool for investigating CO exposure in emergency, isolated or operational situations. Moreover, any emergency team has the necessary equipment to take air samples.

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Data integration: estimation of the exposure response relation between benzene and acute myeloid leukemia by combining epidemiological, human biomarker, and animal data

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Abstract

Background

Chemical risk assessment can benefit from integrating data across multiple evidence bases, especially in exposure-response cure (ERC) modelling when data across the exposure range is sparse.

Methods

We estimated the ERC for benzene and acute myeloid leukemia (AML), by fitting linear and spline-based Bayesian meta-regression models that included summary risk estimates from non-AML and non-human studies as prior information. Our complete dataset included six human AML studies, three human leukemia studies, ten human biomarker studies, and four experimental animal studies.

Results
A linear meta-regression model with intercept best predicted AML risks after cross-validation, both for the full dataset and AML studies only. Risk estimates in the low exposure range (<40 ppm-yrs) from this model were comparable, but more precise, when the ERC was derived using all available data than when using AML data only. Allowing for between-study heterogeneity, RRs and 95% prediction intervals [95%PI] at 5 ppm-years were 1.58 [1.01, 3.22]) and 1.44 [0.85, 3.42], respectively.

Conclusions
Integrating the available epidemiological, biomarker, and animal data resulted in more precise risk estimates for benzene exposure and AML, although the large between-study heterogeneity hampers interpretation of these results. The harmonization steps required to fit the Bayesian meta-regression model involve a range of assumptions that need to be critically evaluated, as they seem crucial for successful implementation.

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Same Data, Same Result? Citizen Science and the Politics of Residual Radioactivity Data after the Fukushima Nuclear Disaster.
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Abstract

In the aftermath of the 2011 Fukushima nuclear disaster, grassroot movements began to confront the risks of residual radioactivity in Japan, especially via activities such as radiation tracking, food monitoring or scientific workshops. These efforts, organized in local organizations or community centers, opened onto the creation of what is now called citizen science. While much has been written on how Japanese citizen scientists were able to successfully produce data after this disaster, the interpretation of data has received little scholarly attention. This paper examines why citizen science data produced via the same technological tools has led to radically contradictory positions, such as saying that Fukushima is either “safe” or “dangerous.” What explains this divergence of interpretation, especially when many citizen scientists produced similar measurements? Based on 14 months of ethnographic fieldwork in Japan, I argue that sociocultural factors – such as gender, occupation, class, political affiliations, or specific understandings of post-disaster recovery – strongly influenced why people entered citizen science, how science around a

controversial hazard is mobilized, as well as how data about radiation risks ends up being interpreted differently. To better understand the inherent complexities involved when citizens step in and claim expertise in areas typically reserved for state agencies more attention needs to focus on civic data interpretation. Within post-disaster contexts, the systemic production of more data does not necessarily produce more knowledge; it also produces conflict, noise, and uncertainty, especially within heterogeneous societies saturated by information and scientific controversies.

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Within-city variation in ambient carbon monoxide concentrations: Leveraging low-cost monitors in a spatiotemporal modeling framework

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Abstract

Exposure to ambient carbon monoxide (CO) may be associated with cardiovascular diseases based on human and animal experimental evidence, but current epidemiological research is limited. The number and distribution of ground-level regulatory agency monitors are insufficient to characterize fine-scale variation of CO. This study aimed to develop a high-resolution CO prediction model at the daily level based on agency monitoring data and measurements from low-cost gas monitors (LOD < 0.005 ppm) in Baltimore, Maryland. We also evaluated the contribution of three novel parameters to model performance: high-resolution meteorological, remote sensing (CO column density), and co-pollutant ($PM_{2.5}$, NO_2, and NO_X) data. We rigorously calibrated low-cost monitors by periodically co-locating with agency monitors, which improved the calibration R^2 to 0.76. Our CO prediction model had spatial CV R^2 of 0.70 with RMSE of 0.02 ppm; the model had temporal CV R^2 of 0.61 with RMSE of 0.04 ppm. The predictions revealed spatially resolved CO hotspots associated with population, traffic, and other non- road emission sources (*e.g.*, railroads and airport), as well as sharp concentration decreases within short distances from primary roads. Similar to our prior work using the same spatiotemporal modeling framework for other pollutants, the three novel parameters, as a supplement to a set of standard geographic features with 180 covariates, did not substantially improve the model performance, suggesting that our prediction framework with geographic features was robust and reliable. As low-cost monitors become increasingly available, this approach to CO concentration modeling can be generalized to resource-restricted environments to facilitate comprehensive epidemiological research.

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Combining Machine Learning and Numerical Simulation for High-Resolution $PM_{2.5}$ Concentration Forecast

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Abstract

Forecasting ambient $PM_{2.5}$ concentrations with spatiotemporal coverage is key to alerting decision makers of pollution episodes and preventing detrimental public exposure, especially in regions with limited ground air monitoring stations. The existing methods rely on either chemical transport models (CTMs) to forecast spatial distribution of $PM_{2.5}$ with nontrivial uncertainty or statistical algorithms to forecast $PM_{2.5}$ concentration time series at air monitoring locations without continuous spatial coverage. In this study, we developed a $PM_{2.5}$ forecast framework by combining the robust Random Forest algorithm with a publicly accessible global CTM forecast product, NASA's Goddard Earth Observing System "Composition Forecasting" (GEOS-CF), providing spatiotemporally continuous $PM_{2.5}$ concentration forecasts for the next 5 days at a 1 km spatial resolution. Our forecast experiment was conducted for a region in Central China including the populous and polluted Fenwei Plain. The forecast for the next 2 days had an overall validation R^2 of 0.76 and 0.64, respectively; the R^2 was around 0.5 for the following 3 forecast days. Spatial cross-validation showed similar validation metrics. Our forecast model, with a validation normalized mean bias close to 0, substantially reduced the large biases in GEOS-CF. The proposed framework requires minimal computational resources compared to running CTMs at urban scales, enabling near-real-time $PM_{2.5}$ forecast in resource-restricted environments.

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Association of PFAS exposure with immune-related diseases and identification of biological activity connected with complex chemical exposure in the CELSPAC cohort study.

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are abundant and very persistent in the human environment. People are exposed to PFAS almost constantly and these chemicals have been shown to be harmful to human health. Our work investigates the impact of PFAS exposure

specifically on human immune health. The relationship between PFAS exposure and immune-related diseases was investigated using data from CELSPAC: YA (Central European Longitudinal Studies of Parents and Children: Young Adults) cohort study (N=309). The association between immune-related diseases (e.g., asthma, allergies) and blood levels of 9 different PFAS were studied using logistic regression and the results were adjusted for relevant confounders (i.e., sex, age, BMI, socioeconomic status, family history, and smoking).
Preliminary data indicate the negative effect of several PFAS on the prevalence of pollen, dust and mite allergy, atopic eczema, and contact dermatitis. In addition, based on the comprehensive list of chemicals detected in the serum of CELSPAC participants (e.g., PFCs, PBDEs, OCPs, PCBs, NFRs), we will present an approach that identifies the most impacted biological endpoints perturbed by environmental mixtures, the EAR (Exposure Activity Ratio) concept. Using EARs, we investigated biological pathways and processes most likely to be impacted by chemical mixtures. Further, we identified the most active chemicals that were responsible for the predicted effect. Preliminary results show that PFAS are the main drivers of biological effects. Authors thank to Research Infrastructure RECETOX RI (No LM2018121) financed by the MEYS, and Operational Programme Research, Development and Innovation - project CETOCOEN EXCELLENCE (No CZ.02.1.01/0.0/0.0/17_043/0009632) for supportive background.

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An Ecological Assessment of the Upper Santa Cruz River Using Environmental Management Tools

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Abstract

Many cities are bolstering their groundwater and surface water supplies by discharging treated wastewater into the environment. The treated water may permeate through the vadose zone and into the aquifer. This study considers the possibility of soil and groundwater contamination due to the release of heavy metals and nutrients, specifically cadmium, chromium, copper, nickel, nitrates, and zinc, via treated wastewater from the Nogales International Wastewater Treatment Plant (NIWTP). The wastewater is discharged from the NIWTP directly into the Santa Cruz River after primary and secondary treatments. The study analyzes contaminant transport and fate by modeling surface water and groundwater flow and identifying areas of concern. To better visualize the movement of groundwater, and therefore the transport of the solutes, the infiltration behavior of effluent is simulated at the outfall of the NIWTP for the year 2016. Results of the modeling show that the treated discharge is slow to penetrate into the soils due to a clogging layer that dominates

shallow groundwater flow, but that permeation into deeper layers is possible. It is likely that contaminants present in the wastewater discharge may migrate to groundwater, depending upon their physicochemical properties that regulate transformation and magnitude of sorption. A substantial concern for contaminant transport is the potable or agricultural use of unregulated well water by residents in the area. Additionally, complexities can arise with international wastewater systems, as different sociopolitical, economic, and regulatory conditions exist between Mexico and the United States. This research hopes to assist in policy development regarding the NIWTP.

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Deposition patterns of non-exhaust emissions on Taraxacum officinale as a potential urban biomonitor

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Abstract

In this paper, we examine if Taraxacum officinale can function as an urban biomonitor for non-exhaust vehicle emissions in the Greater Toronto Area (GTA). Specifically, we measure concentrations of cadmium, copper, lead and zinc from brake dust and tire wear and explore if their relative deposition rates agree with ground-level ambient concentration estimates from a dispersion model. We report on the deposition patterns adjacent to Heart Lake Road in Ontario, Canada, with an annual average daily traffic of 27,000 vehicles. Expected concentrations were modelled with RLINE version 1.2 with receptors at 1, 250 and 500 m from the highway based on past meteorological conditions in the region. Ground- level concentrations of zinc were 0.230329 ng/m3, 0.207604 ng/m3, 0.186777 ng/m3 at 1, 250 and 500 m upwind from the highway. The Zn concentrations decline at a rate of 0.042 per 100 m. Leaves from Taraxacum officinale were obtained in 1 m square plots using the same distance intervals from the highway. Trace metal concentrations were obtained after drying the leaf material at 55 degrees for 24 hours and then 0.2 grams of dry material were ground-up in a powder using a mill. The leaves underwent acid digestion, and an inductively coupled plasma optical emission spectroscopy (ICP-OES) produces trace metal concentrations. This analysis produces a chemical breakdown in which the concentration of particulates can be compared to the dispersion model. This work expands the field of biomonitoring to explore the effectiveness of Taraxacum officinale as a biomonitor for non-exhaust emissions in the GTA.

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Polychlorinated biphenyls in breast milk from Polish women

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Abstract

Introduction
The presence of environmental pollutants is very dangerous for living organisms as these impurities can cause significant health problems. Polychlorinated biphenyls (PCBs), which belong to the group of halogenated aromatic hydrocarbons, has been determined in breast milk. Prenatal and postnatal exposure of infants to PCBs can be associated with health issues. Therefore, it was necessary to develop and adapt an analytical method to analyze PCB compounds.

Aim
To develop and adapt an analytical method to analyze PCB compounds in human milk.

Methods
The whole procedure was applied to 31 breast milk samples, which were collected from Polish breastfeeding mothers. The QuEChERS method was optimized as a fast and cheap sample preparation method. Gas chromatography with mass spectrometry (GC-MS) was used for final determination.

Results & Conclusion
The procedure allowed to obtain recovery values between 96.46% and 119.98% with acceptable relative standard deviations (3.36– 12.71%). The mean concentration of #iPCBs in this study was 30.94 ng/g of lipid. Assigned daily intake of PCBs was lower than the tolerable daily intake, which shows that the analyzed milk is safe to the infants. However, the monitoring of PCBs in milk is still important, and the QuEChERS method with GC-MS can be an effective tool for tracking organic impurities in breast milk.

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Influence of territorial characteristics on incidence of myocardial infarction, a study at fine geographic scale

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Abstract

Cardiovascular diseases (CVD) have been the leading cause of death worldwide. Among environmental conditions, the strongest links were highlighted for air pollution. A holistic approach needs also to integrate determinants of the living environment (noise, greenness, sport facilities, health services, commute modes). The purpose of this study is to build complex profiles of territory that one may investigate at a fine geographic scale the relationship between multidimensional characteristics and the incidence of CVD.

Data from official databases describing environmental health were combined in class by Principal Component Analysis and Hierarchical Cluster Analysis to determine territory profiles. Health data were obtained from the French WHO-MONICA registry and age- and gender-standardized incidence rates (SIR) were computed. Complex profiles were characterized by incidence.

Between 2012 and 2016, the SIRs range from 0 to 3.261 with a mean of 1.040 (sd=0.497). After PCA and HCA 3 classes were obtained. Class 1 is generally located on the outskirts with lower environmental contamination, privileged population but higher accessibility to health services and sport facilities (SIR=0.834). Classes 2 (SIR=1.267) and 3 (SIR=1.132) are generally located the city centers of the largest agglomerations and present different profiles. Class 2 displays unfavorable socioeconomic indicators while air pollution is lowest in these neighborhoods. Class 3 presents a rather socioeconomically privileged population while the environmental conditions are the worst.

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Evolution of COVID 19 measures during the pandemic in industrial settings

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Abstract

At the start of the COVID-19 pandemic information about the hazard posed by the virus and efficacy of various protective measures was very limited. A shortage of certified personal protective equipment such as N95/FFP2 masks existed, even in health care. Nevertheless, many workers, also in the oil and gas industry, had to continue work including large scheduled maintenance projects. Industrial hygienists had to provide guidance despite the lack of resources and information. In this situation social distancing, the use of protective face shields or self-made masks and hand disinfection became the main measures, largely in line with public health advice. Additionally, people with symptoms had to stay home from work to prevent spreading of the virus. Good adherence to these basic rules resulted in very few work-related infections in our setting.

In the course of two years the virus evolved to more infectious variants and contagion through respirable aerosol became more likely. This resulted in specific advice on increased ventilation of indoor work and rest areas.

Technological and scientific developments, notably tests and vaccines, and evaluations of the various measures resulted in precautions that remained surprisingly similar. (PCR) Testing was added to the stay at home and quarantaine advice. Self-made masks and gators are largely replaced by medical or N95/FFP2 masks even for the general public. Social distancing is till a major precautionary measure.

This proves that, even in the absence of specific data, general industrial hygienic strategies can be applied successfully.

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Applying a Scientific Workflow to Estimate Exposure to Emerging Contaminant Scenarios

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Abstract

This discussion will provide an overview of EPA's recently developed scientific workflow for exposure. Several example cases of emerging compounds will be presented, including PFOA, PFOS, and 1,4- dioxane. The cases will consider numerous exposure routes and pathways within relevant exposure scenarios, including product use, bystander exposures, and far-field.

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A Dermal Model Embedded in EPA's Exposure Science Workflow

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Abstract

Dermal uptake is an important exposure route for a wide range of chemicals in the residential environment. Risk assessors typically consider steady-state scenarios and use well-mixed models to estimate dermal uptake. A better understanding of the impact of these assumptions on exposure estimates is required to ensure safe chemical use. In this study, a well-mixed model is applied to predict dermal absorption for a set of chemicals used in cosmetic formulations. To evaluate the model assumptions, we compare model predictions to a set of 30 chemicals used in cosmetic formulations.

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Evaluation of the Lorber-Egeghy-East Model R Package (LEEM-R) exposure estimate across data richness, sample size, and exposure factors.

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Abstract

Concentration data reported in published literature are often expressed as summary statistics. To synthesize data across publications to determine concentration and exposure for a specific media, the Lorber-Egeghy-East Model R Package (LEEM-R) was developed. Exposure estimates to common per- and poly fluoroalkyl substances (PFAS) are in progress. However, to determine the exposure outcomes, the user of the LEEM-R package must specify 1) the n number of points to be generated by the model, 2) the exposure factors/formulae for each individual, and 3) the 'weight' applied to each study in the model. To ameliorate these unknowns, sensitivity analyses for common PFAS are performed within the LEEM-R model. Using a simple first order pharmacokinetic model, daily intake results are compared with National Health and Examination Survey (NHANES) serum concentrations.

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Application of Aggregate Exposure Estimation Methods Learned from Parabens to PFAS

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Abstract

The aggregate exposure method developed for estimating dose for methyl, ethyl, propyl, and butyl parabenzoic acid dose is used to extrapolate dose for PFOS and PFOA. Interindividual variation in the aggregate exposure is estimated using simulation modeling and biomonitoring data. This information will be used in the estimation methodologies for PFAS in various products and exposure scenarios.

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Characteristics and health risks of inhalation exposure to airborne-polycyclic aromatic hydrocarbons in Hong Kong adults: from outdoor to indoor exposure

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Abstract

Research on personal exposure to airborne polycyclic aromatic hydrocarbons (PAHs) at the individual level is scarce. Further, the independent contribution of ambient- and indoor-origin PAHs to personal exposure remains poorly studied. We performed simultaneous ambient, residential indoor, and personal exposure measurements in a panel of healthy adults to investigate particle-bound PAHs, focusing on their carcinogenic congeners (cPAHs). Benzo[a]pyrene equivalent (BaPeq) concentrations of cPAH accounted for 95.2%–95.6% of total carcinogenic potential. Average PAH concentrations were much higher in ambient and residential indoor than personal exposure, with distinct seasonal variations (winter > summer; $p < 0.001$). We employed chrysene as a tracer to investigate residential indoor and personal PAHs exposure by origin. Personal cPAH exposure was largely attributable to ambient-origin exposures (95.8%–98.3%), whereas a considerable proportion of residential indoor PAHs was likely attributable to indoor

emissions (33.3%–33.8%). Uncertainties in estimated PAHs (and BaPeq) exposure and cancer risks for adults were calculated using the Monte Carlo simulation. Cancer risks attributable to ambient, residential indoor, and personal cPAH inhalation exposures ranged from 4.0 × 10-6 to 1.0 × 10-5. A time-activity weighted model was employed for personal PAH exposure estimations. Estimated cPAH exposures demonstrate high cancer risks for adults in Hong Kong, indicating personal exposure to indoor-generated PAHs should be of great concern to the general population.

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Benzotriazoles exposure: genotoxicity and cytotoxicity to human liver stem cells, human biomonitoring and relation to health risks

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Abstract

Benzotriazole and its derivates (BTRs) have been classified as high-production-volume chemicals of emerging concern. They are mostly used as corrosion inhibitors leading to wide distribution in the environment, including human tissues (still major data gaps). In this study, HL1-hT1 cell line (human liver stem cells) was used to evaluate cytotoxic (resazurin/neutral red assay) and genotoxic (Comet assay) effects of 5 frequently used benzotriazoles – 1H-benzotriazole (BTR), 1-methyl-1H-benzotriazole (1M- BTR), 4-methyl-1H-benzotriazole (4M-BTR), 5-methyl-1H-benzotriazole (5M-BTR) and 4- hydroxybenzotriazole (4OH-BTR). The concentration-response relationship was analysed by benchmark dose (BMD) modelling. Liquid chromatography-electrospray ionization tandem mass spectrometry (LC- ESI(+)MS/MS) method for simultaneous determination of these compounds in the samples of human urine have been developed. 165 samples were analysed and the levels in blood were determined by toxicokinetic modelling. Preliminary results from cytotoxicity assays suggest BMD in concentrations from 1.1 to 12.2 μg.mL-1 for all 5 compounds, with 4M-BTR being the most toxic. Significant increase in DNA damage induced by 1H-BTR, 4M-BTR, and 4OH-BTR was detected at the concentration 0.02 μg.mL-1 and higher. The sum of BTRs in human urine ranged from <LOD to 0.029 μg.mL-1 and toxicokinetic modelling is currently ongoing. In this study, benzotriazoles were tested for cytotoxic and genotoxic effects on human cells, to the best of our knowledge for the first time, and our results are essential for future health risk assessment. In the context of internal exposure, our findings preliminarily point to potential genotoxic effects of BTRs in human population and call for more toxicokinetic and human biomonitoring studies.

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Inhalable and respirable dust exposures in French industries, 2011-2020

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Abstract

Objective: By mid-2023, the French regulatory 8-hour occupational exposure limits (OEL8h) for non-specific inhalable dust (ID) will have decreased from 10 mg/m3 to 4 mg/m3, and from 5 mg/m3 to 0.9 mg/m3 for respirable dust (RD). For 2022, temporary OELs are set to 7 mg/m3 for ID and 3.5 mg/m3 for RD. Using data from COLCHIC and SCOLA, two French databases of workplace measurements, we compared the dust concentrations measured to the upcoming OELs over the period 2011-2020.

Methods: We selected personal ID and RD gravimetric samples with a sampling duration over 60 minutes. We computed the relative frequencies of samples with concentrations <10% OEL8h, 10% to <100% OEL8h, and ≥100% OEL8h by industry and by occupation.

Results: We identified 34,285 ID samples and 66,690 RD samples. Geometric means and standard deviations (GSD) were 0.70 mg/m3 for ID (GSD 6.1) and 0.19 mg/m3 for RD (GSD 5.3). Over 40% of ID samples for civil engineering, ship construction, mining, and poultry shackling and butchering exceeded the upcoming OEL8h. For RD, many activities with >25% of samples above the OEL8h, were related to construction, where silica overexposure is also a concern.

Conclusion: The dust samples contained in these databases do not all necessarily fit the definition of “non-specific” as they may contain silica, metals, or other contaminants associated with known health effects. Yet overexposure relative to the upcoming OEL8h values was prevalent for both dust fractions across a wide range of sectors and occupations.

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Review of Workplace Based Aerosol Sampler Comparison and Laboratory Based Aerosol Sampler Performance Studies

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Abstract

We provide a narrative review on published peer-reviewed scientific literature reporting comparisons of personal samplers in workplace settings published between 2004 and 2020 and sampling efficiency or comparisons of personal samplers used in laboratory settings published between 1994 and 2021. Search terms were developed for Web of Science and PubMed bibliographic databases. The retrieved studies were then screened for relevance, with those studies meeting the inclusion criteria being taken forward to data extraction. 22 studies were taken forward in workplace based settings and 22 studies were taken forward in laboratory based

settings. Regarding the workplace settings it can be concluded that no discernible trends could be identified for established correction factors and these also varied between samplers and settings. For the laboratory settings it can be concluded that detailed information on samplers, flow rates, aerosol chambers, test aerosols and wind tunnels used is missing, meaning that the data obtained cannot be compared. Despite the requirements as stated in the European standard series EN 13205, both reviews clearly indicate that there is a need for clear standardized protocols to be developed for workplace and laboratory sampler comparison, and laboratory sampling efficiency studies. This will allow more robust and transparent assessment of aerosol samplers and better-quality evidence for use by industrial hygienists, epidemiologists, and occupational safety specialists alike.

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Outcomes of a Worksafe BC sponsored study on the performance of commonly used respirable and inhalable aerosol samplers.

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Abstract

The goal of this project was to validate novel and existing samplers against “preferred” sampler technologies. The long-term impact of this project is to ensure that exposure data used in epidemiological studies is aligned and precise, which will further inform the setting of OELVs. Both a laboratory wind tunnel study and a field study were conducted using an assortment of inhalable and respirable samplers. The results of this study were somewhat mixed with respect to sampler performance. The IOM SS, IOM CP, and DIS C I performed well against the inhalable convention, but only the DIS C I performed well in the field study, which could be due to methodological concerns regarding wall deposits. For respirable laboratory testing, the PPI and Al cyclone consistently under-sampled compared to the CAS HD for different particle sizes, while the DIS C R was similar to the CAS HD for smaller particles. In the field study, the DIS C R always measured the highest concentrations, followed by the PPI, CAS HD, and the Al cyclone. In the European study the Al cyclone reported consistently low results and needs further investigation. With these mixed results in mind, a “standard” sampler that could be usable across industries should focus on consistency and ease of use, for example, a sampler that includes wall deposits and has low within-sampler variance are both important considerations. Additional work in this area is necessary to fully identify such samplers, but the results here provide some insight on the next steps.

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Development of protocols for laboratory based testing of respirable and inhalable samplers

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Abstract

Inter-comparison of samplers for measuring metal substances in occupational settings is lacking. Testing against the sampling conventions is performed in a controlled laboratory setting, usually with one type of test dust. However, there are some concerns how inhalable and respirable samplers perform in the 'real world' and if all samplers meet the sampling conventions . It is therefore important to assess and compare the performance of the most common and newer personal samplers that are used to sample the respirable or inhalable aerosol fractions. The Nickel Institute has commissioned work with HSE Research and science Centre and University of Utah to develop / harmonise protocols for testing respirable and inhalable samplers in laboratory test chambers against the EN481 and ISO7708 conventions and carry out preliminary validation of the protocols.

Three protocols have been developed; inhalable and respirable sampler testing in calm air conditions and inhalable sampler testing in moving air conditions. All three protocols have been tested at HSE and University of Utah following the draft protocols for a range of samplers. The protocols were discussed at an expert workshop and will be discussed alongside the test results in this session.

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HBM4EU – achievements, challenges and lessons learnt from a successful large- scale research initiative

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Abstract

Human Biomonitoring data supply information on the aggregate exposure from all sources and by all pathways. They can serve as the basis to assess the risks from human exposure to chemicals. The overarching goal of HBM4EU is to inform and support the safe management of chemicals, and consequently protect human health in Europe. Intensive communication with policy makers from the state of planning ensure that HBM4EU results are used in the further development and design of new chemicals policies as well as the evaluation of existing

measures. HBM4EU has established an innovative network at the science-policy interface which allows a fast and effective exchange of knowledge needs and data as well as the preparation of succeeding research projects like PARC and the preparation of institutionalized structures medium to long term.

The research project led by key players of national HBM studies and research programmes will be officially completed by June 2022.

In addition to an overview of the structure and overall goals of the project, the achievements, challenges, and lessons learned from this successfully completed large-scale research project will be presented from the Coordinator's perspective.

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The HBM4EU laboratory network in the future of human biomonitoring in Europe

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Abstract

During the last two decades, human biomonitoring (HBM) in Europe has made great progress in terms of harmonization and comparability of results from different countries. All issues related to the analytical phase are key to achieving this. Chemical analyses in HBM studies have to deal with complex biological matrices, low concentrations, emerging substances with no analytical methods available, ubiquitous chemicals, lack of certified reference materials, etc. Although analytical laboratories follow common procedures and apply internal and external quality controls, the comparability of HBM results can be challenging. HBM4EU has intensively worked on identifying the capacities of the European HBM laboratories, increasing their expertise through collaboration among experts, and providing focused initiatives to improve the Quality Assurance/Quality Control (QA/QC) of the chemical analysis of HBM samples. As a result, the first network of HBM laboratories in Europe has been established with 184 laboratories from 28 countries. The majority of these laboratories have participated in an extensive QA/QC programme that was developed in HBM4EU to ensure the quality and comparability of the HBM analysis results in HBM4EU. After demonstrating the usefulness and potential of the network, the main challenge is to ensure its continuation and the extension with new members. The upcoming Partnership for the Risk Assessment of Chemicals (PARC) will be a great opportunity to continue working on the European HBM laboratory network and to explore ways to ensure its sustainability as an independent body.

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Exposure of European citizens to HBM4EU priority chemicals: results from the HBM4EU aligned studies

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Abstract

As part of the Human Biomonitoring for Europe (HBM4EU) initiative a human biomonitoring (HBM) survey is conducted in 23 countries. This survey builds on existing HBM capacity in Europe by aligning national or regional HBM studies and is referred to as the HBM4EU aligned studies. The HBM4EU aligned studies targets 3 age groups (i) children aged 6-11 years, (ii) teenagers aged 12-19 years and (iii) young adults aged 20-39 years and includes a total of 10097 participants (3431 children, 2950 teenagers and 3716 young adults). The participants were recruited between 2014 and 2021 in 11 to 12 primary sampling units per age group, that were geographically distributed across Europe. Urine samples were collected in all age groups, blood samples were collected in children and teenagers. Auxiliary information including socio-demographics, life style, health status, environment and diet was collected using questionnaires. Depending on the age group, internal exposure to phthalates and substitute Hexamoll® DINCH, brominated and organophosphorus flame retardants, per-/poly- fluorinated compounds, cadmium, bisphenols, polycyclic aromatic hydrocarbons, arsenic species, acrylamide, mycotoxins, UV-filters (benzophenones) and pesticides are assessed. The presentation will provide an overview of the internal exposure levels measured in the HBM4EU aligned studies informing about current exposure levels of the European population.

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HBM4EU and uptake to policy

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Abstract

In HBM4EU, indicators are being developed that can help answer relevant policy questions focusing on chemical exposure. HBM-based indicators may help to illustrate research results in an easy and interpretable way, as well as allowing for an evaluation of policy effectiveness.

Result indicators are descriptive and allow us to respond the question "What is happening?". The choice of substances for which to produce indicators is linked to the existence of HBM-GVs,

crucial for the development of the impact indicators. These are a good way to track policy efficacy ("Are the measures working?") and assessing health impacts ("Are we better off?").

HBM-based indicators are of a scientific nature rather than national reporting-based indicators, therefore also potentially useful for policy uptake due to the shift in the types of policy questions that legislators are trying to answer.

In the recent legislative packages from the European Commission, e.g. 8th Environment Action Plan (EAP), European Green Deal (EGD) and Zero-Pollution Action Plan (ZPAP), the approach is more integrated, looking at linkages between environment and health whereas in the past the focus tended more towards the environmental element. One of the aims of HBM4EU is to develop HBM-based indicators that can contribute to policy uptake in support of future legislations in environment and health.

Another objective of HBM4EU is to provide input to legislative consultations at EU and international level, with HBM data relevant for policy uptake.

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HBM4EU – targeted science communication

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Abstract

The targeted dissemination of outputs from the HBM4EU is crucial to ensuring that our results are understood and used for the protection of human health by key audiences, including policy makers, scientists and other stakeholders. Within our HBM4EU communication strategy our goal is to:

- Build a bridge between science and policy through continuous dialogue and engagement between both individuals involved in cutting edge scientific research and in all stages of chemical risk governance;
- Channel new knowledge to policy makers regarding the impacts of chemicals on human health and facilitate the exploitation of this knowledge in chemical risk governance;
- Foster stakeholder engagement in HBM4EU, so that stakeholders can both contribute to shaping our research agenda and exploit our results in their own activities;
- Make HBM data used under HBM4EU via IPCHEM for re-use and in particular for combination with other data sets, to promote the exploitation of results by other researchers;

- Undertake targeted training and capacity building with the aim of harmonising HBM methods across Europe, contributing to scientific excellence in Europe while producing a robust HBM dataset as a basis for policy making;
- Raise public awareness and engage with public focus groups to better understand societal concerns regarding chemical exposure, to tailor our research to respond to those needs;
- Communicate effectively with survey participants follow up by explaining individual results to participants;
- Raise awareness of the role of HBM activities in protecting human health from chemicals, with the aim of catalysing the development of a sustainable European HBM initiative.

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Exposure to phthalates and their substitutes in the European population

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Abstract

Phthalates are esters of phthalic acid, which are mainly used as plasticizers, and prenatal exposure to several of its agents is associated with adverse effects on the development of reproductive functions. The HBM4EU initiative has gathered existing data, and generated new data on phthalates and the substitute DINCH for European countries and allows examining exposure and time trends of phthalates and their substitutes in the European population. This presentation gives an overview on exposure to phthalates and DINCH for EU sub populations. Survey procedures are used to acknowledge the nested data structure (participants nested within data collections from different countries) and to calculate geometric means and P95 of internal exposure. In addition to describing recent exposure this study also examines differences and changes of phthalate concentrations across the last 20 years. Time trends since the 2000s from two studies in Denmark and Germany with repeated cross-sectional design reveal similar trends between these two countries. More regulated phthalates (DEHP, BBzP, DnBP and DiBP) show yearly decreases by about 10 – 17 % or no change (DiNP, DiDP) in their 24-hr excretion, less regulated phthalates (DEP, DMP) show yearly decreases by about 17 %, and phthalate substitutes (DINCH, DEHTP) show strong increases. This study moves a step towards to a more comparable description of exposure to phthalates in European populations and provides insights into how regulated and less regulated phthalates have changed since the 2000s. We discuss the lack of time trend studies on phthalates and the challenge of harmonizing studies across countries.

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Implementation of effect biomarkers and evaluation of adverse health outcome pathways in the HBM4EU aligned studies

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Abstract

Demonstration of causal associations between chemical exposures and adverse health outcomes is highly relevant for environmental epidemiology and chemical risk assessment and the harmonised use of effect biomarkers needs to be stimulated. To show the added value of complementing exposure biomarkers with effect biomarkers in human biomonitoring studies, traditional and novel effect biomarkers were implemented in the EU-wide HBM studies aligned under HBM4EU, to increase the weight of evidence of causal exposure-effect relations and support evaluation of potential health impact. A structured approach, based on extensive review of epidemiological and experimental studies and data collected in Adverse Outcome Pathways, was followed to generate hypotheses on effect biomarkers and health outcomes associated with chemical stressors for each age group included in the aligned studies. Next, effect biomarkers and HBM studies were selected based on results of validation studies; adequacy of sample types, volumes, and numbers for each biomarker; the possibility to combine traditional and early, molecular biomarkers; and time, capacity, and budget constraints. Health outcome data available from the participating studies were also collected and harmonized to the extent possible. Statistical approaches were developed to study associations between individual effect biomarkers as well as the full exposure-health outcome continuum. This proof-of-principle has generated valuable insight into the mechanisms of action and health relevance of chemical exposures, and into opportunities to further advance and innovate the application of effect biomarkers as indicators of adverse effects of exposure to chemicals and mixtures thereof, including early, predictive effects allowing implementation of effective preventive interventions.

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Computational exposure modelling to support integrative health risk assessment

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Abstract

The aim of this study was to obtain intake estimates derived from the HBM data available for the 1st and the 2nd set of priority substances, that have been identified as such in the HBM4EU context, based on the aggregate data available within the HBM4EU dashboard, that include both the HBM4EU repository data, as well as the one from the aligned studies. The simulations were carried out in the HBM4EU integrated exposure modelling platform, a software that provides exposure assessment coupled with a generic physiologic based biokinetic (PBBK) model and numerical "reverse engineering" techniques for exposure reconstruction, based on the Markov chain Monte Carlo techniques. The process starts from ancillary exposure-related data that are fed into the exposure model taking into account multiple exposure routes. The results are evaluated against the biomonitoring data distributions, aiming at the reduction of uncertainty in back-calculating doses, by minimizing the error between the predicted and the actual biomonitored data. The main results of the study which will be presented in this provide the impetus for integrative health risk assessment taking into account the actual internal dose reaching the target organs of the HBME4EU priority compounds.

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Prioritization of novel replacement flame retardants - combining multiple lines of evidences on exposures, biomonitoring data and mechanistic toxikology

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Abstract

Flame retardants are broadly used additives to consumer products identified as priority group in the HBM4EU (https://www.hbm4eu.eu/). The restriction of polybrominated diphenyl ethers triggered the need for replacement flame retardants (rFRs). Here we present a case study with rFRs, demonstrating an efficient approach in prioritization of data-poor chemical groups.

Data for 52 organic rFRs (organophosphate, chlorinated and brominated) were collected including consumption in the EU, available human biomonitoring data and toxicological information (in vivo, in vitro and in silico), and mechanistic knowledge from adverse outcome pathways (AOPs).

The main concerns posed by rFRs relate to endocrine disruption, reprotoxicity, hepatotoxicity and neurodevelopmental outcomes (https://doi.org/10.1186/s12302-019-0195-z). The research revealed that for most rFRs, only scarce toxicological information is available. Nevertheless, several rFRs were identified as being of major concern, including triphenyl phosphate (TPhP) and tris(1,3-dichloropropyl) phosphate (TDCIPP), both used in large quantities and showing endocrine

disruption potential and reprotoxicity. Anti-androgenicity was identified as a major shared mechanisms for multiple rFRs https://doi.org/10.1016/j.envint.2021.106550.

The approach presented here is particularly useful for prioritizing a large group of chemicals with relatively low available data. We highlight priority compounds that critically need more studies or for which regulatory measures could be envisaged.

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Suspect and non-targeted screening of emerging chemicals from human biological matrices

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Abstract

This work describes the global framework proposed for addressing the potential and challenges of large- scale screening of emerging chemicals as a support to human biomonitoring which was developed within HBM4EU WP16. This framework is including (1) the development of a suspect screening database of emerging chemicals including those for which to date no HBM data is available, (2) the development of a MS reference library susceptible to help annotating a maximum number of these markers, (3) the generation of untargeted high-resolution mass spectrometry (HRMS) profiles from human samples, and
(4) linking of occurrence data with toxicological and hazard data through computational approaches and effect-directed-analysis (EDA).

From the initial state-of-the-art at the early stage of the HBM4EU initiative, the work achieved within WP16 first permitted to build the basis of an EU network with harmonised competences in the field of SS/NTS applied to human matrices, and secondly to develop and conduct several proof-of-concept studies illustrating the usefulness of these approaches.

Overall, these efforts resulted in more than 3000 analysed samples and several hundreds of detected exposure markers. This work also permitted to identify a number of limitations associated to these approaches, in particular the bottleneck associated to the identification of the exposure markers detected by the large-scale approaches, still impairing their real high throughput implementation. From that point, a number of conclusions and recommendations may be

elaborated as sustainable perspectives of this work, in particular with regard to the next PARC initiative.

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Residential PAH exposure in humans and cats: A validation of silicone collars

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Abstract

Polycyclic aromatic hydrocarbons (PAHs) are chemicals with carcinogenic, cardiotoxic and endocrine disruptive capabilities. The lack of methods to quantify PAHs limits our knowledge on exposure. Our main objective was to understand if silicone wristbands could be used to capture PAHs exposure in the residential setting.

We simultaneously measured PAHs in 31 humans and pet cats, using two sampling matrixes, silicone wristbands and collars with silicone rubber. These were worn continuously for 7 days. Extracts from these were analyzed via targeted Gas Chromatography-Mass Spectrometry (GC-MS). Parallelly, we collected nine blood samples from participating cats. These were analyzed via untargeted qualitative Quadrupole Time-of-Flight chromatography (LC-QTOF-MS). Demographics and daily routines for both humans and cats were collected.

Out of 16 PAHs, 14 were detected in both the wristbands and the collars. Naphthalene, fluorene, phenanthrene and fluoranthene were detected in all samples. Concentrations between wristbands and collars were strongly positively correlated for 6 PAHs (Pearson's r 0.49-0.62). PAHs with more than 4 carbon rings were infrequently detected and did not correlate significantly between matrixes. One PAH parent compound and seven metabolites were detected in the blood samples, but we could only identify the chemical structure.

This is the first study to measure environmental exposure to PAHs with silicone rubber in cats. This approach can effectively measure residential exposure to 3-4 ringed PAHs. Deployment of samplers for longer time could increase the limit of detection. In future studies, these cost-efficient method may help us understand links between residential exposure and disease development for semi-volatile compounds.

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Determining Source Attribution for Indoor Air Contaminants at Vapor Intrusion Sites Using Forensics and Probabilistic Modeling

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Abstract

The increasing importance of indoor air quality science on public health is recognized as understanding of the impact of commercial products and industrial sources on indoor air contamination improves. The talk presents complementary lines of evidence useful for determining whether indoor air contaminants are from “background” indoor or outdoor sources or from subsurface vapor intrusion at sites with volatile subsurface contaminants.

Two lines of evidence guide the source attribution determination: (1) forensic methods, e.g., contaminant ratio analyses of different media (soil gas, groundwater, and outdoor air), and (2) probabilistic modeling, e.g., comparing measured indoor air contaminant levels to vapor intrusion model-predicted levels.

Forensic analysis is performed by directly comparing attenuation rates of different chemicals as they migrate from outside the building envelope to indoor air. Another method is by comparing the ratios of different chemicals in the different media. Chemicals are selectively chosen for comparison to minimize bias caused by dissimilar degradation rates. The development of sensitivity factors to strengthen the confidence of the source attribution decision is also explored.

When vapor intrusion modeled indoor air levels are below measured levels, the indoor air contaminants are more likely from a background source. A novel visualization method will be demonstrated in which violin plots display probabilistic modeled results, and measured levels can be compared to the resulting distribution to support the source attribution determination.

Agreement among the different methods provides strong evidence for discernment of sources of indoor air contamination to more effectively address health hazards from vapor intrusion.

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Equity in Exposure Sciences: It’s Time to Declare Disparities Intolerable

Esther Erdei
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Abstract

This is first presentation of the #32 Symposium entitled: "Equity in Exposure Sciences: Just the Beginning"

This introductory presentation will set the stage for the other presenters and will introduce Environmental Justice (EJ) movement to the symposium audiences. EJ movement in the US was initiated through and strongly linked with social actions against the Vietnam War as well as protection of the environment. Stronger social progress had been made since then by identifying and acting upon environmental contamination and racial disparities in communities disproportionately exposed to increased toxicant exposures. Advancements have been made via supporting academic research and education on the socially and politically constructed values directing humans' attitudes toward nature, science and through significant methodological improvements in exposure sciences. Disparities observed on patterns of increased exposures to toxicants as well as to the impacts of those attitudes on built and natural environments regionally, nationally and globally have been investigated more systematically and efforts are ongoing. Parallel to recognition of complex exposure patterns affecting people of color and disadvantaged social groups, targeted industry activities were also linked to EJ community problems as well as disproportionate health burdens. Examples of community actions engaged for improving environmental conditions as well as active community responses, citizen science engagement will be presented as examples of vigorously addressing exposures to contaminant mixtures in various environmental injustice communities. Interactions between increased toxicant exposures, socioeconomic conditions, and mental health effects of living in contaminations will also be offered.

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Guidance for Occupational Biomonitoring - lessons learned from an OECD activity

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[10]SECO, Scientific officer

Abstract

An occupational biomonitoring guidance document was elaborated in a joint activity including more than 40 institutes/ organisations in collaboration with the OECD Working Party on Exposure Assessment and the OECD Working Party on Hazard Assessment. The goal was dual. First, the guidance document presents current approaches used to derive biomonitoring values; and second, it provides globally harmonized recommendations on how-to derive and apply occupational biomonitoring assessment values. The derived health-based human biomarker assessment values are referred to as Occupational Biomonitoring Levels (OBLs). OBLs are suitable for the use in exposure assessment and risk management. The guidance document

draws upon applied approaches and gained experiences from the regulatory context. The procedures and specifications described in the guidance document pave the way for high quality and sound occupational biomonitoring. Consequently, this guidance document is relevant for regulatory authorities, chemical industries, researchers as well as stakeholders interested in addressing occupational and general population biomonitoring. Harmonised guidance will help in interpreting levels found in exposed workers across countries. This work is complementary to other ongoing or upcoming international activities (e.g., HBM4EU, ISES, PARC). The occupational biomonitoring guidance should increase the acceptance of OBLs and implementation of these in biomonitoring programmes to reduce workers' exposures and ultimately, occupational diseases. The presentation will highlight examples and lessons learned in this drafting process.

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Tribal perspectives of tobacco and toxicant exposure disparities

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Abstract

The goal of this presentation is to present a case study of the Cheyenne River Sioux Tribe and how it used its sovereign power to redirect an electronic cigarette (e-cigarette) maker company from
achieving a proposed 'partnership'. The program was presented to the Tribal Health Committee as a public health intervention with the goal of 'partnering with Tribes to improve lives' (O'Leary et al, 2021). The e-cig company offered to 'sell' their product to the tribe at a discounted rate, suggesting that in turn tribal healthcare professionals could distribute e-cigarettes starter kits for free to participating smokers/vapers 21 years or older, violating federal chapter 9 of the US Food, Drug, and Cosmetic Act, as well as contributing to e-cigarette epidemic in the US. The secondary aim of this presentation is to demonstrate how big tobacco companies' marketing methods are used by other industries to target minorities with disproportionate exposures, and how can EJ communities protect and prevent their further exploitation.

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Exposure science: A path forward to level the playing field of environmental injustice.

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Abstract

Environmental contamination coupled with socioeconomic and racial disparities are a long-standing public health problem with deep historical roots. For Indigenous populations, a disproportionately greater burden of chemical pollution and risk of adverse health outcomes, such as cardiovascular and kidney disease can be largely attributed to multi-generational poverty and political disregarding.
Marginalized Environmental Justice populations in urban environments are also burdened with chemical contaminants from runoff and migration from waste sites, as well as air pollution from nearby industry and heavy traffic. This presentation will delineate case studies from both Native American and city- based populations (Brooklyn, NYC) to bring to light how such populations have used community-led exposure pathway measurements to advocate for clean air and water to policy-makers and
regulators. Possible suggestions of how to move environmental health equity forward through exposure science in our post-COVID world, will also be discussed. The use of exposure science tools have used these data to bring awareness and build capacity in both these populations have helped such

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Environmental justice issues in agricultural communities in the United States

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Abstract

Industrial food animal production (IFAP) poses an environmental threat to the surrounding communities and those community residents near these operations. These operations can release air pollutants, such as dust, ammonia, hydrogen sulfide, volatile organic compounds and bioaerosols, as well as contaminate the soil, water and community surfaces of those who live nearby. IFAP practices, such as spraying of waste and storage of waste in lagoons, can lead to the community contamination. With increasing extreme weather events due to climate change, the risk of these lagoons and operations failing and contaminating local communities continues to increase. Microbial pollutants that pose an infectious disease risk and the dissemination of antimicrobial pathogens, both in humans and animals, are also causes for concern in agricultural communities. Often, the communities impacted by these facilities are low-income and minority communities, creating environmental justice issues related to this pollution. In North Carolina, residents of communities in areas surrounded by ILOs have reported poorer health outcomes and reduced quality of life due to proximity to concentrated animal feeding operations (CAFOs) and industrial livestock operations (ILOs). Southeastern North Carolina has some of the highest density of CAFOs in North Carolina and the South, with the pollution from these CAFOs

disproportionately impacting low-income communities and communities of color. IFAP practices impact worker health and safety as well, and these animal-human interactions are interfaces where zoonotic infectious diseases could emerge.

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Exposure assessment and respiratory illnesses in low-income Baltimore communities

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Abstract

The BREATHE Center (JHU P50 Health Disparity Center supported by NIEHS/USEPA) aims to define and eliminate environmental health disparities. Studies across the life stages have quantified the respiratory health effects of indoor air pollutants, including particulate matter and nitrogen dioxide. Increases in indoor particulate matter and nitrogen dioxide have been associated with childhood asthma morbidity and indoor particulate matter associated with exacerbations of COPD among older adults. Evidence suggests that dietary intake modifies susceptibility to air pollution respiratory health effects. Household and neighborhood characteristics influence indoor air quality, including household heating and cooking fuel sources, proximity to roadways and tobacco store density. Individual and community level factors also influence dietary intake. Household interventions that target pollution reduction, including the use of portable air cleaners, demonstrate respiratory health benefits. Future studies that are scalable and define the synergistic benefit of improved diet and improved indoor air quality are needed and planned to translate existing science into action to improve public health.

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Identifying threshold levels of contaminant antibiotics in soils that impact proliferation of resistance

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Abstract

Irrigation with treated wastewater or flooding waters during extreme weather events may introduce contaminants antibiotics in the soil that can lead to adverse environmental impacts or human health effects if exposure occurs. An extensive number of studies have shown that contaminant antibiotics in soils may enhance development of resistance. During infiltration through soils, antibiotics may select for antibiotic-resistant bacteria and impact the transfer of antibiotic-resistance genes among selected bacterial communities. In this work, we aim at identifying threshold levels of antibiotics that have the potential to enhance antibiotic resistance in soil microbial communities. This is accomplished by experimental work where agricultural soil was incubated with different concentrations of antibiotics. Targeted genes that encode for resistance to different antibiotics were quantified using real time polymerase chain reaction. Shot-gun sequencing and analysis was used to characterize changes in bacterial community diversity, resistome and relative abundance. Preliminary results show that low concentrations that may persist for a long time in the soils, have higher effect on development of resistance of some genes compared to high concentrations. Additionally, the levels of resistance observed depend on the soil, antibiotic and resistance gene quantified. Understanding the link between chemical characteristics of antibiotics and their impact on soil bacterial communities contribute to constructing a systematic approach to studying potential risk of exposure to antibiotics and antibiotic- resistance bacteria or mobile genetic elements.

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Quantifying the effect of urban form on NO2 and assessing the impact of interventions on urban design and emissions in the City of London.

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Abstract

In this study, we present three neighbourhood-scale Land-use regression models developed for the heavily trafficked City of London (CoL), an area of high density which includes several tall and very tall buildings. The influence of urban form on NO_2 concentration distribution at neighbourhood-level was comprehensively assessed. A linear LUR, a Generalized Additive Model (GAM) and a Random Forest (RF) model were built to explore the relationship between pollution and urban features. The results demonstrated that the RF model, which captured non-linear relationships, outperformed the other models and helped to better explain the variations in urban pollution. The statistical analysis showed that RF model had the highest overall accuracy with an adjusted R-squared of 0.88, whereas for GAM and linear LUR the adjusted R-squared was 0.80 and 0.72, respectively. After the Leave-one-out cross- validation, the root-mean-square-error and the mean absolute error were 7.6 and 6.25 μg/m3 for the RF, 10 and 7.9 μg/m3 for the GAM and 8.3 and 6.4 μg/m3 for the linear model, respectively. Different scenarios of two types of interventions (i.e., 'emissions-related' and 'technology-related') were examined, which include pre-set long-term plans for buildings and tree canopy developments in CoL, inadvertent changes in building surface cover and height due to the expected population increase and the radical changes in traffic due to the essential Covid-19 restrictions that were imposed. Thus, quantitatively demonstrating the impact of urban form on air quality and evaluating the consequences of two types of interventions can provide information to help policy-makers and stakeholders to reach consensus.

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Facilitating Research amidst Disaster Response: NIH DR2 and Research tools for wildfires

Richard Kwok
NIEHS, Program Director

Abstract

The NIH Disaster Research Response (DR2) program was created to better position research in the midst of disaster response scenarios. With the recent wildfires, the DR2 program served as a central repository for new instruments, protocols and tools that were developed specifically to address this disaster. The efforts of the NIH DR2 Program, which provides a suite of resources, including data collection tools, research protocols, institutional review board guidance, and training materials will help improve the timeliness, quality, and value of future disaster-related data collection and research studies.

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Health effects of wildland fires: What does the future hold?

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Abstract

Research across the globe has documented the deleterious health effects of exposure to wildfire smoke. However, the increasing frequency, intensity, and duration of wildland fires and

concomitant smoke episodes have challenged the current research framework used to evaluate health impacts of smoke exposure, both from an exposure assessment perspective as well as an epidemiological perspective.
With regard to exposure assessment, despite the multiple tools available to assess smoke in the atmospheric column and at the ground level, the field lacks a cohesive definition of smoke, as well as methods to differentiate smoke particle toxicity in real time, and gas-phase as well as biological contaminants found in smoke based on source, distance from source, burn intensity, atmospheric mixing, and particle age. From an epidemiologic perspective, most studies are focused on retrospective assessment of acute morbidity outcomes and have lacked the ability to understand both health effects of repeated measures to smoke, as well as long-term physiological impacts of smoke exposure. Further, the episodic nature of wildfire smoke does not allow for prospective studies, particular on immediate impacts of smoke and impacts on a range of organ systems. Here we present some recent studies to address some current limitations in the wildland fire smoke literature, and suggest some future approaches to help identify the total burden of disease due to wildland fire smoke exposure.

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An assessment of health risks posed by consumption of pesticide residues in fruits and vegetables among residents in the Kampala Metropolitan Area in Uganda

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Abstract

This research aimed to conduct health risk assessment of presence of pesticide residues in fruits and vegetables in Kampala Metropolitan Area, Uganda. Pesticide concentrations were compared with European Union maximum residual limits (EU-MRLs). Mean values of pesticide concentration residues found in fruits and vegetable samples; fruits and vegetables intake and body weight were used to calculate estimated daily intake (EDI) of pesticide residues. EDI values were compared with acceptable daily intakes (ADI) to calculate hazard quotient by age group, and stage at which consumption happened along the chain. Concentrations of fonofos, fenitrothion and fenhexamid were above the EU-MRLs in some samples. Hazard quotients based on dietary ingestion scenarios for eighteen pesticides, including dichlorvos (444) alanycarb (314), fonofos (68), fenitrothion (62), dioxacarb (55) and benfuracarb (24) and others, were above 1, indicating the possibility of chronic health risk to consumers. Chronic health risk decreased with age but was stable for stage at which consumption happens along the food
chain. The number of pesticides with EDI greater than the ADI decreased with increase in age; with 18, 13, 9, 11, 8, 9, and 9 pesticides for age groups <5, 5-12, 13-19, 20-25, 36-49 and ≥50 respectively. Chronic health risk decreased with age but was stable for stage at which

consumption happens along the food chain. Chronic dietary pesticide exposures to Ugandans are common and exceed the health benchmarks for some pesticides. There is urgent need to increase monitoring and regulation of pesticides in fruits and vegetables in order to protect consumers.

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Use of Public Health Surveillance and Big Data to Characterize Social and Environmental Determinants of COVID-19 Disparities in New Mexico, USA

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Abstract

Background – Early in the pandemic, the fast progression of SARS-Cov-2 infection and deaths from severe COVID-19 disease were linked to a combination of preexisting chronic diseases. Social vulnerabilities were also reported as significant factors of severe COVID-19 morbidity and mortality. Most critical environmental factors were not considered systematically yet. These factors are especially affecting rural counties, Tribal lands and underserved minority communities in New Mexico.

Methods – We used a combination of de-identified, confirmed COVID-19 deaths data collected under the public health surveillance efforts of the New Mexico DOH and added USGS, USEPA and other governmental GIS information and mapping of known, documented contamination sources and extend of water, air and soil toxicant exposures in all counties of the State of New Mexico.

Results – Increased deaths were detected in association with proximity to resource extraction sites and windblown dust exposures as well as ground water contamination. Uranium exposures originated from abandoned mining activities across the state were significant predictors of first set of Poisson models applied. Zero inflated models were also shown significant predictions of increased deaths in metal contaminated areas even when population density was low.

Discussion – In New Mexico, where environmental contaminations (water, air pollution, diet) are prevalent and many rural communities live close proximity to toxicants were also hard hit by COVID-19 as well as experienced disproportionately increased number of deaths. The risk of dying from COVID-19 was shown to be associated with increasing age, but also were very significantly predicted by social disparities, poverty and contaminations.

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Exposure assessment and health protection—modern technology applied to dated tools

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Abstract

Significance. The goal of this study is to develop, test, and operationalize a system to detect use of respirators by personnel operating in hazardous situations. This system, which we term Respiratory Emergency Response Alert System (RERAS), is intrinsically safe and enables real-time determination of respirator use. Occupational exposure to hazardous contaminants has been linked to an increased risk of respiratory-caused disability. Respirators rely on dated technology—advances in sensor technology and IoT/communication infrastructure can facilitate proper use.

Methods. RERAS uses micro-pressure differential transducers to detect fluctuations in pressure produced by a wearer's breathing cycle while wearing a respirator and transmits status in real-time to a notification/management application. Evaluation of fit-factor and physiological impacts was conducted on a sample of experienced first responders using respirators with and without the RERAS system affixed.

Results. Quantitative fit testing of 8 participants yields no statistical difference between the RERAS modified device and their full-face respirator when examining fit factors ($p=0.4763$). A survey and observation of physiologic stress and comfort also showed no difference.

Conclusion. A RERAS module capable of real-time communication of physiological status of respirator use has been attained. Future work integrates hazard exposure sensors in/out of the respirator and geolocation—providing users and supervisors real-timer spatial monitoring and verification of protection. Integration of this digital data can assist with compliance and regulatory monitoring and exposure assessment. Moreover, individual, and spatial exposure monitoring furthers total exposure health, total worker health and personalized health initiatives of modern organizations.

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TECHNICAL IMPROVEMENTS AND POPULATION OF THE INTEGRATED RISK MANAGEMENT MEASURE (RMM) LIBRARY (ECEL V3.0) / Cefic-LRI project B15.3

Wouter Fransman, Henk Goede TNO, NL, Senior Scientist

Abstract

Description
B15.3 is an extension of the "Cefic-LRI B15-2 project: Development of an integrated risk management measure library".

The main goal of this proposal is to upgrade ECEL v2.0 to ECEL v3.0 such that it is a well-designed, user- friendly tool with up-to-date information that is supportive to the industry for a wide range of risk management applications.

Objectives:
- 1.adapt the existing user interface to ensure a more intuitive application from the beginning to the end of an assessment
- 2.develop new functionalities that were not previously available in ECEL v2.0
- 3.updating the occupational data and updating the environmental data
- 4.testing, feedback and evaluation

- **Task 1:** User interface improvements

In this task we will adapt the existing user interface to ensure a more intuitive application from the beginning to the end of an assessment (see Mockups in Appendix 1)

- **Task 2:** New functionalities (features)

This task will develop new functionalities that were not previously available in ECEL v2.0

- **Task 3:** Population of the database

For this task, preferably two interns will be employed over a period of at least 6 months – one dedicated to updating the occupational data and another dedicated to updating the environmental data.

- **Task 4:** Testing, feedback and evaluation

During the entire development process, the CEFIC Monitoring Team will have the opportunity to provide feedback to ensure that the database functionalities and content will be suitable for application in making up REACH dossiers.

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Fusing Environmental and Health Data for Managing Wildfire Risk
Jean-Paul Vernier[1], Richard Kwok[2]
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Abstract

The Science for Disaster Risk Reduction (SRD) United-States working group on GeoHealth has gathered Health and Environmental data from federal, state, and local government institutions and academia to address challenges related to data integration to better address the risk posed by wildfires. Through a series of virtual meetings, a conceptual model was created to identify the major science questions needed to be answered and the data pathways between wildfires, exposure, and human health impacts. A data portal was created to visualize multi-temporal and horizontal scale data products available through a Geospatial Information System (GIS). Focusing on Sonoma county, CA, the data integration concept was investigated for the 2020 Wallbridge fire by fusing satellite data and hospitalization databases. Visualized together, we will discuss how the fusion of environmental and health offer a powerful tool to better assess the health impacts of wildfire and reduce risk for vulnerable population.

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Estimating the impact of wildfire smoke on PM2.5 levels in the Contiguous U.S. from 2007 to 2018

Yang Liu
Emory, Professor and Chair

Abstract

Fine particles emitted from wildland fires differ from ambient PM2.5 in size distribution and chemical composition. The health effects of fire smoke exposure is under-studied due to the lack of spatially resolved wildfire smoke PM2.5 estimates. We developed a spatial modeling system to estimate daily PM2.5 concentrations due to fire smoke at 1 km2 resolution in contiguous U.S. by combining aerosol optical depth (AOD) and smoke contours retrieved by satellites, Community Multiscale Air Quality (CMAQ) model simulations, and low-cost sensor data. We first built a random forest model to estimate daily background PM2.5 levels using ground monitors in non-fire area. A second random forest model was then developed in smoke-impacted areas to estimate total PM2.5 concentrations. The R2 and Root Mean Square Error (RMSE) of our model in fire areas in 2018 was 0.80 and 6.14 μg/m3, respectively. The non-fire model for background PM2.5 concentrations had a R2 value and RMSE of 0.62 and 3.41 μg/m3, respectively. Model-estimated PM2.5 levels successfully captured the smoke plumes when compared with NASA true-color satellite imagery.

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Advancing Wildfire Smoke Exposure Assessment for Health Research and Interventions

Rima Habre
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Abstract

Wildfires are increasing in severity, frequency, and extent due to climate change with adverse acute and chronic human health impacts. Wildfire smoke plumes exhibit complex behavior spatiotemporally, with highly dynamic vertical distribution, chemical composition, and (particle) size distribution that depend on fuel type, burn conditions, long-range transport, and plume age among other factors. This creates challenges in accurately assessing source-specific, ground-level contributions of wildfire smoke and disentangling its health impacts from the overall air pollution mixture or other co-occurring exposures (e.g. ozone, heat, etc.). Exposure measurement error is also a large concern in wildfire health research since individuals tend to change their behaviors to avert or minimize exposure during and after wildfire events (i.e. relocation, increased time in indoor spaces with air filtration, etc.). As such, understanding the extent to which wildfire smoke contributes to personal air pollution exposures is challenging. Finally, sensitive and/or disadvantaged populations are often also concentrated in urban heat islands which could increase immediate risk and present additional response and recovery challenges and needs. We will present our work towards improving methods for acute and chronic source-specific wildfire smoke exposure assessment in California, relating external wildfire smoke estimates to personal measurements of PM2.5 exposures, and understanding the impact of wildfire smoke and heat co-exposure during pregnancy on fetal birthweight in an environmental health disparities population. We will also showcase how ongoing efforts in the SDR GeoHealth Data Integration working group can advance capacity for just- in-time personalized interventions, disaster research, and community resilience during wildfires.

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The GESTIS Biological Agents Database – compact information for occupational safety and health protection

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Abstract

A large number of biological agents are put to use in laboratories, as well as in biotechnology and in animal testing. Employees can also come in contact with biological agents in many other activities (e.g. in health services, cleaning and rehabilitation work, veterinary medicine, agriculture, forestry, waste water and solid waste industry). The biological agents arising at the workplace therefore have to be included in the risk assessment. The risk assessment is the central element of occupational safety and health and the basis for systematic and effective safety and health protection in the everyday working environment. The database target group thus mainly comprises those responsible for workplace safety and health.

For more than 18,000 biological agents, the GESTIS Biological Agents Database contains data on their classification in one of the four risk groups and the basic technical, organisational and personal protective measures during activities in laboratories, biotechnology and keeping of experimental animals. For selected biological agents of medical relevance or of relevance to occupational safety and health, datasheets are available containing extended information. It is also possible to access links to reputable national and international science networks.

In addition, datasheets are issued on activities with contact to various biological agents, such as datasheets for agriculture and forestry, which focus on the special features of activities in certain work areas.

The GESTIS Biological Agents Database is an Internet-based database containing data that can be accessed without restriction and free of charge.

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REFINEMENT OF A FRAMEWORK FOR EXTRAPOLATING OF WORKER EXPOSURE MEASUREMENT DATA / Cefic LRI project B19.2

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[1]TNO, Senior Scientist. [2]Triskelion, Senior Scientist

Abstract

The purpose of the currently proposed extension B19.2 project is to improve on the framework delivered in the previous B19 project, by 1) re-assessing the existing case studies in light of the refined read-across approach, 2) developing further case studies to enable testing of determinants that were not studied in the first phase of the project, 3) further refining the read across approach based on the outcome of the case study results, and 4) seeking further support for the framework from regulatory, scientific and industry stakeholders.

As part of the project and largely also in the final report, the following will be delivered:

1. Selection and demonstration of a set of extra case studies (with multiple parameter combinations) demonstrating the framework, including data with more limited data quality

2. Refinement of the framework based on analysis of the extra case studies, as well as previously used case studies from the B19 project
    - Update of the data quality criteria
    - A full description of the approach, including its domain(s) of applicability and rules

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EXPERIMENTAL ASSESSMENT OF INHALATION AND DERMAL EXPOSURE TO CHEMICALS DURING INDUSTRIAL AND PROFESSIONAL ACTIVITIES / Cefic

Wouter Fransman[1], Remy Franken[2]
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Abstract

The purpose of this project is to generate inhalation and dermal exposure data that can be used to evaluate ECETOC TRA worker exposure estimates for key industrial and professional uses of chemicals for PROCs where in previous validation studies the PROCs were either not investigated (due to insufficient data available) or where the ECETOC TRA underestimates the exposure compared to the measured exposure.

Generating dermal and inhalation exposure data in an experimental setting that reflects exposure situations that resemble actual workplace situations will result in representative basic concentration (exposure) estimates. These data can primarily be used to evaluate and refine the ECETOC TRA, but can also be useful to derive ‘general applicable’ exposure values to be used in risk assessment, and ideally even stimulate the collection of more high quality exposure data by governmental and industrial partners.

Deliverables:

- A detailed study plan based on the review with regard to the execution of the different experiments and (if not already available) validation of the measurement and analytical methods;
- A comprehensive database containing contextual information and measurement results (both inhalation and dermal) from the experiments;
- A set of photographs taken under UV-light, that are analyzed to indicate qualitative dermal exposure for all body parts;
- A comparison between model estimates from ECETOC TRA and measured exposure values across the described scenarios from this work and (when available) previous work such as data derived during the LRI B16 project, to help identify areas of the TRA that may benefit from further refinement;

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TMEX-COMPLEX: TIERED METHODS FOR QUANTIFYING EXPOSURE TO COMPLEX SUBSTANCES / Cefic LRI project B22

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Abstract

Project Description

Human exposure to chemicals is usually studied and understood in terms of the effect of a single pure chemical, but most humans are exposed to mixtures of chemicals. The project is focused on determining how human exposure to chemicals is influenced by these chemicals being part of a commercial mixture. Such mixtures could be cleaning products, pharmaceuticals, persona-care products, and commercial chemical mixtures.

Since different chemicals interact in a number of ways, the project is seeking a set of rules that allow regulators and managers to determine what sort of mixture they are working with and how to best assess the exposure risk associated with it. The project will assess the quality and effectiveness of several state-of-the-art tools for predicting the properties of chemicals in mixtures. Ultimately, it will develop a prototype software tool that will allow for the estimation of human exposure from mixture components via inhalation and skin absorption.

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A powerful personal exposome tracker (PET) for precision environmental health

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Abstract

Human health is affected by the dynamic interactions between the genome and the environment. Over the decades, scientists have made substantial breakthroughs on understanding the genome, however, our knowledge about the environmental effects remains limited. The exposome is consists of all the exposures across one's lifetime.Current methods of environmental monitoring, relying on total concentrations of particulate matter (PM) and a handful of substances, cannot fully reflect the complex nature of the human exposome. Moreover, fixed weather stations fail to provide precise exposure information on the personal level, let alone providing evidence for precision environmental health.
Here, we propose a wearable device that captures the diverse airborne exposome and allows users to get a comprehensive view of their exposures. The wearable device, termed Personal Exposome Tracker (PET), is an active sampling device that collects all traditional environmental parameters measured by fixed weather stations, such as temperature, humidity, PM2.5, PM10 and volatile organic compound (VOC), at the personal level. Additionally, PET contains compartment to collect chemical and biological exposomes, respectively. Paired with next generation sequencing (NGS) and high-resolution mass spectrometry (MS), PET provides the most detailed view of the human airborne exposome. The onboard Global Positioning System (GPS) sensor provides an additional layer of exposure information. Therefore, PET is a powerful exposometer that provides insightful information to aid precision environmental health.

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Blood Cadmium, Lead, Manganese, Mercury, and Selenium Levels in American Indian Populations: The Strong Heart Study, 1998-1999

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Control and Prevention/Agency for Toxic Substances and Disease Registry, Deputy Associate Director. [13]Columbia University, Professor

Abstract

Many American Indian (AI) communities are in areas affected by environmental contamination, such as toxic metals. However, studies that have assessed these exposures and their potential adverse health effects in AI communities are limited. We assessed historical exposure in AI communities using blood metals to identify participant characteristics associated with exposure in the Strong Heart Study (SHS) cohort.

Archived blood specimens collected from 2,014 participants (all were ≥50 years) in Arizona, Oklahoma, and North and South Dakota (ND/SD) during SHS Phase-III (1998-1999) were analyzed for cadmium, lead, manganese, mercury, and selenium using inductively coupled plasma triple quadrupole mass spectrometry. We conducted descriptive analyses for the entire cohort and stratified by selected subgroups, such as age, sex, smoking, alcohol consumption, income, and body mass index. Finally, multivariate regression models were used to assess blood metal levels with each factor, adjusting for other available covariates.

Mercury was detected in 73% of participants, and the other four elements had 100% detection. The SHS population had higher levels of blood cadmium and manganese than the U.S. population 50 years and older, while median blood mercury was about 30% lower, potentially due to low fish consumption.
Communities in ND/SD had highest blood cadmium, lead, manganese, and selenium and lowest total mercury levels. Each of the blood metals was associated with demographic, behavioral, income, and/or weight-related factors. These findings will help guide the development of education, outreach, and strategies to reduce harmful exposures and increase beneficial nutrient intake in these AI communities.

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PFAS Exposure Assessment Results and Findings

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Abstract

The Agency for Toxic Substances and Disease Registry (ATSDR) conducted exposure assessments (EAs) in communities near military installations that have documented exposures to PFAS in drinking water. In all cases, exposure to PFAS in drinking water was mitigated prior to initiation of the biomonitoring efforts. These EAs built upon two pilot EAs conducted by state health departments. In total, EAs were conducted in ten communities using a community sampling design to determine the distribution of PFAS serum concentrations in communities with recent or past exposure to PFAS in drinking water. PFAS were measured in urine samples from a subset of participants and in indoor dust and tap water from a subset of participating households at nine of the ten sites.

The following PFAS were present in serum above the national average (2017-2018 National Health and Nutrition Examination Survey), after adjusting for the age of participants in each community:

- PFHxS (10 communities)
- PFOS (8 communities)
- PFOA (7 communities)

Age, sex, residency duration, historical drinking water PFAS levels, water source, and use of filtration were among the factors associated with PFAS serum levels. This presentation will include associations for the combined data set and differences observed among the sites.

Relationships between historical concentrations of PFAS in drinking water at the sites and serum PFAS concentrations will be presented.

The findings and conclusions in this presentation have not been formally disseminated by the Agency for Toxic Substances and Disease Registry and should not be construed to represent any agency determination or policy.

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Impact of the LOD and LOQ on the analytical feasibility of measuring occupational exposure limit values (OELVs) for nickel and its compounds in the workplace

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Abstract

In January 2025 new binding OELVs for Ni compounds will be fully implemented throughout Europe. These binding OELVs are set as 0.01 mg/m³ and 0.05 mg/m³ for nickel compounds, measured as Ni in the respirable and inhalable fraction respectively. The selection of a suitable measurement

procedure depends on the requirements as stated in e.g. ISO 20581. In this standard, it is stated that every procedure should operate within the range of 0.1 and 2 times OELV. For Ni determination in workplaces 21 methods were identified. For 5 methods, only the instrumental LOQs were given, 1 method gave no specific LOQ value, all other methods gave the methods' LOQ values. Based on the method's LOQ, 40% of the methods cannot determine the respirable OELV (t>480 min) and 15% cannot determine the inhalable OELV. In addition, 19 European laboratories responded to a survey on their method for Ni determination in workplace air. Four laboratories responded with a non-workplace air reference method, 2 laboratories could not determine the respirable OELV and 1 laboratory could not determine the inhalable OELV. These results are suggesting no consistency in the calculation and use of the LOQ which makes it difficult to show compliance with binding OELVs. Also standards/methods should clearly state what the typical LOQ values are for the specific analytes on which they act, and there should be a consensus regarding the calculation of the LOQ and the importance of the specificity of the matrix (e.g. workplace air) in this calculation.

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Requirements for measurement methods for the determination of nickel content in dust at workplaces, new digestion methods and analytical possibilities - Presentation of the results of a proficiency test

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Abstract

Suitable measurement methods must comply with defined requirements to be able to evaluate hazardous substances at the workplace. Analytical requirements for suitable measurement methods, sampling conditions, sample preparation and the analysis of nickel are influencing factors.

The standard method for sampling metal containing dusts from workplaces is sampling on filters with specially designed sampling heads for inhalable or respirable aerosol. For quantitative analysis, the normally insoluble metals have to be digested in a suitable acid solution. In the past the digestions were usually performed in open vessels on a hotplate/hot block. The most common acid mixtures were nitric acid/hydrochloric acid mixtures. In Germany, a hot block digestion method is recommended as standard method since the beginning of the 1990s. This method was introduced mainly to improve the comparability of analytical results.

IFA started a project to compare this digestion method with microwave digestion methods. The aim of a study was to revise the recommendation for digestion methods used in occupational health

and safety and to introduce the current state of art. A microwave pressure digestion method was developed and tested at the IFA using dusts from various work areas. The method provides well comparable results to the open vessel hot block method.

To test and establish the microwave pressure digestion method, IFA has initiated an inter-laboratory test in which experienced laboratories from national and international occupational health and safety organizations have participated. In general, the results have a satisfactory comparability for most of the investigated dusts and metals.

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Influence of the Nickel content of the material on exposure height during welding and abrasive tasks

Dorothea Koppisch
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Abstract

Nickel is widely used in metallurgy to produce steel and alloys. Consequently, metal workers are often highly exposed to nickel. Nickel can provoke nickel allergy and several nickel compounds are classified as carcinogens, namely causing lung cancer if inhaled. Data about the exposures of workers can be found in the literature, but seldomly related to the nickel content. The aim of this study is therefore to investigate the influence of the nickel content of the material on nickel exposure during welding and abrasive task using personal samples from the German exposure database MEGA.

The material used is classified into three groups: less than 5% nickel (mild steel); 5 to 30 % nickel (stainless steel); more than 30 % nickel (nickel-base alloy). Additionally, task (welding process or type of abrasive task) and year of measurement are used as criteria for the statistical evaluations.

For example, from 2010 to 2016 the 50th percentile was 0.002 mg Ni/m^3 for mild steel, 0.0051 mg Ni/m^3 for stainless steel and 0.033 mg Ni/m^3 for nickel-base alloys during manual metal arc welding. For dry grinding the 50th percentile was 0.0021 mg Ni/m^3 for mild steel, 0.05 mg/m^3 for stainless steel and 0.15 mg/m^3 for nickel-base alloys from 2007 to 2016.

These results show that high differences in the level of exposure to nickel caused by different nickel content of the material should be considered when using exposure data in epidemiological studies and for prevention in workplaces.

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Nickel in different dust fractions: Conversion of nickel concentrations from inhalable to respirable dust

Cornelia Wippich
: Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), Scientific Officer

Abstract

At workplaces with high nickel dust exposure the risk of nickel associated occupational diseases is increased. They range from allergic reactions to different forms of cancer. In early years of exposure measurement, mainly data of nickel in inhalable dust fraction were measured. This is problematic for retrospective evaluations of exposure levels, epidemiological studies or occupational diseases.
Therefore, it is desirable to convert nickel concentrations from inhalable to respirable dust.

A total of 234 202 respirable fraction measurements, 123 118 inhalable fraction measurements and 32 882 nickel measurements in total were extracted from the exposure database MEGA. After several restrictions were considered, 551 parallel measurements of nickel concentrations in inhalable (ci_{Ni}) and respirable dust (cr_{Ni}) from 2011 to 2020 could be determined and investigated by linear regression after the nickel concentrations were transformed using the natural logarithm.

Inhalable dust is the most important predictor variable, showing an adj. R^2 of 0.767. To refine the conversion of nickel concentrations, the total dataset was divided into working activity groups *'high temperature processing'*, *'filling/transport/storage'*, and *'machining/abrasive techniques'*. From these groups, more task-specific subgroups were formed: *'welding (grinding time fraction [GTF] < 5 %)'*, *'welding (GTF > 5 %)'*, *'high temperature cutting'* and *'grinding'*. For each group an individual conversion function with relating confidence interval could be calculated. All conversion functions (except for *'welding GTF < 5 %'*) are power functions with adj. R^2 between 0.628 and 0.924:

$cr_{Ni} = ci^{k} * e^{C0}$, where *k* and *C* are regression coefficients. Important: The conversion function must

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Quantification of three antineoplastic agents in urine - method validation and application

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Abstract

Despite the implementation of many guidelines and recommendations, healthcare workers are still exposed to hazardous antineoplastic agents. An ultrasensitive method is required to map

this exposure, since healthcare workers are often exposed to lower concentrations than patients. Therefor we aimed to develop and validate a sensitive method enabling simultaneous quantification of cyclophosphamide, ifosfamide and paclitaxel. The method was developed and validated in the first part of the research.

Novum simplified liquid extraction cartridges were used to extract three antineoplastic agents from urine, the extract was analysed using UPLC-UniSpray-MS/MS. A field study was performed in the second part. Twenty-eight out of eighty-three urine samples from Algerian hospital workers had quantifiable concentrations of at least one antineoplastic drug. In conclusion, we were able to develop an ultrasensitive method combining quantification of three antineoplastic agents and ready to be used in real-life occupational settings. This method is a step towards the limitation of unintended exposure to antineoplastic agents and will thereby help to create a safer work environment.

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Industrial air pollution in the port area of Lomé (Togo) from 2010 to 2018

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Abstract

Background: There are concerns about environmental pollution, specifically air pollution, and its impact on human health. The present study builds on this very issue.

Method: The mapping of industrial air pollution sources in the Lomé port area (PA), carried out in accordance with the CORINAIR methodology, is a contribution to the analysis and estimation of emissions in the Lomé port area.

Results: This study shows that manufacturing industries are sources of emissions of sulphur dioxide (SO2), carbon monoxide (CO), PM2.5, PM10 and Non-Methane Volatile Organic Compounds (NMVOCs). The largest NMVOCs emission was recorded in 2012, amounting to 0.0003 Gg. CO and SO2 emissions are mostly attributable to cement production and peaks are estimated at 3.171 Gg of CO in 2017 and 0.211 Gg of SO2 in 2015. Moreover, the cement industry totals particulate matter emissions up to 0.5 Gg of PM10 and 0.283 Gg of PM2.5 in 2017.

Conclusion: This mapping of pollutant emission sources in the ZP of Lomé will be coupled with sensors air quality analysis to provide more reliable data to decision-makers for making good decisions.

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Evolution of pollutants emission in relation to road traffic in the city of Lomé (Togo) from 2010 to 2019

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Abstract

The automobile fleet in Togo has increased in the last decades with a patchwork of vehicles that are in majority older than ten (10) years. Until 2019, the car fleet in Togo was almost dependent upon petroleum products, and was consequently a source of air pollutants emission. Lomé is the capital city of Togo with the characteristic of having the highest road traffic volume that significantly impacts air quality. In accordance with the EMEP/EEA air pollutant emission inventory guide and the COPERT method, emissions of carbone monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs) and particulate matter (PM) are respectively estimated to: 2621.674 tCO ; 82.444 tNOx ; 558.778 tNMVOC and 7.241 tPM. In the time series 2010-2019, emissions of CO, NMVOCs and NOx fell overall with average yearly rates by respectively 83,0234 ; 66,4888 ; and 0,8073 t/year whereas the PM emission rose (0,8208 t/year).

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2-Dimensional Benchtop X-ray Fluorescence Approaches to Exposure Assessment

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Abstract

Introduction: Advances in benchtop micro-XRF allow for the potential expansion of 2D exposure assessment for epidemiological and toxicological samples down to a spatial resolution of 10um for simultaneous 30+ element quantification. We aimed to identify the advantages of this method in comparison to other more traditional methods.

Methods: We used a comparison of methodologies between synchrotron XRF at the Advanced Photon Source at Argonne National Lab, laser ablation inductively coupled plasma mass spectrometry (LA-ICP- MS), and micro-XRF using a Bruker M4 Tornado system in order to measure sectioned human tibia bone samples, paraffin embedded rat lung, and sectioned human teeth samples to identify potential variations among the techniques by specimen type, limits of detection, and quantification.

Results: We found strong agreements between the quantification results from each method (>90% agreement for samples). For a 1 second dwell time, we identified a detection limit of 4.8 ppm for a single 10um pixel. Using a longer dwell time or summation of pixels results in correspondingly lower detection limits. Quantification differences between approaches, particularly with LA-ICP-MS where data is normalized to a major element, did not have broad impacts on the data.

Conclusion: The detection limit of the micro-XRF was within range to analyze teeth and bone effectively with short measurement times. For tissue based toxicological studies, the time per pixel will need to be increased to take advantage of the 10um resolution. Micro-XRF has significant advantages over LA-ICP- MS sample destruction or the necessity for beamtime at a synchrotron source.

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Biomonitoring on PAHs of firefighters during real firefighting missions

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Abstract

Firefighters (N=70) from professional and volunteer fire departments were recruited and 1-hydroxypyrene (1-OHP) was quantified in their urine samples. For this purpose, baseline levels and exposures 2-4, 6-8, and 12 h after firefighting missions were assessed. Exposure was interpreted based on reference levels for 1-OHP (95th percentile) of the general population in Germany. Detailed information about the firefighting operation was assessed by questionnaire.

Baseline exposure to 1-OHP in all firefighters were, dependent on the individual smoking habits, within the normal range of the general population. After the missions, there was an approx. 2-fold increase of mean 1-OHP concentrations (0.13 vs. 0.25 1-OHP µg/g creatinine). Peak exposure

was usually observed 12 h after the mission. However, the majority of the post-exposure levels (77 %) remained in the range of the general population. Operations in which elevated 1-OHP (i.e., higher mean levels) has been measured were characterized by heavy smoke (visibility <2 m), firefighting indoors, and, despite the use of respirators, being a member of the interior attack team. Nevertheless, these exposures were still low compared to many workers with industrial exposures to PAH.

The results indicate that the currently used protective clothing (including respirators) reduces exposures to PAHs. Nevertheless, the study identified specific situations such as firefighting under heavy smoke conditions which can lead to increased exposures on an individual level. Although personal protective equipment was assessed to be used during operations, skin absorption of PAHs must be assumed as a relevant route of exposure in these cases.

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Mixtures of persistent and non-persistent chemicals and associations with pregnancy outcomes in the Atlanta African American Maternal Child Cohort

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Abstract

Background: African Americans (AAs) experience high rates of adverse pregnancy outcomes relative to whites. Differential in utero exposure to environmental chemicals may partially explain these health disparities. Few studies have examined the effects of multiple classes of non-persistant and persistant organic pollutants (POPs). Here, we examined joint effects of multiple POPs and non-POPs on adverse pregnancy outcomes among AAs.

Methods: POPs and non-POPs were measured in 1st trimester serum or urine samples collected from 102 participants within the Atlanta African American Maternal-Child cohort. POPs included per-and polyfluoroalkyl substances (PFOA, PFOS, PFHxS, PFNA), polybrominated diphenyl ethers (PBDE-47, BDE- 99), and organochlorine insecticides (HCB, ppDDE), while non-POPs included urinary phthalates metabolites (MEP, MBP, MiBP, MBzP, MEHP, MEOHP, MEHHP, MECPP) and bisphenol A. Single pollutant associations were estimated using linear regression and mixture associations were estimated using quantile g-computation and Bayesian kernel machine regression (BKMR), adjusting for confounders.

Results: An interquartile range increase in PFNA (β=-0.11, 95% confidence interval [CI]=-0.22, 0.00), BDE- 47 (β=-0.19, 95% CI=-0.35, -0.04), and HCB (β=-0.17, 95% CI=-0.34, 0.00) was

associated with lower birthweight z-scores in single pollutant models. Using quantile g-computation, increasing all POPs and non-POPs by one quantile suggested a negative effect on gestational age and birthweight z-scores, although confidence intervals included the null. BKMR similarly showed that increasing all exposures in the mixture was associated with a modest decrease in gestational age and birthweight z-scores.

Discussion: Prenatal exposure to multiple classes of POPs and non-POPs may be associated with lower birthweight and gestational age at birth.

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Performance and physiological effects of Filtering Facepiece Respirators according to age and exercise intensity

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Abstract

Due to the COVID-19 pandemic, the wearing of Filtering Facepiece Respirators(FFR) has become common for both workers and all age groups. There has been concern about wearing a mask has physiological effects. This study aimed to evaluate the performance of the FFRs and the wearer's physiological effects according to age and exercise intensity.

A total of 28 participants (children(n=10), young adults(10), and elder(8)) were participated. Each participant wore three different FFR types; cup-shaped, flat-folded, and an FFR with an exhalation valve, and performed different intensity exercises according to the protocols. Various physiological effects including respiratory frequency(Rf), minute ventilation(VE), CO2 production(VCO2), oxygen consumption(VO2), heart rate(HR), metabolic equivalents(METs), percutaneous oxygen saturation(SpO2) were monitored.

All tested FFRs were N95 grade and the filtration efficiency was > 99%. All physiological Rf, VE, VCO2, VO2, METs, and HR increased in all exercise sessions, but there was no difference in results between the control (no mask-wearing) and FFR types. In the older adult group, only the Rf value showed a significant difference between rest and low intensity. During exercise, O2 decreased to 17.6% and CO2 increased to 3.7% in the deadspace (the volume of air between the FFR and the wearers' facial surface). Differences in the participants' perception of their amount of exertion in the presence or absence of wearing a mask were only mild. All physiological indicators showed no difference when compared with the control group but this study was conducted only on healthy participants.

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Territorial approach to measuring environmental and social health inequalities: spatialized composite indexes in environmental health

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Abstract

The characterization of spatio-temporal interactions between environmental factors thus requires the development of multidimensional approaches. The challenge of our research is to develop management tools that contribute to the optimization of urban development operations by integrating health issues through a systemic and multidisciplinary approach that combines urban characteristics, socio-economic, political, health and environmental aspects. Therefore, we propose the analysis of the environmental and social health inequalities through two composite spatialized indexes at the infra-communal scale in the Lille metropolis: a vulnerability index and a resilience index. The methodological framework of our research based on six dimensions, described by 83 variables.

The results of our research demonstrate the relevance of spatialized composite indexes for guiding public planning and urban development policies to managing environmental and social inequalities in health, on different scales: a global scale integrating urban and rural areas, a local scale integrating the specificities of the territories (central agglomeration and metropolitan ring) and a neighborhood scale. Within the framework of an overall development strategy for the study area, the tool allowed us to identify 82 territorial black spots, 214 units with a capacity to mobilize resources, 143 units to monitor and 89 resilient units. Comparing only the units of the central agglomeration (urban area), we obtained the following results: 118 territorial black spots, 114 units with a capacity to mobilize resources, 116 units to be monitored and 43 resilient units. Our methodology also makes it possible to orient decisions at a neighborhood scale.

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Occupational environments: A driver for MRSA colonization?

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Abstract

The worldwide escalation in the development of antibiotic resistant human pathogens, including Staphylococcus aureus and particularly methicillin-resistant S. aureus (MRSA) is considered a global challenge. MRSA infections enclose extremely high morbidity and mortality rates and are linked to S. aureus ability in developing new clones and more resistant clones with the capacity to invade community settings. These characteristics lead to an urge to develop effective and efficient assessments of S. aureus colonization in occupational settings, particularly those with increased risk of human and animal colonization as well as food contamination.

We have performed cross-sectional studies with the aim to collect key information regarding MRSA prevalence (asymptomatic carriers) in workers from different occupational environments in Portugal namely, bakeries, swine (humans and animals), ambulances crew, veterinary clinics and health care facilities.

Data demonstrated highly divergent prevalence of MRSA among bakeries workers (25%), swinneries workers (46% MRSA), firefighters (21% MRSA), health care workers (Study 1: 23.7% MRSA, Study 2: 43.3% MRSA) and veterinary staff (0% MRSA). Regarding control groups we observed MRSA prevalence of 4% to 10%.

This study sustains the urge to develop efficient and valuable assessment of MRSA human and animal colonization, particularly in high risk occupational settings, with suitable guidelines and validated procedures in order to access and mitigate potential hazardous health effects caused by bioaerosols exposure.

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Assessment of chemical and biological contaminants in settled house dust in Korea

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Abstract

Settled house dust (SHD) is a reservoir for various contaminants. This study aimed to characterize various chemical and biological contaminants in SHD and identify determinants of the indoor contaminants. In total, 106 SHD samples were collected from 106 houses in Seoul and Gyeonggi Province, Korea in 2021. Thirty of the 106 houses were recruited for collecting bedding dust samples. All participants completed a questionnaire comprised of housing and lifestyle-related factors. Samples were analyzed for 18 organophosphate flame retardants (OPFRs), 16 phthalates, five alternative plasticizers (APs), seven trace metals, and two house dust mite allergens (Dermatophagoides farinae type 1 [Der f1] and Dermatophagoides pteronyssinus type 1 [Der p1]). A multiple regression analysis was conducted to identify the determinants governing the concentrations and profiles of various contaminants. OPFRs, phthalates, APs, and trace metals were detected in all SHD samples, indicating ubiquitous contamination in indoor environments. Among the three EDC groups, APs were detected most frequently with the highest concentrations, followed by phthalates and OPFRs. Der f1 was detected in all bedding dust samples with significantly higher levels than Der p1. The concentrations of OPFRs, plasticizers, and trace metals in SHD were significantly associated with the type and number of electronic appliances and combustion activities. Der f1 was significantly associated with the number of occupants and water penetration. Ventilation, vacuum cleaning, and wet cleaning or dry mopping significantly reduced the levels of most contaminants in SHD.

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Introduction of Korea Air Pollutants EXposure (KAPEX) model

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Abstract

Outdoor concentration is often used as a surrogate for population exposure in epidemiological studies. However, people stay most of their times indoors. The relationship between indoor and outdoor concentration should be considered in the estimation of personal exposure. The Korea Air Pollutants EXposure (KAPEX) model will be developed to predict population exposures to PM2.5 and O3. The input data for the population exposure model are 1) site and time specific outdoor concentrations from outdoor air pollution data from 511 ambient air monitoring stations in Korea, 2) time-activity patterns from the 2019 national population survey data of 30,000 people by Korea Statistics and more detailed time activity patterns by reginal surveys of 20,000 subjects, and the microenvironment-to-outdoor (M/O) concentrations of PM2.5 and O3 at seven microenvironments. M/O was available for specific mocroenvironement and time of the day from 24 hour measurements at seven microenvironments. The personal exposure by KAPEX model will be evaluated by direct measurement of 200 personal exposures. From the preliminary assessment, the population exposures to PM2.5 in Seoul were significantly different by season. The averages of population exposure to PM2.5 were 29.9 ± 10.6 μg/m3 in winter,

21.3 ± 4.0 μg/m3 in summer, 9.8 ± 2.7 μg/m3 in autumn. The population exposure model for PM2.5 could be used to estimate population exposure, identify determinants for high exposure groups and evaluate the effectiveness of control policies to reduce exposure.

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Human biomonitoring of Neonicotinoid Exposures: Quantification of Neonicotinoids and their specific metabolites in urine

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Abstract

Neonicotinoids and neonicotinoid-like compounds (NNIs) are frequently applied insecticides worldwide. Human biomonitoring (HBM) of NNIs has been mainly based on the analysis of the parent substances. Here, we developed an HBM method for the quantification of seven NNIs and nine specific metabolites such as hydroxylated and N-dealkylated NNIs.

Urine samples were enzymatically hydrolyzed with β-glucuronidase and analyzed using liquid chromatography electrospray ionization-triple quadrupole-tandem mass spectrometry with online turbulent flow chromatography for sample cleanup and analyte enrichment (online-SPE-LC-MS/MS).

Our method proved robust and precise with limits of quantitation between 0.06 (acetamiprid (ACE)) and

1. μg/L (imidacloprid-olefin (IMI-olefin)) depending on the analyte. Inter-day and intra-day imprecision was ≤6% for all analytes. The mean relative recovery was in the range between 88 and 112%. In a pilot HBM study analyzing 39 samples from the general German population, we could quantify the parent compounds ACE (10% >LOQ) and IMI (36% >LOQ) together with their specific metabolites N-desmethyl- ACE (54%), 4-/5-hydroxy-IMI (21%) and IMI-olefin (18%). In one sample thiamethoxam (1.7 μg/L) was detected, too.

Summarizing, our method is able to analyze 7 NNIs together with 9 specific metabolites in a single analytical run. Exposure at environmental levels could be quantified for three different NNIs in a pilot study using urine samples of the general population in Germany.

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Abstract

The United States Environmental Protection Agency (EPA) has made it a top priority to take decisive action to advance environmental justice and civil rights in its latest strategic plan. Cumulative impacts are the result of exposures to multiple chemical and non-chemical stressors from the built, natural, and social environments. A significant driver of health disparities in the United States are disproportionate exposures to pollution and environmental degradation exacerbated by racial, economic, and geographic characteristics of individuals and communities. Understanding and addressing cumulative impacts is critical to reducing health disparities and inequities in these communities and local populations. Actions to address cumulative impacts will require accurate and realistic assessments of the combined effects from chemical and non-chemical stressors.

To support decision making at federal, state, tribal, and local levels, EPA's Office of Research and Development is embarking on an effort to strengthen the scientific foundation for assessing cumulative impacts. This presentation will introduce ISES participants to the EPA report on cumulative impacts research recommendations that launches this critical research agenda. These recommendations were developed based on a series of listening sessions and workshops to identify research gaps and barriers to conducting and translating research, and to establish a broad approach that builds knowledge to inform cumulative impact assessments. These recommendations inform research conducted by EPA through 2026 and beyond. (The views expressed are those of the authors and do not necessarily represent the views or the policies of the U.S. Environmental Protection Agency).

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The role of 2-chloro-1,3-thiazole-5-carboxylic acid (2-CTA) and 6-chloro nicotinic acid (6-CNA) as urinary metabolites of Neonicotinoids

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Abstract

Human biomonitoring of neonicotinoids and neonicotinoid-like insecticides (NNIs) was previously performed using 2-chloro-1,3-thiazole-5-carboxylic acid (2-CTA) or 6-chloronicotinic acid (6-CNA), suspected metabolites of NNIs containing a 2-chlorothiazol (e.g., clothianidin and thiamethoxam) and a 6-chloropyridinyl moiety (e.g., acetamiprid, flupyradifurone, imidacloprid, and thiacloprid). Interestingly, in an experimental setting where the aforementioned NNIs were orally-dosed to a volunteer, 2-CTA and 6-CNA could not be detected in urine samples by a qualitative screening using HPLC and high-resolution MS.

Here, we developed and validated a quantitative method with increased sensitivity for 2-CTA and 6-CNA and analyzed urine samples of oral dose studies from three volunteers including the samples of the qualitative experimental study. Because glycine conjugation of carboxylic acids is well-known in humans, we also integrated the respective glycine conjugates (2-CTA-gly and 6-CNA-gly) into the method. The analytes were extracted by liquid-liquid extraction, silylated, and analyzed by GC-MS.

The analyses of all urine samples showed that the urinary excretion fraction (Fue) of 6-CNA was ≤0.1% for NNIs containing a 6-chloropyridinyl moiety, whereas, for the glycine conjugate 6-CNA-gly, we found Fues of 0.5% (imidacloprid), 2% (thiacloprid), 8% (flupyradifurone), and 9% (acetamiprid). The Fues of both, 2-CTA and 2-CTA-gly, were <1% for NNIs containing a 2-chlorothiazol moiety.

In sum, 6-CNA, 2-CTA, and 2-CTA-gly are of minor importance in the human metabolism of the studied NNIs, whereas 6-CNA-gly seems of increased relevance, specifically in the metabolism of flupyradifurone and acetamiprid. In case of mono exposures to flupyradifurone and acetamiprid, 6-CNA-gly might be a useful biomarker for biomonitoring.

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Exploring hormones and antibiotics in soils of Crohn's disease clusters in Northern France

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Abstract

Crohn's disease (CD), a chronic inflammatory disease, has no known etiology, however, environmental exposures are suspected. The exposure from soil pollution is not examined, despite its various exposures to humans by ingestion, inhalation, and contact. This research will explore

the characteristics of soils in predefined CD clusters in Northern France, identify soil pollutants and compare them between high- and low-incidence clusters.

Contaminants in soil were interpreted based on a national data base called RMQS on soil quality. It showed a higher concentration then national background for Arsenic, Chromium and Lead in clusters of high-incidence, with a concentration of 11, 50.03 and 32.51mg/kg respectively. These results appeared to be consistent with a study on CD, which showed high concentrations of lead and chromium in the baby teeth of patients. Concentration of all heavy metals in clusters of high-incidence were higher than low-incidence clusters and showed a correlation of p=0.557 with the relative risk of the disease.

With the need to explore all contaminants in soils and a scarcity in existing data on soil, a sampling campaign was done in all clusters of CD, examining the presence of metals, hydrocarbures, benzenes, polychlorobiphényles in addition to a list of pharmaceuticals including 17α-estradiol, 17β-estradiol, estrone, estriol, and 17α-ethinylestradiol, ibuprofen, bisphenol A, paracetamol, carbamazepine, penicillin G, Roxithromycine, sulfadiazine and testosterone.

The results of this campaign will allow further research by epidemiologists. The presence of these elements in soils is studied for the first time in relation to CD and soils on a large-scale map.

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The Role of Environmental Exposures in Amyotrophic Lateral Sclerosis (ALS)

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Abstract

Background:
The United States National ALS Registry is a multi-faceted research platform. Its goals are to determine the epidemiology of ALS as well as examining its risk factors. ALS is a devastating neuromuscular disease with no cure, and most patients only survive 2– 5 years. Since the etiology of ALS is largely unknown, it has been hypothesized that environmental exposures may increase risk and susceptibility to ALS.

Methods:
One of the activities the Registry undertakes is funding academic institutions to identify possible environmental exposures linked to ALS. This has been accomplished by funding investigator-initiated R01 grants that allow institutions to explore etiologies.

Results:
Since 2013, the Registry has funded over 20 grants. Key findings from the research supported by these grants include statistically increased risks for ALS from pesticide exposures (glyphosate (OR=1.29, 95 % CI 1.19–1.39); lead (aOR=2.3, 95% CI 1.1, 4.6); mercury (OR=2.3, 95% CI 1.10–4.58); and polychlorinated biphenyls (PCB) congeners 118 (HR 1.50, 95% CI 0.95 to 2.39), PCB 138 (HR 1.69, 95% CI 0.99 to 2.90), PCB 151 (HR 1.46, 95% CI 1.01 to 2.10), and PCB 175 (HR 1.53, 95% CI 0.98 to 2.40). Occupations with potential environmental exposures (e.g., construction, manufacturing, painting, and military service) were also associated with elevated risk (aOR=3.95; 95% CI 2.04–8.30).

Conclusions:
Research funded by the National ALS Registry has resulted in increased understanding of the etiologic role of environmental exposures and ALS. This research supports the development of mitigation strategies to limit or reduce risk in the future.

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Participant Engagement to Develop Report-Back Materials for Personal Air Monitoring

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Abstract

Background: Studies measuring environmental toxicants in biospecimens often provide participants their results and, when done in a meaningful way, these are beneficial to participants and researchers. In contrast, studies using personal air monitors do not typically provide participants their personal air pollution data. The objective of this study was to engage study participants who completed personal air sampling to develop report-back documents containing their results.
Methods: We recruited adolescents and their caregivers who completed personal air sampling to participate in focus groups and guide the development of personal air monitoring report-back materials. We convened experts in community-engagement, reporting study results, and human subjects research to provide feedback on initial materials. Final revisions to the report-back document were made based on follow-up focus group feedback.

Results: Eight adolescents and their caregivers were enrolled in separate focus groups. Essential components to include in the report-back document were identified as background information, a comparison of individual data to the overall study population, a guide to

interpreting results, visualization of data, and additional information on sources, health risks, and reduction strategies. Adolescents indicated their desire for an electronic and interactive document. Thus, the final report- back document was electronic and contained background material, participants' results in interactive maps and figures, and additional material regarding pollution sources.

Conclusion: Participant engagement was critical to ensure personal air monitoring report-back materials are meaningful to study participants. Studies using personal air monitoring technology should provide individual results to empower participants with increased knowledge to guide exposure reduction strategies.

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Tea and coffee fungi and mycotoxins contamination: From a food safety issue to an occupational health concern

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Abstract

Objective: This work aims to characterize fungal and mycotoxin contamination of tea and coffee.

Methods: Forty tea samples (17 green tea; 13 black tea; 10 herbal or white tea) purchased from different markets in Lisbon, and 18 coffee bean samples from two coffee industries from Brazil, were screened for fungal contamination in malt extract agar (MEA) supplemented with chloramphenicol (0.05%), and in dichloran-glycerol agar (DG18). The molecular detection of

toxigenic Aspergillus sections was achieved by PCR. Screening of fungal resistance to azoles was conducted, adapted from the EUCAST norm. Mycotoxins were characterized by HPLC-MS.

Results: The highest fungal counts in tea were obtained in green raw tea (87.7% MEA; 69.6% DG18). Aspergillus sp. was the most prevalent genus on MEA (54.3%) and on DG18 (56.2%). One Aspergillus section Fumigati isolate, from green tea beverage, recovered form itraconazole-Saboraud dextrose agar (SDA) medium, presented itraconazole and posaconazole E-test MICs above MIC90 values. In raw tea, 23 samples (58%) were contaminated by one to five mycotoxins in the same sample; in coffee beans, 12 samples (67%) were contaminated by one to three mycotoxins. The assessment of coffee beans' fungal contamination is ongoing.

Conclusions: The observed contamination of raw tea and coffee beans might imply health risks for coffee and tea consumers. Future research targeting workers' exposure to fungi and mycotoxins in the workplaces where tea and coffee are manufactured and processed must be conducted.

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Pre and post-natal exposure of children to organophosphorus flame retardants: a nationwide survey in France

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Abstract

The use of organophosphate flame retardants (OPFR) is increasing. The objectives of this study are to describe the pre- and postnatal exposure of children to OPFR and to explore their possible determinants.

A total of 259 children aged 3.5 years and 388 mothers from the French Elfe mother-child cohort were included. Pre and post-natal exposure to 15 OPFR were assessed using concentrations in hair of pregnant women and their 3.5-year-old children. The highest (geometric mean) prenatal exposures were 272 ng/g for tris(1-chloro-2-propyl)phosphate (TCPP), 69.7 ng/g for triphenyl-phosphate (TPP) and
54.4 ng/g for tris(1,3-dichloro-2-propyl) phosphate (TDCPP). The highest postnatal exposures were 249.6 ng/g for TCPP, 85.3 ng/g for TDCPP and 83.8 ng/g for 2-ethylhexyl diphenyl

phosphate (EHDPP). Prenatal exposure to the 9 OPFR detected in more than 20% hair samples was associated to prenatal exposure to other flame retardants such as brominated flame retardant 209 (BDE209), 47 (BDE47), butylated hydroxytoluene (BHT), and 2,4,6 tribromophenol (TBPH). Mother's body mass index and the home renovation work before birth were also associated with prenatal exposure, except for tris(2- butoxyethyl) phosphate (TBEP) and triethylphosphate (TEP). Higher socioeconomic status appeared to be associated with lower exposure for several OPFR.

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Combined chemical exposure using exposure loads (EL) on Flemish human biomonitoring data (FLEHS)

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Abstract

People are exposed to a combination of chemicals. To improve our understanding on combined exposure and determinants, the concept of exposure load (EL) was applied as was done before by Canadian colleagues in the CHMS. The EL calculates "the number of chemicals to which individuals are internally exposed above a predefined threshold". In this study, the 50th and 90th percentile of each of the 45 chemicals of FLEHSIV (Flemish Environment and Health Study; 2016–2020) were applied as thresholds for the EL calculations for 387 study participants. The investigated chemicals were per- and polyfluoroalkyl substances (PFAS), bisphenols, phthalates and alternative plasticizers, flame retardants, pesticides, toxic metals, organochlorine compounds and polycyclic aromatic hydrocarbons
(PAHs). Around 20% of the participants were exposed to >27 chemicals above the P50 and to >6 chemicals above the P90 level. This shows that participants can be internally exposed to multiple chemicals in relatively high concentrations. When the chemical composition of the EL was considered, the variability between individuals was driven by some chemicals more than others. Associations between the EL and exposure determinants suggested determinants formerly associated with fat soluble chemicals, PFAS, bisphenols, and PAHs. This information adds to the knowledge needed to reduce the exposure by policymakers and citizens. However, a more in depth study is necessary to explore the causes for the higher EL in some individuals. The EL is a first useful step to get more insight in multiple chemical exposure in higher exposed subpopulations (relative to the rest of the sampled population).

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Connection of modelling approaches for estimating inhalation exposure during spray applications

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Abstract

Sprays are used in workplace as well as in consumer environments. Although spraying has several advantages such as uniform distribution of substances on surfaces in a highly efficient manner it is often prone to high inhalation burden which has to be quantified for adequate risk assessments. There are occupational exposure models with different degree of complexity available that are applied for spray applications. In the presentation we report on an effort to create an overall model for estimating inhalation exposure caused by spray applications by re-analyzing, refining and integrating three already existing models into a 2-level tiered approach. The single models used in this context are a 1- and 2-box mass balance model (Tier 1), Spray Expo and a newly developed binary system model (Tier 2). The Tier 1 level models are used for an initial assessment generally designed to deliver conservative results. Only if product safety cannot be derived from these results higher level models are used which are expected to generate results with a lower degree of conservatism. These higher level models are based on the solution of transport equation in space and time for the ingredients, taking into account the complex evaporation kinetics of interacting binary systems and consider the relevant sources in the spraying and post-spraying phase such as evaporation from droplets and treated surfaces. The presentation will contain the description of the overall model, results on plausibility and sensitivity, and the comparison with measured data.

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How many people live in the vicinity of asbestos processing facilities in Colombia?

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Abstract

The first asbestos-cement facility of Colombia began operations in the municipality of Sibaté (Cundinamarca) in 1942. Additional asbestos-cement facilities were installed in the cities of Yumbo (Valle) and Barranquilla (Atlántico) in 1944, and another two facilities began operations in the city of Manizales in 1967 and 1982. An asbestos friction-products plant started operation in Bogotá (DC), the capital of Colombia in 1960, and a chrysotile asbestos mine began operation in Campamento (Antioquia) in 1980. Although millions of tons of asbestos were distributed in Colombia, no health or environmental surveillance strategies were implemented. The objective of this study was to estimate the population living in the vicinity of asbestos processing facilities and the mine that have operated in Colombia. For this, a literature review was conducted to identify at which distance bands from asbestos processing facilities an increased risk of mesothelioma has been observed. Based on these distances, concentric circles around the asbestos facilities and the mine were generated using a GIS, and data from the 2005 and 2018 censuses was used to estimate the number of people living within these areas. The results indicate alarming high numbers for the entire country, ranging from 10.489 people within 500 m in 2005 to 6'724.677 people living within 10.000 m in 2018. The location of these facilities in densely populated areas can help explain these figures. Therefore, it is crucial to implement an asbestos related diseases surveillance strategy in the country.

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Capturing air pollutant gradients and exposures in Swiss residences during the COVID-19 pandemic

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Abstract

The COVID-19 pandemic has caused changes to the working arrangements of many people who are now based at home and may continue to work at home. As a result, residential air pollution contributes to human daily personal exposure more than ever before. In this study, we explored complex relationships between personal and stationary indoor air pollutant concentrations in residences of 36 participants working from home during the heating season. The stationary sensors and passive samplers were located in the bedroom, living room and home-office area while personal exposure was measured with sensors and samplers worn by the participants (PEM). During three consecutive weekdays, real-time data were obtained for particle number

concentration (size range 0.3-10 μm), carbon dioxide, and total volatile organic compounds, while integrated samples were collected and analyzed for specific VOCs, SVOCs. Additionally, the participants used a time-activity diary application to record their activities. The average concentration for CO_2 during the entire study was higher for PEM (1300 ppm) followed by the bedroom (1200 ppm), living room (960 ppm) and kitchen (900 ppm). Similarly, PEM reported a higher concentration for particles with sizes between 2.5-10 μm (12 μg/m^3), followed by the bedroom and living room (11 μg/m^3). A total of 44 chemical compounds were identified. During the entire study, sleeping recorded the highest average personal exposure to CO_2 (1600 ppm) continued by screen-time (1300 ppm) and eating (1200 ppm). PM_{10} average personal exposure was higher during cooking activities (73 μg/m^3) followed by cleaning (39 μg/m^3) and eating (37 μg/m^3).

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Using publicly available data to describe multiple environmental pressures and explore the link with end-stage renal disease

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Abstract

End-stage renal disease (ESRD) is the final stage of chronic kidney disease, where renal function is highly impaired leading to the need of a long-term dialysis or a kidney transplant. Etiology of ESRD remains partly unknown and in particular the role of the environment. The objective of the present work is precisely to identify new etiological hypothesis related to the environment.

Since 2005, in Northern France, newly detected ESRD cases are recorded in a health register called Nephronor. On this basis, standardized incidence ratios were calculated at the municipal level after being adjusted for several confounding factors, including : age, sex, social deprivation, distance to dialysis centers and glomerular filtration rate. Using spatial statistics, heterogeneity in ESRD incidence was studied and atypical spatial clusters were detected.

In parallel, a complete environmental database was built using publicly available data. After an exhaustive inventory of existing data, the most appropriate databases were selected and a long data management process was achieved. Finally, more than one hundred variables were included and allocated in one of the six following dimensions : Contamination levels (air, water, soils), Emission levels, Source locations, Land use, Agricultural practices and Climate. For each dimension, a composite indicator was built at the municipal level. Each of these composite

indicators were used to test etiological hypothesis, by comparing high-incidence with low-incidence ESRD spatial clusters. With this territorial approach, the ambition is not to demonstrate causal effects but rather to identify hypothesis that could be tested at the individual level in future epidemiological studies.

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Evaluating Environmental Chemical Exposure in Families Using Silicone Wristbands

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Abstract

Background: Silicone wristbands can be used as passive sampling devices. We used them to measure environmental chemical exposures in households across two seasons. We identified chemical exposure profiles for each member and assessed correlations for shared exposures between children and other household members.

Methods: We enrolled households, defined as two adults, a child, and companion pet. The eight urban- living households, n=32, were from the University of Utah Environmental Influences on Child Health Outcomes (ECHO) cohort. Five rural-living households, n=20, were from the Navajo Birth Cohort. Each participant wore a silicone wristband, or tag for pets, for seven consecutive days in winter and summer. Chemical exposures were identified and evaluated for each participant and between families.

Results: 169 total chemicals were detected from the 52 participants across both seasons, out of over 1,500 detectable by the wristband platform. Total exposures were similar for each participant across both seasons. Shared exposures between children and other members were similar in both seasons, about 75%. The most detected chemical classes were phthalates and pesticides, with insecticides the most prevalent. No single chemical exposure was identified in every wristband; however, 100% of urban wristbands had the insecticide N,N-Diethyl-m-toluamide (DEET), and 100% of rural wristbands included Butyl benzyl phthalate, Di-n-butyl phthalate, and Diisobutyl phthalate.

Conclusions: Data did not support the hypothesis that future studies could use other household members to predict chemical exposure among children as correlations were not strong or consistent.

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Health risks associated with occupational exposures to multiple chemical agents in the French COLCHIC database

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Abstract

Background: Workers may be exposed to multiple chemical agents in the workplace. However, the most prevalent coexposure situations and their associated health risks remain relatively understudied.

Objective: To characterize health risks associated with occupational coexposure situations in France using data from the COLCHIC database.

Methods: We extracted personal measurement data to 123 chemical agents from the COLCHIC database for the period 2010-2019. We grouped measurements by work situation (WS, combination of sector, occupation, task, and year). We used the MiXie France tool to calculate hazard indices (HI) of coexposures for 24 toxicological classes relative to the agents' concentrations and French occupational exposure limits.

Results: Of the 5284 WS identified, 3296 had exposures to ≥2 agents sharing the same toxicological class, the most frequent being upper airway damage (n=2025), carcinogenicity (n=1925), and eye damage (n=1794). Frequent coexposures included quartz-cristobalite (lower airway damage and carcinogenicity), copper-manganese (lower airway damage), and ethylbenzene-

xylene (upper airway and central nervous system damage, otoxicity). Overall, 809 WS were overexposed (HI>1) to at least one toxicological class. Manufacturing of composite material parts, chemical surface treatment and porcelain manufacturing each had at least 50% of WS with overexposure.

Conclusion: While COLCHIC does not necessarily represent a random sample of the activity sectors in France, we observed a relatively high prevalence of exposure to multiple chemical agents with similar health endpoints. This data is useful to identify the most common chemical mixtures and to target prevention efforts for those work tasks presenting a high potential of overexposure.

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Agreement between French occupational exposure limits and selected exposure banding tools

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Abstract

Control banding (CB) and occupational exposure banding (OEB) tools can provide exposure bands (EB) representing ranges of target concentrations for exposure risk management based on hazard statements of chemical substances. We compared current French 8-hour occupational exposure limits (OEL8h) to exposure bands assigned by four available CB/OEB tools (COSHH-Essentials, EMKG, NIOSH OEB and Solvay-OEB).

For each tool, we assigned exposure bands (EB) to 352 agents using hazard statements. We calculated ratios between the OEL8h and the target concentrations of the EBs. We also evaluated the agreement between the EBs assigned using hazard statements to the EBs containing the OEL8h using quadratic- weighted Kappas (κ). We observed higher agreement between the EBs assigned with hazard statements to the EBs containing the OEL8h for vapors (κ=0.31-0.48 between tools) than for aerosols (κ=0.12-0.26). Vapors had 43-71% of OEL8h higher than the EB (aerosols: 72-94%) and 4-15% below the EB (aerosols: 0-3%). Several OEL8h from the 1980s for carcinogens were high relative to the EBs, such as for 1,2- Dichloropropane, acetaldehyde, and silicon carbide.

Overall, EBs tended to have better agreement with OEL8h for vapors than for aerosols; for the latter, the agreement could be influenced by factors such as size fraction. While OEB tools are primarily geared towards data-poor substances without OELs, they can also serve to prioritize candidate substances for OEL re-evaluation. Comparisons of risk assessments based on these tools to those from OEL8h using workplace measurements are ongoing.

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Estimating vehicle flows using satellite imagery for air pollution modelling: a deep learning approach

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Abstract

Background: Accurate traffic data is crucial for modelling vehicle emissions. However, the availability of traffic data is geographically fragmented and is rarely held in an accessible form. We aimed to quantify vehicle flow on each road in Barcelona using high-resolution satellite imagery and Deep Learning (DL).

Methods: We trained a DL object detection algorithm (You Only Look Once (YOLOv3)) to identify vehicles, road by road, in Barcelona (2017-2019), based on high-resolution WorldView-2/-3 satellite imagery. DL accuracy was improved via fine-tuning techniques. Additionally, we developed a novel geospatial method to estimate vehicle speed from satellite images by exploiting the fraction of a second gap between each image capture from the 8 multi-spectral sensors on board the WorldView-2/-3 satellites.

Results: Our best performing vehicle detection model had a precision (percentage of model detections that are correct) of 71% and a recall (percentage of vehicles in the image scene identified by the model) of 72%. The model detected 601,450 vehicles in 10 satellite images across Barcelona, with estimated average speeds of 7km/h on residential roads and 77km/h on motorways; validation with Google Directions API showed good agreement. As ~85% of vehicles in Barcelona are parked, we are currently improving the model to remove parked vehicles.

Conclusions: High-resolution satellite imagery can be used in object detection to identify vehicles on all roads in cities and vehicle speed can be calculated from satellite multi-spectral sensors. Our approach could be translated to model vehicle emissions in LMICs, where traffic counts and air pollution measurement is limited.

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UK hyperlocal air pollution model – use of inverse modelling to increase the spatial detail of air pollution predictions

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Abstract

Aim: To develop a hyperlocal model which predicts air pollution every 20m across all of UK's roads.

Method: We address the lack of detailed traffic counts, speed and emissions by utilising ~12,000 diffusion tube and local sensor measurements in the UK, with a road traffic emissions optimisation method (EOM). The EOM uses model sensitivity coefficients in Taylor series expansions of the models' response to varying emissions, allowing Monte Carlo emissions calibration to be performed at every monitoring location. This has created previously unavailable road emissions estimates, as well as calibrating emissions on those roads that were already in the model. For other sources we used a combination of European, UK National Atmospheric Emissions Inventories. Air pollution was predicted using the WRF met. model and the CMAQ-urban coupled model.

Results: The EOM has enabled an emissions calibration process of unprecedented scale – improving traffic emissions estimates and enabling air pollution predictions at 20m resolution for every road in the UK. The NO_X, NO_2 and O_3 model performance compares favourably with out of sample measurements and the EOM addresses the uncertainty NO_X, NO_2 emissions from road transport, which has hitherto been under predicted.

Conclusions: We have demonstrated what is possible with coupled CTM and local scale air pollution models, when combined with sufficiently detailed emissions inventories. This new approach is ideally suited for use with low cost sensor networks globally, providing detailed data, including for $PM_{2.5}$ and PM_{10}, for local populations, policy development and health research, across entire cities and even countries.

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Can the UK achieve the $PM_{2.5}$ WHO 10 μg m^{-3} interim target by 2030?

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Abstract

Aim: The aim of this research was to combine existing UK 2030 emissions forecasts, the UK's Climate Change Committee (CCC) Net Zero vehicle forecasts, and the Greater London Authority's policy forecasts, to establish whether the UK can meet the $PM_{2.5}$ WHO 10 μg m^{-3} interim target by 2030, and to assess the likely exposure reduction.

Method: We used European, UK and London Atmospheric Emissions Inventory forecasts between 2018 and 2030. We calculated road transport emissions for the Balanced Net Zero Pathway, published by the CCC, including widespread vehicle electrification, and two London specific scenarios aimed at reducing $PM_{2.5}$. The emissions were combined with the WRF met. and CMAQ-urban coupled model, providing UK $PM_{2.5}$ concentrations at 2km spatially, down to every 20m close to major roads.

Results: Between 2018 and 2030, UK $PM_{2.5}$ concentrations fell 23% to below 10 μg m^{-3} for over 99% of the population. London scenarios reduced $PM_{2.5}$ locally, with <1% of the area of London predicted to be above 10 μg m^{-3}. Accounting for model uncertainty resulted in ~4% of the UK remaining at risk of exceeding 10 μg m^{-3} albeit in cities such as Birmingham and Manchester.

Conclusions: We have shown the combined benefits of UK air quality, Net Zero and local policies for $PM_{2.5}$ control, in almost achieving the $PM_{2.5}$ WHO interim target. We identified important but uncertain emissions sources, such as non-exhaust vehicle emissions, cooking aerosol and domestic and industrial wood burning. This work has been submitted to the UK Environment Bill consultation.

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A field study on volatile organic compounds generated during cooking in a large pot using PTR ToF MS

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Abstract

Various volatile organic compounds (VOCs), including aldehydes, are present in fried food being cooked in high-temperature oil. In this study, real-time VOC concentration was measured in the upper part of a large pot in the cooking room using Proton Transfer Reaction Time-of-Flight Mass Spectrometry (PTR ToF MS) for 3 days (roasted on the first day, fried on the second day, and simmered on the third day).

The average concentration of diacetyl was the highest on the first day of stir-frying and steaming. The highest concentrations of formaldehyde was on day 3 when pork was cooked in sugar and sauce.
Formaldehyde, 1,3-butadiene, acrolein, diacetyl, and naphthalene were detected during the frying process on the second day.

The maximum/minimum concentration ratio was the highest for acrolein (3,030), so it was confirmed that many aldehydes were generated during frying. Although there is a limit to direct comparison with Occupational Exposure Limit as a result of area sample by PTR ToF MS, the mean concentrations of formaldehyde and diacetyl during the frying operation for 15 minutes were 232 ppb and 16 ppb, respectively, which was 80% of the ACGIH STEL TLV. After the frying was over, the VOC concentration began to decrease, and it took more than 3 hours to lower the VOC concentration to the level before the oil was heated.

As various harmful gaseous substances are generated when cooking deep-frying, improvement methods such as using oil with high boiling points and developing respiratory protection programs should be devised

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Influenza D virus exposure among US cattle workers: A call for surveillance

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Abstract

Influenza D virus (IDV) is a newly identified and emerging zoonotic virus, and little is known about human infection. Cattle are believed to be a host species, and while occupational exposure to cattle is believed to be a risk factor for exposure, surveillance in this vulnerable workforce is scant. We assessed IDV exposure and associated health effects among United States dairy workers, a population at heightened risk of cattle zoonoses, using paired nasal lavage washes and personal bioaerosol monitors, and self-reported symptoms monitoring. In repeated cross-shift sampling across five workdays of workers employed at five large-herd dairy operations (n=31), we found evidence of IDV in the nasal washes of 68% (n=21) and in personal bioaerosol monitors of 23% (n=7) of participants. Nasal carriage was transient, not chronic, in more than 80% of

participants with a positive specimen (n=17). IDV recovery from bioaerosol samplers and nasal washes was not associated. Concordance in time between bioaerosol and nasal lavage sampling was low. IDV positive nasal wash was not associated with respiratory symptoms. These findings demonstrate notable, silent, and understudied exposure to IDV among this workforce. Zoonotic influenza viruses pose pandemic risks and our study underscores the need to study IDV spillover to humans.

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Concentration Profile and the Health Risk of Pesticide Exposure in Breastmilk: A Multicenter Study in China

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Abstract

China is the world's largest pesticide user. These chemicals are bioaccumulative in the human body, and eventually could be transferred from the mother to the fetus/infant via placental and breastfeeding transport, which might pose developmental deficiency risks. In this study, human biomonitoring of legacy pesticides was conducted in three Chinese cities using sixty breast milk samples. The patterns, chemical structural signatures, and the estimated daily intake of pesticides were assessed. The median concentration of HCB was the highest among all pesticides, whereas the HCHs, DDXs, TCVP, and heptachlor were also detected. A significantly different pattern of pesticides was found among three sampling cities: the Mianyang cases were mostly DDXs oriented while the Wuhan and Hangzhou cases were under HCB, HCHs, TCVP, and heptachlor influences. Maternal age and pre-pregnancy BMI were found to be the influencing factors for the pesticides in the breast milk, and dietary preferences were a key factor in the exposure scenario. Chemical structural signatures indicated that for HCHs and DDXs the exposure was mostly historical, while the lindane and dicofol exposure may exist among the volunteering mothers. The EF for chiral pesticides did not deviate significantly from the racemic value.

The risk from breastfeeding was negligible according to the Chinese and UN standard, while some cases from Hangzhou and Wuhan exceeded the Canadian restrictions. Thus, the adverse health effects of chemical exposure by dietary intake for infants need to be closely monitored in future studies.

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Building Capacity for Disaster Research Response (DR2): Lessons, Tools and Resources from the University of Washington - National Institute of Environmental Health Sciences DR2 Workshop

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Abstract

Background and Aim: Time-sensitive environmental health disaster research can contribute to learning about short- and long-term disaster health impacts and response and recovery strategy effectiveness. However, there are several relational, logistical and administrative barriers facing disaster research, necessitating intentional and collaborative planning among researchers, practitioners, and communities. In response, the University of Washington (UW) and the National Institute of Environmental Health Sciences (NIEHS) collaboratively designed a "Disaster Research Response" (DR2) workshop to improve preparedness to conduct rapid environmental and health-related research that concurrently advances science and is responsive to community information needs. This presentation will provide an overview of the DR2 workshop planning process and resultant tools, resources, and lessons learned.

Methods: NIEHS staff, UW researchers, and public health, healthcare and emergency management practitioners worked together for 2.5 years to build relationships, identify community-driven research priorities, develop research protocols and plans, plan for ethical review of time sensitive research, and identify workforce development needs.

Results: The workshop resulted in the development of several sharable tools and resources, including: a Concept of Operations Plan; approaches to engaging communities in pre-disaster research planning, including protocols for and highlights of community listening sessions; research plans and protocols; institutional review board training; a gap analysis of disaster and health graduate training in the U.S.; as well as identification of lessons learned for communities embarking on similar efforts.

Conclusions: Processes, tools, resources, and lessons learned from UW-NIEHS DR2 workshop can inform other communities seeking to build capacity to conduct environmental health disaster research.

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Evaluating Accuracy of Satellite-Based Methods to Estimate Residential Proximity to Agricultural Crops

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Abstract
Background: Remote-sensing derived datasets are commonly used to estimate residential proximity to agriculture as a means of approximating individual-level pesticide exposure. Few studies have examined the accuracy of these methods and the implications for exposure misclassification.

Methods: We inspected the presence of agricultural fields (n=349) and identified crops in current production within a 0.5 km radius of 40 residential locations in Idaho. We calculated 1) the distance from the participant's home to the nearest agricultural field and 2) the total acreage of agricultural fields within a 0.5 km buffer. We compared these fieldwork-based estimates to satellite-derived estimates from three widely-used datasets: CropScape, the National Land Cover Database (NLCD), and Landsat imagery

Results: We found poor to moderate agreement between the classification of individuals living within
0.5 km of an agricultural field between our ground-truth method and the comparison datasets (53.1- 77.6%). All satellite-derived estimates overestimated the total acreage of agricultural land within 0.5 km of each home (average =82.8-148.87%). Using two satellite-dervied datasets in conjunction resulted in substantial improvements; specifically, combining CropScape or NLCD with Landsat imagery had the highest percent agreement with the ground-truthing data (92.8-93.8% agreement).

Significance: Our results provide a better understanding of the strengths and limitations of commonly used satellite-based methods for estimating residential proximity to agricultural land. We advocate for the use of either NLCD or CropScape with a Landsat-based method in order to minimize exposure misclassification. Satellite-based methods have many benefits and should continue to be used while correctly acknowledging their limitations.

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Effect of prenatal PM2.5 and its constituents exposure and fetal growth pattern on children's accelerated growth in the first three years

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Abstract

Background: No study investigated the effect of prenatal exposure to PM2.5 and its constituents on accelerated childhood growth, considering fetal growth pattern. We aimed to examine the effect of prenatal PM2.5 and its constituents exposure, fetal growth pattern on children's accelerated growth in the first three years.

Methods: The study was embedded in a population-based birth cohort in China, including 5,424 mother- child pairs. Prenatal PM2.5 and its constituents [organic carbon (OC), elemental carbon (EC), sulfate (SO42-), nitrate (NO3-), and ammonium (NH4+)] concentrations were estimated. K-means algorithm was used to cluster the ultrasound-measured estimated fetal weight (EFW) Z-score growth pattern.
Children's accelerated growth was defined as the change of BMI Z-score from birth to three years >0.67. Generalized logistic regression was used to analyze the effect of prenatal PM2.5 and its constituents exposure and fetal growth pattern on children's accelerated growth.

Results: Compared with higher fetal growth, children with lower fetal growth had 1.707 (95%CI:1.521,1.916) times higher risk of children's accelerated growth. An IQR increase in PM2.5, OC, NH4+, and SO42- was associated with 1.140 (95%CI:1.003,1.296), 1.335 (95%CI:1.096,1.626), 1.116 (95%CI:1.006,1.237), and 1.246 (95%CI:1.001,1.549) times higher risk of children's accelerated growth, respectively. Prenatal PM2.5 and its constituents exposure and fetal growth had a joint effect on children's accelerated growth, especially for OC (RERI:0.485, 95%CI: 0.018,0.952).

Conclusions: Prenatal PM2.5 and its constituents exposure and fetal growth had an individual and joint

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EIRE - nEonicotinoid Insecticide exposuREs: an environmental and occupational exposure study of neonicotinoid insecticides

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Abstract

Neonicotinoid insecticides and neonicotinoid-like compounds (NNIs) are the most extensively used insecticides worldwide, registered in 120 countries with global sales in excess of $3.5 billion. Internationally, there is controversy about their toxic effect on pollinators; however, there are increasing concerns about their potential to cause adverse human health effects. Due to the limited number of human biomonitoring (HBM) studies investigating NNIs, there is a dearth of information on the range and magnitude of human exposures to NNIs, required to further understand the impact of NNI exposure on human health.

HBM studies to date found that the specific metabolite of acetamiprid, N-desmethyl-acetamiprid, is most frequently detected in urine samples. The EIRE 'nEonicotinoid Insecticide exposuREs' project aims to characterise acetamiprid exposures among occupationally exposed amenity horticulturists and in the general population. Therefore, a newly developed and validated HBM method quantifies seven NNIs (i.e. acetamiprid, clothianidin, flupyradifurone, imidacloprid, sulfoxaflor, thiamethoxam, thiacloprid), including nine of their specific metabolites derived from N-dealkylation and hydroxylation will be applied to evaluate NNI exposure in Ireland. Contextual information on diet, occupation, lifestyle and health will be collected using questionnaires aligned with the HBM4EU protocols and drinking water samples will be analysed with the aim of identifying exposure sources.

The EIRE project will produce the first datasets on NNI exposure in an occupational and environmental context. Preliminary results of the EIRE project will be presented at the conference, including the human biomonitoring sampling strategy, the inadvertent ingestion exposure methodology, and the sampling protocols developed for the project.

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Assessing risk in relation to metal pollution in Hindon river water irrigated soils of Western U.P. of India

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Abstract

Human health risk from ingestion of metal by way of eating of plants, raised on these soils, was predicted based on the free ion activity in contaminated soils followed by their movement to food-chain of human, using solubility-free ion activity model (FIAM). Soil degradation with metal pollution was assessed in polluted river water-irrigated soils. Soil quality index (SQI) was found to be lowest (PCA- SQI=0.28) in river water irrigated soils collected from Nithari and Barnawa village of Uttar Pradesh, India. Degree of soil health degradation due to metal accumulation as indicated by PCA-SQI follows the order: Nithari= Barnawa >Makreda >Rewari >Parsi >Kinauni. Plants grown on soils irrigated with river water showed higher accumulation of metals like zinc, copper, nickel, lead and cadmium compared to plants raised on tube well-irrigated soils. Variation in metal content in plants grown in river as well tube well irrigated soils could be successfully predicted by solubility-free ion activity model. Suitability of crops (rice grain, spinach, carrot, cucumber, pumpkin) as raised on river water irrigated soils for human consumption was expressed in terms of hazard quotient, which were well within the safe limit.

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Oral Exposure to TiO_2 and Cellulose Nanomaterials: review of hazard identification in the adverse outcome pathway landscape

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Abstract

Several products in the global market have been improved using titanium dioxide nanomaterials (TiO_2 NMs), and many other NMs under development, e.g., cellulose NMs (CNMs), with potential for use in agriculture, food, and feed industries. Despite being considered *key enabling technologies*, the exponential use of NMs in food technology leads to concerns about adverse health outcomes upon ingestion, such as potential genotoxicity and cancer of the gastrointestinal tract (GIT) due to their bioaccumulation.

The aim of this study, considering oral exposure to TiO_2 NMs and CNMs as case studies, was to explore the knowledge about these NMs' cellular and molecular mechanisms of action that may be central to their predicted adverse outcomes pathways at the GIT. For this purpose, literature reviews were setup to target the hazard of these NMs in the GIT context, directed to identify the molecular initiating event (MIE) and key events (KE) that mediate potential genotoxic and carcinogenic effects, thus contributing to Adverse Outcome Pathways (AOP) landscape.

From the review of *in vitro/in vivo* studies, the suggested MIE involves the cellular uptake by intestinal cells and effects at lysosomal level. Several possible KE like inflammation, persistent cell injury/cell death, ROS generation, and DNA damage that may mediate the formation of adenomas/carcinomas were identified for TiO_2 NMs; the information for CNMs is scarce. Some knowledge gaps were also identified, opening new avenues for more mechanistic research that will feed into AOPs.

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Personal Care and Consumer Product Use Among Youth with Asthma Living in Baltimore City

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Abstract

Over 6 million U.S. children have asthma with higher rates reported among Black children. Accumulating evidence suggests that chemicals in personal care and other consumer products may play a role in asthma development and control; however, consumer product use patterns and behaviors among children with asthma remain sparse. We characterized personal care and consumer product use among 110 youth with asthma(ages 8-17 years) living in Baltimore City using an interviewer-administered survey. We queried participants on their use of personal care products, hair services, feminine hygiene products, and use of household products and other consumer product behaviors and assessed differences in product use by age (8-11 vs. 12-17 years) and gender. Participants were majority Black (87%), aged 8-11 years (66%), and 56% were male. Participants reported using an average of 17 personal care products (range:5-33), including 13 face and body products (range:4-23) and 5 hair products (range:0-10) in the previous 12 months. Older youth (12-17 years) and females reported more frequent use of hair products (hair gel, conditioner), hair services (press and curl, weaves, braids), face products (cleanser, moisturizer), and body

products(body wash,perfume) compared to younger youth(8-11 years) and males, respectively. Overall, we observed no age or gender differences in household consumer product use or behaviors. Older youth may be at increased risk of chemical exposures through more frequent use of personal care products. Future research should examine this further to understand the potential impact of product use and chemical exposures on pediatric asthma.

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Development of Iron-based Catalysts to Remove Aldehydes in Indoor Air

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Abstract

Among the pollutants commonly found in indoor air, aldehydes have been reported to pose a particularly high human health risk; however, they are difficult to be removed by current air purification methods due to their physicochemical properties (e.g., vapor pressure). The iron ions are known to form specific complexes with aldehydes, which could be photochemically degraded. In this study, we apply these phenomena to remove airborne aldehydes and evaluated the effects of carriers, such as cloth, ion-exchange membrane, and ion-exchange resin, to immobilize iron ions on the removal performance of aldehydes (e.g., formaldehyde) in the air. The iron-immobilized cloth was obtained by dipping a cotton cloth in iron (II) sulfate solution, followed by a drop of $NaBH_4$ solution and drying. The iron ions were immobilized on the ion-exchange membrane and the ion-exchange resin by soaking in the iron (II) sulfate solution and drying. The experimental results revealed that all the iron-based catalysts fabricated in this study could remove formaldehyde in the air. The removal performances of the irons immobilized on the ion exchange membrane and ion exchange resin tended to be higher than that on the cloth. To estimate the removal performances of the iron-based catalysts developed in this study in practical use, the simulation model was developed, suggesting that they could have the potential to sufficiently decrease the concentration of formaldehyde in indoor air in the simulated actual indoor environment, in which the emission of formaldehyde from pollutant source in the indoor environment was considered.

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Dermal Exposure to Phosphorus Flame Retardants in Car Seat through Actual Clothing

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Abstract

The dust ingestion and inhalation via indoor air have been recognized as major exposure routes for phosphorus flame retardants (PFRs) in indoor products. Recently, the dermal exposure via dust adhered on the skin and/or indoor air has been attracting attention as an alternative significant exposure route; however, few studies focused on the dermal exposure via direct contact with products despite that the concentrations of PFRs in products are remarkably higher than those in dust or indoor air. In addition, the current assessment methods for dermal exposure ignore the PFRs accumulated in the skin with short contact with the product and the effects of clothing worn, even though people cover most of their skin with clothing. Therefore, it is necessary to establish a dermal exposure assessment method based on more realistic exposure scenarios. In this study, we conducted the skin permeation experiments of PFRs contained in a product (car seat) using artificial skin to evaluate the effects of different exposure scenarios, such as presence or absence of clothing and contact scenario (continuous and intermittent contacts with the product), on the potential dermal exposure rates. To evaluate the effects of the PFRs accumulated in the skin, the simulation model was developed. The experimental results revealed that clothing could reduce the permeation rate, and the dermal exposure rate was higher in intermittent contact than in continuous contact with the car seat. The short contact with the product and the accumulation of PFRs in the skin could significantly affect the exposure rates.

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Feasibility of Simplest Wet Scrubber to Remove Formaldehyde in Indoor Air

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Abstract

Air purifiers have started to become popular in households due to the growing interest in indoor environmental air quality. However, most of the existing air purifiers are designed as high performance, making them expensive and difficult to purchase, especially in economically challenged countries, despite their Air Quality Indexes are likely to be higher. The wet scrubber method is a low-cost and easy way to clean the air, which is particularly effective against water-soluble pollutants, such as aldehydes which are feared to pose the highest risk indoors. In this study, we evaluated an air purification method using the simplest wet scrubber, which consists of the combination of a bucket and an electric fan, to remove 55 volatile organic pollutants, especially formaldehyde, in an actual indoor environment. The experimental results revealed that formaldehyde in the indoor air of a room (5.65 m × 5.65 m × 2.65 m = 85 m^3) was absorbed into the water in the bucket, and its concentration was decreased with time and then achieved at steady-state due to the emission of formaldehyde from furniture in the room (950 μg h^{-1}). This method is expected to be applied more efficiently, especially in high humidity areas, such as in combination with a dehumidifier, thereby bringing the condensed water into contact with the contaminated air.

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Source Apportionment and assessment of Air Quality Index of PM2.5-10 and PM2.5 in at two different sites in Urban Background Area in Senegal

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Abstract

Identifying the particulate matter (PM) sources is an essential step to assess PM effects on human health and understand PM's behavior in a specific environment. Information about the composition of the organic or/and inorganic fraction of PM is usually used for source apportionment studies. In this study that took place in Dakar, Senegal, the identification of the sources of two PM fractions was performed by utilizing data on the elemental composition and elemental carbon content. Four PM sources were identified using positive matrix factorization (PMF): Industrial emissions, mineral dust, traffic emissions, and sea salt/secondary sulfates. To assess the effect of PM on human health the air quality index (AQI) was estimated. The highest values of AQI are approximately 497 and 488, in Yoff and Hlm, respectively. The spatial location of the sources was investigated using Potential Source Contribution Function (PSCF). PSCF plots revealed the high effect of transported dust from the desert regions to PM concentration in the sampling site. To the best of our knowledge, this is the first source apportionment study on PM fractions published for Dakar, Senegal.

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German Environmental Specimen Bank: evidence of increasing population exposures to the UV filters octocrylene and 2-ethylhexyl salicylate from 1996- 2020

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Abstract

Octocrylene (OC) and 2-ethylhexyl salicylate (octisalate, EHS) are UVB filters that are increasingly applied in sunscreens. However, no data on possible time trends of human exposures for both substances existed so far.

A total of six specific biomarkers of OC (CPAA, DOCCA, 5OH-OC) and EHS (5cx-EPS, 5OH-EHS, 5oxo-EHS) were analyzed in 420 24 h-urine samples of the German Environmental Specimen Bank collected between 1996 and 2020 (4-year intervals, 60 per year; 30 females, 30 males, aged 20-29). Analysis was performed blinded and randomized using online-SPE-LC-MS/MS with stable isotope dilution. The limits of quantification (LOQ) were between 0.015 (5OH-OC) and 0.5 µg/L (CPAA).

Median concentrations of the most sensitive OC and EHS biomarkers (CPAA and 5cx-EPS) increased from
<LOQ in 1996 (with 5% of the samples >LOQ for both) to 4.79 µg/L for CPAA (100% >LOQ) and 0.071 µg/L for 5cx-EPS (93% >LOQ) in 2016, followed by slight decreases to 3.12 and 0.060 µg/L in 2020 (97% and 88% >LOQ), respectively. These time trends were confirmed by the other biomarkers. Via reverse dosimetry, we calculated maximum daily intakes of 24.3 µg/kg bw/d for OC and 74.7 µg/kg bw/d for EHS.

This study is the first to provide evidence of continuously increasing OC and EHS exposures in humans over a period of about 2,5 decades. According to current knowledge, the exposure levels have sufficient margins of safety. However, the assessment of reproductive/developmental toxicity of EHS is still ongoing on the EU level.

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Arsenic and its species in urine of children and adolescents in Germany – human biomonitoring results of the German Environmental Survey 2014–2017 (GerES V)

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Abstract

Results from the population representative German Environmental Survey 2014–2017 (GerES V) on the exposure of children and adolescents to arsenic and arsenic compounds are presented. All samples had urinary arsenic concentrations above the limit of quantification (LOQ = 0.6 µg/L), however total urinary arsenic is difficult to assess as it comprises inorganic as well as organic arsenic species. Therefore, inorganic (As^{III} and As^{V}) as well as organic species (MMA,

DMA, Arsenobetaine) have been quantified, accounting for 75.3 % of total arsenic levels found. Biomonitoring equivalent (BE) values derived in 2010 for chronic exposure to inorganic arsenic (As_i) of 1.3 µg/L and toxicologically relevant arsenic species (As_{tox} = $\sum As_i$+MMA+DMA) of 6.4 µg/L are exceeded by 2.7 % and 21.5 % of the participants, respectively. As_{tox} contains the organic arsenic species MMA and DMA, which are usually considered less toxic than inorganic arsenic, however are still possibly carcinogenic to humans.

Relevant exposure determinants for total arsenic are consumption of fish and seafood, age of participants, migration background and frequent consumption of rice. Interestingly, the latter was not among the significant exposure determinants for inorganic arsenic. Concerning arsenobetaine, additionally consumption of eggs seems to be a relevant exposure pathway, possibly via fish meal feed.

The results of the study suggest a relatively low internal exposure of inorganic arsenic, which is considered the most toxic form of arsenic. However, open questions remain concerning the toxicologic impact of MMA and DMA as well as of the 25 % of not covered arsenic species.

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Development and evaluation of a Hybrid Air Dispersion Exposure System (HADES) for regional and national scale exposure assessment.

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Abstract

Urban air pollution is traditionally estimated by land use regression (LUR) or dispersion modelling approaches. LUR is a low cost approach that quantifies the relationship between measured pollutant concentrations and proximity to nearby activities (i.e. indirect source measurements). However, LUR may incorporate spatially detailed surrogates, including descriptions of the local geometry (i.e. street canyons) and satellite derived transboundary concentrations in the troposphere. Meanwhile, dispersion models consider quantified source emission rates and airflows, informed by temporally detailed meteorological parameters, however, these benefits come with increased computational and financial cost.

As such, we have developed a GIS-dispersion model that draws on the benefits of LUR, while directly accounting for source contributions and their movement in the atmosphere via a streamlined Gaussian- dispersion approach. This Hybrid Air Dispersion Exposure System (HADES) can rapidly estimate spatiotemporally detailed air pollution concentrations over large geographical areas, and it is developed from open access datasets that have near global coverage.

Integration of these hourly 25x25m outdoor surfaces with population mobility data will enable the investigation of time-weighted exposures, reflective of activities within the course of the day (i.e. residential, commute, and workplace). This mitigates issues of exposure misclassification found in existing epidemiological research, which typically rely on coarse spatiotemporally static residential exposures (i.e. 100x100m annual concentrations).

HADES targets the calculation of local air quality levels across medium sized cities in under 1-hour on local hardware, or substantially faster on high-performance-computing servers. These run-times will enable policy to be developed, tested and refined in an iterative and prompt manner.

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Biomonioring Nitrated Polycyclic Aromatic Hydrocarbons (Nitro-PAHs) Emitted from Specific Combustion Sources

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Abstract

Certain nitro-PAHs are emitted from specific combustion sources. Hence, biomonitoring metabolites of nitro-PAHs may present a method to assess exposures to sources such as diesel and wood combustion. This presentation aims to integrate the findings from recent real-world studies. In residents of London, UK, urine samples were measured for 5 amino-PAHs (metabolites of nitro-PAHs). Results showed that 2- aminofluorene concentrations were higher in those residing within 100m of a major traffic road and that 2-aminofluorene and 1-aminopyrene were each associated with diesel-traffic volume within 100m radius of residences. The relative abundance of urinary amino-PAHs was consistent with that of the parent nitro-PAHs in the emissions from engines burning diesel/biodiesel blends. In a factory worker cohort, urinary 1-aminopyrene was 12.8 times more likely to be detected in diesel engine testers than in non-tester controls and was significantly correlated with personal exposures to elemental carbon but not with PM2.5, regardless of smoking status. In addition to urine biomonitoring, blood biomonitoring for hemoglobin-adducts of nitro-PAH metabolic intermediates emerged as a promising method. In adult residents of New York city, 2-aminofluorene and 1-aminopyrene in hemoglobin hydrolysis extracts were the most and the 2nd most abundant amino-PAHs, consistent with the diesel/biodiesel blend emission profile. In rural residents exposed to wood smoke emitting 9-nitrophenanthrene as the most abundant nitro-PAH, 9-aminophenanthrene was the most abundant amino-PAHs in hemoglobin extracts. Taken together, 1-aminopyrene, 2-aminofluorene, and 9-aminophenanthrene in urine or hemoglobin may serve as exposure biomarkers specific to conventional diesel, diesel/biodiesel blend, and wood emissions, respectively.

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An Infrared Particle Identification System for Occupational Exposure Assessments

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Abstract

Occupational exposure to airborne dust is responsible for numerous respiratory and cardiovascular diseases. Because of these hazards, air samples are regularly collected on filters and sent for laboratory analysis to ensure compliance with regulations. Unfortunately, this approach often takes weeks to provide a result, which makes it impossible to identify dust sources or protect workers in real-time.
Electronic devices that employ light scattering or gravimetric measurements are sometimes used to quantify the total amount of dust continuously; however, they do not identify specific hazards.

To address these challenges, TNO developed a system that characterizes airborne dust by its spectro- chemical profile. In this device, a micro-cyclone concentrates particles from the air and introduces them to a hollow waveguide where an infrared signature is obtained. The smart algorithm provides chemically-specific information about respirable particles in near-real time. This technique allows occupational hygienists to identify specific hazards and take appropriate action. The detection concept was demonstrated as a proof of principle in field tests with a stationary device, and progress has been made towards a wearable system.

The primary development focus has been on the identification of crystalline silica at construction
sites. Since then, the core technology has been tested in other environments where particulates pose a risk, and it appears promising for defense and agricultural applications. It is hoped that this flexibility will enable the device to ultimately reduce exposures across multiple sectors.

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Design and calibration of a mobile sensor system for air pollution in near-road environments: The Urban Scanner Platform

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Abstract

Urban air pollution contributes to premature deaths and chronic illness worldwide. Existing urban air pollution networks primarily rely on fixed monitoring sites with low spatial coverage. There is yet much to be learned about the performance of low-cost sensors operating on moving vehicles. This paper describes the design and calibration of an urban sensing system, the Urban Scanner,

that uses air quality sensors and ancillary instruments (GPS, FHD video/camera imagery, LIDAR 3D scanner imagery, and wind direction and speed sensors) mounted on the rooftop of a vehicle. In addition, the hardware is supported by a platform for data analytics that extracts traffic characteristics and built environment features from the video camera and LIDAR streams and pairs air quality measurements with real-time vehicle location, traffic activity, and meteorology. The study includes three significant steps of architecture, calibration and evaluation of Urban Scanner. We also present the application of Urban Scanner to the City of Toronto, where high-resolution data collection was conducted over the span of a year with over 700 hours of driving in different seasons (Aug 2020 to Aug 2021). This study demonstrates that mobile air quality sampling with low-cost sensors requires cutting-edge signal processing techniques to resolve challenges with signal alignment, noise, and hysteresis removal. Our results indicate that Urban Scanner yields an accurate spatial distribution of air pollution and is capable of relating air quality to traffic composition, traffic congestion, and other aspects of the urban environment.

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Development of a Predictive Signal Processing Model to Detect Chemical Substances Using Nanofiber Sensors

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Abstract

Recent developments in nanofiber-based sensors give rise to the possibility of disease detection, immunosensing, and environmental monitoring using ultra-compact sensors. Although nanofiber technology improved the sensor's sensitivity and selectivity, the signals measured are often contaminated by instrumentation noise, motion artifacts and other interferences. In this study, a multivariate data analysis technique was proposed to evaluate and improve the performance of a newly designed nanofiber sensor for detecting different chemical substances (i.e., NO2, NH3, SO2, and H2S).

The results showed that a combination of initial signal pre-processing (filtering and baseline removal and peak alignment), principal component analysis, linear discriminant anal and k-Nearest Neighbours is suitable to analyze and predict the non-linear behaviour of the chemical substances using a nanofiber sensor. The results showed that chemical substances are detected with an accuracy of 99.2% using the proposed technique and nanofiber sensor. For the case of different gases interface, we proposed multivariate curve resolution techniques to find the individual sources of concentrations without the need for sensor per-calibration. We also used the partial least squares method to predict NH3, SO2, H2S, and NO2 concentrations. The output of PLS compared with the observed concentrations showed that the sensor exhibited small and acceptable standard errors. Despite the excellent performance of proposed multivariate signal and

data processing tools in Nanofiber sensors, understanding the advantages and limitations of these methods still requires further investigations using multi-source gases under real-world conditions, especially when applied to the measurement of substances used as

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Black carbon exposures in the multi-country HAPIN trial

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Abstract

Background Comprehensive exposure assessments are important for estimating the potential benefits to air quality and human health from cleaner-burning alternatives in low- and middle-income countries (LMICs), where residential biomass use for cooking emits elevated levels of household air pollution (HAP). Black carbon (BC) is a major component of HAP and a contributor to climate change, but knowledge of levels and drivers of exposure is lacking in these settings.

Methods As part of the Household Air Pollution Intervention Network (HAPIN) trial, we analyzed 7,165 24-hr BC measures of scanned gravimetric filters from 3,103 pregnant women across four LMICs settings in (Guatemala, India, Peru, and Rwanda). We developed country-specific models to predict personal BC exposure based on stove type and fuel characteristics collected at baseline and during 2 follow-up periods using stepwise mixed model building.

Results Respective mean (SD) BC levels for biomass and LPG users were 11.8 (10.1) μg/m3 and 4.1 (5.5) μg/m3. Compared to traditional biomass cookstoves (TCS), LPG stoves were associated with reduced BC exposures in Guatemala (-66.0%), India (-70.7%), Peru (-74.4%), and Rwanda (-58.1%) (all results $p < 0.001$). Compared to TCS, chimney stoves were associated with reduced BC exposures in Guatemala (- 14.0%; $p = 0.002$) and Rwanda (-34.0%; $p < 0.001$). Compared to TCS, Rondereza stoves were associated with reduced BC in Rwanda (-7.64%; $p = 0.04$). Compared to wood fuel, charcoal was associated with reduced BC in Rwanda (-13.6%; $p < 0.001$).

Conclusion Our data show that stove and fuel types are key determinants of BC exposure.

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Comparison of black carbon measurements from transmittance through Teflon filter media

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Abstract

Black carbon (BC), a by-product of incomplete combustion processes, can be estimated through relatively cheap and non-destructive light absorption techniques that typically compare the light intensity through a blank reference filter (I0) and that through a post-sampled filter (I). However, filter- specific I0 values are recommended due to the inherent variability from one filter to the next.

The Household Air Pollution Intervention Network (HAPIN) trial conducted pre- and post-sample measurements of filter intensity for BC data from three of the four study sites and can therefore evaluate the added benefit of measuring filter-specific I0 values. We compare BC measurements using pre-sampled filters (Method 1; filter-specific I0) vs lab blanks (Method 2; average blank filter I0) as a reference for the attenuation of light through post-sampled filters (N = 9,475 filters) by assessing the correlation (Spearman) and agreement (Bland-Altman) between the two methods.

Respective median (IQR) BC levels for Methods 1 and 2 were 10.0 μg/m3 (5.7 – 14.4) and 10.7 μg/m3
(6.4 – 15.1) for biomass users and 3.2 μg/m3 (1.7 – 5.3) and 4.1 μg/m3 (2.6 – 6.3) for liquified petroleum gasoline (LPG) users. The correlation between methods was stronger for biomass users (ρ = 0.983) than for LPG users (ρ = 0.892). Compared to Method 1, Method 2 overreported BC measures among biomass and LPG users by 7.5% and 27.3%, respectively.

Our results suggest that BC measurements from Method 2 are sufficient in most settings; however, the additional effort of analyzing filter media before sampling adds substantially to BC accuracy.

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Autism spectrum disorder and parental occupational exposures to multiple combustion products in a Danish cohort

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Abstract

Background: Studies have suggested associations between parental occupational exposures and risk of autism spectrum disorder (ASD) in offspring, with increased risk for parents were exposed to exhaust fumes.

Objective: To investigate associations between parental occupational exposures to diesel exhaust, formaldehyde, gasoline, and benzo[a]pyrene (BAP) and odds of ASD in offspring.

Methods: 1898 singleton ASD cases with parental occupation data were identified from the Danish National Patient Registry and 141,702 sex- and birth year-matched controls from 1982-2016. We acquired parental occupation history from the age of 16 years through 6 months post-childbirth from the Danish Pension Fund then estimated cumulative diesel exhaust, formaldehyde, gasoline, and BAP exposures for mothers and fathers based on job exposure matrices (JEMs). Adjusted odds ratios (aOR) and 95% confidence intervals (CI) for exposures one year prior to conception and during pregnancy were obtained using conditional logistic regression.

Results: No significant results were seen for cumulative exposure to formaldehyde, gasoline, or BAP during pregnancy. However, we observed a significant increase in ASD for people whose mothers were occupationally exposed to diesel exhaust during pregnancy (aOR = 1.24; 95% CI: 1.01, 1.54). Additionally, risk of ASD was higher in children whose fathers were exposed to diesel exhaust (aOR = 1.88; 95% CI 1.28, 2.79) and gasoline (aOR = 3.37; 95% CI 1.86, 6.13) one year prior to conception.

Conclusion: Our study suggests an association between parental exposures to diesel exhaust with risk that may differ for mothers and fathers based on timing of exposure.

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The technological evolution of busses and their impact on the drivers' hazard exposition

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Abstract

Bus drivers are exposed to many occupational and environmental hazards, generally associated with poor health and increased mortality. Those hazards include diesel exhaust, vibrations and noise. In addition, public transport infrastructure has evolved over the past 60 years, including bus design and technology. However, the overall impact of these innovations on drivers' health is unknown. The hypothesis is that technological changes, which aim at improving the vehicles in term of energy and comfort, have a positive effect on drivers' health. To verify this hypothesis, we use a tool from occupational epidemiology: a job-exposure matrix (JEM). It is a multidimensional table providing, for each workstation in a company, the level of exposure corresponding to the hazards related to that workstation. Since the driver's workstation is buses and trolleybuses, we will create a Bus Exposure Matrix (BEM) by analogy to the JEM.

For this purpose, we make an inventory of the Swiss bus fleet of the past 60 years. Then, we identify 12 bus models representative of the evolution of the bus fleet. We then carry out evaluations of physico- chemical risks and the design of the driver's cabin for each representative models. The studied hazards are the electromagnetic fields, the air exchange rate, the PM10, nanoparticles, the noise, the vibrations, the seat temperature, the visual contrast and the design of the driver's cabin.

The measurements carried out will make it possible to assess whether the technical developments of the last sixty years have really improved the working conditions of driver.

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The development and validation of the Asbestos Removal Exposure Assessment Tool (AREAT)

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Abstract

Exposure to asbestos fibres is linked to adverse health effects and the use of asbestos is banned in many countries. Still, asbestos applications remain present in residential and professional/industrial buildings or installations which need to be removed. Measuring exposure to asbestos fibres might not always be possible. Therefore, the mechanistic model 'Asbestos Removal Exposure Assessment Tool (AREAT)' was developed to estimate exposure to asbestos fibres released during asbestos abatement processes where measurements are not available. In such instances, control regimes can be implemented based on modelled exposure levels. The model consists of several exposure determinants such as the substance emission potential, activity emission potential, control measures and dilution in air taking into account the near- and far-field of the source. Through an algorithm, AREAT calculates dimensionless scores based on the model inputs, which are translated to estimated fibre concentrations by a mixed effect model

which was applied on the dataset. The model was trained with the use of 370 personal exposure measurements.

Next, the model was validated with a set of personal exposure measurements (N= 283) not used for the training of the model. Model estimates show good correlation with measurements (Pearson r = 0.73). The overall relative bias was 124%, and the model underestimated 4% of the measurements. Linear regression analysis was applied on the total combined data (N=653) personal measurements with the model determinants as fixed effects. Results of this linear regression was used to alter two parameters. The model was recalibrated on the combined dataset.

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Methodological advances in road traffic flow estimation using a Geographical Information System approach.

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Abstract

Exposure to traffic-related air pollution and noise are major concerns for adverse health impacts. Accurate and detailed traffic flow modelling is a fundamental requirement for the development of environmental exposure models. To date, most traffic data is limited to major roads and describes current or past distributions of flows.

The aim of this research is to predict traffic flow across a whole connected network, and then to assess the environment and health impacts following the implementation of traffic interventions at a city- region scale. This investigation uses PgRouting, PostGIS, to develop a high resolution traffic model to simulate vehicular flow around Leicester, East Midlands, a city that has launched several transportation initiatives to meet national air quality targets. The model uses origin-destination (O-D) data to estimate traffic flow in Leicester between 2,888 Output Areas (OAs), the smallest set of geographical units from the UK Census. In conjunction with Dijkstra's algorithm, the model demonstrates how impedance factors on the road network can be modified to demonstrate the impacts that different policy actions have on traffic flow, and in-turn, environmental pollution.

First modelled results explain 70% ($R2 = 0.71$) of the variability in Department for Transport (2011) traffic counts. At present the model under-estimates the number of journeys made in and around Leicester due to the O-D data not accounting for all trips. Future developments of the model have the potential to provide policymakers an insight into the effectiveness of transport policies to improve the social-environmental health of a city.

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An investigation to evaluate glyphosate exposure among farm and non-farm families using a human biomonitoring strategy.

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Abstract

Glyphosate is extensively used worldwide in agricultural and horticultural applications, resulting in its ubiquitous environmental presence. Debates about glyphosate's potential to cause adverse human health effects have intensified since the International Agency for Research on Cancer classified it as '2A probably carcinogenic to humans'. Glyphosate exposures can occur by applying glyphosate products and dietary intake of food/water with glyphosate residues. The Human Biomonitoring for Europe initiative classed glyphosate as a priority substance, and previous studies have detected glyphosate exposures among the general population.

The IMAGE project: Ireland's bioMonitoring Assessment of Glyphosate Exposures evaluated environmental glyphosate exposures among farm and non-farm families to investigate whether farm families would have elevated exposures from living with an occupational pesticide user. Using a human biomonitoring sampling strategy, urine samples were collected (following morning after glyphosate use for the farmers) to quantify for glyphosate and its main metabolite, aminomethylphosphonic acid.

Sampling protocols were aligned with HBM4EU studies, and the contextual data collected included information on diet, occupation, lifestyle and health. Study samples and questionnaires were collected from both parents and children in each family.

The study recruited 67 families, including 53 non-farm and 14 farm families. No statistically significant differences were found between the families for glyphosate or AMPA quantification rates and concentrations. Although, the five highest concentrations found in the study were from the occupational pesticide user. Overall, study results identified low glyphosate and AMPA exposures

among families in Ireland, at concentration levels similar to previous studies found in scientific literature.

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Assessing exposures to household air pollution: personal exposures to air toxics among pregnant women in the Tamilnadu Air Pollution and Health Effects (TAPHE-II) cohort, India

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Abstract

Fine particulate matter ($PM_{2.5}$) is the preferred exposure metric in assessing exposures to household air pollution (HAP). The present study aims to assess personal exposures to a suit of air toxics including $PM_{2.5}$, black carbon (BC), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) and metals among pregnant women in the TAPHE-II cohort. Personal sampling was undertaken for 24-hour using ultrasonic personal aerosol sampler (UPAS®) on 37 mm PTFE filters. Mass concentration of $PM_{2.5}$ was gravimetrically determined by a microbalance and BC was measured using an off-line SootScan transmissometer. Particle-phase PAHs were extracted from a portion of the filter and quantified using HPLC fluorescence technique. A total of 610 follow-up measurements have been completed in 249 pregnant women between 2020 and 2022. Personal exposures to $PM_{2.5}$, BC and PAHs were 53.7 (39.6) µg/m^3, 10.0 (9.0) µg/m^3, 212.7 (138.5) ng/m^3 and 96.3 (107.7) µg/m^3, 10.84 (10.9) µg/m^3, 259.1 (227.5) ng/m3 among urban (n=24) and rural (n=225) participants, respectively. Personal exposures to PM2.5, BC and PAHs were 76.7 (94.8) µg/m^3, 14.6 (14.8) µg/m^3 and 284.8 (212.8) ng/m^3 for biomass users, 61.4 (41.6) µg/m^3, 14.4 (15.8) µg/m^3 and 261.8 (321.6) for mixed-fuel users and 54.6 (32.9) µg/m^3, 9.6 (6.2) µg/m^3 and 221.5 (120.8) ng/m^3 for LPG users. Living room $PM_{2.5}$ was significantly correlated with personal PM2.5 (r^2=0.3), personal BC (r^2=0.3) and personal PAHs (r^2=0.5) levels. Analysis is underway for VOCs, metals, and oxidative potential of PM.

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Defining the Cutting-Edge to the U.S. EPA's Computational Exposure Science

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Abstract

Exposure science in EPA's Office of Research and Development is being transformed from its traditional "after the fact" and "one chemical at a time" approach. Advances in computational exposure are providing foresight on exposure potential prior to the manufacture of chemicals and these advances can be applied to most of the chemicals considered for commercial use. This research is being advanced on four related fronts. First, a carefully curated web-accessible chemical resource has been created to characterize the chemicals known to be used in commerce and believed to occur in the environment. The DSSTox database lists >900,000 unique chemical substances relevant to the environmental exposure landscape and links the unambiguous identification of the chemical's structure to measured and modeled data resources. Next, data and model development efforts span chemical, physical, and behavioral aspects of exposure and occur iteratively such that data and model development inform one another. Modeling efforts rely on monitoring and other data that are analyzed using machine learning. This generates predictions of chemical exposures and associated uncertainty for thousands of chemicals at a time. Lastly, the development and application of non-targeted analysis methods are capturing chemical occurrence in a broad chemical space and revealing contaminants of emerging concern. These integrated research efforts are tailored to support timely large-scale exposure assessment to prioritize and manage risk and provide exposure foresight to enable innovative green chemistries. This abstract does not reflect EPA policy.

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From Data to Policy? Tracing Air Pollution and Health Data in Morocco

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Abstract

Urban air pollution in low- and middle-income countries is a growing global health concern. Casablanca is a large, densely-populated city exposed to air pollution levels that often greatly exceed both WHO and state-limit values. Air quality is monitored in the city, yet it is unclear whether this data is made public to protect at-risk populations, nor is it clear if it is used to inform environmental policy. It is also unknown whether doctors documenting respiratory conditions transfer their data and knowledge to decision-makers. As data-driven policies become standard worldwide, it is relevant to analyze the struggles developing nations may

face in incorporating data into their policy-making process. Other factors that are considered –as well as those that are ignored– in environmental (health) policy also deserve exploration, especially given Morocco's climate-vulnerable location, governmental configuration, and self-adjudicated role as a leader in the green transition.

The aim of this qualitative study is to trace the path that air quality and health data follow in Casablanca to shed light on how this data plays a role in air quality or environmental legislation at the city or national level. Results were obtained through semi-structured interviews with citizens, researchers, medical doctors, and state actors, carried out in Casablanca and Rabat between May and June. This research is part of a doctoral thesis in the field of Science and Technology Studies taking place under the GlobalSmog project, which aims to better understand the intricacies of air pollution management in cities across the Global South.

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Stereoselective toxicokinetics of the UV filter homosalate in humans

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Abstract

Homosalate (HMS) is a salicylate UV filter used worldwide in sunscreens and other personal care products. Although commercial products generally contain mixtures of *cis*- and *trans*-HMS, previous studies have not dealt with this aspect. The aim of this study was to investigate human toxicokinetics of HMS, differentiated by *cis*- and *trans*-HMS, which is relevant for exposure and risk assessment.

For this purpose, toxicokinetics after a single oral HMS dose were investigated in plasma and urine of four volunteers. Both *cis*-rich and *trans*-rich HMS isomer mixtures were studied. The four previously identified HMS-specific hydroxy (OH) and carboxylic acid (CA) metabolites *t*HMS-CA, *c*HMS-CA, 3OH-*t*HMS and 3OH-*c*HMS, which could be quantified up to 24-96 h after single sunscreen use in a pilot study, were investigated using isotope dilution analysis, and further isomers were investigated semi-quantitatively.

Peak urinary concentrations were reached 1.5-6.3 h post-dose and > 80% of these metabolites were excreted within 24 h. The mean total urinary excretion fraction (F_{ue}) was 0.045% for the metabolites derived from *cis*-HMS (range 0.036-0.049%) and 6.4% for the metabolites derived from *trans*-HMS (range 4.5-9.2%). Plasma and urine data indicated that the availability of *trans*-HMS in plasma after oral administration is about 10-fold higher and the formation of its oxidized metabolites even two orders of magnitude higher than that of *cis*-HMS.
Our data proves diastereoselectivity in toxicokinetics of *cis*-/*trans*-HMS, emphasizing the necessity to address isomer ratios. The reported biomarkers and conversion factors will be used in future human biomonitoring population studies for exposure and risk assessments.

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Associations between environmental exposures and children's social mobility opportunity outcomes

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Abstract

The Opportunity Atlas project traces upward social mobility and adulthood socioeconomic (SES) outcomes back to childhood residential neighborhood. In its initial analysis, the project found that half (R^2=0.50) of the variation in adulthood socioeconomic outcomes was explained by neighborhood-level SES characteristics during childhood. This leads to the question: what other variables explain the remaining variability? To answer this question, using k-mean clustering we first clustered census tracts based on opportunity levels into 7 ranked clusters. We then used logistic regression to assess the associations between the "best" two or the "worst" cluster assignment and 26 census-level environmental variables for the entire US and for each of ten EPA regions. At the national level, seven variables (including higher $PM_{2.5}$ concentrations and Reproductive Hazard Indices) were associated with the best opportunity clusters and thirteen variables (including higher Environmental Quality Index, Lead Paint Indicator, and Respiratory Hazard Indices) were associated with the worst clusters. For

individual EPA regions, there was substantial variability in associated environmental variables, with percent of housing built before 1960 commonly associated with cluster assignment across many regions. Collectively, all 26 environmental exposure variables explained an exceptional proportion of the total variation in differentiating census tracts in the two best from the two worst opportunity clusters (McFadden's $R^2 = 0.43$). Our research suggests that some environmental variables have a cumulative impact on community level of opportunity; and thus, these exposures can be targeted directly in interventions to improve residents' opportunity for social upward mobility and address environmental injustice.

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Density/proximity of oil and gas wells in Northeastern British Columbia (Canada) and indoor air radon concentrations

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Abstract

Background: Northeastern British Columbia (Canada) is a region of oil and gas exploitation. Oil and gas extraction activities can emit contaminants, including radon, but studies assessing exposure are scarce.

Objective: To evaluate the association between the proximity/density of oil and gas wells and indoor air radon concentrations.

Methods: Data from the British Columbia Radon Data Repository (BCRDR) and the Exposures in the Peace River Valley study (EXPERIVA) were used, with 497 radon measurements taken from dwellings between 1992 and 2019. Within different buffer zones around each dwelling (2.5, 5 and 10km), well density was calculated and an exposure metric, Inverse Distance Weighting (IDW), of both well density and proximity was derived. Linear regression models were used to evaluate the associations between well density and IDW, and indoor air radon

concentrations while adjusting for the floor where measurement was taken. We also conducted stratified analyses to examine associations before and after 2007, a time when the industry switched from conventional to unconventional oil and gas extraction methods.

Results: No statistically significant association was found between well density and IDW, and indoor air radon concentrations. We found no significant difference between indoor air radon concentrations before and after 2007. Radon levels were higher in basements compared to other floors.

Conclusion: We did not observe an association between oil and gas well density/proximity and indoor air radon concentrations in residences of Northeastern British Columbia. Additional studies with more measurements and information on construction type/year are needed to confirm these results.

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Association of lung function with benzene, toluene and xylenes (BTX) in end-exhaled air of gas station attendants

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Abstract

Background – Gas station attendants are exposed to benzene, toluene and xylenes (BTX) from fuels. The aim was to study the association between this exposure and spirometry parameters in gas station attendants and office workers as controls.

Method – In 44 male gas station attendants and 38 office workers in the Gampaha district of Sri Lanka spirometry was performed according to the guidelines of the American Thoracic Society (ATS). Pre- and post-shift end-exhaled air samples were collected from a subset of both study groups and analysed for BTX by gas chromatography-mass spectrometry.

Results – Among gas station attendants (n=20) median pre-/post-shift end-exhaled air concentrations (ng/L) were: benzene 11.23/21.05; toluene 10.39/22.19; m/p-xylene 1.62/2.45; o-xylene 1.01/1.45. For controls (n=11) these values were (ng/L): 9.47/12.04, 3.13/4.00, 1.52/1.25 and 0.50/0.48, respectively. The peak expiratory flow rate (PEFR) and %-predicted PEFR were

significantly lower among gas station attendants compared to controls ($p<0.012$). The % predicted FVC and FEV1/FVC ratio were not different but in gas station attendants benzene in post-shift samples was associated with %-predicted FVC (Spearman's correlation coefficient of -0.469, $p=0.037$). The %-predicted FVC was lower in gas station attendants working ≥5 years compared to those who worked <5 years. In controls a distinct pattern was observed, indicating a moderate to strong association of post-shift toluene and m/p-xylenes with all lung function parameter but not benzene. These results were adjusted for smoking.

Conclusion – In gas station attendants and controls we observed alterations in spirometry that were associated with BTX exposure.

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Occurrence, metabolism and contribution to human exposure of new chemicals present in the Flemish indoor environment

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Abstract

In recent years, new compounds have been incorporated to consumer products to comply with current legislation. Human exposure to these chemicals (i.e. contaminants of emerging concern, CECs) requires thus continuous monitoring. Dust, handwipes and urine were collected in 2019 from 25 homes located in Flanders (Belgium) from families with at least one toddler. Our aims were 1) to identify new CECs in the indoor environment and to investigate 2) their levels and sources, 3) the formation of metabolites within the human body, and 4) their internal exposure.

Six new CECs, namely dimethyl-azelate (DMA), dimethyl-sebacate (DMS), di-propylene glycol-dibenzoate (DiPGDB), tri-n-butyl trimellitate (TBTM), isooctyl-2-phenoxyethyl-terephthalate (IOPhET) and bis-3,5,5-trimethylhexyl-phosphate (TMHPh), were identified for the first time via LC-HRMS and quantified in 50 dust samples (total concentrations up to 130 µg/g). DiPGDB, TBTM, IOPhET and bis-TMHPh were measured also in 164 handwipes, with values up to 5,400 ng/g. The human exposure assessment via inadvertent dust ingestion and dermal absorption showed no or limited risk for adverse health effects.

Further, Phase I metabolites of TMHPh, DiPGDB, and TBTM were identified via an in vitro assay with human liver microsomes and analysis by LC-HRMS. Finally, the identified metabolites of DiPGDB and TBTM were semi-quantified via LC-HRMS in 164 human urine samples up to 10,840 ng/mL. Trends and correlations were observed between the

concentrations of parent compounds and related metabolites in the different matrices and the personal habits of participants, highlighting the need for (bio)monitoring of new chemicals present indoors and in humans.

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Reliability of low-mass toenail samples as biomarkers of chronic metal exposures

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Abstract

Introduction: Toenails are a promising matrix to assess chronic metal exposure, but sample mass requirements and temporal variability of metals in toenails are not well-understood.This study evaluated the reliability of a ~25 mg toenail sample (1 - 2 clippings) for metals analysis and temporal variability over 2 - 4 years in a sub-sample of men from the Gulf Long-term Follow-up (GuLF) Study.

Methods: Toenail samples from 123 GuLF Study participants were collected at two visits 2 - 4 years apart and analyzed for 18 metals using inductively coupled mass spectrometry (ICP-MS). Participants with samples > 200 mg (n = 29) were selected for 3x repeated analysis using ~25 mg sub-samples. Kendall's coefficient of concordance (Kendall's W) was used to assess subsample reliability and Spearman's correlation coefficients were used to assess toenail metal correlations over time.

Results: Cd, Co, Mo, Sb, and V were detected in less than 60% of the samples and excluded from the analysis. Kendall's W for the remaining metals ranged from 0.72 (Cr) to 0.90 (Cu). Spearman's correlations of metal concentrations over time ranged from 0.14 to 0.59 with Ni (0.14) and Al (0.19) with the lowest estimated correlations and Cu (0.55) and Hg (0.59) with the highest.

Conclusion: Findings from this study suggest that a ~25 mg subset (1 – 2 clippings) can be used for the analysis of most toenail metals with ICP-MS. Se, Cu, and Hg concentrations in toenail clippings reasonably reflect chronic exposures over multiple years in the Gulf population.

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Early Life Manganese Exposure is Associated with Attention and Behavioral Function in Italian Adolescents: Evidence of Critical Periods of Susceptibility

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Abstract

Background: Manganese (Mn) is both an essential nutrient and neurotoxicant, and the effect Mn may depend on timing of exposure. However, less research has quantified the neurotoxicity of Mn across exposure time windows.

Methods: We used data from 125 Italian adolescents (10-14 years) to estimate associations of Mn with ADHD-like behavior. Mn was quantified in deciduous teeth using laser ablation ICP-MS, representing prenatal (2nd-trimester to birth), postnatal (birth to 1-year) and childhood (1 to 7 years) exposure. Adolescent attention was assessed using T-scores from the self-, parent-, and teacher-reported Conners Behavior Rating Scales. We used multivariable linear regression to quantify beta (β) estimates and 95% confidence intervals (CIs), and multiple informant models to compare associations across Mn exposure windows.

Results: Median tooth Mn concentrations (normalized to calcium) were 0.2 AUC 55Mn:43Ca x 104, 0.02 AUC 55Mn:43Ca x 104, and 0.000001 55Mn:43Ca for the prenatal, postnatal and childhood periods. An interquartile range increase (IQR) in prenatal Mn was associated with a 0.04 (95% CI=-0.07, 0.00) point decrease in teacher-reported inattention. An IQR increase in postnatal Mn was associated with a 0.04 (95% CI=-0.08, 0.00) and a 0.04 (95% CI=-0.08, 0.00)

point decrease in parent-reported inattention and ADHD index. Childhood Mn was associated with worse scores for parent-reported ADHD index.

Discussion: Protective associations in the prenatal and postnatal periods suggest Mn is essential for early brain development, but childhood Mn exposure may be neurotoxic. These findings support the hypothesis that the neurotoxicity of Mn may depend on exposure timing.

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Associations of an Industry-Relevant Metal Mixture with Verbal Learning and Memory in Italian Adolescents: The Modifying Role of Iron Status

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Abstract

Background: Exposure to metals has been associated with neurodevelopment, and these associations may differ according to iron status (e.g., deficiency). No prior study has assessed modification of associations between metal mixtures and neurodevelopment by iron status.

Methods: We evaluated associations of a metal mixture with verbal learning and memory, measured on the California Verbal Learning Test (CVLT-C), among 383 Italian adolescents (10-14 years). Using ICP-MS, manganese, copper, and chromium were quantified in hair and lead was quantified in whole blood. Iron status was measured as serum ferritin using immunoassays. Covariate-adjusted associations of the metal mixture with CVLT subtests were estimated using Bayesian Kernel Machine Regression. We further examined modification of the mixture by ferritin. Beta (β) estimates and 95% credible intervals (CIs) were estimated.

Results: Median biomarker concentrations were 0.07, 9.6, and 0.04 μg/g for hair manganese, copper, and chromium, and 1.2 μg/dL for blood lead. Within the mixture, an increase from the 25th to 75th percentiles of copper was associated with more words recalled on the recall trials, when other metals were fixed at their 75th percentiles (for example: trial 5: β=0.37, 95% CI=0.17,

0.57). The beneficial association between copper and trial 5 recall was stronger at the 75th percentile of ferritin, compared to the 25th or 50th percentiles.

Conclusions: Copper was beneficially associated with neurodevelopment, and the benefits of copper were more apparent at higher ferritin concentrations. These findings suggest that metal associations with neurodevelopment may depend on iron status, which has important public health ramifications.

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A Concept Model for Exposure Related Disease in Vieques, Puerto Rico Residents after US Navy Contamination

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Abstract

Background: The U.S. Navy used the east and west sides of the island of Vieques, Puerto Rico, as a military training site with live bomb trainings from 1947 to 2003. Land, water, seafloor, and air were contaminated with several known and unknown contaminants. The island was included as a Superfund site on the National Priorities List in 2005.

Objective: Create a concept model for exposure-related diseases in Vieques, Puerto Rico, through individual interviews and focus group discussions and the creation of a resident timeline.

Methods/Results: Qualitative review of 20+ hours of timeline interview (n=8) and focus group (n=6) transcripts reveal cancer (n=28 mentions), mental health decline (n=6), asthma (n=5), and kidney disease (n=5) as of greatest concern and prevalence in the community of Vieques. These and other conditions are concentrated in the center of the island where the island residents live. Resident interviews provide examples of ingestion, inhalation, and dermal exposures via contaminated seafood, bomb detonations, and foul-smelling water during the US Navy training and to date. Recurrent mentions of the limitations in healthcare (e.g., few providers, unreliable transportation, and limited bariatric accommodations) exacerbate existing conditions.

Conclusions: The interview data provide diseases and locations of concern along with the underlying structural damage that the military occupation created in Vieques, Puerto Rico. This unsustainable infrastructure consequently creates greater barriers in the community to access their health concerns. It will be important to consider these factors moving forward with a land, water, and air remediation plan.

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Temporal trend and cross-sectional characterization of urinary concentrations of glyphosate in Japanese children from 2006 to 2015

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Abstract

Over the past two decades, domestic shipments of glyphosate (Gly), in the form of an ionic salt, have been increasing steadily in Japan. This increase has raising concerns about the effects of chemical exposure on children. The purpose of the current study was to analyze Gly in urine samples of Japanese children to determine temporal changes, seasonal changes, and gender differences. First-morning urine samples were obtained from 50 Japanese children (4–6-year-old) in October of 2006, 2011, and 2015 (total = 150) to investigate the temporal trends in urinary Gly concentrations. Additionally, first-morning urine samples were collected from 3-year-old children in August–September of 2012 (summer; n = 42) and in February of 2013 (winter; n = 42) to investigate the seasonal and gender differences, and the correlations between urinary Gly concentrations and insecticide exposure biomarkers. Urine samples were analyzed to measure for Gly using a liquid chromatography with tandem mass spectrometry (LC-MS/MS). Detectable Gly concentrations were found in 41% of the 234 children. The 75th percentile and maximum concentrations of urinary Gly were 0.20 and 1.33 μg/L, respectively.

The urinary Gly concentration in 2015 was significantly higher than in 2006, suggesting that the Gly exposure levels have been increasing. No seasonal or gender-specific differences in urinary Gly concentrations were observed, and no correlation with insecticide exposure biomarkers was found. This study revealed that Gly exposure trends show an increase between 2006 and 2015, and that season and gender were not the exposure-determining factors.

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Urinary methyl-, ethyl-, and propylparaben concentrations of Korean and US women by fasting status

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Abstract

Paraben is associated with potential adverse endocrine and reproduction-related outcomes in humans. Personal care products have been considered major sources of exposure to parabens, but the contribution of diet is not well known. We compared the urinary levels of three major parabens of methyl-, ethtyl-, and propylparaben (MeP, EtP, PrP) and investigated the diet contribution to the body burden of the parabens among Korean and the US adult women.

Fasting Korean women (n=469) were recruited in 2015-2016, and were measured for urinary MeP, EtP, and PrP concentrations. Non-fasting Korean women of matching age (25-45 years) were chosen from Korean National Environmental Health Survey (KoNEHS) Cycle 3 (n=579). For US women, both fasting and non-fasting women populations (n=154 and 201, respectively) were chosen from NHANES 2015-2016 participants.

In the fasting Korean women, urinary MeP, EtP, and PrP concentrations (median) were measured at 47.30, 17.90, and 2.30 ng/mL, respectively. The EtP and PrP levels in the fasting women were significantly lower than the Korean non-fasting women (median of 26.40 and 3.57 ng/mL). EtP levels of the Korean women were significantly higher than the US women (regardless of fasting status), but MeP levels were lower. In the US population, fasting status did not influence the urinary paraben levels. On average, the dietary contribution of EtP was determined at 63.6% of the total body burden among Korean women, and it became greater among the high exposure group. Major dietary constituents

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Exposure Science as a solution provider to meet sustainability ambitions

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Abstract

Exposure science applied holistically across chemicals legislation is a key stepping-stone towards safe, secure and sustainable transitions of chemicals. To shape this stepping stone in 2016, the European chapter of the International Society of Exposure Science (ISES Europe) was founded with the ambition to strategically focus on restructuring and strengthening exposure science knowledge, use and application across scientific and policy domains. The approach is tailored to the way how chemicals are regulated in Europe and how chemical safety science is currently defined, funded and enforced in Europe, which is mainly hazard driven. This hazard driven mechanism hampers investments and innovation to develop regulatory accepted innovative non-animal testing and monitoring methods comprising the urgently needed redefinition of the current scope and concepts of chemical safety science towards 2030-2050.

To meet future ambitions, it is key to embed exposure science into strategic research and innovation schemes and future policy cycles boosting green technologies, green materials, and innovative business models. Therefore, exposure science applied holistically across chemicals legislation is a key stepping-stone towards safe, secure, and sustainable transitions of chemicals. This presentation will discuss a strategic scientific framework shaping the future of exposure science as a solution provider for the ambitions of the global green deals and sustainability transitions.

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The European Exposure Science Strategy 2020–2030

Peter Fantke[1], Natalie von Goetz[2,3]

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Abstract

Ambitions laid out in the European Green Deal and in the global sustainable development agenda require innovations in various chemicals and environmental management frameworks through advancing exposure science. Historically, hazard assessment is a well-established scientific application field that dominates many assessment frameworks, while exposure science is still in an early stage of development towards being a field that is adequately recognized in the academic world and disposes of broadly-agreed methods and standards. However, since hazard and exposure are equally relevant components for evaluating human and ecological health risks and impacts, and since exposure reduction measures are often the only means to effectively reduce risk, there is an urgent need to bolster exposure science and its uptake into regulatory risk assessment and management frameworks. In response to this challenge, an overarching strategy for exposure science is needed.

Therefore, the European chapter of ISES (ISES Europe) has adopted a self-mandate to define a strategy for exposure science in Europe by building upon a set of strategic objectives across priority areas in exposure science. European exposure science experts have identified the priority areas and strategic objectives in a bottom-up approach. They reflect a broad consensus on measures to enhance regulatory and scientific recognition of exposure science, which are crucial to providing the financial and scientific momentum necessary to advance exposure science methodology and data availability. This talk will give an overview of the different priority areas and explain how the strategic objectives of each of them feed into the common goals.

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Exposure science in education, training and communication as part of the European Exposure Science Strategy 2020–2030.

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Abstract

One of the main strategic aims of the European Exposure Science Strategy is to establish exposure science in education, training and communication. Advances in exposure science strongly rely on the input from well-trained and experienced experts, but there are no formal education and training programmes solely dedicated to exposure science in Europe. Furthermore, it was identified that it is also crucial to harmonize the terminology used among exposure scientists to ensure appropriate and comparable interpretation with relevant publications. To tackle this challenge, essential building blocks were identified, including developing a harmonized glossary of terms for exposure science and having a tiered education/training scheme with ECTS equivalent points/certificates.

The ISES Europe Education, Training and Communication working group was established in 2018 with the goal to anchor exposure science in academic research and education. Initially, a glossary of terms was developed with future ambitions to create a live glossary to create better harmonization worldwide. Furthermore, to create purposely trained experts within the discipline, there is a need to develop a curriculum that yields credible, well-defined career pathways in exposure science. This working group has developed the first steps of this curriculum; a framework has been outlined with harmonized learning outcomes identified based on exposure science-specific descriptors. Furthermore, intended learning outcomes have been specified under eight different requirements and categorized based on knowledge, skill and competence. Finally, an overview of the achievements and future aims of the working group will be presented.

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Exposure modelling in Europe: How to pave the road for the future as part of the European Exposure Science Strategy 2020–2030

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Abstract

Exposure models are essential for almost all contexts relevant to exposure science. To address the numerous challenges and gaps, exposure modelling is one of the priority areas of the European Exposure Science Strategy developed by the European chapter of ISES.

A strategy was developed for the priority area of exposure modelling. Four strategic objectives are deemed essential by ISES Europe to improve exposure modelling and thereby support a better understanding of and consideration of exposure science in Europe. These objectives are 1. Improvement of models and tools, 2. Development of new methodology and support for understudied fields, 3. Improvement of model use, and 4. Regulatory needs for modelling.

In a bottom-up approach, exposure modellers from different European countries and institutions who are active in the fields of occupational, population and environmental exposure pooled their expertise. In the ISES Europe Working Group on exposure models and in three ISES Europe workshops, the current situation of modelling was assessed by collecting and evaluating the most relevant and most used models and tools for exposure assessment with a focus on Europe, since some aspects of modelling are not readily transferable across the globe.

For ISES Europe stakeholders, clear actions were defined, such as the collection of available models and accompanying information in a living document curated and published by ISES Europe and the development of a best-practices handbook, planned as a longer-term activity. Alongside these actions, recommendations are made to stakeholders outside ISES Europe, on their contributions to the strategic objectives.

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Human biomonitoring as a part of the European strategy for exposure science

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Abstract

Human biomonitoring (HBM) is a powerful tool to monitor chemicals and improve the understanding of their health impact, as emphasized in Europe's 'Chemicals Strategy for Sustainability' (CSS). Under the ambition to serve the challenges in the chemicals management domain, ISES Europe presents their vision to inspire future research and use of HBM in the decision-making process, as established during several rounds of expert consultations and workshops and translated into strategic objectives and a roadmap 2022-2030. HBM offers four contributions: (1) bridging regulatory silos by informing aggregate exposure, (2) monitoring the effectiveness of risk management measures, (3) assessing exposure at various life-stages across life-stages (exposome), (4) assessing combined exposure to multiple chemicals (mixtures).

HBM has the potential to become a regulatory enabler, especially when integrated in, e.g. source-to-dose modelling and exposure-response research capturing aggregated exposure pathways (AEP's) and adverse-outcome pathways (AOP's). HBM can provide consistent aggregate exposure estimates for "One Substance, One Assessment" challenges across legislations (CSS). To make this happen, we need clear regulatory guidance on the generation and use of HBM data in all chemical management, including developing health-based guidance values. In addition, continued optimization, harmonization, and quality assurance/ quality control from study design to reporting and communication) are necessary. Since HBM data inherently contain personal information, careful and streamlined data management and data protection are pivotal, whereas, at the same time, the EU Open Data policy underlines the importance of full implementation of the FAIR principles (Findability, Accessibility, Interoperability, and Reusability).

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Prediction of Dermal Exposure to Chemical Substances Using a Fluorescence Method within the SysDEA Project.

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Abstract

Dermal exposure is an important exposure route for occupational exposure assessment. A fluorescence method has been developed to quantify occupational dermal exposure based on a visualization technique, using Tinopal SWN as a fluorescent tracer. The method was developed within the framework of a large experimental study, the SysDEA project. In SysDEA, dermal exposure was measured with different methods for 10 simulated exposure situations by sampling powder and liquid formulations containing Tinopal SWN on coveralls

and patches and subsequently chemically analysing them. For the fluorescence method, photographs of exposed volunteers who performed the experiments were taken inside a room which consisted of an optimized arrangement of several UV irradiating tube light brackets, reflective and non-reflective backgrounds for maximum light diffusion and a camera. Image processing analysis software processed these photographs to obtain corresponding light intensity in terms of summed pixel values. To be able to estimate the amount of Tinopal SWN, 25% of the measured data from the SysDEA experiments were used to calibrate by correlating the summed pixel values from the photographs to actual measured exposure values using a second order regression model. For spraying activities, dumping of powder, rolling and handling objects immersed in liquid, strong Pearson correlation coefficients ($R > 0.73$) were observed. In contrast, the correlations were inconsistently poor ($R = -0.17$ to 0.28 for pouring, rolling high viscosity liquid, manually handling objects immersed in low viscosity liquid and handling objects contaminated with powder). The fluorescence technique seems appropriate in situations where uniform exposure patterns are expected.

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Challenges and prospects for data analytics and repositories: How to pave the road for the future as part of the European Exposure Science Strategy 2020–2030

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Abstract

High-quality and comprehensive exposure data are critical for different decision contexts, including environmental and human health monitoring, and chemicals risk assessment and management. In support of the European Exposure Science Strategy, the data repositories and analytics ISES Europe Working Group was established in 2020 to guide an integrated European exposure data production and management framework for use in science and policy.

Exposure-related data are scattered, frequently of unclear quality and structure, not readily accessible, and stored in various data repositories and the literature, leading to inefficient and ineffective data usage in Europe and globally. To address these challenges, the existing exposure data landscape was mapped to requirements for data analytics and repositories across European policies and regulations, and needs and ways forward for improving data generation, sharing, and usage were identified. These needs were then translated into an operational action plan as a framework for European and global advancements in the generation, analysis, and sharing of exposure data relevant to EU policies and regulations. Identified key areas of action are to develop consistent exposure data standards and vocabularies for data production, collection, reporting, and analysis, increase data

transparency and availability, enhance data storage and related infrastructure, increase automation in data management, increase data integration, and advance tools for innovative data analysis. An overview of these strategic objectives identified by the data repositories and analytics working group and the action plan to overcome challenges and advance exposure data generation, usability, and uptake into EU chemical policies will be presented.

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Development of an exposure database to share occupational dermal measurement data

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Abstract

It is often claimed in the scientific community that not enough dermal measurement data are available to evaluate dermal exposure models or base assessments on dermal measurements. However, several institutes have collected dermal measurement data, although these have never been systematically collated, to facilitate sharing of data. The aim of this contribution is to present an initiative to jointly develop a database through which dermal measurement data can be exchanged between different partners. The design and usability of the database should be as clear and simple as possible. Nevertheless, the essential contextual information should be covered that is necessary for model development and/or model evaluation.

Based on our experiences with the coding of dermal measurement data that we used for determinant analyses, model development and model calibration, we present an outline of the typical contextual information available (and missing) in field study data. By considering previous literature reviews and model developments, such as RiskOfDerm and the dermal Advanced REACH Tool (dART), important dermal exposure determinants were proposed and included in the database structure. Examples are for instance incidental and often 'random' events associated with dermal exposure such as frequency of contacts, splashes and hand immersions. An overview of the database structure and content is presented.

This may encourage scientists who perform dermal measurements in the future to gather this information. It is our intention to include both individual measurement data as aggregated data.

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An exploratory approach for developing a dermal model for spray applications at the workplace

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Abstract

Spraying activities at workplaces require special attention with regard to dermal exposure because they pose the potential of high exposure and risks for workers. Simultaneously, spraying is a frequently occurring activity in various workplaces, such as disinfection or painting.

In addition to generally less activity-specific routes of exposure such as direct contact or splashing that are drivers for dermal exposure in all workplaces, the component of aerosol deposition must also be considered.

Modelling dermal exposure in purely physical terms is particularly challenging, as they are partly based on random effects e.g. caused by human behaviour. Consequently, data-driven modelling approaches pose a way to quantify dermal exposure.

In preparation, we have compiled measurement data and comprehensive contextual information from our own research projects in a database.

We currently pursue an exploratory approach aiming at finding an appropriate model that can be used to estimate dermal exposure caused by spray applications. Methodologically, we first perform cluster analyses in an iterative framework and in combination with other statistical procedures such as principal component analysis.

This procedure is intended to uncover any (scientifically meaningful) structure or pattern that may be present in the data. These can be for instance dependencies between variables, the relevance of variables or special, exposure-determining characteristics in sub-datasets.

Results of the exploratory analyses should then form the framework for the selection of an appropriate type of model for predicting occupational dermal exposure for spraying activities. This contribution discusses structures and characteristics discovered in the data within the described exploratory techniques.

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Data and knowledge base for estimation and modelling of oral exposure

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Abstract

In occupational contexts, oral exposure has not been in focus of research in the scientific community or risk assessment in regulatory frameworks. However, parallel measurements of inhalation exposure, dermal exposure and biomonitoring campaigns indicate relevance of unintended ingestion also for workplaces.

Aim of this presentation is to outline the current data and knowledge base for occupational oral exposure measurement and modelling.

A literature search was conducted on workplace monitoring, which provide clues on the role of oral exposure. Existing measurement and modelling approaches as well as mechanisms, which lead to oral exposure, were identified. Behavioral studies on adults and the transfer of chemicals between surfaces, hands and face were reviewed.

Preliminary results suggest a relevance of oral exposure at workplaces. It is described by few modelling approaches based on the transfer of the substance between contaminated surfaces to the mouth as the main mechanism. This transfer is influenced by contact frequencies of e.g. hands and mouth and thus, human behavior. Therefore, the increasing number of behavioral studies on adults play an important role. However, the current modelling approaches do not yet include existing dermal exposure data as a starting point for transfers towards the mouth.

Finally, there is need for the estimation of occupational oral exposure because the collected data indicate a relevance of it compared to dermal and inhalation exposure. Identifying further parameters of occupational oral exposure as well as the complementation and simplification of modelling approaches are seen as next steps towards efficient oral exposure modelling.

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Enhancing the use of exposure science across EU chemical policies as part of the European

Exposure Science Strategy 2020–2030

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Abstract

To accelerate transitions towards sustainability exposure science innovation needs to be better embedded along the whole policy making cycle, and be integrated into companies' safety and sustainability management systems. A scientific framework on exposure science will boost the multiuse of exposure knowledge across EU chemicals-related policies and improve risk assessment, risk management and communication across European and global safety, security and sustainability research and policy domains. To this end, it is crucial to stimulate public and private actors to align and strengthen the cross-policy adoption of exposure assessment data, methods and tools across EU legislation. This presentation will present the EU regulatory landscape making use of exposure information serving as a starting ground to identify policy and research challenges. Identified key areas of actions will also be presented such as the development of a common scientific exposure assessment framework supported by baseline acceptance criteria and a shared knowledge base enhancing exchangeability and acceptability of exposure knowledge within and across EU and global chemicals-related policies. Such framework will support communication and management across EU chemical safety, security and sustainability policies comprising sourcing, manufacturing and global trade of goods and waste management and constitutes an important step towards the implementation of the EU Green Deal and its underlying policy strategies, such as the Chemicals Strategy for Sustainability.

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A chemical industry perspective on the European Exposure Science Strategy

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Abstract

Industrial partners highly welcome the European exposure science strategy further to guide the development of regulatory chemical safety assessment and aspire to safe and sustainable manufacture and use of products. The strategy can contribute to industries' motivation, defined outputs and modalities. Industrial associations undertake much work, and health and environmental protection are non-competitive areas; this benefits from pooling resources and engaging collectively.

Future data repositories will require understanding of legal obligations from an industry perspective, currently primarily aimed at operating facilities (occupational exposures, environmental discharges); however, REACH legislation focuses more on product life-cycles in different legal entities ('downstream users'). For industry to use exposure data, exposure assessments must be realistic and targeted. Currently, exposure assessment data is derived for different contexts, potentially creating biases, for example if as their aim is to show compliance with limit values, hence prioritizing worst-case situations. As exposure assessment methods and tools are developed largely by industry partners, they should be

efficient in terms of invested effort versus insights obtained and can best follow a tiered approach, which requires continuous adaptation. Exposure data production and monitoring should be ongoing activities that can be extended or adjusted due to changing requirements.

Exposure education and communication will require attention, as exposure science is not yet widely understood in the industry but can play a crucial role in addressing scientific, regulatory and societal concerns. It is important to build partnerships and collaborations to ensure that researchers and policymakers conduct the relevant work to advance and progress exposure science.

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ISES Europe's strategies plenary session

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Abstract

An overview of the ISES Europe exposure science strategy will be given including a summary of activities and milestones planned for the advancement of the strategy in the next 10 years. This short presentation will stimulate discussion among the participants for the plenary session, which will be centred on the key thematic areas and building blocks for the advancement of exposure science in Europe.

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Risk communication: a prerequisite for safety and sustainability

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Abstract

Objective & Background:
Information on intrinsic properties, use and exposure of chemicals, materials and products are crucial for assessing risks and implementing appropriate protection measures. To date, a wealth of information has been compiled. Nevertheless, little attention is paid to communicating this interdisciplinary information in a way that is understandable and applicable to business practice. It seems as if this should work effortlessly and by default in complex supply chains across different legal disciplines.

Methods:

In chemical supply chains the safety data sheet is used as communication tool to transmit information that enables the user of the chemical to protect human health and the environment.

Results:
Previous findings including the second REACH review report, a number of research projects and workshops with various stakeholders showed that the supply chain communication is not working as intended. Therefore, this shows that the current communication practice is not up to new challenges.
Conclusion:
Proper risk communication is the prerequisite for safety and sustainability. This is becoming increasingly important due to the European Green Deal, the Chemical Strategy for Sustainability and further interlinked initiatives. Especially because they aim to ensure the safe and sustainable use of chemicals, materials and products throughout their life cycle. The German Federal Institute for Occupational Safety and Health (BAuA) supports this by a large number of activities in legal tasks, policy advice, research and development.

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Measurement method of eye fatigue, accommodation and convergence after intense usage of AR devices

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Abstract

Current development of virtual and augmented reality (VR&AR) suggests that in the near future we should expect increasing amount of these devices used as work tools. Although they are relatively new, we already know that there are several problems arising from intense usage of these devices on daily basis. Some of them are well known and described, including epileptic seizures or simulator sickness effects, such as nausea, sweating, and sensory disruption. There are arising concerns regarding user safety of these devices if used for work on daily basis. In this study we propose a procedure for measurement of short term effects on eye accommodation, convergence and fatigue after intense usage of AR devices. First, the participant is tested using a series of psychomotor tests (Line judgment, Stroop test) as well as ophthalmological examinations focused on changes in eye accommodation and convergence. The tests are performed before and after standard n-back psychomotor test aimed at mental and eye fatigue. The n-back test was performed on the 27” IPS panel with native resolution 2560x1440 in 16:9 aspect mode, and by using AR device with Si-OLED-See-Through OTG screen installed in both eye pieces. Testing is conducted in controlled

environment ensuring stable illuminance, temperature and humidity. The method was validated on a representative group of participants and revealed that it is able to detect changes in eye accommodation after usage of AR equipment.

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$PM_{2.5}$, NO_2 and O_3 exposure assessment on London's subway and overground trains

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Abstract

The London Underground (LU) carries 2.8 million passenger journeys per day providing an important mode of urban transportation. However, there are increasing concerns over the potential health effects to LU staff and commuters of short and long-term exposure to subway PM.

To improve our understanding of the possible relationship between subway $PM_{2.5}$ exposure and the subsequent health effects, we are undertaking a randomised cross-over study subjecting age-matched COPD and control participants (n=120, 40-90 years old) to exposures on LU and overground railway journeys. The exposure of participants to $PM_{2.5}$, ozone, nitrogen oxides and environmental stressors such as noise, are measured on the two separate journeys (one below and one above ground) and a series of physiological health measurements are taken before, during, and after exposures to assess any resulting physiological changes. $PM_{2.5}$ samples are collected on each journey for laboratory analysis of chemical composition and oxidative potential. Following the requirement of passengers to wear a mask on public transport, as a result of the COVID-19 pandemic, additional measurements of $PM_{2.5}$ are made through a masked dummy head to mimic the impact of the mask wearing status of

participants. Mask wearing has been found to reduce $PM_{2.5}$ exposure by 40% on the underground.

This study will be the first of its kind to investigate the effects of controlled exposures in a subway system of two cohorts of participants over two separate journeys, to improve our understanding of the potential health impacts of subway travel on the commuting population.

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Exposures and risks of antineoplastic drugs in indoor environments: hospitals, pharmacies, households of oncology patients

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Abstract

Drugs used for treatment of cancer (antineoplastic drugs, ADs) represent hazard for hospital and pharmacy staff, caregivers or family members of oncology patients. To assess the exposures and risks, monitoring of indoor surfaces is an efficient tool (https://doi.org/10.1007/978-3-030-21048-9). Here, we report comprehensive and long-term (2008-2021) profiles of ADs in more than 40 healthcare workplaces in the Czechia and Slovakia, and we provide first results on ADs inside houses of oncology patients, hospices and retirement homes. The wipe samples were analyzed by multitarget LC-MS/MS and ICP-MS for 11 ADs (cyclophosphamide – CP, 5-fluorouracil, Paclitaxel, Ifosfamid, Irinotecan, Metotrexat, Capecitabin, Doxorubicin, Docetaxel, Gemcitabine, Epirubicin, and total platinum). Carcinogenic CP was among the most commonly detected in hospitals and pharmacies, occurring in high concentrations (maxima 800 ng/cm2, 75th percentile 50 pg/cm2, N=829). Levels of ADs were comparable in both large hospitals and smaller patient care units, contamination repeatedly exceeded 10 ng/cm2, which calls for remedial action (https://doi.org/10.1007/s11356-021-17607-y). In households of oncology patients, contamination by CP was commonly found with maxima 500 pg/cm2 indicating potential temporal risks for familly members (https://doi.org/10.1186/s12302-021-00544-5). Urine and sweat of the patients are important media for the spread of contamination. Overall, the study shows persisting exposures of healthcare staff to hazardous drugs, which requires management and remediation actions. Increasing trend in administration of chemotherapy in households represent an issue, which should be explored in detail. [Supported by the Ministry of Health of the Czech Republic, grant No. NV18-09-00188].

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Biomonitoring of emerging chemicals of potential concern among hairdressers primarily serving women of color: A Pilot Study

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Abstract

Few studies have quantified chemical exposures via biomonitoring among hairdressers despite ubiquitous chemical exposures from hair products. We quantified concentrations of urinary biomarkers among hairdressers and examined exposure predictors. We recruited 23 hairdressers predominantly serving women of color and a comparison group of 17 office workers from the Maryland/DC metropolitan area. We used non-targeted liquid chromatography-high-resolution mass spectrometry to identify and compare chemical profiles among study participants. We further quantified select abundant chemicals including 2-naphthol, capsaicin, ethylparaben (EPB), methylparaben (MPB) and propylparaben (PPB). Concentrations were also compared with those reported among U.S. women (NHANES). Interviewer-administered questionnaires were used to capture information on potential exposure predictors. All biomarkers were detected among hairdressers, while all but EPB and PPB were detected among office workers. Overall, median concentrations for the most frequently detected biomarkers (2-naphthol, MPB) were 2.5-4 times higher among hairdressers than office workers. Median MPB concentrations were 1.4 times higher in hairdressers than women from the U.S. general population. Compared to hairdressers who did not provide chemical-intensive services, those providing straightening/relaxing had higher median MBP (152 vs. 124 ng/mL) and 2-napthol (18.6 vs. 12.8 ng/ml) levels; those providing hair coloring had higher median MPB levels (152 vs. 118 ng/mL). Hairdressers that braided hair had lower median MPB concentrations than those who did not (129 ng/mL vs. 204 ng/mL). Overall, higher biomarker concentrations were found among hairdressers. Larger multiethnic studies are needed to confirm findings, inform interventions, and assess potential health risks.

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Mobile monitoring of air pollutants; performance evaluation of a mixed-model framework in relation to number of drive-days

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Abstract

Background and Aim. Due to the short-term nature of mobile measurements, most mobile monitoring studies have used empirical modeling to stabilize predicted concentrations, thereby losing local spatial information. In a previous paper, we demonstrated that a mixed-model can stabilise measurements by a land use regression (LUR) model, while allowing street segments to deviate from the LUR prediction based on between-segment variation. Here, we analyse how many drive-days are needed for the mixed-model to improve predictions from LUR models and data-only mapping.

Methods. We used data from the Air View study in Oakland, where every street was measured around 50 times. We selected one drive-day per street and compared the measurement, the LUR prediction and the mixed-model prediction with the average concentration based on 50 drive-days of that street. We then sequentially added drive-days to the dataset and computed the explained variance (R^2) and RMSE.

Results. With one drive-day on every street, the LUR model explained 63% of the variation, with very limited improvement in performance with increasing number of drive-days (65% for 50 drive-days). The data-only map predicts less than 30% for one drive-day and more than 90% of the variance after 15 drive-days, surpassing the LUR model in explained variance at 4-5 drive-days. The mixed-model outperformed the data-only and LUR model estimates, with 75% explained variance after 2 drive-days and 90% after 12 drive-days.

Conclusion. The mixed-model improves predictions compared to LUR and data-only already with two drive-days and updates the model when more drives become available.

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Using mobile monitoring to map air pollution: A practical review

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Abstract

Background and Aim: Mobile platforms can capture the hyperlocal variation of air pollutants in a complex urban terrain, in a limited time, and with a limited number of (costly) high-resolution monitoring devices, but limited temporal coverage per location. In this practical review, we focus on the applicability of mobile monitoring to develop air pollution maps, either by data-only mapping or LUR modelling.

Methods: We assessed multiple mobile monitoring studies and summarize conclusions, focusing on the critical design issues. We highlight the trade-off between temporal and spatial variability, as well as differences between pollutants. We specifically assessed spatial

coverage, number of streets and repeats per street, on-road versus of-road measurements, need for a reference site and modeling options.

Results For data-only mapping, at least 20 repeats are needed to generate robust long-term concentrations, though with about 5 repeats, data-only mapping can outperform LUR modelling. To retain the hyperlocal variation, it is advised to keep the spatial resolution as low as possible (< 200m). Robust mobile LUR models can be made with about 10% of the streets in the domain and limited (or no) repeats. However, it is important to have enough spatial and temporal coverage by including all spatial characteristics of the domain and measure during different parts of the day, days of the week and season.

Conclusions: Mobile monitoring is a cost-effective scalable approach to map air pollution at fine spatial resolution with various use cases, e.g., hotspot detection, evaluation of measures and models, support (future) policies and epidemiology.

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Functional requirements for the development of a new qualitative biological risk assessment model

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Abstract

There are many reasons that make it difficult for OHS professionals to assess the exposure to biological agents such as, little knowledge on the biological agents potentially present in the different economic activities, their effects on health, the lack of standardized methods for quantitative sampling or the lack of reference values available for most biological agents. Different qualitative risk assessment tools for biological agents have been developed and differ in their scope, the parameters used and the results obtained. Some examples are the simplified evaluation of the INSST from Spain, the Biogaval-Neo of the INVASSAT from Spain, the bioaerosol tool of the IRSST from Canada or the method of the NKAL from the Netherlands.

These four tools were compared in order to better understand their limitations and applicability. The proposed improvements could be implemented in the development of a new qualitative biological risk assessment model in the Stoffenmanager® tool.
After the comparison was carried out some additional specific parameters have been proposed as essential for the development of this new model. Two key determinants of exposure are: a) the source of contamination depending on the sector or economic activity;

b) non-infectious biological agents should be included, as they can have serious health effects (irritation, allergies, mutagenic) in workers.

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Exposure To Phthalate and Alternative Plasticizers In Neonatal Intensive Care Unit Patients

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Abstract

Phthalates, plasticizers used to increase elasticity of plastic materials, can leach from medical devices into the human body. Di-(2-ethylhexyl)-phthalate (DEHP) was the most popular plasticizer. Due to adverse health effects, its use was restricted in medical devices (EU MDR 2017/45), being replaced by alternative plasticizers (APs). Neonatal intensive care unit (NICU) patients, relying on invasive plastic medical devices, may be exposed to high amounts of plasticizers. This study aimed to quantify current phthalate and AP exposure in the NICU and identify patients at higher risk.

Multiple urine samples were collected per patient during their NICU hospitalization. This resulted in 249 urine specimens from 26 preterm and 10 control neonates which were analyzed for phthalate and AP metabolites by LC-MS/MS. Medical device exposures were analyzed as predictors for urinary metabolites of plasticizers using univariate non-parametric tests.

Median urinary phthalate metabolite concentrations were lower compared to past NICU studies. Detection frequencies of all phthalate metabolites were above 90%. Detection of AP metabolites ranged 11-95%, with secondary DINCH-metabolites the most prevalent (DINCH > DEHTP > DPHP > DEHA > DINP > TOTM). Secondary DEHP metabolites were used to assess predictors of exposure. Respiratory support and blood products were significantly associated with increased urinary concentrations.

This study shows a favorable evolution of DEHP exposure in the NICU. It is the first to map neonatal exposure to APs. Nevertheless, despite changing legislation, respiratory support and blood products persist as important sources of phthalate exposure. Sources of AP exposure in the NICU need further investigation.

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Contribution of parenteral nutrition to phthalate and alternative plasticizer exposure in the Neonatal Intensive Care Unit

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Abstract

Phthalates, plasticizers used to increase elasticity of plastic materials, can leach from medical devices into the human body. DEHP was the most popular plasticizer. Due to adverse health effects, its use was restricted in medical devices (EU MDR 2017/45), being replaced by alternative plasticizers (APs). Neonatal intensive care unit (NICU) patients may be exposed to high amounts of plasticizers via parenteral nutrition, administered intravenously through plastic circuits. This study aimed to quantify current phthalate and AP exposure leaching from parenteral nutrition in premature neonates. Presence of plasticizers in different plastic medical devices was identified by solvent extraction. Further, to assess leaching during clinical use, we developed ex vivo leaching experiments, based on a clinical theoretical assumption – to mimic the in vivo situation. Samples were analyzed for phthalates and APs by LC-MS/MS and GC-MS. The plastic medical devices contained several plasticizers. Leaching of plasticizers occurred in lipid emulsions, with different leaching profiles between different types of emulsions, while hardly any exposure occurred during administration of non-lipid solutions. In a clinical setting, a neonate was estimated to be exposed to doses (ng/kg bw per day) of DEHP (320), ATBC (86800), TOTM (900), BBzP (700), DnBP (620), DEHT (250) and DiBP, DEP (200) and DEHA (60) through parenteral nutrition. Estimated DEHP exposure was below the tolerable daily intake. Our data indicate that NICU patients are exposed to a wide range of plasticizers. Influence of the type of lipid nutrition and administration time on plasticizer exposure seems to be plasticizer-specific.

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Measurements of radiofrequency electromagnetic field exposure of smart meters

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Abstract

In this study, measurements of the radio frequency (RF) electromagnetic fields (EMF) levels were performed near advanced utility meters, also called smart meters. These fields must be monitored to limit the exposure of an ever-growing number of IoT devices and to have a better overview of the daily RF EMF exposure. Both spatial (at three distances – 40, 100 and 200 cm) as well as temporal measurements of the exposure to radiofrequency (RF) electromagnetic fields (EMF) emitted by smart meters were performed in this study. The observed communication technologies and frequencies are meter depended and varied between General Packet Radio Service (GPRS) – 800 MHz;), Long Term Evolution (LTE) – 800, 1800 MHz; NB-IoT – 800 MHz.

At a distance of 40 cm, peak exposure values ranged from 0.24 V/m to 8.65 V/m. The electric field values decreased as function of the distance. Temporal measurements yielded 6-min-average duty cycles (DC) of 0.18% to 4.07%. However, this DC is dependent on the quality of service to the BS rather than on the technology-frequency combination. Combining the results, maximum time averaged exposure values of 0.20 V/m to 0.61 V/m were obtained. This is only 0.01% of the ICNIRP limit at this frequency, which is considered as the reference in RF EMF exposure.

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Work clothes as a vector for microorganisms: Accumulation, transport, and resuspension of microorganisms as demonstrated for waste collection workers

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Abstract

Take-home exposure, by means of bringing home contaminated clothes, has been studied for chemical agents such as lead and pesticides and for biological agents, secondary exposure has been studied for e.g. cat allergens and pollen. However, the accumulation, transport and resuspension of microorganisms from work clothes has not been studied before. Using a new method, we studied this in a work environment with elevated exposure to microorganisms,

namely that of waste collectors. A total of 32 workers were equipped with clean cotton T-shirts where electrostatic dust cloths (EDCs) were sewn onto the chestside of the T-shirts, here termed E-Cloths. They also wore portable GSP samplers mounted with Teflon filters which sampled airborne microorganisms in the inhalable air throughout their entire workday. Stationary GSP samplers were placed in cleaned truck cabs of the waste trucks. At the end of the workday, microorganisms were extracted from the E-Cloths and filters and then plated on different agar media. The cultivable bacteria and fungi were quantified for all samples and isolates were identified to species level using MALDI-TOF mass spectrometry. Results show that microorganisms accumulated in large quantities on the E-Cloths (GM=3.69×105 CFU/m2/h for bacteria, GM=8.29×104 CFU/m2/h for fungi) and concentrations and species composition in the air of the truck cabs correlated significantly with that of the E-Cloths. The same was not found for bacteria. We conclude that especially fungi are released from contaminated work clothes, and workers can prevent take-home exposure by showering and changing into clean clothes before leaving work.

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Microbial exposure and exposure to antibiotic resistant bacteria and fungi in nursing homes

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Abstract

There are 40,000 seniors (65+ years) who currently reside in nursing homes in Denmark. Half of these have a chronic disease, and many are in close contact with doctors and are at periods admitted to hospitals. This may increase the microbial exposure for the nursing home staff towards pathogenic microorganisms, as well as microorganisms resistant to antibiotics.
To study the occupational exposure to microorganisms, we visited five nursing homes twice. Nursing home staff was equipped with personal air samplers, which were worn over a standard working day, while the staff conducted their normal tasks, such as personal care, nursing, and cleaning tasks. Stationary samplers were also placed in rooms and common areas.

Using MALDI-TOF MS we identified 100 different bacterial and 13 different fungal species. Endotoxin was also determined, and ranged markedly between staff members (geometric mean 1.94 EU/m3; ranging from 0.02 – 59.00 EU/m3). Identified S. aureus species, which can cause skin infections, were examined for resistance to methicillin – i.e. Methicillin-resistant S. aureus (MRSA) - using selective agar and PCR methods. MRSA was detected in the rooms of residents already infected with MRSA but not in common areas. The fungus Aspergillus

fumigatus, which can cause serious lung infections, was likewise tested for resistance to four different antibiotics using the EUCAST broth microdilution method. Results showed that 9 of the 40 tested isolates were resistant to one of the antibiotics. In conclusion, nursing home staff are exposed to infectious microorganisms, some of which can be resistant to normal antibiotic treatment.

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Associations between manganese in three critical periods of development and adolescent verbal learning and memory

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Abstract

Manganese (Mn) is a metal found ubiquitously in the environment. Low and high Mn concentrations have been associated with adverse neurodevelopmental outcomes. Evidence suggests that these associations may depend on exposure timing, but prospective data on Mn in multiple early life windows, remain sparse.

Subjects were 10-14-year-olds and enrolled in the Public Health Impact of Metals Exposure study (N=140; 44% female). We measured dentine Mn in naturally shed baby teeth in three early-life critical periods (prenatal, infancy, and childhood) using laser-ablation mass spectrometry. Neuropsychologists administered the California Verbal Learning Test for Children (CVLT-C) to assess adolescent verbal learning and memory. Adjusted associations between dentine Mn in each window and adolescent CVLT-C scores were computed using multivariable linear regression. Multiple informant models tested differences in Mn associations across exposure time periods. Sex-specific associations were explored in stratified models.

For boys and girls, prenatal tooth Mn was inversely associated with number of intrusions (per interquartile increase in Mn, $\beta = -1.46$ [95% CI: -2.33, -0.57]). This association was not observed in the other periods and was significantly different from postnatal and childhood associations ($p\text{-value} < 0.05$). Among boys only, childhood Mn was positively associated with the number of words recalled ($\beta = 0.40$ [95% CI: 0.03, 0.77]).

Prenatal Mn was associated with better adolescent verbal learning and memory. Beneficial Mn associations were less evident in later exposure windows, although exploratory analyses suggest protective associations of childhood Mn exposure only among boys. Exposure timing is critical for understanding Mn-associated changes in cognitive function.

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Nonylphenol - oxidized metabolites in human urine as novel exposure biomarkers

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Abstract

Nonylphenol (NP) is an environmental pollutant and endocrine disrupting chemical. It is starting material for the production of NP ethoxylate detergents and plastic additives. Despite its widespread use, rugged data on human exposures is lacking. So far, parent NP has been the only exposure biomarker, but its determination is severely compromised by external contamination.

We identified oxidized NP (OH-NP and oxo-NP) as NP metabolites unaffected by external contamination and developed a sensitive and rugged online-SPE-LC-MS/MS method for their determination in urine. In a human oral dosing study, 62% and 9.3% of the NP dose were excreted as OH-NP and oxo-NP, respectively (compared to only 6.6% for unchanged NP). The new NP biomarkers were analyzed in urine samples from different countries. OH-NP could be quantified in 100% of Japanese children from Hokkaido, Japan (n=180) and in 76%, 100%, and 100% of children from Thailand (n=104), Indonesia (n=89), and Saudi Arabia (n=108), respectively. Regional differences were observed with highest median concentrations in the Saudi (8.6) µg/L and Indonesian children (8.1 µg/L). In urine samples from the German Environmental Specimen Bank collected between 1991 and 2021 (n=660 adults) median OH-NP concentrations decreased from 4.2 µg/L in 1991 to 0.70 µg/L in 2021. The detection rate dropped from 100% until 2017 to 90% in 2019 and 77% in 2021.

Our data demonstrates omnipresent NP exposure, considerable regional differences and significant time trends. The new biomarkers fill the long-standing need for a robust exposure and risk assessment of NP.

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NJHANES, A State Population Surveillance to Assess Environmental Exposure and Public Health

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Abstract

NJDOH is conducting the first probability-based population surveillance study, NJ Health and Nutrition Examination Survey (NJHANES). NJHANES collects basic health, exposure, and nutrition data through surveys, and biospecimens from 500 randomly selected NJ participants to measure body burden of 133 environmental pollutants. The exposure and survey data will be used to assess NJ population exposure levels and factors that may affect exposures and health. It will also address the knowledge gaps in the CDC's NHANES, which surveys the US general population, but lacks state-specific focus.

Subject recruitment started in September 2021 by mailing recruitment packages to randomly selected 2000 households. As of March 31, 2022, 49 households responded with interest, 34 participants were consented by virtual meeting, 29 home visits and specimen collection were made by simultaneously administering online surveys, and 26 participants' specimens were analyzed and reported. Consent through virtual meeting and online survey are effective, saving labor and time. Despite significant challenges from COVID-19 NJHANES staff has successfully implemented the population-based surveillance. However, COVID-19 still brings unanticipated recruitment challenges including low response rates and predominance from certain sociodemographic subdomains. Statistical differences were observed between NJHANES participants and NJ general population, including higher participation rates from people with higher educational attainment and the elderly. These biases will be addressed by adopting alternative strategies such as strengthening recruiting efforts for nonresponse households via door-to-door approach. Preliminary recruitment results and exposure data for toxic metals and select other organic contaminants on the populations will also be presented at the meeting.

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IMPRESS: Improving occupational exposure assessment methodologies for epidemiological studies on pesticides

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Abstract

The IMPRESS project, http://www.impress-project.org/, aims to better understand the performance of existing methods of occupational exposure assessment to pesticides used in epidemiological studies, and to use this information to recommend improvements in scientific practice for the future. To achieve this aim the project used existing and newly collected data from five cohorts these being the: Prospective Investigation of Pesticide Applicators' Health (PIPAH), Pesticide Users Health Study (PUHS), Study of Health in Agricultural Work (SHAW) in the UK; Pesticide use in tropical settings (PESTROP) in Uganda and the farm workers study in Malaysia. In addition IMPRESS completed a robust systematic review of pesticide exposure assessment methods and meta-analysis exploring the impact of occupational pesticide exposure assessment method on risk estimates for prostate cancer, non-Hodgkin's lymphoma and Parkinson's disease.

The project is now in its final stages and in this presentation we provide a high level overview of our key results, for example, recall ability of pesticide users and an evaluation of associations between different exposure-modifying factors and urine metabolite measurements. We will focus on providing the IMPRESS project teams overall insights and conclusions regarding the reliability and validity of currently used pesticide exposure assessment methods, what gaps and uncertainties remain and thoughts on how the how the community can work together to enable these to be actioned.

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Establishing Community-Level Consumption Behaviors of 50 Adults in North Carolina with Comparisons to NHANES

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Abstract

Survey estimates of foods people eat are a key component of nutritional intake and dietary exposure calculations. These calculations drive our understanding of the impact food choices have on nutrition, possible exposure to environmental contaminants, and, ultimately, health. A study was conducted to 1) characterize food consumption of a targeted geographical area (Chapel Hill, NC) based on 24-hr food diaries and 2) determine if national food consumption rates by category accurately represent those of the community. Fifty adults were recruited in which food diaries were completed on 12 separate days over six-weeks. The foods were categorized into 13 groups and consumption rates were converted from cups to grams. The consumption habits were characterized and compared to the National Health and Nutrition Examination Survey (NHANES) What We Eat In America (WWEIA) for the US population.
The community consumption rates differ from the national averages except for beverages – both alcoholic and non-alcoholic, excluding water. SPSS and R were used to evaluate the data

for relationships between demographic, consumption, and temporal variables through descriptive and inferential analysis. Community level data can offer critical details for consumption habits. Inclusion of temporal factors indicates variations in overall consumption habits. Community level data highlight significant differences in consumption by food categories (i.e., fruits, proteins) from the national survey results suggesting the need for more in-depth information on eating habits at a community level to be gathered for health research and policy. Unique behaviors and food choices may be lost when using nationally combined information.

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HBM4EU chromates study – overview of the study and potential policy implications

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Abstract

Exposure to hexavalent chromium [Cr(VI)] may still occur in several occupational activities, e.g., welding, Cr(VI) electroplating and other surface treatment processes, raising concerns due to its carcinogenicity. The aim of the HBM4EU chromate study was to provide EU relevant data on occupational Cr(VI) exposure to support the regulatory risk assessment and decision-making. In addition, the usefulness of different biomarkers for the assessment of Cr(VI) exposure were evaluated. The study involved nine European countries and involved 399 exposed workers performing welding, bath plating or other tasks involving exposure to CrVI, and 203 controls. We applied a cross-sectional study design and used chromium in urine , in red blood cells (RBC) and exhaled breath condensate (EBC) for biomonitoring of exposure to Cr(VI). These were complemented with air and dermal wipe samplings. The results show that among the studied industry sectors the highest internal exposures were related to the use of Cr(VI) in electrolytic bath plating. In stainless steel welding the internal Cr exposure was lower when compared to plating activities. Although unspecific to Cr(VI), urinary chromium showed its value as the first approach for the assessment of total, internal exposure, EBC-CrVI and RBC-Cr measurements providing complementary data. According to the survey made for EU and national policy makers, the results provide useful data for the future updating of occupational limit values and support national enforcement programs. The results were also considered to support the use of biomonitoring in the management of CrVI exposure at workplaces.

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Determinants of exposure to hexavalent chromium

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Abstract

Work-related exposures in industrial processing of chromate (chrome plating, surface treatment and welding) raise concern regarding health risk of hexavalent chromium (Cr(VI)). In this study we focused on better understanding the determinants of exposure and to recognize how risk management measures (RMMs) contribute to a reduction of exposure. HBM and occupational hygiene data were collected from 399 workers and 203 controls recruited in nine European countries. Urinary total chromium (U-Cr), personal inhalable and respirable dust of Cr and Cr(VI) and Cr from hand wipes were collected. Data on the RMMs was collected by questionnaires. We studied association between different exposure parameters and the use of RMMs. The relationship between exposure by inhalation and U-Cr in different worker groups was analysed using regression analysis and we found a strong association. Automation of Cr electroplating dipping explained lower exposure levels in platers. Use of personal protective equipment resulted in lower U-Cr levels in welding, bath plating and paint applications. An effect of wearing gloves was observed in machining. An effect of local exhaust ventilation and training was observed in welding. Regression analyses showed that in platers exposure to air level of 5 μg/m3 corresponds to U-Cr level of 7 μg/g crea. In welders, the same inhalation exposure resulted in lower U-Cr levels reflecting toxicokinetic differences of different chromium species.

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Effect biomarkers in the HBM4EU chromate study and their value as early indicators of adverse health outcome

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Abstract

This work aimed at characterizing effect biomarkers in workers from several sectors exposed to Cr(VI) and controls, to explore the relationship between exposure and early effects and ascertain the risk of adverse health outcomes.

Workers were categorized according to the activities performed, namely, bath platers, welders, chromate painters, machining workers, and other activities. Controls included office workers from the same company and subjects from companies with no chromate-related

activities. Effect biomarkers comprising the alkaline comet and the micronucleus assays in leukocytes and reticulocytes, urinary oxidative stress, DNA-global-methylation and metabolomics were analysed.

Electrolytic bath platers displayed the highest internal exposures to Cr (Urinary Cr) and significant levels of genetic damage in leukocytes and reticulocytes compared to out-of-company controls. Welders showed the lowest internal exposure but exhibited the highest frequency of micronuclei in reticulocytes. This later finding may reflect the effect of co-exposure to Cr(VI) and other metals used in stainless steel welding. Genotoxicity biomarkers provided evidence that within company controls displayed levels of genetic damage significantly higher than those of other controls, suggesting a bystander effect in those office workers. A significant decrease in global DNA methylation level was observed in exposed workers compared to controls, which might result in altered gene expression. Analysis of urinary metabolome showed altered metabolic pathways in workers.

The observed association between exposure and effect biomarkers supports the value of effect biomarkers, particularly for early detection of groups of workers who may be at enhanced risk and for whom mitigation measures should be prioritized.

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Occupational study in e-waste

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Abstract

Workers involved in the processing of electronic waste (e-waste) are potentially exposed to toxic chemicals. If exposure occurs, this may result in uptake and potential adverse health effects. Thus, exposure surveillance is an important requirement for health risk management and prevention of occupational disease. Human biomonitoring by measurement of specific biomarkers in body fluids is considered as an effective method of exposure surveillance. The aim of this study is to investigate the internal exposure of workers processing e-waste using a human biomonitoring approach, which will stimulate improved work practices and contribute to raising awareness of potential hazards. The study was conducted in eight European in a target population of 300 exposed and 150 controls. Biomarkers of exposure for the following chemicals were used: chromium, cadmium and lead in blood and urine; brominated flame retardants and polychlorobiphenyls in blood; mercury, organophosphate flame retardants and phthalates in urine, and chromium, cadmium, lead and mercury in hair. In addition, the following effect biomarkers were studied: micronuclei, epi-genetic, oxidative stress, inflammatory markers and telomere length in blood and metabolomics in urine.

Occupational hygiene sampling methods (airborne and settled dust, silicon wristbands and handwipes) and contextual information were collected to facilitate the interpretation of the biomarker results and discuss exposure mitigating interventions to further reduce exposures if needed. This study protocol can be adapted to future European-wide occupational studies.

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Diisocyanate biomonitoring data

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Abstract

To understand the human health effects of current occupational diisocyanate exposures, a health impact assessment based on biomonitoring data was executed. Using an unpublished Finnish human biomonitoring data (HBM) set - in combination with exposure reconstruction modelling, and information on the diisocyanate exposure-excess risk relation on bronchial hyperresponsiveness (BHR) established by the Risk Assessment Committee - we found in general that excess risk was highest for MDI. Especially in the construction sector where we derived an excess risk of BHR of 3.5%, indicating that for the Finnish construction sector the expected excess number of BHR cases is 200. Also for HDI and TDI the construction sector poses the highest risk: 2.9% and 3.2% accounting for 165 and 180 excess BHR cases in the Finnish worker population respectively. For the other sectors (i.e. the motor and vehicle repair, manufacturing of PUR products and assembling of industrial products) excess risk estimates were between 1.1 – 3.0%.

When comparing Finnish urinary values with published data we noticed higher exposures in some sectors among published data. However, a recently conducted field study on diisocyanates within HBM4EU found, in general, that diisocyanate air levels were below the binding occupational levels proposed in EU. In the future, the sensitivity of analysis methods should be able to detect even lower HBM levels of these compounds to efficiently monitor exposure. Advantages of performing a risk assessment by using HBM data include the fact that the use of respiratory equipment and potential dermal exposure are taken into account.

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Community Garden Soil Sampling for Metals to Inform a Community Renovation and Expansion Project

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Abstract

Objective: Students in a graduate course characterized metal concentrations in soil from an urban community garden in Boston, MA to provide recommendations before garden renovation and expansion. The US Environmental Protection Agency (US EPA) Soil Screening Guidelines were compared to the Massachusetts Department of Environmental Protection (MassDEP) S-1 Soil Standards for applicability to public health.

Methods: Soil composite samples (n=20) were analyzed for 33 metals through X-ray fluorescence (XRF). Summary statistics of metals with more than 50% of samples over the XRF limit of detection were compared to state standards due to their enforceability and stringency in comparison to federal guidelines. Therefore, the analysis progressed with lead and arsenic.

Results: Lead was found above state standards in 95% of the samples (n=19, GM: 532 mg/kg, GSD: 1.83 mg/kg, range: 96.8 - 1380 mg/kg, standard: 200 mg/kg). Arsenic was above state standards in 90% of the samples (n=18, GM: 39.5 mg/kg, GSD: 1.81 mg/kg, range: 7.07 - 97.7 mg/kg, standard: 20 mg/kg). Only one sample showed lead and arsenic levels below standards. No other metals had any sample concentration over their state standard.

Conclusion: Historical use of leaded paint, lead-arsenate pesticide, and chromated-copper arsenate-treated wood likely contributed to the deposition of lead and arsenic in the garden above background levels. Recommendations included testing new soil, raising beds, and planting hyperaccumulators. MassDEP standards account for regional differences in background metal levels and are more health-protective than US EPA guidelines.

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The Aging Exposome: Characterizing Bidirectional Effects of Exposures and Aging

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Abstract

Effects of a lifetime of environmental and lifestyle exposures on aging or age-associated diseases are not well understood. Exposures not only directly affect biological pathways but also have mutagenic and epigenetic mechanistic influences on disease and well-being. Aging leads to reduced reserve capacity to compensate for the effects of exposures due to changes in biomolecular and cellular kinetics and dynamics. While general effects are well

documented, details on how temporal patterns of exposures may affect systemic and targeted aging are not well understood. Characterizing differential, additive effects of continuous low-level and intense sporadic multi-agent exposures require advanced big data and artificial intelligence methods.

Quantifying bidirectional effects of environment and aging requires time series of data from all contributing exposures which can span endogenous processes within the body, biological responses of adaptation to environment, and socio-behavioral factors. Gaps in measured data may need to be filled with computationally modeled data. Essentially, the challenge in generating aging exposome is the absence of readily available records for individuals over the course of their life. Instead, these would need to be assimilated from historic person reported data (e.g. residential location, durations, behaviors) along with publically available data. This could lead to potential gaps and uncertainties that would need inform on how the exposomic records can be used for aging research.

We present a pragmatic approach to generation of longitudinal exposomic and aging records as required for different study archetypes. Such records can then be used to understand the bidirectional effects of exposures and aging.

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Impact of e-cigarette use behaviors and device characteristics on heavy metal biomarkers in a Maryland cohort

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Abstract

Introduction: Electronic cigarettes have rapidly evolved from “mod” devices mostly used by smokers as a risk reduction strategy with adjustable settings, to “pod” devices with disposable cartridges, marketed to youth never smokers. Inhalation of metals that have been found in e-cigarettes can lead to adverse health outcomes such as asthma and lung cancer. Evaluating e-cigarette use behaviors, device type, settings, and biomarkers are essential to understanding potential heavy metal exposures attributed to e-cigarette use.

Objective: Assess heavy metal concentrations in blood, urine, and exhaled breath condensate (EBC) of e-cigarette users and controls by use behaviors and device type.

Methods: We recruited 17 Mod, 24 Pod, 10 smokers, 14 dual users (cigarette and e-cigarette), and 30 non-users. Sociodemographic characteristics, e-cigarette/tobacco use behaviors, and device characteristics were collected by survey. Blood, urine, EBC and aerosol samples were analyzed for heavy metals using ICP-MS. Data was corrected for background and limit of detection. Chi-squared tests for categorical variables, ANOVA tests for continuous variables, and linear regressions were used to assess relationships between variables and user groups.

Preliminary Results: Never smokers and younger users were more likely to use higher nicotine concentration than former smokers. Significant differences ($p<0.05$) were found between user group and Cd, Mn, Ni, and Zn in blood. Cr and Ni in mod users was 1.2 and 1.5 times higher, respectively, than pod and nonusers.

Conclusions: Differences in user behaviors and device type determine exposure to certain metals. Blood Cd, Mn, Ni, and Zn were associated with user group.

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Exposure estimation from HBM data

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Abstract

HBM is the essential approach to reveal the range and trend of exposure to chemicals for the specific population. i-HBM working group has developed Biomonitoring Guidance Value Dashboard, which allows us to search for information on currently available human biomonitoring guidance values. In addition, large-scale cohort studies are being conducted to investigate the relationships between exposure to chemicals and health outcomes using the target chemical levels in the biospecimen as an indicator of exposure. It is, however, difficult to estimate the exposure from the levels in the biospecimen because the information on pharmacokinetics is available only for limited chemicals. Reduction of exposure would be required if the biomonitoring levels exceed the guidance values, but it is difficult to take measures when the pathway and contribution constituting the levels in biospecimen are unknown. In this regard, exposure reconstruction, which is to back calculate the exposure from the levels in biospecimen, is necessary for evidence-based policy making using HBM data. In the presentation, recent studies on exposure reconstruction of some environmental contaminants will be briefly summarized. Furthermore, we have conducted an intervention study that controlled diet and use of personal care products of the participants without any chemical administration to investigate the pharmacokinetics. Decreasing trends were observed for some chemicals such as parabens, triclosan, neonicotinoids, during the study period. Estimated elimination half-lives were consistent with the previous reports. Therefore,

this intervention approach has been shown to be effective in estimating the pharmacokinetic parameters that can be applied for exposure reconstruction.

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Outcome of HBM4EU

Marike Kolossa-Gehring
Umweltbundesamt, Head

Abstract

People in Europe are still substantially exposed to various chemicals from different sources and via different exposure pathways. The 117 partners from 30 countries cooperate in the European Joint Programme HBM4EU on generating data and knowledge decision makers need to improve Europe's environment and health actions and programs. Highly quality assured HBM data were harmonized and generated in the HBM4EU aligned studies. The datasets for priority substances, such as phthalates and DINCH, PFAS, cadmium and BPA cover the four European regions (north, south, east, west) and consist of 2000 to 3000 samples per substance from 9-12 different countries. Derivation of HBM Guidance Values (GV) was broadly discussed and consented in the HBM4EU consortium. Application of these values to the results of the aligned studies reveal higher exceedance rates for Cd, phthalates, and PFAS than to be expected considering the elaborate risk assessment requirements in the European Union. The exceedance rate for BPA is still under discussion as the GV might need adaption due to a new opinion of the European Food Safety Agency EFSA. Additionally, interpretation of HBM data is supported by mixture assessment approaches, exposure modelling and physiologically based pharmacokinetic modelling, mechanistic studies, and systematically identified effect biomarkers. Improvement of novel analytical techniques to screen for emerging chemicals in human samples broaden the view on the coincident exposure to a complex mixture and support priority setting for next HBM studies. Through 2021 and well beyond, HBM4EU contributes directly to the improvement of health and well-being of European citizens.

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Analysis of Human Biomonitoring Data from the Canadian Health Measures Survey using Health-Based Biomonitoring Guidance Values

Annie St-Amand
Health Canada, Head

Abstract

The key objective of this work is to assess the biomonitoring data for 42 chemicals or groups of chemicals including metals, perfluoroalkyl substances (PFAS), pesticides, plasticizers, and

volatile organic compounds collected as part the Canadian Health Measures Survey (CHMS), in a health risk context using health-based biomonitoring guidance values. The assessment included a number of chemicals measured in cycles 5 (2016 to 2017) and 6 (2018 to 2019) of the CHMS and a few chemicals from earlier cycles. Fourteen chemicals were assessed for the first time in this study, whereas the assessments for 28 chemicals are updates to an earlier evaluation using more recent biomonitoring data or recently established or updated biomonitoring guidance values. Hazard quotients (HQs) were calculated as the ratio of the mean concentrations (geometric mean (GM) or arithmetic mean (AM)) and upper concentrations (95th percentile or maximum) of a chemical to a guidance value. HQs exceeded 1 for inorganic arsenic, 3-phenoxybenzoic acid (3-PBA), PFAS and xylenes in the general population, however, HQs remained below 1 for most chemicals suggesting that population exposures are not of concern. Bisphenol A, diethyl phthalate, and dioxins and furans, PFOS and PFOA showed a temporal decline in HQ based on a comparison with earlier findings using previous cycles of CHMS data. Our limited analysis of exposures in racial populations showed exceedances of HQ for inorganic arsenic in Asian and Black sub populations and not in other sub-populations. Chemicals having biomonitoring levels exceeding a guidance value may be prioritized for future follow-up activities.

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Interpreting Biomonitoring Data: Introducing the International Human Biomonitoring (i-HBM) Working Group's Guidance Value Dashboard

Tyler Pollock
Health Canada, Senior Scientist

Abstract

Human biomonitoring (HBM) data measured in specific contexts or populations provide information for comparing population exposures. There are a large number of health-based guidance values, but to locate these values, interested parties need to seek them out individually from publications, government reports, websites and other sources. Until now, there has been no central, international repository for this information. Thus, a tool is needed to help researchers, public health professionals, risk assessors, and regulatory decision makers to quickly locate relevant data on numerous environmental chemicals. A free, online repository for international health-based guidance values to facilitate the interpretation of HBM data is now available. The repository is referred to as the "Human Biomonitoring Health-Based Guidance Value (HB2GV) Dashboard." The HB2GV dashboard represents the efforts of the International Human Biomonitoring (i-HBM) Working Group, affiliated with the ISES. The i-HBM Working Group's mission is to promote the use of population-level HBM data to inform public health decision-making by developing harmonized resources to facilitate the interpretation of HBM data in a health-based context. Here we will discuss the methods used to compile the health-based guidance values. We will also demonstrate how to access and

use the HB2GV dashboard, including the search, visualization, comparison, and download features. To our knowledge, the HB2GV dashboard is the first open-access, curated database of guidance values developed for use in interpreting HBM data. This new resource can assist HBM data users such as risk assessors, risk managers and biomonitoring programs with a readily available compilation of guidance values.

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Using and talking about health-based biomonitoring guidance values

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Abstract

The i-HBM (or (HB)2GV) Dashboard is a freely available, on-line, curated repository of human health-based biomonitoring values from around the world. These kinds of assemblages of values can be readily used for various type of purposes, including comparisons with data from national surveys and smaller-scale research. However, various issues around the use of these values, including communication with various interested parties, must be considered. These issues include differing levels of confidence in the individual values, difference in the meaning of the various value types, to whom these values apply, strengths and limitations of the underlying approaches, and communication issues around interpretation. The Dashboard itself does not include information on these potential issues and it is incumbent on the users to be aware of these problems and to consider how they impact the use and interpretation of the HBMs. Of particular importance are considerations around interpreting biomonitoring data that exceed BEs for a specific HBM value. Further, communication approaches will need to be targeted to specific stakeholder groups, including lay people, physicians and patients, regulators, and legislators. Case studies for each of these issues will be given.

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A method for the simultaneous determination of polar and non-polar volatile organic compounds using an activated carbon-silica gel active sampler to evaluate indoor work environments

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Abstract

Some volatile organic compounds (VOCs) can have short and long-term adverse health effects, including irritation of the eyes, mucous membranes, and skin; damage to the nervous system; and carcinogenic activity. Exposure to VOCs is likely to be higher in workplaces than in

residential indoor and outdoor settings. Therefore, exposure to VOCs in the work environment poses a high health risk. To protect workers in Japan, the Industrial Safety and Health Act in Japan has established guideline values for VOCs in indoor workplace air; however, because the physicochemical properties of these VOCs are diverse, appropriate analytical methods have not yet been developed. Here we performed recovery tests to simultaneously measure VOCs and to optimize the analytical parameters (the extraction solvents and their mixture ratio) of a commercial activated carbon–silica gel active sampler. In the recovery tests, 46VOCs were added to the adsorbents of the sampler (activated carbon and silica gel) at three concentration levels relative to the guideline values (0.5×, 1×, and 2×); we then extracted the VOCs from the absorbents by using various mixtures of acetone and carbon disulfide. The mixture comprising 80% acetone and 20% carbon disulfide was the best solvent overall for extracting the 46 tested VOCs from the adsorbents in the sampler; this mixture achieved adequate recovery rates (within the range of 80 to 120%) for 40 (87%) of the targeted VOCs.

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Personal exposure to $PM_{2.5}$ in Bangladesh by using portable $PM_{2.5}$ monitor

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Abstract

Personal exposure to $PM_{2.5}$ and PM_{10} were measured in Dhaka, Bangladesh in December 2019, before the outbreak of COVID-19. Portable PM monitor developed by Dr. Ishigaki was used for monitoring $PM_{2.5}$ and PM_{10} concentration. The PM monitor was connected to the smartphone, powered by the smartphone, and used the GPS information of the smartphone. The measurement was carried out around the University of Dhaka with this PM monitor. $PM_{2.5}$ concentrations at the University of Dhaka ranged from 110 μg·m^{-3} to 250 μg·m^{-3} on average for minutes to hours, varying from day to day. The $PM_{2.5}$ concentration was high near the Buriganga River in Dhaka, with an average of 330 μg·m^{-3}. At restaurants in Dhaka, $PM_{2.5}$ concentrations could temporarily exceed 500 μg·m^{-3} due to cooking smoke. In addition, $PM_{2.5}$ concentration decreased in the car where the air conditioner is operating. When the $PM_{2.5}$ concentration in Shizuoka, Japan was measured using this monitor, it was 10 μg·m^{-3} or less, and it was suggested that the air pollution in Dhaka City was serious. The $PM_{2.5}$ monitor used is palm-sized and weighs only 67g, and it could be used to measure the concentration of $PM_{2.5}$ simply. Furthermore, we have also collected $PM_{2.5}$ in Dhaka university, and determined PAH concentrations in $PM_{2.5}$. The PAH concentration range and its characteristics will also be presented.

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Simultaneous analysis of urinary insect repellents and its metabolites using high-performance liquid chromatography-tandem mass spectrometry

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Abstract

Insect repellents picaridin (IUPAC name: butan-2-yl 2-(2-hydroxyethyl) piperidine-1-carboxylate) and DEET (IUPAC name: N,N-diethyl-3-methylbanzamide) are widely used on human skin and clothing to repel mosquitoes, biting flies, ticks, fleas, and chiggers. The analytical method for urinary repellents exposure markers needs further development for application to epidemiological studies, which provide strong evidence related to risk assessment from daily repellent exposure. In this study, we have developed an analytical method of the concentrations of picaridin, DEET, and two DEET metabolites (N,N-diethyl-3-(hydroxymethyl)benzamide (DHMB) and 3-(diethylcarbamoyl)benzoic acid (DCBA) in human urine sample. After formic acid-induced acidification of a urine sample, urinary repellent exposure markers were extracted using solid-phase extraction (EVOLUTE® EXPRESS ABN, Polymeric SPE column). A separation analysis was performed using high-performance liquid chromatography-tandem mass spectrometry within 10 minutes. The limits of detection ranged from 0.06 to 0.11 μg/L of urine. The extraction recoveries ranged from 74 to 88%. The within-day and between-day variation was 1.5–17.5 and 0.9–15.8%RSD, respectively. The preservation in room temperature and 4 °C was 89–108 and 85–102%, respectively. The stability of the analytes after three freeze-thaw cycles was 94–101%. This method was successfully applied to urine obtained from 5 Japanese adults (20–43 years old) who used picaridin or DEET containing products within a week. The urinary concentration of repellent exposure markers were reached the maximum level within 15 hours after repellent usage. These results indicated that our present method might be used to evaluate insect repellents exposure levels.

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Occurrence of Novel Phosphorus-based Flame Retardants in Indoor Dust Collected from Japanese Dwellings

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Abstract

Alternative flame retardants, especially phosphorus flame retardants (PFRs), increases their usage and diversities to meet flammability standards. In our previous paper, triphenyl phosphine oxide (TPhPO) and tris(2,3-dibromopropyl) isocyanurate (TDBP-TAZTO) were detected as alternatives from flame retardant-curtains. In addition, we also reported that 3 compounds, 6-benzylbenzo[c][2,1]benzoxaphosphinine 6-oxide (BzlDOPO), naphthalen-2-yl diphenyl phosphate (NDPhP), and (5-ethyl-2-methyl-2-oxido-1,3,2-dioxaphosphorinan-5-yl)methyl methyl methylphosphonate (PMMMP), were identified as novel alternative PFRs from the flame-retarded curtains. Although the novel alternatives were detected from the indoor products, information on the occurrences of these compounds in indoor dust have been limited, especially for BzlDOPO, NDPhP, and PMMMP. In this study, the concentrations of 4 novel alternative PFRs, TPhPO, BzlDOPO, NDPhP, and PMMMP including its dimer (di-PMMMP) and 14 conventional PFRs in indoor floor dust collected from 29 Japanese dwellings was determined. In addition, their time trends in 2015–2019 and seasonal variations were also investigated. The results of this study revealed that the novel PFRs have been present in indoor environments and exposed to human. Further study is urgently required to evaluate their risks.

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Development of a nicotine passive sampler for exposure assessment of Environmental Tobacco Smoke and its application in determining nicotine concentrations indoors.

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Abstract

Environmental tobacco smoke (ETS) is classified as a human carcinogen. It is necessary to evaluate the health effect of such carcinogens. ETS personal exposure measurement is indispensable when considering the health effects of passive smoke. In this study, we developed an analytical method of nicotine in low concentration range, investigated the influence of wind speed on the measurement accuracy of the passive sampling method, and evaluated the collection efficiency and accuracy of the sampler.

We firstly developed an analytical method of nicotine by LC-MS/MS, which is 1600 times more sensitive than the conventional method by GC-MS. This achievement is due to reduction of nicotine adsorption on the column, improvement in instrumental selectivity, and increase of injection volume. To reduce the effect of wind speed on the sampling rate (SR), we attached a lid to the sampler and examined the SR of the sampler with an aperture ratio of 0.9, 1.8, 2.7, 3.6,

and 4.4%. The SR of nicotine is a coefficient for converting the collected amount by the passive sampler into the concentration in the air. There was significant correlation between the amounts collected by the passive sampler and air concentrations by active sampler (r^2=0.99). This suggests that the SR (0.23 mL min^{-1}) can be used under a wide-range of environmental concentrations. The nicotine concentrations in the rooms measured by the developed sampler were 0.34–51 μg m^{-3}. The passive sampler developed in this study is useful under various conditions such as non-smoking environments and passive smoking environments.

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The impact of European legislation on the reduction of Environmental Tobacco Smoke and Polycyclic Aromatic Hydrocarbons between 1995 and 2019 in Germany

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Abstract

The first regulations to reduce the exposure to environmental tobacco smoke (ETS) focusing on non-smoker protection in Germany were implemented starting in 2002 and have been continuously expanded over the years. The present work aimed to assess how enforced non-smoking regulations and smoking bans affected the ETS exposure of the non-smoking population in Germany since 1995 and to evaluate the relationship between secondhand smoke exposure and polycyclic aromatic hydrocarbons (PAHs). To do so, cotinine and selected monohydroxylated PAHs (OH-PAHs) were analyzed by means of (UP)LC-MS/MS in 510 24-h-urine samples from the German Environmental Specimen Bank collected over a time span of 24 years from 1995 to 2019. Urinary cotinine levels declined steadily and significantly from 1995 to 2019. During the same period, a significant decrease of urinary 3-hydroxybenzo[a]pyrene, 1-OH-pyrene, 1-naphthol, 1-, 2-, and 3-OH-phenanthrene was observed. This is the first HBM study systematically assessing the urinary excretion of Cot and nine different OH-PAHs, including 3-OH-BaP, in Germany over a time period of 24 years. The observed decrease in urinary levels of cotinine and several OH-PAHs can most likely be attributed to smoking bans and regulations limiting ETS and PAH exposure. However, due to their carcinogenic properties, further reduction of PAH exposure is warranted. This study therefore highlights the importance of human biomonitoring to investigate the exposure to chemicals of concern, assess the effectiveness of regulatory measures, and support policies in enforcing provisions to protect public health.

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Determination of exposure factors including use of personal care products via web-based questionnaire.

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Abstract

Exposure factors are essential components for risk assessment and management of chemical substances. The National Institute for Environmental Studies have been developing a Japanese Exposure Factors Database. In this study, we derived exposure factors related to lifestyles and the use of personal care products (PCPs) for Japanese adults using web-based questionnaire.

The exposure factors such as number of cigarettes smoked, heat-not-burn tobacco, drinking water consumption, duration of bathing and/or showering, time spend outdoors, duration of swimming, mobile phone or PC usage, and frequency and amount of PCPs use were obtained via web-based questionnaire from 600 each of Japanese men and women at the age of 20-69 in February 2021 and February 2022.

For men, the median of cigarette smoking, drinking water consumption, duration of bathing, PC usage, time spend outdoors, and frequency of sanitizer use were 15.0 cigarettes/day, 1.5 L/day, 10 min/day, 3.0 hours/day, 60 min/day, and 5 times/day, respectively. For women, those were 12.5 cigarettes/day, 1.5 L/day, 15 min/day, 2.0 hours/day, 60 min/day, and 4 times/day, respectively. Some factors are comparable to the previous reports from Japan and other countries. The median of the usages of skin toner, hand cream, face wash, shampoo, and toothpastes for women were 0.5, 0.2, 0.5, 3 and 0.8 g/day, respectively.

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Association between Air Pollution, Stress, and Sleep Efficiency in 6 -7 year old Children living in East Harlem.

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Abstract

Environmental toxicants, broadly defined to encompass chemical and non-chemical risk factors, present in the built environment, can adversely impact children's growth and

development. Children are particularly vulnerable to environmental exposures because of the sensitive nature of children's neurodevelopment, a prenatal life stage marked by cell differentiation. Yet, little is known about the relationship between air quality and sleep efficiency among children, within the larger context of household and psychosocial conditions.. Specific research aims are: 1) Convene and engage with the Community Advisory Board (CAB) quarterly to elicit meaningful input on pilot study design, implementation and dissemination of how air quality impacts child sleep in 6–7 year-old children in East Harlem. 2) Together with East Harlem families and MPH student researchers, we will quantify a). PM2.5 exposure using indoor air monitors, b). children's time spent sleeping, quantity of awakenings, and c). children's 24-hour activities wearing continuous wrist-worn actigraph watches over 7 days, to examine potential associations between air quality and sleep, and 3) The research team and the CAB will collaborate on the design, and implementation of a bi-lingual study questionnaire, to assess child caregivers' understanding of air pollution, sleep, and household environmental risk factors. A diary along with instructions will be given to all caregivers to write down how they interpret sleepiness and sleep quality in their own words. This will provide important information that can guide meaningful study report back to study participants, and add to the literature.

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Occupational exposure to airborne fungi and bacteria in greenhouses

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Abstract

Fungi and bacteria form close interactions with plants, facilitating microbial richness in agriculture and horticulture. However, these environments also constitute sources of fungal and bacterial exposure for workers. At present, little knowledge exists on the exposure profile to microorganisms in greenhouses and the risks associated with it. In this project, we investigated the microorganisms present in air sampled from the inhalation zone of greenhouse workers from two separate horticultural facilities; one used for cultivating flowers and one for vegetables. Sixty-seven samples extracted from personal air samplers were cultivated at 37 degrees thereby selecting for species able to grow at human body temperatures. MALDI-TOF was applied in order to elucidate the composition of both fungal- and bacterial species as well as to identify pathogenic species, posing a risk for workers. Pathogenic fungi were isolated, and later tested for antibiotic resistance. We show that the species composition of particularly fungi differs considerably between the two facilities. In addition, the concentration of microorganisms in air samples varies between different work tasks, as well as different sampling time points during the year. The findings from the

horticulture environments were compared to existing literature on exposure to microorganisms in other working environments. The microorganisms found in the workers exposure included allergenic species, but only few pathogens. However, emerging pathogenic species could constitute a hidden risk. The different fungal compositions in the two related working environments highlights the importance of obtaining knowledge on the health risks associated with the different species compositions.

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Effects of air pollution exposure predicting sleep efficiency in children modified by exposure to violence, 4-7 years, in the PROGRESS birth cohort.

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Abstract

Introduction: Studies suggest that exposure to air pollution and violence plays an important role in how the human body reacts to environmental toxicants affecting sleep efficiency. We propose that postnatal air pollution exposure may interact with Exposure to Violence (ETV) to affect the efficiency of slee

Methods: We studied 314 children enrolled in Programming Research in Obesity, GRowth, Environment and Social Stressors (PROGRESS), a birth cohort in Mexico City. Sleep efficiency was assessed at ages 6 - 7 years with Actigraph accelerometers worn during sleep. ETV was estimated using questionnaires

Results: Participants were mostly low SES families (54.6%) and all Mexican. In all samples we observed negative associations between ETV exposure and sleep duration (b = - 4.71; CI: -12.80, 3.37, p-value = 0.2517); critical window observed at 58 – 62.5 months (Fig. A). In boys, ETV exposure at 72 months was negatively associated with sleep duration (b = -14.43; CI: -26.24, -2.62, p-value (0.0169). High dose ETV exposure in boys, we observed a critical window at 56.7 – 58.3 months (Fig. B). While in girls there was observed a positive association of ETV at 72 months on sleep duration (b = 2.29; CI: -8.84, 13.44, p-value (0.6844) (Fig. C).

Conclusion: This research study adds to the literature by addressing the main effect of prenatal air pollution on sleep outcomes in children. Such findings further suggest neighborhood disadvantage may influence child sleep health. Future research should target potential mitigating associations between SES, and PM exposure in household environments.

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Old legacies and new concerns – Lessons learnt from the German Environmental Survey for Children and Adolescents 2014–2017 (GerES V)

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Abstract

The German Environmental Survey for Children and Adolescents (GerES V) was conducted 2014–2017 and 107 substances have been analysed in the human biomonitoring (HBM) programme, yielding population-representative data on the exposure to environmental contaminants in Germany. The majority of HBM data have already been published and include an update on the exposure to 1. "classic" environmental chemicals (like lead, mercury, PAH, and POPs), 2. current substances (like phthalates, PFAS and Glyphosate), and 3. substances for which no analytical method had been available up to now. Thus, GerES V provides first population representative results for e.g. the antimicrobials CIT/MIT and BHT, fragrances such as Lysmeral, alternative plasticisers such as DINCH and DEHTP, and the aprotic solvents NMP and NEP. For some substances that were deemed highly relevant in previous GerES studies, like PAH, a decline in exposure could be seen. Current exposure to phthalates and PFAS exceeds health-based guidance values in a relevant portion of the study participants. Although data from the German Environmental Specimen Bank (ESB) showed a general decline in exposure to phthalates, 3 % of the children still had urinary concentrations exceeding the health-based guidance values for at least one phthalate. Concurrently, exposure to alternative plasticisers is increasing as evident from ESB data, reaching toxicologically relevant concentrations in children. This example demonstrates that the observed decreasing exposure to harmful substances after regulation calls for caution with regard to possible substitutes, and how different HBM tools complement each other to provide a more comprehensive picture of human exposure.

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Sensor application in the occupational epidemiological context – EPHOR project

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Abstract

Lower cost sensors provide opportunities to measure a range of exposures at high temporal resolution. A number of environmental epidemiology studies have begun using these sensors for exposure assessment, but occupational uses are limited. We will discuss the development and application of a multi-exposure sensor box developed in the EPHOR project to measure particulate matter, noise, light, UV, temperature and humidity. The sensor box will be

deployed for two short-term work week case studies – one on shift work and one on respiratory health. Study participants will be asked to wear the sensors during their waking hours throughout the week. A sensor validation study was done to compare the EPHOR sensor box with reference instruments. Subsequently, the sensors have been tested by each case study prior to deployment in the short-term studies. In the sensor validation study, the noise, light, UV, temperature and humidity sensors demonstrated R2 values of 0.9 and above in laboratory or field comparisons with reference monitors. Calibration equations have been developed based on these relationships. A method for calibrating different types of particulate matter, to reflect different workplace aerosols and nonworkplace aerosols is being developed. Contextual information will be gathered via a mobile phone questionnaire app and sleep/activity data will be collected using commercially available, wrist-worn activity trackers during each day of the study. A summary of initial field results from the case studies will be presented.

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Exposure data of cosmetic products for patients undergoing cancer treatments

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Abstract

Dermo-cosmetics are important in the management of side effects due to treatments. Exposure data is required to ensure the safety of cosmetics for patients undergoing cancer therapy. The aim of this study was to obtain information regarding consumption habits and cosmetic product quantities used by those patients.
150 patients attending the Avène thermal station following a cancer therapy were recruited. They completed a questionnaire which enquired about their cancer, side effects, consumption behaviors and frequencies of use of 31 cosmetics. A consumption follow-up including 5 products was also performed. 149 subjects recorded daily usage information over a week. Products were weighed at the beginning and at the completion of the follow-up. Frequency of use and quantity applied were determined for each product.

As the dataset is under analysis, the results presented are based on 75 participants. Mean, standard deviation and 90th percentile of frequency of use and quantity used were calculated for the 5 investigated products. The frequency of use was 1.37±0.51;2.00 times/day for the cleansing oil, 1.79±0.58;2.69 times/day for the face cream and 1.36±0.58;2.00 times/day for the moisturizer balm. The quantity was 5.42±3.58;8.83 g/application for the cleansing oil,

0.42±0.20;0.66 g/application for the face cream and 4.81±2.42;8.42 g/application for the moisturizer balm.

This study provides information on cosmetic consumption habits and quantity data for patients undergoing cancer treatment. These results will be used to assess the exposure to cosmetics and conduct specific safety assessments of cosmetics for this population.

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Applying sensors for occupational exposure assessment in different industries: making sense of sensor data.

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TNO, Researcher

Abstract

Continuously collecting exposure data using low-cost sensors gives opportunities for active management and targeted prevention of occupational diseases, but the successful deployment of these new technologies is still in its infancy. Within the TNO, NIOSH and HSE collaboration, the width of use of low-cost PM sensors is investigated in laboratory and field studies.

The presentation shows the results from multiple measurement campaigns in the following three industries: bakery industry (11 workers), welding shops (14 workers) and wood handling industry (12 workers). Both personal and stationary measurements were conducted during several days, testing several low-cost sensors in parallel with more validated methods, such as inhalable/respirable gravimetric samples and the Aerodynamic Particle Sizer (APS, static only). In addition, contextual information was collected both real-time (e.g. indoor location tracking) and offline (observations).

Comparing the personally applied low-cost sensors with the gravimetrical results (on time-weighted average data) varied considerably between and within industries (R2 between 0.18 and 0.92). Similar variations were found with the comparison between the static low-cost sensors and APS (on high-resolution data). With the contextual information we were able to explain peaks in exposure both in time and place, with location and performed activities being important explanatory variables. A summary of the more in-depth analyses from the measurement results will be presented.

Although low-cost sensors still not perform as well as traditional methods in quantifying exposures, they can contribute in other ways, such as the early detection of peaks of exposure and help in the management of exposures.

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Population dietary exposure to acrylammide in Sardina, Italy: a market basket study

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Abstract

Acrylamide (AA) is a food contaminant that forms in vegetable products during cooking, including industrial processing, at >120°C and low moisture. AA also has many non-food industrial uses and is present in tobacco smoke. Experimental animal studies indicate that AA is a genotoxic carcinogen (classified by IARC in Group 2a) and identified several other adverse effects of chronic oral exposure (e.g. neurotoxicity). AA forms especially in foods containing free asparagine and reducing sugars. For processed products, manufacturers have devised strategies for reducing AA formation by modifying food processing. Further progress, also for home-cooked food, may be possible by variety selection and optimising crop management. However, efforts for decreasing the AA-forming potential of crops may be challenged by the concurrent need to cope with the adverse impact on agriculture of climate change, which is particularly severe in the Mediterranean.

Chronic dietary exposure to AA in Sardinia, an Italian insular region, has been assessed by (i) representative sampling of all known intake contributors, for a total of 493 individual food items, and (ii) characterisation of their AA concentration, which was (iii) combined with national individual food consumption data. Lower- and upper-bound estimates indicates a concern for non-neoplastic (neurotoxic) effects in youngsters with high level exposure. In addition, MOEs indicates a concern for neoplastic effects at mean level exposure for all age groups. Biscuits, coffee beverages, bread and crisp products were major contributors to exposure. A brand-loyal scenario for a local crisp brand led to 30% increase of the exposure in youngsters.

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Dietary exposure to migrants from new cellulose-based food contact materials

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Abstract

The concerns with excessive use of plastic packaging associated with poor end-of-life management and fossil-based resources depletion, have boost the application of paper-based packaging in food. Furthermore, recycling is promoted as it is recognised as one of the highest in the hierarchy of options to sustainable packaging.

Several substances are known to be potentially present in paper incorporated in the production process or during recycling, such as residues of printing inks, phthalates, surfactants, bleaching agents, hydrocarbons etc. These substances migrate into food at levels that depend on the food contact conditions. To improve the performance of cellulose-based materials and widening its applicability to more challenging applications, such as intermediate moisture and fatty food, new formulations, coatings, and processing methods are being researched and used to produce packages. In the phasing out of per- and polyfluoroalkyl substances (PFAS), other strategies are researched and used by industry. These new materials bring new health and environmental hazards that are reviewed in this work.

Under the scope of the European project Circul-a-bility CA19124 – Rethinking Packaging for Circular and Sustainable Food Supply Chains of the Future, a screening of the market was performed to characterise the solutions and applications, levels of migrants and contaminants and the exposure of consumer to these new migrants. The potential consumer exposure through diet is addressed combining experimental data from materials composition, mathematical models to derive migration and statistical data on food consumption available from European Food Safety Authority (EFSA).

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Evaluation of the RISKOFDERM model based on published (workplace) measurement data for dermal exposure

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Abstract

RISKOFDERM is an established model that is used for REACH and biocidal product assessments of workplaces. It estimates potential dermal exposure to chemicals that are handled at workplaces. RISKOFDERM is classified as a higher-tier tool by the ECHA Guidance, among others. As a higher-Tier tool, RISKOFDERM should estimate exposures realistically, but tending to conservative levels. However, to the best of the authors' knowledge there has been no comparison of the RISKOFDERM model estimates and measured dermal workplace exposures after the initial development of the model.

In addition to the symposium “Data as essential elements for developing, calibrating and evaluating dermal and oral occupational exposure models”, the aim of the presented evaluation presented here is to better understand the level of conservatism of the RISKOFDERM model. For this purpose, a systematic literature review was conducted and measurement data suitable for model comparison were extracted. This was then compared to the corresponding RISKOFDERM model outputs. The analysis will include a comparison of the 50th and 90th percentiles for different DEO units. Possible effects of the various dermal measurement methods will be discussed.

Initial comparison of the gathered data with the RISKOFDERM model output indicates that the RISKOFDERM model seems to estimate predominantly conservative.

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Development of three novel Stoffenmanager® algorithms for quantitative estimation of occupational exposure to respirable dust and quartz in the construction, formulating and metal manufacturing industry

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Abstract

Stoffenmanager® is a well-established and widely accepted tool that is applied for regulatory risk assessments (e.g. REACH). This online-tool enables companies to identify hazardous chemicals, chemical risks and to control exposure to hazardous substances at the workplace. In the current version, however, Stoffenmanager® is not applicable to all areas of activity with solids in which dusty hazardous substances are used or may arise. Therefore, the aim of this project is to expand the applicability domain of Stoffenmanager® by developing three innovative algorithms: 1) respirable dust and quartz for tasks with dusty products, 2) respirable dust for metal-cutting manufacturing and 3) respirable dust and quartz for the mechanical processing of stone.

To derive new quantitative regression models calibration and validation measurement datasets on hazardous substances are required. In this project, comprehensive contextual information were selected and extracted from the IFA Exposure database MEGA and converted into Stoffenmanager® variables. Subsequently, the variables were divided into classes with scores on a logarithmic scale. Spearman correlation coefficients were calculated to study the relation between the calculated Stoffenmanager® scores and measured exposure concentrations. Statistical regression analysis between the Stoffenmanager® scores

and the exposure data were performed to further explore the relation between scores and exposure measurements. After the development of the new algorithms, exposure models will be validated against exposure data from the MEGA database. Our preliminary findings will be presented.

The new algorithms serve to improve workers' health by reducing occupational exposure to respirable dust and quartz which are known to be human carcinogens.

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Overview of current assessment approaches and tools for aggregated exposure assessments at workplaces

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Abstract

Workers may come into contact with a specific chemical substance via different pathways (inhalation, dermal contact) and / or through multiple workplace activities. Additionally, they may be exposed to the substance through consumer activities, food ingestion, or via the environment. There is currently no good overview of how aggregated worker exposure assessments are conducted in practice, how realistic they are, and what tools are available and/or useful for workplace aggregated exposure assessment.

The purpose of this presentation is to identify terminologies and requirements that are imposed on aggregate workplace exposure assessments by various stakeholders and regulatory frameworks as well as to identify tools and methods used in practise. The study was designed to include a literature review and interviews with various stakeholders. In addition, a small selection of dossiers from different European regulatory areas as well as from the US Toxic Substances Control Act were examined regarding aggregate exposure assessments.

It became apparent that the concept of aggregate exposure is interpreted quite diverse by different stakeholders und under different requlatory frameworks. We will elaborate on how different aspects of aggregate exposure are targeted in practice, on reasons why aggregate exposure assessments are not performed and on expressed limitations / uncertainties in current assessments. We will further outline what models and tools have been applied in practice or described in literature for workplace aggregate exposure assessments.
Our study is intended to support the development of guidance documents and to help researchers develop methods for specifically estimating aggregate exposures for workers.

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Hourly LUR modelling of hyperlocal NO_2 using mobile monitoring data

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Abstract

BACKGROUND:
Long-term average hourly air pollution concentration maps in fine spatial resolutions facilitate the estimation of dynamic exposures based on human activities. Mobile measurements may be useful to capture fine spatiotemporal variations of air pollution. As not all locations can be measured repeatedly for every hour, we evaluated the merit of hourly land-use regression (LUR) models that use mobile monitoring data to map hourly hyperlocal air pollution concentrations in a city.

METHOD:
We monitored 1-second NO_2 concentrations in Amsterdam by two Google StreetView cars, from 8:00 to 20:00 on weekdays for 10 months (5.7 Million measurements). These mobile measurements points were aggregated into 50m road segments and divided into one-hour intervals. Trained with this hourly mobile data, we developed twelve hourly LUR models based on random forest (RF_LUR).

RESULT:
The hourly averaged mobile measurements of NO_2 across the city varied from 40 (rush hours) to 28 ug/m^3 (non-rush hours). The RF_LUR model explained the variations of the mobile measurements well (cross-validation R^2 from 0.62 to 0.69 for the different hours). The Pearson correlations between RF_LUR predictions and RIVM stational measurements (n=9) fluctuated from 0.32 to 0.80 in different hours. Regarding individual road segments, the hourly max-min variations of RF_LUR predictions on major roads (mean 43.2 ug/m^3) were larger than those on residential roads (31.7 ug/m^3). The spatiotemporal distribution of NO_2 strongly follows intra-urban commuting patterns.

CONCLUSION:
Hourly LUR models based on mobile measurements can capture the fine spatiotemporal patterns of NO_2. These models can be used for dynamic exposure estimation.

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Exposure assessment following dioxins/furans soil contamination from a former waste incineration plant in the region of Lausanne (Switzerland).

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Abstract

In December 2020, soil surveys were performed during the redevelopment of a parcel in the city of Lausanne (Switzerland). High dioxins/furans (PCDDs/Fs) concentrations, of 96 and 107 ngTEQ/kg were measured in two composite samples. Successive measurements conducted in 2021 showed a contamination throughout a large part of this town of 140'000 inhabitants, with concentrations that reached several hundred ngTEQ/kg. The contamination distribution suggested that the most likely source was a former waste incineration plant.
A health risk assessment was conducted to evaluate the potential inhabitant exposure to PCDD/Fs and to define appropriate preventive measures. A detailed mapping of the PCDD/Fs contamination was performed and used to build up exposure scenarios. We considered three main scenarios: consumption of products from food-producing animals raised on contaminated soil, consumption of vegetables from private gardens, and direct (involuntary) ingestion of soil by children. A simple toxicokinetic model was used to evaluate the different scenarios and to estimate the expected increase of PCDD/Fs concentrations in the serum of persons consuming the contaminated food with respect to "regular" food consumption. The most exposing scenario was the consumption of eggs from private poultry houses, with increases in serum of an order of magnitude higher than those normally expected. Direct soil ingestion by children and vegetable consumption did not result in an increase in serum concentrations, with the notable exception of cucurbits. These results made possible to propose targeted preventive measures and emphasized imbalances in the regulation of these environmental contaminations.

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Time-trends in human urinary concentrations of phthalates and substitutes DEHT and DINCH in Asian and North American countries (2009–2019)

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Abstract

Background: Many phthalates are polluting and harmful for man and the environment. Following phthalate regulations, human exposure to several phthalates has decreased with time in European countries, the US and Korea. Conversely, exposure to their substitutes DEHT and/or DINCH has increased. In other countries, including China, little is known on the time-trends.

Objective: We aimed to estimate time-trends in the urinary concentrations of phthalates, DEHT, and DINCH metabolites, in general population from non-European countries, in the last decade.

Methods: We compiled HBM data from 123 studies worldwide in a database termed "PhthaLit". We analyzed time-trends in the urinary concentrations of the excreted metabolites of various phthalates as well as DEHT and DINCH per metabolite, age group, and country/region, in 2009–2019. Additionally, we compared urinary metabolites levels between continents.

Results: We found solid time-trends in adults and/or children in the US, Canada, China and Taiwan. DEHP metabolites decreased in the US and Canada. Conversely, 5oxo- and 5OH-MEHP (DEHP metabolites) increased in Chinese children. For low-weight phthalates, the trends showed a mixed picture between metabolites and countries. Notably, MnBP (a DnBP metabolite) increased in China. The phthalate substitutes DEHT and DINCH markedly increased in the US.

Significance: We addressed the major question of time-trends in human exposure to phthalates and their substitutes and compared the results in different countries worldwide.

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Elevated Levels of Short-Chain PFAS in US Homes and People

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are a group of organic fluorinated compounds used in consumer products and for industrial applications. The two most widely used PFAS, perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), have been phased out on a global scale because of their high persistence and toxicity. As a result, shorter-chain PFAS (with <8 carbons in their structure) are being used as their replacements, raising environmental and health concerns. In this study, we measured the concentrations of 47 PFAS in paired samples of residential dust and drinking water from 81 households in Indiana, United States, and in blood serum and urine samples collected from the residents of these homes. Our results show that short-chain PFAS were the most abundant PFAS in all four matrices with average contributions of 50-100% to the total PFAS concentrations. Trifluoroacetic acid (TFA, C2) and perfluoropropanoic acid (PFPrA, C3), the two shortest PFAS, were generally the most abundant PFAS found in these samples. Significant positive correlations were found between the TFA concentrations in dust and those in serum ($p < 0.001$). In addition, the levels of TFA, perfluorobutanoic acid [PFBA, C4], perfluoro-n-hexanoic acid [PFHxA, C6], and perfluoro-n- heptanoic acid [PFHpA, C7]) in drinking water were significantly correlated with those in serum ($p < 0.05$). These findings suggest that accidental dust ingestion and drinking water consumption can be significant exposure pathways for these PFAS. These results demonstrate that short-chain PFAS are now abundant in the environment and people.

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Inter-Comparison of Low-cost Optical Counters across a wide range of PM2.5 concentrations with focus on Indoor Home Applications

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Abstract

Low-cost optical counters for measurement of fine particulate matter (PM2.5) have become popular worldwide in the last decade. Most previous studies on the performance of these sensors have focussed on concentrations found in ambient air (≤ 250 µg/m3). There is limited

literature on the efficiency of these low-cost air quality sensors to quantify PM2.5 concentrations that are found indoors in many homes where solid fuels are used for cooking (≥250 μg/m3). In the present study, we evaluated three groups of sensors: (1) Purple-PA-II-SD PurpleAir; (2) sensors from the EPHOR project (developed by VTEC); and (3) BlueSky Air Monitor Model 8143 TSI Inc. We compared two of each sensor type in (a) low concentration environment (LCE) and; (b) an indoor setting where cookstove and solid fuel combination generate high concentration environment (HCE). The concentrations predicted by the different sensors for the LCE ranged from 0-169 μg/m3. Preliminary evaluation of results indicate that the correlation between sensors of the same brand varies (R2 between 0.84-0.96). Oneway ANOVA measurements indicate statistically significant differences ($p<0.05$) between and within sensor types. BlueSky data were consistently 3-4 times lower than those of the other two sensors. In the second part of the study, we will compare these sensors against a reference mass-based measurement in both LCE and HCE. Findings of the study will lead to democratizing air quality data in low- and middle-income countries where such high concentration environments are common, leading to increased resident awareness and facilitating policy change driven by residents with local governments.

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HHEAR Data Repository: A Resource for Environmental Health Research

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Abstract

The U.S.-based, NIH/NIEHS funded, Human Health Exposure Analysis Resource (HHEAR) provides scientific investigators access to both laboratory and statistical analyses aimed at incorporating and expanding environmental exposures within their research. To benefit the broader research community, the HHEAR Data Center has created a public data repository that houses deidentified epidemiologic and biomarker data from all studies accepted into the HHEAR program. The goal of this repository is to promote the secondary analysis of pooled environmental health data by providing data in a manner that is findable, accessible, interoperable and reusable. The public repository has been constructed by coupling the open-source Human-aware Data Acquisition Framework with precisely-developed semantic annotation templates for epidemiologic metadata. Users of the public repository have the ability to simultaneously view, search and download data from multiple epidemiologic studies that have been harmonized to a common vocabulary (the HHEAR ontology). This facilitates data pooling across studies to conduct novel epidemiologic investigations of environmental contributors to human health. To illustrate the value of this repository, we demonstrate the application of common data standards to harmonize epidemiologic variables across multiple

studies. We then provide examples of pooled analyses conducted with these harmonized data. This increased availability of data will encourage secondary data analysis of pooled epidemiologic studies, allowing for investigations that can leverage larger sample sizes and greater exposure variability.

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Community exposure assessment of heavy metals in ultrafine particulate matter near an industrial complex

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Abstract

Ultrafine particles (UFPs; < 100 nm) in urban ambient air are emitted from various combustion sources (i.e., tailpipe or industrial emissions). Although the characterization of UFP number near roadways and stationary sources has been widely examined previously, residential exposure to UFP mass and its chemical constituents is less explored in urban communities adjacent to an industrial complex. The purpose of this study was to compare UFP mass and metal compounds at two residential locations: one near an industrial complex (IND) and the other surrounded by a commercial area (COM). Size fractionated particulate matter (PM), including UFP, was collected using a cascade impactor in IND and COM in Houston, Texas, USA, in 2021. Preliminary results showed that UFP mass concentrations were higher (0.44 μg/m^3) in IND than in COM (0.30 μg/m^3), constituting about 4.8 and 4.3 percent of PM_1 in IND and COM, respectively. Although most metal-specific mass mean diameters (MMDs) were of coarse sizes, the MMDs of vanadium (V), nickel (Ni), and arsenic (As) were less than 1 um (0.30-0.82 μm) at both sites. The concentrations of V (7.40 pg/m^3), Ni (147 pg/m^3), and As (21.5 pg/m^3) in UFP were higher in IND than the concentrations of V (1.08 pg/m^3), Ni (61.5 pg/m^3), and As (6.03 pg/m^3) in UFP in COM. The results suggest that people in a neighborhood near an industrial area are exposed to elevated levels of V, Ni, and As in UFP, potentially associated with fossil fuel combustion from industrial emissions.

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Metal fume fever (MFF), a Fenton-like reaction triggered by ZnO photocatalysis?

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Abstract

The role of metal fumes in triggering an inflammatory response, known as metal fume fever (MFF), is not fully elucidated. During welding the concomitance of high energy radiation (UV-C) and nanoparticles of metal oxides generated via heat/condensation process could promote a series of redox reactions leading to highly harmful byproducts.
In this experimental study, two redox phenomena are investigated : (1) the photocatalytic reactivity of ZnO, through the production of hydrogen peroxide (H_2O_2) of ZnO nanoparticles irradiated with UV-C, and (2) the Fenton-like reactions occurring with magnetite (Fe_3O_4) nanoparticles and H_2O_2 at physiological pH via the interaction of biological chelators (citrate, oxalate or mucus) promoting the production of hydroxyl radicals ($HO^{\cdot}$). Quantitative measurements of reaction products are performed using a multiscattering-enhanced absorbance device adapted to FOX-II assay and assessing the degradation of bromophenol blue with microplate photometry for H_2O_2 and hydroxyl radicals ($HO^{\cdot}$), respectively.

The photocatalytic behavior of ZnO is observed in the presence of UV-C radiation, resulting in the generation of airborne H_2O_2. The presence of biologically-relevant ligands, enabled the Fenton reaction to happen at physiological pH with either Fe(II), Fe(III) or Fe_3O_4 nanoparticles. Interestingly. For the latter nanoparticles the heterogeneous Fenton-like reaction was already efficient in the absence of ligands. These results support the hypothesis of a two-step mechanism scenario of MFF onset leading to hydroxyl radical generation: the prior presence of iron in the lungs (chronic exposure) exacerbates the oxidative stress via in-situ Fenton-like reactions triggered by the H_2O_2 originating from ZnO photocatalysis (acute exposure).

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Identifying chemical exposures that may lead to varied health outcomes in a population

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Abstract

Interactions between environmental exposures and genetics underlie the majority of chronic human diseases. However, connecting chemical exposures and genetic variability in disease progression to assess how chemicals exert variable effects in a population is a challenge that often depends on epidemiological data for highly-exposed populations. Therefore, new approach methodologies (NAMs) are necessary to incorporate genetic variability into chemical risk and impact assessment to protect vulnerable populations. We integrated diverse datasets, including chemical activity data from ToxCast high-throughput screening and human disease data from DisGeNET, to form new chemical-pathway-disease associations and identified genetic variants that chemicals may act on in these pathways. We use this

dataset to characterize how insecticide groups with different modes of action (78 acetylcholinesterase (ACHE) inhibitors and 18 GABA-gated chloride channel blockers) may differentially affect vulnerable populations in nervous system disease progression. For example, GABA blockers implicated more genetic variants than ACHE inhibitors, suggesting that a population exposed to GABA blockers may have more variable responses as compared to ACHE inhibitors exposure. To distinguish adverse effects from potential therapeutic associations, the insecticide pathway-variant-disease associations were compared to those for 42 nervous system drugs. We found that many genetic variants were implicated by both insecticides and pharmaceuticals (e.g., ACHE inhibitor chlorpyrifos and pharmaceutical acetaminophen implicated many variants in Alzheimer's disease), but the pathway activity differed. This approach can serve as a starting point to characterize how chemical exposures lead to varied health outcomes in a population to incorporate inter-individual variability into chemical risk and impact assessment.

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What is the best low-technology method the public can use to remove *Bacillus* spores from indoor surfaces?

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Abstract

An outdoor, wide area release of a biological agent will significantly disrupt society. An unexplored aspect of consequence management and public health guidance is the need to minimize the risk from immediate and delayed exposure to Ba spores within the indoor environment. The possibility that "low technology" or "self-help" surface cleaning methods for the disinfection, removal, and resuspension of Ba spores with materials and chemicals readily available to the public could minimize risk requires research. We tested different combinations of cleaning materials, cleaning solutions, application methods, and cleaning force to cover a broad range of exposure and hazard risks. Experiments were conducted on laminate flooring loaded with dry *Bacillus* thuringiensis kurstaki (Btk) spores inside a sealed glove box. Spores resuspended, removed by the cleaning material, and remaining on the surface were extracted from the sample, plated, and incubated and counted. Comparison of spore resuspension, collection, and residuals within and between experimental conditions were inconclusive. We noted, however, that the spore counts on the cleaning material were 10 to 100 times higher than the number of spores resuspended or remaining on the surface. This observation led us to develop a risk minimization ratio, defined as the sum of the spores resuspended and remaining on the surface divided by the number collected by the cleaning material. This analysis determined a wet wipe with any type of cleaning liquid performed best, a paper towel with bleach or dry was in the middle, and a sponge dipped in bleach solution or dry was worst.

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Association between mercury exposure and type 2 diabetes among First Nations in Canada

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Abstract

First Nations (FNs) in Canada are disproportionally affected by type 2 diabetes (T2D). Recent studies suggest that mercury exposure may contribute to the development of T2D. Some FNs are potentially more vulnerable to higher mercury exposure due to their reliance on locally harvested fish.

This study examines the associations between total hair mercury concentrations and self-reported prevalence of T2D among Canadian FNs.

Data from the cross-sectional First Nations Food, Nutrition and Environment Study (2008-2018) were analyzed. Dietary, health and lifestyle information was collected using household interviews. Mercury concentrations were measured in hair samples. This study included 3,260 FNs adults (≥19y) who participated in hair sampling and answered questions on T2D. The associations between hair mercury concentrations and T2D were assessed with logistic regression models adjusted for confounders.

A positive trend in the associations between hair mercury concentration groups and T2D was observed in the total FNs population and among men while a negative trend was found in women; however, the associations were not statistically significant. In Quebec (n=381), the average hair mercury concentration was significantly higher (1.39µg/g) than in other regions (0.18-0.45µg/g)(p value=0.001). In participants in Quebec, mercury exposure was positively associated with T2D (OR=4.31 (95%CI:1.07-17.21)(p value=0.038) when comparing the highest exposure group to no exposure group, and after adjusting for known risk factors, fish consumption and dietary DDE/PCBs exposure.

Our results showed that elevated mercury exposure was associated with an increased risk of T2D. These findings should be further examined in longitudinal studies.

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Particulate Air Pollution in the Copenhagen Metro: Low-Cost Sensors and Micro-Environment Classification

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Abstract

In this study, fine particulate matter (PM2.5) levels throughout the Copenhagen metro system are measured and characterised for the first time. They are found to be ~10 times the roadside levels and produced predominantly by the metro system itself. Low-cost sensor (LCS) nodes designed for personal-exposure monitoring are tested against a conventional mid-range device (TSI DustTrak), and gravimetric methods. The nodes were found to be effective for personal exposure measurements inside the metro system. Micro-environment (ME) classification techniques are also developed and tested, involving the use of auxiliary sensors, measuring light, carbon dioxide, humidity, temperature and motion. The output from these sensors is used to distinguish between specific MEs, namely, being aboard trains travelling above- or under- ground, and determining whether sensors were aboard a train or stationary at a platform.

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Prenatal Screening and Interventions for Lead and Mercury

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Abstract

Lead and mercury readily cross placental barriers and harm developing babies' brains and bodies, change behavior, and cause other diseases. NJ Department of Health (NJDOH) and University Hospital in Newark, NJ translate this science into improving human health by conducting standard-of-care prenatal toxic metals screening. Education and micronutrients are given at the first prenatal visit. Blood is collected at first visit and delivery, is analyzed by NJDOH, and results are returned to help guide medical decisions. Elevated patients receive medical care and resources through Program partners and elevated mercury samples are speciated. Follow up testing confirms interventions are successful in reducing mothers' and in utero exposure.

Data from 10,000 individuals (2019-2022) provide insight into risks and show significant improvement in population and individual (e.g., 44.7 mg/L Hg to 3.4) outcomes over time. This population is heavily minority, urban, and immigrant (high-risk groups). 20% of patients have lead levels at which health effects can be expected in babies, and 50% do so for mercury. Exposed babies have higher likelihood of immigrant mothers (74.7% vs. 20.2% control [$p=<0.0001$]), abnormal newborn screening hits (30.8% vs. 5.06% [$p=<0.0001$], and ICU admission (35.4% vs. 20.5% [$p=0.037$]). Data on the effect of early interventions on birth outcomes are currently being analyzed and will be presented, if available.

Presentation will cover challenges overcome in establishing the program, expanding to other hospitals, and generating statewide data. Educating communities and doulas turns exposure data into improved health outcomes. Implications are global as immigrant patients are at highest risk.

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The Superfund Research Program: Tailoring Risk Communication Strategies to Mitigate Exposures to Hazardous Substances

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Abstract

The National Institute of Environmental Health Sciences (NIEHS) Superfund Research Program (SRP) is a network of multi-disciplinary scientists that provide practical, scientific solutions for pressing public health issues. SRP researchers study health effects of exposure to hazardous substances and investigate effective, sustainable ways to mitigate or prevent exposures through a nationwide grantee network. SRP grantees also develop innovative strategies to communicate risk about environmental exposures and reduce those risks in communities impacted by hazardous waste sites.

A unique aspect of the SRP is the University-based multi-project center concept, where scientists and engineers working in transdisciplinary teams contribute their diverse expertise to address the center's research focus. SRP centers tailor strategies to communicate risk from hazardous exposures and facilitate knowledge exchange between scientists and local communities to improve health and lower health disparities. SRP grantees engage with various stakeholders to share research results and develop educational resources that can be used to inform ways to reduce exposures. SRP grantees also create interactive maps to

communicate exposures and health risk to communities and identify and prioritize regions of heightened vulnerability.

The multidisciplinary SRP Center concept provides a framework for research teams to rapidly respond and apply knowledge and expertise to understand and reduce environmental threats. This poster will provide examples of successful communication strategies by SRP grantees to mitigate environmental exposures or reduce the toxicity of environmental contaminants. It will also describe how SRP grantees have tailored strategies to communicate exposures based on the needs of diverse communities.

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A review of face touch studies for modeling fomite transmission of SARS –CoV – 2

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Abstract

The magnitude of the contribution of Covid – 19 infection from touching fomites is it still uncertain, partially due to relatively sparse data on touching behaviors and surface loadings. We conducted a rapid review to evaluate available data on face touches, particularly to mucous membranes. In general, face contact was much less frequent in manufacturing and engineering settings and laboratories (mean values less than 10 contacts per hour) than in office settings or listening to lectures (mean values 20 or more contacts per hour). The number of face touches varies greatly from study to study. Mean mucous membrane contacts/hour ranged from 1.9 for observations of the general public to 61 in a graduate student office. No discernible differences were found between sex or for people wearing/not wearing glasses. There was an indication of a higher number of face touches for people with facial hair, showing that there may some gender differences. This data was used to the relative role of fomite transmission versus near and far field inhalation and direct contact with virus particles using the Covid Exposure Model for Risk Assessment (CEMRA) developed to examine infection risk from environmental transmission of SARS-CoV-2 in a hospital and office setting. Fomite transmission remained a relatively small contributor to infection risk, however presence of a highly infectious person increases the contribution of this route. A more consistent approach that can be scaled to larger numbers is needed for collecting data on touching behaviors to improve models of infection risk from fomite.

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Application of Ground-Based Measurements and Air Quality Model To Improve the Estimations of Air Quality in Nairobi, Kenya

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Abstract

The state of air quality in Nairobi has gained scientific and public attention owing to rapid growth in population, motorization and urbanization, factors that significantly affect air pollution, yet no deliberate effort has been put into monitoring and assessment of air pollution exposure. An air monitoring campaign was conducted over two years (2020-2021) to measure fine particulate matter mass ($PM_{2.5}$) and nitrogen dioxide (NO2) mixing ratio across multiple sites within Nairobi using low-cost sensors (Clarity Node-S). The sensors were first collocated at urban background site (IPA office) for the whole year of 2020. A second collocation happened in 2021 (January-April) and involved side-by-side deployment of six Clarity Node-S devices with reference-grade $PM_{2.5}$ monitor (BAM-1020) at University of Nairobi (UoN) urban site, which was used to derive correction factors for these readings. The sensors were redeployed in April to an urban site at Kenyatta University (KU), an urban background site (Buruburu), and sub-urban sites (Marurui and Ngong). The corrected measurement of PM2.5 at the IPA, UoN, KU, Buruburu, Marurui and Ngong sites (April-December) 2021 were17.1 µg/m3, 17.5 µg/m3, 24.6 µg/m3, 21.9 µg/m3, 22.0 µg/m3, and 18.8 µg/m3 respectively. The uncorrected NO_2 measurements at the IPA site (January-December) in 2020 suggested annual mean concentration of 30.1 µg/m3. However, some sensors showed inconsistencies in NO_2 diurnal patterns during the third quarter of 2020, in the fourth quarter, the drift was more significant, suggesting a strong influence of sensor-aging. The ground-based measurements and the modeled results of Chemistry-Transport model (CHIMERE) are expected to provide further insights into source-contribution to air pollution.

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The Adverse Health Effects of Exposure to PM2.5 on the London Underground – a retrospective occupational cohort study

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Abstract

The London Underground (LU) employs 19,000 staff who are regularly exposed to PM2.5 concentrations 15-fold higher than those found at outdoor sites in London. However, PM2.5 in these environments differs in physical and chemical characteristics relative to outdoor air, and the health impacts are largely unquantified.

Working in the LU contributes significantly to the daily exposure of LU employees; however, staff personal exposure has not been studied extensively. We have assessed the daily exposure of LU staff to PM2.5 and linked to adverse cardiorespiratory health effects through sickness absence records. Through a deeper understanding of the variety of jobs in the LU, we have developed a job exposure matrix that categorises staff by their exposure. Targeted measurement campaigns that used short- and long-term, static- and personal measurements better quantified staff exposure. Comparisons of the physical and chemical characteristics of PM have been established between the exposure categories within our job exposure matrix. We have used the sickness absence records to model cardiorespiratory sickness absence through Poisson models, and the relationship between exposure and sickness absence episodes have been investigated using multiple linear regression.

This study is the first to use subway worker sickness absence records to assess the health impacts of subway PM2.5 on an occupational cohort and has increased our understanding of causative relationships between exposure and sickness absence and will contribute to a safer working environment for staff and has the potential to understand the potential health impact on the commuting population.

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Glutathione, suitable effect biomarker for real-life mixture risk assessment

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Abstract

The necessity of using effect biomarkers for mixture risk assessment has recently been brought to the fore. Previous studies highlighted that the increasing oxidative stress, or the detoxification metabolism, could determine a reduction of the GSH/GSSG ratio, in relation to exposure to metals as well as to aromatic organic compounds (AOC).
In this study, we evaluated the potential of GSH/GSSG ratio to detect relevant adverse effects in workers exposed to complex mixtures and compared with a non-exposed population. Exposed workers were recruited from a copper refinery (n=50) and a furniture factory (n=30); 40 non-occupationally exposed people were recruited as control. Air exposure was measured for metals and for AOC using active air monitors. Biomonitoring of specific biomarkers in urine and analysis of GSH/GSSG in blood samples were performed.
The analysis of air samples have shown higher exposure to metals dust in the copper refinery, while exposure to AOC was higher in the furniture factory, compared with the general population. These finding were also confirmed by the analysis of exposure biomarkers in urine. When the blood levels of GSH/GSSG were measured, a higher ratio was found in the control population compared with metals and AOC exposed workers. This GSH depletion found in the exposed workers, was correlated with the intensity of the exposure, be it metals and/or AOC.

This finding are confirming that effect-biomarkers, like glutathione, are suitable tools for addressing the effects of the known and even unknown components of a mixture.

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Effect of Atomization Power and Flavors on Size-resolved E-cigarette Aerosol Mass, and Respiratory Deposition

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Abstract

Inhalation exposure to e-cigarette aerosol has been an essential environmental health issue. The inhaled aerosols, especially sub-micrometer, are further deposited in the human lower

airways, causing potential adverse health effects such as pulmonary impairment. However, the understanding of e-cigarette aerosols topography (physical characteristics in the air and behavioral characteristics in respiratory airways) is largely lacking. This prevents the accurate estimate of inhalation exposure and dose in the human airway. The objective of this study was to improve the inhalation exposure estimate and lung deposition rate by examining the physical and behavioral characteristics of e-cigarette aerosols.

The experiment was carried out by injecting e-cigarette vapor by different atomization power (device wattage) into an exposure chamber. A total of six e-cigarette flavors were used. Using a multi-stage cascade impactor, mass concentrations of aerosols by 11 size bins (0.056 to 18 μm) were determined. The aerosol depositions on different airways were estimated by applying the lung deposition model of the International Commission on Radiological Protection.

The mass of aerosol was mainly attributed to sizes ranging from 0.56 to 1.0 μm. The mass per puff was significantly increased with the increase of atomization power. There was no significant difference in mass per puff among the six flavors. The sub-micrometer size e-cigarette aerosol was highest in the head airway followed by the alveolar region. These results suggest that most of the e-cigarette generated aerosol is respirable size (< 4.0 μm), and the passive vapers are at risk of e-cigarette aerosol exposure in their lower respiratory tract.

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Evidence For Health Effects in The Travelling Public Associated with Exposure To Particulate Matter In The London Underground

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Abstract

Exposure to ambient air pollution – notably PM – increases mortality and morbidity risk. Subway transport systems have elevated airborne PM mass concentrations compared with ambient air, raising concerns about the potential health impact of such particles. However, PM emission sources in these environments are different from those in ambient air, such that the physical and chemical properties of PM differ from those found in ambient air. Consequently, it may not be valid to extrapolate the health impacts recognised for ambient air pollution to subway environments.

A review of evidence for health effects in the travelling public associated with exposure to particulate matter in the London Underground was undertaken by the UK's Committee on the Medical Effects of Air Pollution (COMEAP). To establish the most up-to-date assessment, experimental studies conducted to assess the effects of in subway systems and its adverse effects, were reviewed. The importance of the data from human and animal exposure responses is considered alongside occupational and in vitro studies. The relative strength of evidence from these different approaches and what is known about the chemical and physical composition of subway PM is used to infer potential toxicological mechanisms. Finally, several research approaches deemed most suitable to generate the further required evidence are recommended.

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Ambient Air Pollution, PurpleAir-II-SD low-cost sensors & sub-Saharan African countries: Gains and Challenges

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Abstract

Introduction: Ambient air pollution is a significant public health challenge especially in urban centres in sub-Saharan Africa (SSA). In a sequence of events culminating in clean air policies, air quality monitoring using low-cost sensors is a vital step to achieve the latter. Our network aimed to utilize PurpleAir-II-SD sensor to measure longitudinal $PM_{2.5}$ in seven SSA countries to document the gains and the challenges of using these sensors.

Methodology: Thirteen exposure scientists from seven countries (Gambia, Kenya, Uganda, Benin Republic, Burkina Faso, Cameroon and Nigeria) were given PurpleAir-II-SD sensors which were installed and used for data collection throughout July 2019. The data was downloaded from the SD memory cards and sent to the Principal investigators weekly for analysis. A log of all challenges encountered was kept by all scientists and sent alongside.

Results: Data recovery achieved ranged between 72.1 % and 100%, with 92% of sites achieving at least a 92% data recovery rate. All sites sampled had daily $PM_{2.5}$ readings above the WHO recommended threshold of 15μg/m3. Challenges experienced in the process of use of the Purple Air-II-SD sensors were power and power pack outages, SD memory card issues, internet connectivity problems and sensor hardware maintenance concerns. The details of these were found in table 2.

Conclusion: Longitudinal ambient $PM_{2.5}$ measurement is achievable in SSA using low-cost sensors. There are challenges in the process of doing this, but these are surmountable and should not be an impediment to air quality monitoring by all interested stakeholders in SSA.

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Modeling future weather impacts on indoor temperature and utility costs in multi-family housing in Boston, MA

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Abstract

Increasing ambient temperatures due to warming climate will affect home thermal comfort and associated utility costs. However, little is known about the cost versus comfort tradeoffs for residents living in colder climates. We modeled a multi-family home using the building simulation tool EnergyPlus with current (2020) and projected future (2050) temperature, for households that ran AC always (full AC), those without AC (no AC), and those using AC sometimes (some AC). We simulated the impact of stylized cooling subsidy policies that allowed for AC group transition, both independently and in conjunction with energy efficiency building retrofits. Outputs included hourly indoor temperatures and building cooling/heating energy use and utility cost, which were compared across weather, AC, and retrofit groups. Future weather resulted in higher indoor temperatures for the no AC households (+2.1°C), increased cooling demand (+33%) for the some and full AC households, but net utility cost decreases given reduced heating demand (range for all: -$107 to -$1421). Subsidies that enabled greater AC utilization resulted in summer indoor temperature decreases (range for all: -2.6°C to -6.5°C) and net increases in utility cost (+$1456-$5126) since increased cooling costs outweighed reduced heating costs. Retrofitted homes in future weather had decreased heating use for all groups compared to non-retrofitted homes, but yearly net utility costs increased due to higher AC utilization. Coordinated public policies that combine residential cooling subsidies and energy efficiency retrofits will be critical to maintain comfortable indoor temperatures and utility affordability in future climates for residents of

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Occupational exposure to emerging cellulose nanomaterials and potential respiratory effects: uncovering exposure-effect relationships using *in vitro* systems

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Abstract

The application of innovative cellulose nanomaterials (CNMs), particularly, cellulose micro- and nanofibrils (CMF, CNF) and nanocrystals (CNC), in technology and biomedicine has expanded in recent years. However, there is still a lack of reliable indicators to assess workers' exposure, mainly by inhalation, and the associated health outcomes.

This study aimed at identifying genotoxic, oxidative stress, or epigenetic endpoints that could be used as promising effect biomarkers to predict health outcomes from CNMs exposure, exploitable for human biomonitoring.

Three well-characterized CNMs were used, at a low concentration range, to expose cell systems representative of the respiratory tract, namely, bronchial epithelial (BEAS-2B) cells or co-cultures of lung (A549) and macrophage-like (THP-1) cells. No induction of chromosomal instability was detected in co-cultures for all types of CNMs analysed through the cytokinesis-block micronucleus assay. Likewise, neither significant toxic effects nor oxidative stress was found. Interestingly, preliminary data showed differentially expressed microRNAs in BEAS-2B cells after exposure to CNC, but not to CMF or CNF, compared to untreated cells. Moreover, a profile of microRNAs associated with CNC exposure was identified.

Overall, no major concern regarding CNMs genotoxicity and oxidative stress was raised. Epigenetic effects were uncovered for CNC and the identified miRNA profile has potential to be used as an effect biomarker for occupational biomonitoring. However, further investigation with longer exposures and validation of that profile using in vivo models must be conducted, to prove its value to assess early effects from CNMs exposure.

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Spatiotemporal assessment of environmental exposure to radiofrequency electromagnetic fields using distributed sensor networks

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Abstract

As wireless communications infrastructures evolve and densify (e.g. the worldwide rollout of the fifth generation of telecommunications networks (5G) and smart-city networks), our daily exposure to environmental radiofrequency (RF) electromagnetic fields (EMF) is constantly changing. In order to overcome public uncertainty and anxiety about RF-EMF and the associated delays in the rollout of these infrastructures, it is key to continuously monitor the RF exposure levels in our environment, both in space and time. However, dedicated RF-EMF monitoring networks are rare as the cost of the sensors remain high. Here, we present a low-cost modular RF-EMF exposure sensor designed to measure at a rate of one sample per second up to four frequency bands in 2G–5G telecommunications networks. Furthermore, the results of a pilot study featuring a small-scale fixed sensor network and a mobile network covering a wide geographical area with over a year of data between January 2019 and May 2020 (about 10 million samples) are presented and their implications are discussed for future RF-EMF sensor networks, such an adequate sensor density (100 sensor nodes per km^2) and the errors induced when sampling at slower speeds (up to one sample every 4 h). In summary, the presented study offers valuable insights applicable to future RF-EMF sensor design and the deployments of distributed RF-EMF sensor networks.

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Air Quality Data Awareness and Health Implications: A Scoping Review Protocol

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Abstract

Exposure to air pollution is known to negatively affect health outcomes. Air quality data are broadcast via smartphone applications, websites, television, and radio. There have been studies that describe different components of air quality awareness, e.g. preferred source of information or effects on behaviors. The goal of our scoping review is to better understand what has been reported in the literature regarding air quality data awareness.

We will conduct our scoping review with guidance from the latest version of the JBI Manual for Evidence Synthesis utilizing the 5 stages from the Arkshey and O'Malley framework, and will adhere to the PRISMA-ScR reporting guidelines. Citation management and duplicate detection and removal will be accomplished with EndNote (Clarivate Analytics). We will use Covidence (Veritas Health Innovation) to screen and select studies and Excel (Microsoft) to extract and chart our data.

We will include original articles, conference proceedings and grey literature that report healthcare consumer awareness of air quality data, with the goal to rapidly map the literature regardless of quality. Two reviewers will independently screen titles and abstracts, review full text for inclusion, and extract and chart the data from included studies. When no consensus can be reached between the two reviewers, a third reviewer will be the deciding vote. Inter-rater reliability will be measured. Data concepts that will be extracted include sample size, methods, study design, data mindset categories, and

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Wildfire Variable Health Risks: Identifying Biomass Burn Exposure Groupings through Transcriptomic Similarity Scoring

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Abstract

The prevalence and intensities of wildfires continue to grow world-wide, with exposures resulting in increased risk of pulmonary disease and other health outcomes. Characterizing these health risks remains difficult due to the wide landscape of exposures that can result from variable burn conditions. This study tested the hypothesis that select biomass burn scenarios group together based on transcriptional response profiles, informing which wildfire-relevant exposure scenarios are the most toxic and may be evaluated collectively. Female CD-1 mice were exposed to smoke from eucalyptus, peat, pine, pine needles, or red oak biomass burned under flaming/smoldering conditions. Lung transcriptomic signatures were collected and used to derive transcriptomic similarity scores, based off Jaccard distance metrics and clustering algorithms. Groupings were anchored to cardiopulmonary toxicity markers, and compared to the pro-inflammatory agent, lipopolysaccharide (LPS). Groupings based on exposure chemistries were also compared. Biomass burns elicited differential response patterns across the transcriptome and were grouped by transcriptomic similarity scores. Exposures from flaming eucalyptus, flaming peat, and smoldering eucalyptus consistently induced the greatest transcriptomic responses, and grouped together with LPS. These exposures also showed enrichment for pathways involved in cell stress, hypoxia, and inflammation. Smoldering red oak and smoldering peat burns induced the least transcriptomic responses. Groupings differed when based solely on exposure chemistry, suggesting that combined approaches to mixtures health assessments are needed. This approach addresses the need to identify wildfire exposure scenarios that induce similar biological responses, informing human health risk assessment strategies to protect public health.

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Assessing meteorological impacts on PM2.5 concentrations in an urban heat island using low-cost PurpleAir sensors

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Abstract

There is limited research characterizing the effects of meteorological variables on PM2.5 concentrations in urban heat islands. This study used continuous, real-time data from five low-cost monitors to assess variations in PM2.5 concentrations across Chelsea, MA, USA. We secured PM2.5 (ug/m3) and temperature (˚F) data from five PurpleAir Sensors' Real-Time Map, and meteorological data (relative humidity, wind speed, and wind direction) from the NOAA ISD Database from April, 2021-March, 2022. Data QA/QC followed verified methods from the US EPA. We used a linear mixed effects model with a random intercept and random slope for each air monitor to explore the relationship between meteorology and PM2.5, adjusting for temporal trends.

Results show that temperature is more strongly correlated with PM2.5 in warmer months: the average correlation (r) throughout some spring and summer months was approximately 0.50, while the average correlation throughout fall and winter months was around 0.20. Model results show temperature (˚F), relative humidity (%), wind direction (∘), and wind speed (miles per hour) were significantly associated with PM2.5 concentrations. Notably, for a 1˚F increase in temperature, PM2.5 concentrations increased by approximately 0.06 ug/m3 (95% CI 0.055, 0.067).

Further research is needed to extend time-series analyses as data becomes available. Climate change may play a large role in future PM2.5 distributions; evaluating multiple exposures such as PM, temperature, and/or ozone will improve understanding of Chelsea's cumulative environmental health burden. Finally, it will be important to develop appropriate community-based data dissemination strategies.

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The role of European chemical manufacturing companies in promoting effective communication of conditions of safe use

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Abstract

The European Union's chemical control legislation REACH introduced the concept of Exposure Scenarios (ES) as the operational conditions and risk management measures

required for safe use of a particular chemical substance in a particular identified use. The ES is expected to be communicated to downstream users of the substance via the extended Safety Data Sheet and indeed the requirement is that the receiving company implements the ES in its operations. A variety of ES formats have emerged with differing levels of detail, which have led to suboptimal use of the instructions provided, compounded by differences in occupational health and safety legislative requirements at the national level in EU member states. CEFIC has actively participated in the ENES (Extended Network on Exposure Scenarios) platform and contributed to tools to promote standardization, such as Generic Exposure Scenarios and standard phrases for ES authoring, and also stimulated research into exposure assessment tools, efficiency of risk management measures and optimization of safe use communication. Furthermore, several networks have been maintained which bring together industry associations across value chains at various levels, such as manufacturers, distributors, formulators and product end users. The complexity of these interactions needs to be fully understood in order to achieve maximum benefit in terms of real worker health protection from extensive work by registrants on defining meaningful and pragmatic conditions of safe use throughout the stages of a substance life cycle. Increasing digitalization opportunities are currently being explored for their contribution to this purpose.

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Longitudinal changes in maternal serum per- and polyfluoroalkyl substances (PFAS) concentrations during lactation

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Abstract

Background: PFAS are persistent contaminants frequently found in maternal serum and breast milk, indicating lactational exposure in breastfed infants. To date, changes in PFAS concentrations over lactation have not been fully characterized.

Objective: To evaluate the longitudinal changes in maternal serum PFAS concentrations during lactation.

Methods: Repeated serum samples were collected from 30 breastfeeding women in North Carolina at 2-7 weeks and 3-4 months postpartum as part of the Methods Advancement for Milk Analysis (MAMA) pilot study. We measured 77 PFAS in serum samples. We calculated the

average percent change in PFAS concentrations and Spearman's rank correlation coefficients for repeated serum PFAS concentrations.

Results: Concentrations for 60 out of the 77 PFAS were below the limit of quantification at the first and/or the second visit. Perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), perfluorohexanesulfonic acid (PFHxS), perfluoroheptanesulfonic acid (PFHpS), perfluorooctanesulfonic acid (PFOS), and perfluoroethylcyclohexane sulfonate (PFECHS) were found in nearly 100% of the serum samples. Serum concentrations at the second visit were on average 10% to 20% lower for 4 PFAS, and 1% to 51% higher for 12 PFAS, but changes varied widely in terms of direction and magnitude across individuals. Serum PFAS concentrations were correlated between visits 1 and 2, with coefficients ranging from 0.36 to 0.91.

Conclusion: These results demonstrate that maternal serum PFAS concentrations correlate well across the first months of lactation, but that the direction and magnitude of changes in concentrations vary from one PFAS to another, and from one participant to another.

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REACH worker exposure assessments: ensuring meaningful health risk communication

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Abstract

Within this study, an extensive literature search including 21 studies and 13 tools was carried out. The outcomes were discussed and further supplemented by means of 18 interviews concerning 37 internal safety and REACH documents to build six different use cases representing different downstream companies. For the upstream perspective also 2 sector organisations and 2 registrants were interviewed. Three online workshops were organised in order to share insights and gather input on international recognition, potential suggestions and further recommendations with 30 participants from 9 different EU countries.

This study revealed that even though there are currently activities to improve communication on safe use of chemicals, communication in the scope of REACH should be improved. This includes e.g. the future involvement of actual end-users in activities and development related to communication of safe use information in the scope of REACH including feedback, less complicated and complex documents and clear communication concerning legislations and updates of documents. Furthermore, the issues recognized in the Netherlands are mostly also

recognized by international workshop participants, thereby indicating international benefits in various areas by means of improved communication.

The study confirmed that many of our generic conclusions were already part of the shared knowledge in the REACH community, but that it is very valuable that this knowledge has been explicated, validated and reported in a structured way in the present project. Besides uncovering some crucial aspects that offer potential improvements regarding risk communication, this study offers possible solutions and next steps to be taken.

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Disclosing REACH- and CLP-information in an understandable manner for SMEs and self-employed workers

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Abstract

Communication on working safely with chemical substances is considered very important, but simultaneously difficult. Target groups that are particularly difficult to reach are SMEs and self-employed workers. It is commonly known that these groups often lack information on working safely with hazardous substances or the information is found to be too complex to implement in practice. In 2020 a program focused on disclosing REACH- and CLP-information in an understandable manner for this group of workers.

The existing knowledge level on REACH and CLP was collected by performing interviews with representatives from two sectors, i.e. garage owners and nail salons. The interviews reveal that workers handle numerous products containing hazardous substances to which they may be exposed frequently. However, they have little knowledge of the potential risks, safety data sheets are often not available and they are not familiar with REACH- and CLP-terminology. Based on the collected information it was decided to develop visually appealing infographics. The infographics are developed in close cooperation with both sectors, using available sector information on product groups and common activities resulting in exposure. All texts and graphics are edited and designed by communication specialists.

The results are two infographics, accessible via www.chemischestoffengoedgeregeld.nl. For every identified product group or activity a brief summary on hazardous properties is presented. Subsequently necessary control measures and CLP hazard pictograms are shown. Finally, in the last step more detailed information is provided on health risks and additional control measures. The infographics will be further promoted via the sectors.

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The Plot Thickens: Determination of Heavy Metal Exposure in North Brooklyn Parks

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Abstract

The history of Brooklyn has long been synonymous with industry, manufacturing, and shipping; practices known to release heavy metals, organic compounds, and other toxicological agents into the surrounding environment. In recent decades Northern Brooklyn – particularly Williamsburg and Greenpoint – has transformed into predominantly residential areas. Due to Brooklyn's inherent lack of green space, what few open space areas remain are heavily traversed, necessitating environmental studies to identify contaminated exposure pathways. To further explore this question, the environmental health and community advocacy group, North Brooklyn Neighbors (NBN) partnered with the NYU School of Medicine, Dept. of Environmental Medicine, to examine metal contamination in public open spaces – including parks and playgrounds. The NBN community-based science initiative collected soil from nearly all community open spaces, testing for 27 heavy metals. Elemental analysis using ICP-MS revealed concentrations of lead (Pb) and arsenic (As) as high as 563.3 µg/g and 138.2 µg/g, respectively, greatly exceeding WHO maximum allowable soil limits of 100 µg/g (Pb) and 20.0 µg/g (As); copper and zinc were frequently measured in soil at concentrations >1000 µg/g. The carcinogenic and/or toxicologic consequences of such heavy metals in wildlife and humans are well documented. Adhering to pollutant guidelines/standards are critical for reducing exposure and adverse health effects. Despite Williamsburg and Greenpoint's gentrification, the high concentrations of heavy metal legacies in this study, familiar in other urban environments, require further investigation and potential remediation to protect the public and particularly, high-risk populations.

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Chemical exposure identification in relation to gestational diabetes diagnosis using non-targeted analysis

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Abstract

Gestational diabetes mellitus (GDM) is a significant health issue because of increasing prevalence and is a risk factor for several complications in pregnant populations and their offspring. Chemical exposure can increase the risk of adverse maternal and fetal health outcomes, but studies mainly focus on known chemicals via targeted methods. Our study uses non-targeted analysis (NTA) to evaluate the range of chemical exposures during pregnancy and their relationship to GDM. We used NTA to identify exogenous and endogenous compounds in 233 pairs (n = 466) of matched maternal and cord blood samples using High-Resolution Mass Spectrometry (HRMS) data measured by LC-QTOF/MS. We developed a data treatment workflow to match the MS1 data with molecular structures from US EPA's DSSTox Database and match MS2 data to the MS-Dial database. We evaluated the relationship between detected chemical features and blood glucose levels, and GDM diagnosis using multiple linear regression models. Fifteen participants had a definitive GDM diagnosis, and 16 participants were marginal with higher glucose levels (n = 31, glucose value ≥ 130). We detected 685 chemical features. Eighty-three chemical features were positively and negatively correlated with glucose levels ($p < 0.05$) and had distinct clustering via hierarchical clustering analysis. Twenty-four of these had a confidence level of 3 or better with 14 being exogenous compounds, including select PFAS compounds (PFOS, PFDA, and PFNA) and siloxanes, and the rest endogenous metabolites. This study advances the application of NTA to better understand relationships between chemical exposure and adverse pregnancy-related health outcomes.

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Exposure to PM2.5 and cardiovascular diseases – air monitoring as the first step for burden of disease estimation

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Abstract

Particulate matter with a diameter of 2.5 µm or less (PM2.5) are one of the air pollutants more detrimental to human health, being responsible for around 400 000 premature deaths in Europe every year. The cardiovascular diseases (CVD) and air pollution are linked, with evidence of a causal relationship between exposure to particulate matter and cardiovascular morbidity and mortality. PMCardImpact, a national funded project, collected data for years 2005-2021 from two air monitoring platforms, QualAr (Portuguese Environment Agency) and Copernicus Atmosphere Monitoring Service (European Commission). The air monitoring data and parameters such as exposure-response factors will support the risk assessment in AirQ+ software (WHO Regional Office for Europe).The PM2.5 levels over the years decreased, except in years 2015 and 2017 with a significant increase relative to the prior year. Results will include the number of cases of CVD attributable to exposure to PM2.5 in the Portuguese population, considering four scenarios of exposure: current scenario of exposure, new WHO Air Quality guidelines, European Commission Air Quality Directive and lastly, a worst-case scenario. This assessment will be the starting point for calculation of the burden of disease of CVD that exposure to PM2.5 represent in Portugal. PMCardImpact will make available to policy makers the needed supporting information to act, including actionable knowledge on air pollution trends and related health effects, to implement reducing air pollution policies.
This work is funded by FCT/MCTES through national funds to PMCardImpact (EXPL/SAU-PUB/0944/2021) and CESAM (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020).

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Consideration of Demographic Differences when Selecting Human Exposure Factors for Estimating Exposures to Chemicals in Personal Care Products

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Abstract

Under the Chemicals Management Plan (CMP), the Government of Canada aims to reduce the risks posed by chemicals to Canadians and their environment. Estimating human exposures to chemicals across a range of age groups to personal care products (PCPs) requires product information such as the frequency of use and amount of product used. This type of information is usually obtained from various questionnaires and surveys on use behavior and is available in the scientific literature or from regulatory guidance documents. When selecting defaults from these studies to estimate general population exposures, values

are selected from the summarized statistics for the entire sample population and may not reflect higher usage by different sub-populations. There is increased awareness that different subpopulations have different use patterns and therefore different exposures to chemicals found in PCPs. To ensure exposure estimates used in chemical risk assessments are protective, an analysis of existing literature used to derive defaults will be examined and a comparison of the results for the sample population with available results for different subpopulations or demographics (e.g., sex, ethnicity) will be presented. Potential impacts on exposure estimation will also be explored. This work supports and strengthens risk assessments conducted under Canada's CMP and potentially other programs assessing or managing substances in PCPs.

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A Multi-Pollutant Analysis of Socioeconomic Disparity in Air Pollution Exposure in Hamilton, Canada

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Abstract

The underlying causes and effects of spatial variations in air pollution exposure must be understood to improve monitoring and target air pollution interventions for the people and localities that are most vulnerable to its adverse effects. Most of the research investigating these relationships is limited to either particulate matter or nitrogen oxides and is typically constrained geographically to the United States. Our research aims to further investigate if the trend of worse air quality observed in marginalized groups is consistent when examining more rarely studied air pollutants and its relevance to the Canadian context. To capture local variations in pollution levels across the study city, Hamilton, Canada, nitric oxides (NO_x), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2) and benzene (C_6H_4) are measured for four fourteen-day periods spread between the winter, spring, summer, and autumn, starting February 2022 and ending January 2023. In total, 67 sites across the city were selected to capture local pollution variation. At these sites, NO_x, NO_2, O_3, and SO_2 measurements are taken using passive OGAWA samplers, and C_6H_4 with SKC ULTRA passive samplers. NO_2, NO_x, SO_2 and O_3 are then quantified with ion chromatography, and C_6H_4 via gas chromatography. Spatial differences in pollutant concentration from the study will be discussed, along with preliminary evidence of correlations between socioeconomic differences and pollution exposure. By examining many pollutants concurrently, this study will be able to inform which pollutants, and in turn their typical sources, are the greatest contributors to environmental inequality within a city

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Bayesian Integration of Monte Carlo Exposure and Pharmacokinetic Modeling for Lambda-Cyhalothrin with Urinary 3PBA Measurements

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Abstract

Biomonitoring data is becoming an important resource for many areas of research and public policy, including pesticide exposure and regulatory risk assessment. However, complexities of biomonitoring for rapidly metabolized chemicals have often been ignored, with inappropriate steady-state assumptions used in place of more realistic time-dependent models. In this paper we present an integrated Bayesian exposure and pharmacokinetic model combining dietary recall data individually matched to biomonitoring data, with pesticide residue information to predict exposures to lambda-cyhalothrin that are calibrated to urinary pyrethroid metabolite 3-phenoxybenzoic acid (3PBA) measurements. The model predicted urinary 3PBA concentrations similar to the actual measurements recorded in the National Health and Nutrition Examination Survey (NHANES), a nationally representative sample. Using Approximate Bayesian Computing (ABC) to accept or reject Monte Carlo exposure candidates, we only accepted exposure estimates resulting in predicted urinary 3PBA concentrations within thresholds of either an order of magnitude or half an order of magnitude from their respective measured values. Correlation between modeled 3PBA measurements and the NHANES measurements was 29% and 65% for the two ABC thresholds, with acceptance rates of 76% and 43%, respectively. The median measured urinary 3PBA concentration was 0.38 µg/g creatinine, whereas the median value of the unfiltered Monte Carlo predicted urinary 3PBA concentrations was 1.0 µg/g. With ABC, the median predicted 3PBA concentration decreased to 0.89 and 0.76 µg/g respectively for the two thresholds. Bayesian integration of exposure and pharmacokinetic modeling with measured biomarkers is a powerful tool for producing more realistic exposure and risk assessments.

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Ambient size-fractionated ultrafine particles and nitrogen oxides in a near-airport community

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Abstract

Introduction: In communities near airports, aviation emissions are a source of multiple air pollutants, including particulate matter of different sizes and nitrogen oxides (NOx). In this study, we examine particle size distribution (PSD), total particle number concentration (PNC), and NOx measured in a community near Logan International Airport in Boston, MA to inform aviation-related contributions to ambient air quality.

Methods: Our site was in Winthrop, MA, 1.0 km from the end of the most-easterly runway. Landing and takeoff flights for the nearest runway brought planes within 300-500 m of the site. Measurements were made continuously between May and December 2021. Particles were counted in 32 size bins ranging from 6 to 523 nm. NO and NO2 concentrations were measured separately, and NOx was calculated as the sum. Five-second measurements of PSD, PNC and NO/NO2/NOx were aggregated to hourly averages for each pollutant and were compared with meteorological and flight activity data.

Results: Pollutant concentrations were highest during westerly winds when the monitor was downwind from the airport. Airport activity increased throughout the study period as pandemic-related travel restrictions eased. PNC in the smallest size bin (6-20 nm) doubled between the first months and later months during westerly winds (from 1500-2000 #/cm3 in the spring/summer to 4000-5000 #/cm3 in the fall/winter). By contrast, NOx, NO2, and NO data did not differ as much between the seasons.

Conclusions: Our study emphasizes the importance of examining PSD to inform UFP source attribution in communities near aviation sources.

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Derivation of Biomonitoring Equivalents for Perfluorooctanoic Acid (PFOA)

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Abstract

Background: Biomonitoring Equivalents (BEs) are biological concentrations consistent with exposure guidance values (EGVs). To our knowledge, no BE has been determined for perfluorooctanoic acid (PFOA).

Objective: To derive BEs for PFOA non-cancer EGVs from Health Canada (HC), U.S. EPA and ATSDR.

Methods: BEs were derived using concentrations measured experimentally or estimated using pharmacokinetic modelling, and including relevant uncertainty factors. For the EGV based on adult animal doses (HC), we linearly interpolated serum concentrations from available measurements. For EGVs based on animal gestational/lactational doses (U.S. EPA 2016, ATSDR), we derived BEs in maternal serum using animal and human pharmacokinetic gestation/lactation models to obtain matching child/pup concentrations for four metrics: average prenatal, average postnatal, average overall, and maximum concentration. For the draft EGV based on epidemiology (U.S. EPA 2022), we derived a BE in maternal serum using a human gestation/lactation model.

Results: BEs (ng/mL) were 684 for HC, 15-28 for U.S. EPA (2016), 6-10 for ATSDR and 0.012 for U.S. EPA (2022 draft), despite published EGVs being similar for the first three. BEs for ATSDR were slightly higher than epidemiology-based EFSA (1.9 ng/mL) and German HBM-I (2 ng/mL) values, and than 95th percentiles of serum levels from the Canadian Health Measures Survey (CHMS) and National Health and Nutrition Examination Survey (NHANES); the BE for U.S. EPA (2022 draft) was two orders of magnitude lower.

Conclusion: BE varied over four orders of magnitude, with some being lower or close to Canadian and American national survey levels.

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Prediction of personal exposure to $PM_{2.5}$ in mother-child pairs in rural Ghana

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Abstract

Air pollution epidemiological studies usually rely on estimates of long-term exposure to air pollutants, which are particularly difficult to ascertain in settings where sources of personal

exposure differ from those of ambient concentrations. The objective of this study was to assess the feasibility of estimating usual exposure to $PM_{2.5}$ based on short-term measurements.

We leveraged three types of short-term measurements from a cohort of mother-child pairs in 26 communities in rural Ghana: (A) personal exposure to $PM_{2.5}$ in mothers and age four children, ambient $PM_{2.5}$ concentrations (B) at the community level and (C) at a central site. Baseline models were linear mixed models with a random intercept for community or for participant. Lowest root-mean-square-error (RMSE) was used to select the best performing model.

Medians (IQR) of $PM_{2.5}$ were 19.5 (36.5) μg/m^3 for the central site, 28.7 (41.5) μg/m^3 for the communities, 70.6 (56.9) μg/m^3 for mothers, and 80.9 (74.1) μg/m^3 for children. The ICCs (95% CI) for community ambient and personal exposure were 0.30 (0.17, 0.47) and 0.74 (0.65, 0.81) respectively. The sources of variability differed during the Harmattan season. Children's daily exposure was best predicted by models that used community ambient compared to mother's exposure as a predictor (log-scale RMSE: 0.165 vs 0.325).

Our results support the feasibility of predicting usual personal exposure to $PM_{2.5}$ using short-term measurements in settings with high levels of household air pollution and suggest that mother's exposure may not be the best proxy for child's exposure at age four.

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Changing exposures with changing diets: How would exposures to Persistent Organic Pollutants change with a shift towards plant-based diets?

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Abstract

Reduction in animal agriculture is a key pillar in sustainable development, as such activities have a large greenhouse gas, water, and land use footprint. Furthermore, animal-based foods are a route of human exposure to some persistent organic pollutants (POPs), so a reduced consumption of such food items could impact exposure to some chemicals. Here, we employ the "Integrated Model to Assess the Global Environment" (IMAGE) framework to model three scenarios of global agricultural production, trade, and consumption patterns under different human development and environmental change pathways out to 2100. Two of the scenarios include major shifts towards plant-based diets, either through healthy diets (i.e., reduced meat

consumption) or shifts towards plant-based/artificial meat. Projected legacy emissions of an archetypal POP (PCB-153) are obtained from the literature and used in the BETR-Global chemical fate and transport model to estimate abiotic chemical concentrations globally. A version of the ACC-HUMAN bioaccumulation and human exposure model is used to estimate chemical uptake into agricultural products in the human food web. These chemical concentrations are paired with agricultural product production and consumption patterns via trade relations from the IMAGE scenarios across 26 regions globally. The IMAGE consumption patterns are reflected in the ACC-HUMAN food item ingestion rates for estimating PCB-153 exposure regionally. Our exposure analysis establishes a novel framework for exploring changing POP exposures under dietary transition scenarios, and highlights the need to consider the implications for changing chemical exposure – to POPs as well as other chemicals – when developing planetary and human health dietary recommendations.

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Estimating daily total $PM_{2.5}$ mass and speciation concentrations with uncertainty based on WRF-Chem simulations.

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Abstract

Exposure to fine particulate matter ($PM_{2.5}$) has been proved to be associated with broad adverse health outcomes. Epidemiological studies on $PM_{2.5}$ mass and speciation in rural areas, where the $PM_{2.5}$ ground observations are sparsely distributed, are limited by the lack of high-resolution $PM_{2.5}$ exposure data with high precision over large geographical areas. Weather Research and Forecasting model coupled to Chemistry (WRF-Chem) can provide hourly and spatially continuous simulations on both $PM_{2.5}$ mass and speciation concentrations. In this study, we applied a two-stage ensemble model to estimate the daily mean $PM_{2.5}$ mass and speciation with 1 km resolution over the region across New York City and Boston in 2018. We firstly used a statistical downscaler to incorporate WRF-Chem simulations with ground measurements to predict daily $PM_{2.5}$ mass and speciation with uncertainty. A Bayesian ensemble model was then adopted to combine $PM_{2.5}$ mass predictions respectively from the WRF-Chem simulations and the Geostationary Operational Environmental Satellite-16 Series (GOES-16) aerosol optical depth (AOD). Our ensemble model showed high performance in predicting $PM_{2.5}$ mass with an overall spatial R^2 of 0.81 and a root mean square error of 1.75 ug/m^3 in the ten-fold cross-validation and outperformed both input downscaler models (WRF-Chem [R^2 = 0.76]; GOES-16 [R^2 = 0.78]). The leave-one-out cross-validation results of $PM_{2.5}$ speciation revealed similar predictive performance among all species with R^2 of at least 0.67.

The highly spatiotemporally-resolved $PM_{2.5}$ mass and speciation can improve air pollution exposure assessment in future epidemiological studies.

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Biomonitoring of glyphosate and AMPA in the urine of Moroccan farm family

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Abstract

Levels of glyphosate and their metabolite AMPA were measured in urine of farmers and their spouses that lived in intensively farmed area in Morocco. The levels were used as proxies for exposure of these target population to herbicides. 154 samples of urine were collected and information from sociodemographic characteristics and occupational exposure was collected from questionnaires administrated to farmers and spouses. Urinary glyphosate and AMPA were extracted using solid phase extraction (SPE) and analyzed by liquid chromatography-tandem mass spectrometry (LC-MS/MS). The detection frequency (DFs) was 67% for glyphosate and 62% for AMPA among farmers, and 56% for glyphosate and 48% for AMPA among spouses, with the mean concentration of 1.22 μg L^{-1} and 0.85 μg L^{-1} among farmers, and 0.58 μg L^{-1} and 0.50 μg L^{-1} among spouses, respectively. Multiple regression analysis showed that smoking status, applying glyphosate in the last 7 days, and glove use are the most important contribution to urinary levels of glyphosate and AMPA among farmers, and proximity of home to spraying area, and herbicides drift enters house are the main predictors of urinary glyphosate and AMPA exposure among spouses. With the regard to the health risk assessment, estimated daily intake (EDIs), hazard quotient (HQs), and a hazard index (HI) were calculated. The GMs of EDI were 1.26 and 1.39 μg/kg of body weight BW/day for glyphosate and AMPA among farmers, respectively. This study provides further evidence on factors associated with glyphosate and AMPA exposure, especially in developing countries.

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IMPACTS OF A NASAL RINSE ON INFLAMMATION AND MICROBIOME DIVERSITY IN DAIRY WORKERS

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Abstract

Livestock workers experience an increased burden of bioaerosol-induced respiratory disease including high prevalence of asthma and rhinosinusitis. Dairy farms generate high concentrations of bioaerosols that span the inhalable size range (0-100 μm), which can carry diverse microbial communities (including pathogens and inflammagens). Because larger particles impact in the nasopharyngeal region, we evaluated the effectiveness of a hypertonic saline nasal rinse in reducing inflammatory responses in the upper airways in dairy workers. Additionally, we investigated potential treatment impacts on the nasal microbiome. Pre- and post-shift nasal lavage samples were collected from each participant over five consecutive days. Treatment group participants received a hypertonic saline rinse while control group participants received normotonic saline rinse. Pro- and anti-inflammatory cytokines (i.e., IL-8, IL-10, and TNF-a) were measured from lavage samples using a multiplex assay. Nasal microbiomes were characterized using 16S rRNA sequencing on lavage samples. We present comparisons of inflammatory cytokines between treatment and control groups in the context of a statistical model. Distinct bacterial communities were observed in pre- and post-shift lavage samples indicating bacterial uptake from the dairy environment. Using Faith's phylogenetic diversity metric, we observed higher alpha diversity in the treatment group compared to the control. However, statistical analysis indicated the difference was not significant. Weighted UniFrac Beta diversity tests indicate that there was not a significant difference in beta diversity between groups. These results demonstrate that use of a nasal rinse as a low-cost, non-invasive intervention to reduce inflammation among bioaerosol-exposed dairy workers does not negatively impact microbial diversity.

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Computational Modeling of Endocrine Disruption of Gonadotrophin-Dependent Ovarian Follicle Maturation

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Abstract

Environmental exposure to various endocrine disrupting chemicals (EDCs), including microcystins —a harmful algal bloom toxin, per- and polyfluorinated substances (PFAS) — poorly regulated industrial chemicals used in consumer products, and chemicals found in personal care products, can result in adverse outcomes in female reproduction. Dominant follicle selection is a key step in folliculogenesis to ensure successful ovulation. This gonadotrophin-dependent process requires stimulation of antral follicles by follicle-

stimulating hormone (FSH), which rises above a threshold in the early stage of the menstrual cycle. To better understand and predict relationships between adverse outcomes of EDC exposure and follicle selection, it is helpful to construct quantitative adverse outcome pathway (qAOP) models simulating perturbed key molecular events involved in follicle maturation. Here we report our effort in developing a computational model simulating signal transduction pathways and gene regulatory networks that underpin follicle dominance selection, and feedback between ovarian hormones and FSH. Induced gene products including CYP19A1 (aromatase), insulin-like growth factors, and pregnancy-associated plasma protein can synergize the activities of signal transduction pathways, forming multiple intrafollicular positive feedback loops (FPLs). These PFLs function as a bistable switch underpinning the FSH thresholds required for dominance acquisition and maintenance of preovulatory follicle. By disrupting the cross-talk in signal transduction and blocking estradiol signaling, the model recapitulates the adverse effects of exposure to microcystins and ERβ antagonists on antral follicle progression to dominance, menstrual cycle length, and ovulation. The model can help elucidate the pathophysiology of ovarian disorders such as anovulation and polycystic ovarian syndrome associated with environmental exposures.

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Measuring In Flight: Validating Air Quality observations made on-board Unoccupied Aerial Vehicles

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Abstract

When tracking gaseous plumes using an Unoccupied Aerial Vehicle (UAV), a popular strategy is to discretize the volume of interest into a searchable grid of voxels. The UAV moves through the grid, hovering at each point while an observation is collected by onboard sensors. Once the grid-like search is complete, a raster map of concentrations can be created using the observations collected. A discretized search strategy expects an uncontaminated observation at each grid point. This requires the UAV to cause minimal disturbance to the overall field when moving. However, as the UAV enters and exits each voxel of the grid, downwash and turbulence caused by the maneuvers of the UAV can distort the field. It is therefore useful to quantify the magnitude of disturbance caused by the mobility of the UAV, as well as the time taken for the turbulence to stabilize before a reliable observation can be made. With the ability to account for turbulence, observations collected by the UAV may be equivalent to those collected by a network of stationary samplers mounted at each point of the grid. The purpose of this study is to validate observations of air quality taken onboard an UAV. By demonstrating the ability for a UAV-based system to reliably monitor outdoor air quality at a level comparable to stationary samplers, this study demonstrates how UAVs may be used as robust tools for mobile monitoring.

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Variability of per- and polyfluoroalkyl substances concentrations among pregnant African American women and newborns

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Abstract

Background: Longitudinal trends in PFAS levels across pregnancy have not been thoroughly examined. We sought to characterize variability of PFAS concentrations during pregnancy and to examine maternal-fetal transfer rate of PFAS.

Method: We quantified serum concentrations of twelve PFAS among 376 pregnant women during early (8-14 weeks) and late (24-30 weeks) gestation, as well as levels of four PFAS in dried blood spots (DBS) from paired newborns in the Atlanta African American (AA) Maternal-Child cohort (2014-2018). We characterized the variability of PFAS levels across gestation using intraclass correlation coefficients (ICC) and transfer rate. Multivariable linear regression models were fit to assess how maternal early or late PFAS levels predict newborn PFAS levels.

Results: PFHxS, PFOS, PFOA, and PFNA were detected in >95% of both maternal and newborn samples, with PFHxS and PFOS having the highest median concentrations. All PFAS median concentrations increased across pregnancy, except for PFOA and NMFOSAA, which decreased. Prenatal PFAS were weakly to moderately correlated with newborn PFAS ($-0.11 < r < 0.54$). Compared to late pregnancy, maternal PFAS in early pregnancy can better predict the newborn PFAS while adjusting for covariates. PFAS levels across pregnancy has high variability (ICC: 0.001-0.59), with the greatest change in PFHxS (ICC=0.001). The mean maternal-fetal transfer rate of PFAS decreased with increasing carbon chain length.

Conclusions: In AA mother-newborn dyads, we found most PFAS concentrations increased across pregnancy, and the magnitude of variability differed by PFAS species. Future studies are needed to

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Use of high-resolution metabolomics to assess the biological perturbations associated with maternal exposure to Bisphenol A and Bisphenol F among pregnant African American women

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Abstract

Background: Human and animal exposure to bisphenol A (BPA) and its analogues bisphenol F (BPF) is strongly associated with adverse developmental and reproductive effects, while the underlying molecular mechanisms are not well-understood. In current analysis, we conducted an untargeted metabolome-wide association study to identify metabolic perturbations associated with BPA/BPF exposures in a pregnant African American (AA) cohort.

Methods: From a subset (N=230) of participants enrolled in the Atlanta AA Maternal-Child cohort during early pregnancy (8-14 weeks' gestation), we collected urine and serum samples for targeted exposure assessment of BPA and BPF and high-resolution metabolomics (HRM) profiling, respectively. Using an established untargeted HRM workflow, we investigated the potential metabolic pathways and features associated with BPA/BPF exposures.

Results: The geometric mean of urinary BPA and BPF were 0.85±2.58 and 0.70±4.71 μg/g creatinine, respectively. After false positive discovery rate correction, 264 and 733 unique metabolic features were significantly associated with BPA and BPF levels, representing 10 and 12 metabolic pathways, respectively. Three pathways, including steroid hormones biosynthesis, lysine and lipoate metabolism, were significantly associated with both BPA and BPF exposure. We confirmed the chemical identity of 16 metabolites significantly associated with BPA or BPF exposure with Level One evidence using reference standard.

Conclusions: Our findings support that exposure to BPA and BPF in pregnant women is associated with the perturbation of aromatic amino acid metabolism, xenobiotics metabolism, steroid biosynthesis, and other amino acid metabolism which are closely linked to stress responses, inflammation, neural development, reproduction, and weight regulation.

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Identifying Metabolic Profiles Associated with Ambient Air Pollution in the Cancer Prevention Study-II Nutrition Cohort

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Abstract

Background. Mechanisms underlying ambient air pollution toxicity remains largely unknown. There is growing interest in applying high-resolution metabolomics (HRM) to study air pollution and health. Broad application of HRM is limited, however, due to concerns over statistical power and study generalizability.

Methods. Using previously collected data, we conducted a cross-sectional metabolomics wide association study among 1,263 postmenopausal women within the American Cancer Society Cancer Prevention Study-II Nutrition Cohort. Modeled estimates of PM2.5, NO2, and O3 concentrations were linked to the participant residence at enrollment. Metabolic profiling on serum samples was measured by mass spectrometry-based platforms. We followed an untargeted metabolome-wide association study framework to evaluate metabolite and metabolic pathway perturbations associated with chronic exposures to air pollution.

Results. We detected and analyzed 1,186 metabolites in serum samples. Sixty-five unique metabolites were significantly associated with at least one air pollutant (false positive discovery rate <0.05), after controlling for covariates. We observed perturbations in several inflammatory and oxidative stress related metabolic pathways associated with lipid, xenobiotic, amino acid, and vitamin metabolism. We subsequently confirmed the chemical identity of 43 unique metabolites with level 1 evidence, including diacylglycerol, taurine, docosapentaenoate, alpha- carboxyethylhydroxychroman, and palmitoyl ethanolamide.

Conclusions. In this large cross-sectional analysis of ambient air pollution and serum metabolites, we identified several novel metabolic markers and pathways associated with long-term exposures to air pollution. These results support future development of sensitive metabolic markers of air exposures, as well as corresponding investigation into the specific molecular mechanisms and disease etiologies indicated by these markers.

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Internal and external exposure levels of legacy and alternative plasticizers among Japanese children and the contributions of house dust to urinary metabolites: The Hokkaido Study

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Abstract

Phthalates and alternative plasticizers (AP) are plastic additives. Since some legacy plasticizers, such as phthalates are partly regulated, the use of plasticizers has gradually shifted to APs, such as terephthalates, and DINCH. Humans are daily exposed to these chemicals, however, internal and external exposure of APs are not well investigated. The aim of this study is to document the internal and external exposure levels of phthalates and APs among Japanese children and to estimate the contribution of house dust to internal exposure.

We included 96 children aged 7 who completed both house dust sampling and morning void urine collection during home visit conducted in 2011-2013. We measured 9 phthalates and 8 APs in dust and 10 and 12 urinary phthalate and AP metabolites using HPLC/MSMS, and daily intakes are calculated.

Urinary metabolites of phthalates were detected >90% of the samples, while APs were ranged from 94% for 5Cx-MEHTP (median 0.35ng/mL) to 3% for MINCH, followed by 5HO-MEHTP: 63%, 0.13ng/mL; 6oxo-MPHP: 56%, 0.35ng/mL; 6OH-MPHP: 55%, 0.18 ng/mL. All phthalates and DINCH in dust were positively correlated with the corresponding urinary concentrations. None of AP intakes exceeded the EFSA TDI, while DnBP and DEHP were exceeded in 30% and 7% of the children. Contribution of DINCH in dust was 81%, followed by DINP 46%, and DEHP 35% to their corresponding internal exposure. Caution should be taken in interpreting the contribution of internal exposure from dust, as not all urinary metabolites corresponding to the compounds in dust have been measured.

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Newborn Metabolomic Signatures of Maternal Serum Per- and Polyfluoroalkyl Substance Levels and Reduced Length of Gestation: A Prospective Analysis in the Atlanta African American Maternal-Child Cohort

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Abstract

Background. Preterm birth (PTB) and early term birth (ETB) disproportionately affect marginalized populations. Exposure to per- and polyfluoroalkyl substances (PFAS) has been reported to reduce length of gestation, but the underlying mechanisms are unknown. Our

aim was to characterize the molecular signatures of prenatal PFAS exposure and gestational age at birth outcomes in the newborn dried blood spot (DBS) metabolome.

Methods. This prospective cohort study included 267 African American pregnant people who gave birth to a singleton in Atlanta, Georgia between 2016 and 2020. Maternal PFAS concentrations were measured in serum samples obtained between 6–17 gestational weeks. Linear and logistic regression was used to assess associations between PFAS concentrations and gestational weeks at birth or PTB and ETB compared to full-term birth, respectively. Molecular signatures of the exposure-outcome relationships were phenotyped in newborn DBS samples with high-resolution metabolomics.

Results. Relative to the lowest quartile, the second quartile of serum PFOA concentration was significantly associated with increased odds of ETB (odds ratio (OR), 2.85; 95% CI 1.16, 7.02) and the second quartile of PFHxS concentration was significantly associated with medically-indicated PTB or ETB (OR, 6.39; 95% CI 1.20, 34.09) versus healthy full-term birth. After false discovery rate correction, the effect of prenatal PFAS exposure on reduced length of gestation was associated with 8 metabolomic pathways and 52 metabolites in newborn dried blood spots, which suggested perturbed tissue neogenesis, neuroendocrine function, and redox homeostasis.

Discussion. These mechanisms may be translated into strategies for addressing maternal and child health disparities affecting African Americans.

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Assessing injury risk associated with occupational noise exposure among miners

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Abstract

This cross-sectional study at ten US surface mining sites had four goals: 1) to assess the relationship between noise exposure and injury risk, adjusting for individual factors, psychosocial stressors, and organizational influences; 2) to determine the relative importance of noise on injuries; 3) to estimate the lowest observed adverse effect level (LOAEL) of noise on injury risk to determine the threshold of noise considered hazardous to injuries; and 4) to quantify the fraction of injuries that could be attributed to hazardous noise exposure.

Traditional mixed-effects, Poisson regression and boosted regression tree (BRT) models were run on the number of reported work-related injuries in the last year. The LOAEL of noise on

injuries was identified by estimating the percent increase in work-related injuries at different thresholds of noise exposure using a counterfactual estimator through the BRT model. A population attributable fraction (PAF) was quantified with this counterfactual estimator to predict reductions in injuries at the LOAEL.

Among 18 predictors of work-related injuries, mine site, perceived job safety, age, and sleepiness were the most important predictors. Occupational noise exposure was the seventh most important predictor. The LOAEL of noise for work-related injuries was a full-shift exposure of 88 dBA. Exposure ≥88 dBA was attributed to 20.3% (95% CI: 11.2%, 29.3%) of reported work-related injuries in the last year among the participants.

Our study further supports the possibility of a dose-response relationship between occupational noise exposure and work-related injuries, and suggests that exposures ≥88 dBA may increase injury risk among miners.

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Evaluation of personal PM_{10} exposure estimated by GPS and ambient monitoring data

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Abstract

Personal exposure could be indirectly estimated by microenvironmental concentration and time-activity pattern. Indirect estimation of personal exposure could be improved with new technology such as a global positioning system (GPS). The purpose of this study was to evaluate indirect personal PM_{10} exposure using personal GPS information and PM_{10} data from fixed monitoring stations. The three different methods were applied to determine PM_{10}: the stations of the administrative district (M1), the nearest station (M2), and kriging (M3). The I/O ratio of 0.8 was applied to estimate indoor PM_{10} concentrations. The indirect personal exposure was compared with directly measured personal exposure. The average measured daily PM_{10} personal exposures were 42.0 ± 31.4 μg/m^3 and 52.2 ± 36.3 μg/m^3 in summer and winter, respectively. The estimated daily personal exposures were slightly lower than the measured level, but had a positive correlation. Three methods to match PM_{10} data provided similar results of estimation. The Pearson's coefficients (r) of the estimated personal exposures to PM_{10} from the nearest monitoring station (M2) in summer and winter were 0.665 ($p = 0.002$) and 0.881 ($p < 0.001$), respectively. However, the correlation between hourly averaged personal exposures and measured exposures was lower than that of the daily personal exposures. The results implied that GPS information with ambient PM_{10} concentration could estimate daily personal PM_{10} exposure.

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Metabolome-wide association study of prenatal exposure to air pollution and adverse birth outcomes in the Atlanta African American Maternal-Child cohort

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Abstract

Background. African Americans (AA) are disproportionately exposed to high air pollution and elevated risks of adverse birth outcomes, while the underlying mechanisms are still largely unknown. We aimed to address the knowledge gaps by investigating the associations between air pollution exposures, perturbations in maternal metabolome, and preterm (PTB) and early term birth (ETB).

Methods: In 288 participants from the Atlanta AA Maternal-Child cohort we performed metabolomic profiling and estimated individual residential exposures to NO2, PM2.5, and O3 during the first trimester and one-year before conception. Using meet-in-the-middle approach, we investigated whether the maternal metabolic perturbations associated with air pollution are also associated with PTB and/or ETB.

Results: In the HILIC chromatography column, 95 and 190 metabolic features were associated with at least one air pollutant during the first trimester and one-year before conception, respectively, while 3 and 4 features were associated with PTB and ETB. From C18 chromatography column, 243 and 48 features were associated with first trimester and one-year before conception exposures, while 5 and 1 were associated with PTB and ETB, respectively. Perturbations in purine metabolism were associated with both air pollution and PTB in pathway enrichment analysis. Using chemical annotation, we confirmed inosine and inosinic acid, which were enriched in purine metabolism and involved in DNA damage and repair.

Conclusions: The findings suggested a potential role of purine metabolism in connecting air pollution exposures and PTB, which may support future development of sensitive biomarker and targeted interventions to reduce adverse birth outcomes induced by air pollution.

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A preliminary study on the effect of pesticide intake on gut microbiota and metabolites in middle-aged and elderly Japanese.

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Abstract

Pesticides play a significant role in increasing crop productivity. A limited number of previous animal experiments have reported that pesticides exposure may affect the gut microbiota, which is responsible for short-chain fatty acids (SCFA) and polyamine (PA) production. This study aimed to present a preliminary observation of the relationship between pesticide exposure and fecal SCFAs and PAs in middle-aged and elderly Japanese. In total, 36 healthy adults aged 69 ± 10 years (mean ± S.D) were recruited and submitted stool and spot urine samples. Urinary dialkylphosphates (DAP), 3-phenoxybenzoic acid, and glyphosate were assayed as pesticide exposure markers of organophosphorus insecticide (OP), pyrethroid insecticide, and glyphosate, respectively. Fecal acetate, propionate, butyrate, valerate, lactic acid, putrescine, and spermidine were quantified by separation analysis. Significant negative correlations ($p<0.05$, Spearman's rank correlation coefficient) between urinary DAP and fecal acetate ($r = -0.34$) and lactic acid ($r = -0.57$) were found. Multiple regression analyses (stepwise forward) were performed using acetate and lactic acid as criterion variables and urinary concentrations of pesticide exposure marker and intake frequency of food items as explanatory variables. The analysis revealed that urinary DAP is a significant explanatory variable of fecal acetate concentration ($p < 0.001$, $\beta = -24.0$, SE = 4.9, $t = -4.9$) and intake of some vegetables (adjusted R-square = 0.751). None of our statistical analyses showed a significant relationships between the urinary DAP and fecal acetate concentrations. These findings suggest that OP exposure may be linked to a low fecal acetate level in humans.

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Urinary metabolomic profiles of youth at risk for chronic kidney disease in Nicaragua

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Abstract

Chronic kidney disease of non-traditional origin (CKDnt) poses a significant public health threat in Central America. The disease often presents in young, working-aged men, although little is known about kidney health among youth in the region. We hypothesized that kidney metabolism patterns may reflect early, subclinical evidence of renal dysfunction among youth at high-risk of CKDnt. Using nuclear magnetic resonance (NMR) spectroscopy, we analyzed urine specimens from Nicaraguan adolescents aged 12-22 years (n=137) for 49 metabolites relevant to kidney health. We compared metabolic profiles by region/department, concurrent eGFR (<90 vs. ≥90 ml/min.1.73min^2) and concentrations of kidney injury biomarkers NGAL and IL-18. We used partial-least squares discriminant analysis, random forest plots and pathway analysis to evaluate metabolites and pathways of consequence. Age- and sex-adjusted multivariable linear regression models were used to further evaluate risk factors. Glycine levels were lowest in males from regions of high CKDnt prevalence (metabolite importance score=0.49, p-value<0.001). Tricarboxylic acid cycle (TCA) intermediates oxaloacetate and 2-oxoglutarate, along with amino acids glycine and taurine, were detected at lower levels in high-risk groups compared to referents and significantly differentiated males and females (importance>0.1, p<0.05). Participants with high IL-18 had lower levels of taurine (importance=0.43, p<0.001). We did not observe significant relationships in other comparisons. Disruption of mitochondrial metabolism and taurine/hypotaurine metabolism have been associated with kidney injury, and our findings may indicate early renal dysfunction in some high risk groups.

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Characterizing Heat Stress Among Outdoor Workers in El Salvador and Nicaragua

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Abstract

The epidemic of chronic kidney disease of unknown etiology in Central America has led to a focused attention on heat stress experienced by outdoor workers in this region, particularly sugarcane workers. However, there are relatively sparse data on heat stress and heat strain metrics for these workers, particularly outside of the sugarcane industry. We collected continuous measurements of core body temperature (Tc), heart rate (HR), physical activity, and wet bulb globe temperature (WBGT) among569 participants of the MesoAmerican Nephropathy Occupational Study (MANOS) in January 2018 – May 2018ng. Participants were recruited in various job tasks across five industries in El Salvador and Nicaragua: sugarcane, corn, plantain, brickmaking, and construction. Data also included self-reported break

duration, work shift duration, and hydration practices. Median WBGTs were high (> 27°C) at most sites, but particularly among workers whose work shift spanned the afternoon hours (e.g., 29.2°C among plantain workers). Sugarcane workers, especially cane cutters in both countries, and agrichemical applicators in Nicaragua, had the highest estimated work rates and were more likely than other workers to experience WBGTs above their recommended exposure limits. Workers in most industries spent little time on break (<10% of the shift), as determined from accelerometer data. Overall, sugarcane workers, particularly those in Nicaragua, experienced higher Tc and HR values than other workers. However, we also found evidence that workers in other industries occasionally reach high core temperatures (> 39°C) as well. Sugarcane workers self-reported drinking the highest volumes of liquid (often > 1L/hour).

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A Pilot Study on Exposures to Heavy Metals in an Occupational Chilean Cohort.

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Abstract

Chile's competitive mining and agricultural industries generate toxic waste from mining ores and agrochemicals that include heavy metals previously linked to an array of adverse health effects such as nephrotoxicity. Still, the extent and determinants of exposure to many heavy metals among worker populations in Chile remains unknown. We conducted a pilot study to assess exposure to heavy metals and assess exposure determinants in an occupational population in the Chilean agricultural region of Maule. Spot urine samples were collected from a subset of 467 workers participating in the Maule Cohort (MAUCO) study. Lead (Pb), inorganic arsenic (iAs), copper (Cu), chromium (Cr), and manganese (Mn) were quantified in urine samples using ICP-MS. Interviewer-administered questionnaires were administered to capture demographic characteristics, including sociodemographic data, general health history, occupation, and overall lifestyle behaviors. About half of the participants were females (53%) and worked in agriculture (51%). Preliminary findings from a subset of 340 participants indicate that detection frequencies (DF) for target metals were: Pb (DF:3%), iAs (DF:98%), Cu (DF:44%), Cr (DF:20%), and Mn (DF:32%). Median iAs concentrations were almost twice as high as those reported in adults from the U.S. general population (8.5 vs. 5.4mg/L). Ongoing analyses to be presented aim to characterize exposure to heavy metals among all 467 participants and to assess their respective determinants in this subsample of workers to identify modifiable exposure risk factors in a vulnerable working population.

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Nephrotoxic Potential of Particulate Exposures Among Sugarcane Workers in Guatemala

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Abstract

Rationale: A high prevalence of chronic kidney disease of non-traditional etiology (CKDnt), a potentially life-threatening condition, is observed in sugarcane workers. Dehydration and thermal stress may not fully explain the CKDnt risk; consequently, critical questions remain on the etiology. We assessed sugarcane worker exposures to resuspended particulate matter that is likely comprised of contaminants that are toxic or reactive with kidney tissue.

Methods: Using a longitudinal study design, we conducted personal air monitoring using SKC Aluminum Cyclones affixed in the breathing zone of male workers (employed at an operation in Guatemala) while they manually harvested sugarcane. Respirable particulate was collected onto 37-mm PVC filters with a 5 µm pore size. Samples were then processed for analyses, including gravimetry, Fourier transform infrared spectroscopy (FTIR) and inductively coupled plasma mass spectrometry (ICP-MS). Field and laboratory blanks were included for quality assurance and control.

Results: To date, we have collected personal air samples from workers across three sampling campaigns conducted in the 2021/2 harvest season. Based on the volume of air sampled, mass concentrations of respirable dust ranged from 0.14 to 1.14 mg/m3. While these results are well below recommendations by the U.S. OSHA and ACGIH for particles with no applicable Permissible Exposure Limit or Threshold Limit Value, further analyses are warranted to determine the reactivity and toxicity of the particulate matter. We present our exposure data and describe the nephrotoxic potential of the particulate matter based on identification and quantification of contaminants such as silica and heavy metals using FTIR and ICP-MS.

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Air and Heat Monitoring of Male Sugarcane Workers at Risk for CKDu

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Abstract

Rationale: We monitored airborne respirable particulate matter (PM4) and its components as well as heat stress in male Guatemalan sugarcane workers at-risk for chronic kidney disease of non-traditional etiology (CKDnt) in Guatemala.

Methods: We initiated personal air and heat monitoring in male sugarcane cutters employed at a sugarcane company in southwest Guatemala. Over the course of three monitoring sessions over the 2021/22 harvest (December, February, and March) we measured PM4 (SKC Cylones, Dorset UK), heat stress using iButton (Hygrochron™, Maxim Integrated, San Jose, CA) and heat strain using a pill-sized ingestible capsule telemetric sensor (Bodycap e-Celsius Performance®, Caen, France).

Results/Discussion: We describe our repeat measures study design, work environment, and approach for assessing exposure in this high-risk population that lead high sample capture. Overall, PM4 levels were high, ranging up to 1 mg/m3 (GM=0.49; GSD 0/14 mg/m3), so 4-hour monitoring periods were used to develop individual estimates of PM exposure based on a similar exposure group (SEG) approach. Initial findings for exposure reconstruction show very high respirable particulate matter levels and heat stress in these workers, that within subject variability in PM exposure was less than between participant variability, and that within-subject heat exposure varied much less than between subject heat exposure. We discuss the overall statistical relationships between PM and heat in these subjects as well as the results of initial chemical analysis and characterization of airborne silica exposure in these workers.

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Estimating short and long term impact of COVID-19 on China's air quality change and health economic losses through machine learning counterfactual simulations

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Abstract

The short-term reduction in air pollutant concentrations due to acute lock-down during COVID-19 has been widely studied but fewer studies have analyzed the long-term impact of COVID-19 on local air quality or studied their social impacts. Our study uses machine learning counterfactual simulations to analyze both the acute (~weeks) and chronic (~year) impacts of COVID-19 on air quality, human health, and the economy in China. We analyzed concentrations of six air pollutants ($PM_{2.5}$, PM_{10}, SO_2, NO_2, CO, O_3) in 39 major cities in China during and after COVID-19 lockdown (January 28th, 2020 to April 30th, 2021) and predicted the pollutant concentrations for each pollutant in a counterfactual scenario – with no "COVID-19" lockdown, using local

meteorological data with XGBoost machine learning model. Among the cities surveyed, 64%, 93%, 82%, 95%, 81% of the cities showed a statistically significant reduction between the observed $PM_{2.5}$, PM_{10}, SO_2, NO_2, CO during the lockdown, compared to the model prediction. We observed an increase in O_3 concentrations in all cities during the lockdown, but this increase was only significant for 34% of the cities analyzed. The total amount of observed gaseous oxidants (O_X= NO_2+O_3) remained mostly the same, compared to the counterfactual scenario. In both the observed and predicted simulations, NO_2 and O_3 were the leading cause of excess health and economic burdens. The implementation of COVID lockdown in China resulted in a significant reduction of various air pollutant concentrations. Long-term impacts varied among the cities and pollutants studied.

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Consumer and Personal Care Product Use is Associated with Increases in Phenol and Paraben Exposures Among Black Children with Asthma.

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Abstract

Chemicals in personal care and other consumer products like phenols and parabens may be linked to adverse respiratory effects. A high asthma burden is reported among U.S. Black children while exposures to many consumer product chemicals are reported to be higher among blacks compared to other races/ethnicities. Still, little is known regarding consumer product use patterns that contribute to increased chemical exposures among Black children with asthma. We characterized exposure to consumer product chemicals and examine their association with specific products and behaviors in 110 predominantly Black children with asthma, ages 8-17 years, from Baltimore. We quantified biomarker concentrations of bisphenol A (BPA), bisphenol S (BPS) and parabens (methylparaben, propylparaben) in urine samples. General and recent (prior 24-hours) consumer product behavior information was captured via questionnaires. For the present analysis, we focused on recent consumer behaviors based on the biological half-lives of target chemicals. Associations between biomarkers and consumer product uses/behaviors were assessed using linear regression. Models with consumer product uses/behaviors explained 30%-40% of biomarker variability. Use of air freshener was associated with a 72%, 98%, and 96% increase in BPA, BPS, and propylparaben concentrations, respectively ($p<0.01$). Use of scented candles was associated with a 100% increase in methylparaben and propylparaben concentrations ($p=0.04$). Consuming canned goods and drinking from plastic containers was also associated with a 60% increase in BPA and BPS concentrations. If prior associations with

asthma and target chemicals are causal, findings could inform asthma control guidelines and exposure mitigation interventions to potentially harmful chemicals.

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Measuring occupational and household exposures among female sugarcane workers in Guatemala

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Abstract

Rationale: In Central America, the epidemic of chronic kidney disease of non-traditional etiology (CKDnt) has been well-described in males, however, females have rarely been studied and their true disease burden remains unknown. Potential risk factors include airborne pollutants, dehydration and heat exposure, agrochemicals, and metals. Women sugarcane field workers are likely to have exposures both at work and at home, such as household biomass burning emissions as well as occupational exposure to burning sugarcane. We aim to characterize work and home exposures among women workers.

Methods: We recruited and initiated personal monitoring and biosample data collection in December 2021 among 16 female field workers employed at a sugarcane company in Southwest Guatemala. The workers wore personal air samplers and temperature monitors during one work shift and one rest day in December, February, and March. In addition, the workers wore silicone wristbands as passive samplers for seven continuous days in December.

Results: We present our exposure measurement approach and preliminary exposure data for the air samples and silicone wristbands from these three time points. Median PM4 levels were 0.218 and 0.411 mg/m3 on their rest days and 1.01 mg/m3 on their work days. We describe the type of chemical exposures encountered by these workers in their home and work environment.

Conclusions: These research findings will aid in the development of strategies to reduce nephrotoxic exposures for populations of women in agricultural communities both at home and at work.

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Exposure over the life course – using archived dry blood spots to measure persistent organic pollutants in decades past

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Abstract

Dried blood spots (DBSs) are routinely collected from newborns to screen for a suite of diseases and disorders, often allowing early diagnoses and lifesaving treatments. Some jurisdictions archive these materials, providing a sample repository that now spans two and sometimes three generations, e.g., child, mother, and grandmother, each of whom provided a DBS as an infant. The samples represent a small volume of capillary blood that may be stored under suboptimal conditions, but instrumentation now allows detection of miniscule levels of metals and organic compounds from which prenatal exposure can be derived. We examine 41 paired archived blood spots, each pair consisting of the DBS and a comparably sized but clean section of the same DBS collection card. These samples are drawn across the Michigan and represent a sample of births occurring over the past three decades. Both the DBS and clean section were analyzed for pesticides, BFRs, PCBs, and other compounds by GC/MS-MS. Compounds most commonly detected and at the highest levels include DDT derivatives (e.g., 4,4'- DDE), hexachlorobenzene, chlordanes, PBDEs (e.g., PBDE-47, 99, 193), and PCBs (e.g., PCB-110, 154, 118, 99/100, 138). Most compounds were found at low levels in the clean card section (e.g., <30 pg/card section) with some exceptions (e.g., more volatile PCBs). We discuss approaches to assess contamination, background levels, temporal trends, sample volume, blood concentration, and analyte integrity. Archived DBS samples represent a unique resource for quantifying early life exposures that may be relevant to health outcomes affect young to now middle-age individuals.

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Application of geostationary satellite and high-resolution meteorology data in estimating hourly $PM_{2.5}$ levels during the Camp Fire episode in California

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Abstract

Wildfire smoke contains large amounts of $PM_{2.5}$ that traverse hundreds of kilometers, resulting in significant deterioration of air quality and excess mortality and morbidity in downwind regions. Estimating wildfire smoke $PM_{2.5}$ levels has been challenging due to lack of ground monitoring coverage near the smoke plumes. We estimate total $PM_{2.5}$ concentrations during the Camp Fire episode, the deadliest wildland fire in California history. Our random forest (RF) model combines calibrated low-cost sensor data (PurpleAir) with regulatory monitor measurements (Air Quality

System, AQS) to bolster ground observations, Geostationary Operational Environmental Satellite-16 (GOES-16)'s high temporal resolution to achieve hourly predictions, and the Synthetic Minority Oversampling Technique (SMOTE) to reduce model underestimation at high $PM_{2.5}$ levels. Meteorological fields at 3 km resolution from High-Resolution Rapid Refresh model and land use variables were also included in the model. Our AQS- only model achieved an out of bag (OOB) R^2 (RMSE) of 0.84 (12.00 μg/m^3) and spatial and temporal cross-validation (CV) R^2 (RMSE) of 0.74 (16.28 μg/m^3) and 0.73 (16.58 μg/m^3), respectively. Our AQS + Weighted PurpleAir Model achieved OOB R^2 (RMSE) of 0.86 (9.52 μg/m^3) and spatial and temporal CV R^2 (RMSE) of 0.75 (14.93 μg/m^3) and 0.79 (11.89 μg/m^3), respectively. Our AQS + Weighted PurpleAir + SMOTE Model achieved OOB R^2 (RMSE) of 0.92 (10.44 μg/m^3) and spatial and temporal CV R^2 (RMSE) of 0.84 (12.36 μg/m^3) and 0.85 (14.88 μg/m^3), respectively. Our study showcases techniques to overcome challenges in modeling a climate change related event of acute and intense production of $PM_{2.5}$.

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Distinguishing heat-not-burn tobacco smokers from cigarette smokers using novel biomarkers and machine learning model

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Abstract

Heat-not-burn tobacco (HNBT) smokers have drastically increased worldwide in the past 5 years. Especially the marketing of the HNBT started in Japan where its world share has been 98% in 2016. However, effects of the HNBT on our health has not been thoroughly assessed. No biomarker has been proposed for the distinguishment of HNBT and cigarette smokers.

An analytical method was developed to determine biomarkers of smoking, including cotinine (COT), anatalline (ANA), anabasine (ANAB) and anatabine (ANAT), in a human urine sample. Urine samples were collected from healthy adult volunteers who smoked either cigarette or HNBT. The biomarkers were analysed using a liquid chromatography tandem mass spectrometer. Then a machine learning algorithm was applied to the measurement data to predict a type of smoking, i.e., cigarette or HNBT.

Method reporting limits of COT, ANA, ANAB and ANAT were 0.055, 0.072, 0.027 and 0.029 ng/ml, respectively. These compounds were quantified from all samples. Urinary COT concentrations were comparable between cigarette and HNBT smokers. On the other hand, ANA, ANAB and ANAT concentrations of cigarette smoker were higher than those of HNBT smokers. Sensitivity, specificity and overall accuracy of the prediction model were 0.97, 0.96 and 0.96, respectively. This

finding suggests that urinary biomarkers and machine learning prediction model can be used to distinguish HNBT smokers from cigarette smokers.

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Estimating the Indirect Costs of Work-related Disabilities and Fatalities in Private Sector in Thailand

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Abstract

Background: The cost of Occupational Injuries and illnesses (OIIs) reported by the Workers' Compensation System (WCS) on an annual basis mislead public health policymakers. Not only the cost was limited to compensation payments to eligible workers but also disregarded other related social costs of OIIs. Additionally, the transferred WCS payments were not included in the output of the productivity of the whole national economy. Thus, these hidden societal costs are left uncovered for decades, including lost expected earnings of disabled workers and decedents which burden their family members and society as a whole.

Method: This study applied the human capital method, a combination of direct and indirect cost, and utilized the data of OIIs in 2016 for cost estimation. This study collected the number of disabilities and fatalities and multiplied them by Gross National Product (GNP) per capita in the same year to yield expected work-lifetime costs, converted to the present value with a 1% discount rate.

Results: This study found that the expected work-lifetime cost of disabilities and fatalities were US$ 1.2 Million and US$ 69.6 Million, respectively. These cost burdens to society were higher than the total annual WCS payment of US$ 52 million reported.

Conclusion: The work-lifetime costs of disabilities and fatalities incurred were substantially higher than the superficial cost of WCS's payments. This huge burden of social costs due to OIIs should trigger policymakers to revise their priority and pay more attention to these preventable costs.

Keywords: Occupational Injury, Illness, Cost, Workers' compensation system

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Estimating the effect of household incense burning on urinary metals using a nationwide longitudinal survey of human biomonitoring in Taiwan: Analysis of the first year survey

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Abstract

Background
Incense burning has determined as an atmospheric source of heavy metals in household environment. However, few studies have estimated the effect of household incense burning (HIB) on the body burden of heavy metals referred to a precision biomarker for human health.

Objectives
We aimed to evaluate the effect of HIB on urinary metals using a nationwide longitudinal survey.

Methods
A total of 1,578 participants with questionnaire data and urinary metal measurements were recruited in the first survey of the Human Biomonitoring (HBM) study in Taiwan, 2019. HIB status was defined as never, occasional, and persistent exposure according to the frequency of HIB reported by participants. Urinary metals were measured by ICP-MS, and then adjusted by urine creatinine. The effect of HIB on urinary metals were estimated using propensity score matching method.

Results
The weighted average Mn, Sr, and Pb levels in urine (1.2, 134.4, and 1.1 μg/g, respectively) were significant higher among the subjects with persistent exposure to HIB than those with never exposure (0.9, 116.7, and 1.0 μg/g, respectively) and occasional exposure (0.9, 125.9, and 1.0 μg/g, respectively). Comparing persistent- and never-exposure subjects, after matching other covariates the estimated average proportions of HIB effects increased 16.4, 10.5, 10.3, and 11.9% of urinary Mn, Ni, Sr, and Pb levels, respectively.

Conclusion
Our study identified and quantified the positive effect of HIB on urinary metals, highlighting the potentially hazard of HIB to human body burden. Our finding provided references for further policy measures to improve human health.

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Association between Parabens Exposure and Attention Deficit/Hyperactivity Disorder Symptoms

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Abstract

Background
Parabens are widely used as preservatives by pharmaceutical and cosmetic industries. The effect of parabens on the development of neurotoxicity in children is still controversial.

Objective
This study aimed to evaluate the association between exposure to four parabens and the development of neurobehavioral symptoms related to Attention-Deficit/Hyperactivity Disorder (ADHD) in early childhood.

Methods
We used the long-term follow-up study of Taiwanese generation, Taiwan Birth Panel Study II (TBPS II). We recruited children which grown up to 6-9 years old. We measured four kinds of parabens including methylparaben (MP), ethylparaben (EP), propylparaben (PP) and butylparaben (BP). We assessed the psychometric symptoms in children using three structure questionnaires, including Conners Kiddie Continuous Performance Test 2nd Edition (K-CPT II/4-7), the Chinese versions of Swanson, Nolan, and Pelham IV scale (SNAP-IV) and the Child Behavior Checklist/4-16 (CBCL/4-16).

Results
A total of 330 subjects completed the parabens analysis and questionnaire survey. We found that PP exposure had the significant negative association with performance. And, we have observed that exposure to paraben is associated with detectability and commission in K-CPT II (β=1.001 (95% CI: 0.145- 0.186) and β=0.947 (95% CI: 0.013-0.188)), respectively, as well social problems, rule-breaking behavior and externalizing problems in CBCL (β=0.243 (95% CI: 0.032-0.454) and

β=0.127 (95% CI: 0.004-0.250) and β=0.469 (95% CI: 0.011-0.928)) in CBCL. And, the significant relationship was observed in girl.

Conclusions
Children exposure to paraben associated with ADHD-related neurobehavioral symptoms among seven- year-old children. We suggested that it is necessary to elucidate the causal relationship in further studies.

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An Analysis of Raw Material Composition for Estimating Exposure to Volatile Organic Compounds in the Use of Consumer Spray Products
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Abstract

A lot of consumer spray products (CSPs) are used in our daily life. Despite the fact that there is an ingredient label and SDS, it is difficult to properly identify the hazardous ingredients in the product. This study aims to compare and analyze substances that existed in CSPs using headspace sampling and two solvent dilution methods.

The 10 CSPs (5 spray types and 5 trigger types) were selected in the order of high usage and sales in Korea. Samples were prepared in two ways; One is to collect a sample by spraying it on vial, and the other is extracted directly from CSPs. Sample analysis was performed by GCMS using 48 mix of VOC standard products, diluted with CS2 and MeOH.

As a result of 10 CSPs analysis, results for a total of 39 substances could be obtained. Among the analyzed substances, benzene, Toluene and 1, 2-dichloropropene were analyzed relatively well when CS2 was used, and in the case of Dichloromethane, Mesitylene, and Xylene, analysis through MeOH was effective. By type, ethyl tert-butyl ether (ETBE), p-Xylene, and 2-chlorotoluene were mainly analyzed in trigger products, and p-Cymene was well identified in spray type products. In the case of other materials, the inclusion was mixed depending on the purpose of use of the product.

At the presentation, the results of adding the headspace method and the harmful component classification of the analyzed component will also be compared.

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Determination and health risk assessment of alternative termiticides in Japanese residences

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Abstract

Alternative termiticides such as neonicotinoids (NNIs), pyrethroids (PYRs), phenyl pyrazole, and their potentiator have neurotoxic and/or carcinogenic properties. There is concern about the risk of alternative termiticides indoors via indoor dust ingestion because their low volatility allows them to adsorb onto indoor dust. However, information on the concentrations of alternative termiticides in indoor dust is limited. In the present study, we determined the concentrations of alternative termiticides in indoor dust samples collected from 30 Japanese residences by LC-MS/MS and/or GC- MS/MS. We then evaluated the health risk to humans using margin of exposure (MOE) approach.

Twenty alternative termiticides targeted in this study were detected in the samples. Median values of fipronil, permethrin (PYRs), and imidacloprid (NNIs) were 22, 300 and 520 ng g^{-1}, respectively. Samples with higher concentrations of imidacloprid and permethrin tended to have higher concentrations of cyproconazole and S-421 being used as potent enhancer. The cyproconazole, is 14α-demethylase inhibitor- (DMI-) fungicides, obtains their fungicidal activity by disrupting ergosterol biosynthesis via cytochrome P450 inhibition. Thus, the simultaneous exposure to multiple alternative termiticides may pose a synergistic effect on human health risks. The MOE values for imidacloprid and permethrin were greater than 100,000, while the MOE for fipronil was 800.This suggests that further observation of fipronil concentrations in indoor dust samples is still needed due to the increasing usage of fipronil in Japan.

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A Study of Filler Metal, Core Filler Components to control Fume and Hexavalent Chromium Generation in Shielded Metal Arc Welding and Flux Cored Arc Welding

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Abstract

Welding fume and hexavalent chromium are IARC Group 1 carcinogens. In particular, Shielded Metal Arc Welding(SMAW) and Flux Cored Arc Welding(FCAW) have severe health risk to exposed worker because of high contents of fume and hexavalent chromium. This study aims to estimate welding filler material components that can reduce fume and hexavalent chromium generation in SMAW and FCAW.

A total of nine SMAW and eight FCAW filler materials were tested. Each product was welded under uniform welding conditions for each welding type in fume-hood. Fumes were collected and analyzed by gravimetric analysis for fume generation rate(FGR) and IC-UV for hexavalent chromium generation rate(H.CGR). Filler material were analyzed by IC, ICP-MS and XRF. Finally, Pearson correlation test was used for estimating association between FGR & H.CGR and welding filler material. .

For nine SMAW welding rods, FGR and H.CGR were 198.0-289.3(AVG=237.8) mg/min, 5.3-8.0(AVG=6.7) mg/min, respectively. For eight FCAW wires, FGR and H.CGR were 511.3-775.1(AVG=608.0) mg/min, 0.3- 3.3(AVG=1.8) mg/min, respectively. The Pearson correlation analysis showed significant association about K, F, Na(%) for SMAW and Na(%) for FCAW with FGR(mg/min). In the case of H.CGR(mg/min), the contents(%) of Na, K, F, and SiO_2 in the welding material showed a significant correlation ($r>0.6$) with H.CGR in both welding type. This study suggests that it is necessary to reduce the content of Na, K, and F in order to reduce welding fume and hexavalent chromium as long as welding quality is guaranteed.

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Receptor-based aggregate exposure estimation for parabens in children's personal care and cosmetic products

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Abstract

To manage the risk of consumer chemical exposure, realistic exposure estimation through aggregate exposure from multiple consumer products are considered. Accurate aggregate exposure assessment should be based on individual's exposure factors. Due to children's product usage patterns are strongly related to the demographic characteristics, receptor-based aggregate exposure assessment is required. The aim of this study was to estimate aggregate exposure of parabens in multiple personal care and cosmetic products (PCPs) by Korean children. We collected exposure factors of 11 PCPs (shampoo, body wash, soap, hand wash, body lotion, body oil, baby powder, sunscreen, lip care, nail makeup, and lip makeup) by face-to-face interviews. The survey was conducted to 20,000 households with children aged 0-12 years in twice, July to October 2017 and February to March 2018. The number of subjects was determined by proportional

quota sampling based on the children's gender, age, and region distribution. Aggregate exposures were calculated for methyl-, ethyl-, propyl- and butylparaben according to individuals' exposure factor response and simultaneous PCPs use. Children's PCPs use rates were ranged 7.5-98.7% for 11 products. Average number of simultaneous PCPs use was 5.4 ± 1.3. A worst-case exposure (0.4% parabens to each PCPs) estimated aggregate exposures of paraben for 13.3 μg/kg-bw/day to 95th percentile population. In tier 2, aggregate exposures are calculated by considering of actual paraben concentration for each product. These aggregate exposure data would be useful input data for risk assessment and regulation of parabens in PCPs for children.

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Correlation between the levels of air pollutants measured with a portable device with a low-cost sensor and results of pulmonary function test

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Abstract

A number of studies have reported that air pollution is significantly related to increased mortality and prevalence, and air pollution exposure and health impact assessment with environmental diseases require objective and reliable exposure assessment using personal monitoring methods.

From December 2019 to February 2020, 20 asthma patients living in Guro-gu, Seoul, Korea were combined with three types of PEFR data: (1) portable measuring instrument (PICO), (2) outdoor simple fine dust measuring instrument (KTR), and (3) national automatic measuring network (AK) and subjected to 72 hours of exposure.

As a result of the study, all graph directions of changes in lung function according to the concentration of fine dust showed a downward direction, and the lung function decreased as fine dust increased, showing significance at the levels of $P<0.05$ and $P<0.01$. As a result of comparative analysis of three personal exposure evaluation methods among exposure variables (PICO-KTR-AK) for accurate health impact evaluation according to fine dust, overall, the correlation between PICO and KTR and lung function was greater than AK, and the maximum value of 72 hours was KTR and PICO.

According to the results of this study, it is believed that using KTR and PICO rather than AK will enable more reliable health impact evaluation. Considering exposure to various environments, KTR cannot measure indoors, but PICO can measure indoors and outdoors, so it is strongly recommended to use portable measuring devices considering indoor and outdoor measurements in future studies.

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A high-sensitive analytical method of particulate polycyclic aromatic hydrocarbons (PAHs) and halogenated PAHs using thermal separation probe coupled to gas chromatograph-triple quadrupole mass spectrometer

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Abstract

Some polycyclic aromatic hydrocarbons (PAHs) and their halogenated derivatives (XPAHs), despite their high toxicity, have not been observed due to low analytical sensitivity. An analytical method for PAHs and XPAHs with adequately high sensitivity is therefore required to accurately determine their concentrations. In the present study, we developed a high-sensitive analytical method using thermal separation probe coupled to gas chromatograph- triple quadrupole mass spectrometer (TSP-GC-MS/MS) for 26 PAHs and 40 XPAHs in particulate matter (PM). PM on the filters spiked with 2 ng of six deuterium labeled PAHs in the TSP was introduced directly into GC. Since solvent extraction was not performed, we saved time and solvent. We optimized the inlet temperature, compared the limits of quantitation (LOQs) with those of conventional method, and applied the developed method to indoor air samples. The optimized temperature at the inlet of the GC was 230°C. The LOQ values by the TSP method for 73% of the target chemicals were 1.1-fold to 906-fold higher than those by the conventional solution injection method. The concentration of 6-chlorobenzo[a]pyrene (6-ClBaP), chlorinated derivative of benzo[a]pyrene, in indoor air was determined to be 0.9 pg m-3 by the developed method. This value is lower than the LOQs of 6-ClBaP in the conventional method (6.0 pg m-3). The developed method using the TSP enables us to detect newly 17 target chemicals in indoor air despite the concentrations below the LOQs of conventional method.

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Advancing the “New European Bauhaus” for Environmental Health and Wellbeing – the AdNEB Project

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Abstract

“Advancing the New European Bauhaus: Sustainable Mobility and Resilient Urban Spaces for a Better Quality of Life” (AdNEB) is a research project of the German Environment Agency (UBA) linking to the New European Bauhaus (NEB) initiative by the European Commission. NEB aims i.a. for transforming Europe’s building stock to achieve climate-neutrality by 2050.

AdNEB started in 2022 and is augmenting the NEB approach by conducting research on resilient, sustainable, fair and health-promoting urban areas, exploring environmentally friendly mobility in living laboratories, identifying sustainable and healthy construction methods and materials, and contributing to the envisioned “Founding Bauhauses” by deriving specific objectives on a scientific and political level. Data of the German Environmental Survey for Children and Adolescents 2014-2017 (GerES V) will be evaluated with respect to environmental justice issues and social infrastructure, such as green and blue space.

Preliminary results of an UBA online survey show that more than 80% of German municipalities state a “high” to “very high” development pressure being exerted upon inner urban land plots. In GerES V, approximately 52 % of the children and adolescents in Germany living in urban areas reach a public green space within a 5 min. walk from home. This walking time differs by socio-economic position.

AdNEB is performing integrated research relevant for various aspects of urban exposure science, such as active mobility, traffic-related stressors, and sustainable building and renovating. Our project demonstrates that further interdisciplinary collaboration is required to reduce environmental exposures

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Exposure to arsenic, lead and mercury in two Swiss Cantons: Towards national reference values for human biomonitoring (HBM) and identification of respective exposure sources

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Abstract

The pilot phase of the Swiss Health Study aims at exploring the study design for identifying population- based HBM reference values for Switzerland and associated exposure sources. For this, a cross-sectional study was conducted in 2020/21 in the Cantons of Vaud and Bern, covering two different language/cultural zones in Switzerland. The 406 participants (Bern: 175; Vaud: 231; 216 men/190 women) aged 20-69 years were recruited at random. Questionnaires covered sociodemographic, health and targeted exposure information. Blood sampling was performed at

two regional health facilities and a large range of metals was analysed with ICP-MS in whole blood. We calculated the 95 percentiles (P95) overall and by study centre for arsenic, lead and mercury and compared them to population-based data from neighbouring Germany, neighbouring Italy and Canada. Overall P95 for blood arsenic was 5.2 ng/mL (Bern 3.2; Vaud 7.1), which is similar to what was found in Italy (5.3), but higher than in Canada (2.0). Overall P95 for lead in blood was 42.1 ng/mL (Bern 41.2; Vaud 42.7), thus higher than in Germany (35.0) and Canada (33.0), but lower than in Italy (51.7). Overall P95 for mercury in blood was 4.0 ng/mL (Bern 3.1; Vaud 4.2), which is higher than in Germany (2.0) and Canada (2.3), but lower than in Italy (5.2). Conclusively, metal levels in the two Swiss populations investigated are similar to other countries. The origin of the observed regional differences in human exposure to arsenic and mercury is currently tracked down by individual-based exposure modelling.

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Evaluation of airborne hazardous materials emission while using 3D-pen

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Abstract

In addition to 3D printers, the use of 3D pens is increasing recently. Concerns arising from the study of hazardous substances generated by 3D printers are also predicted in 3D pens, but the research is very limited. This study aims to to evaluate the hazardous substances (particulate, metals, VOCs, ion, and aldehyde) during 3D-pen use.

The experiment was conducted in a 2.5m^3 chamber, and the presence or absence of ventilation and the type of pen and filament(ABS, PLA) were used as variables. The real-time particle number concentration was evaluated through SMPS and OPS. metals, VOCs, ions, and aldehydes were analyzed by ICP/MS, GC/MS, IC, and HPLC-UV/VIS, respectively.

When operating in a non-ventilated place, for particles with size range of 10nm to 420nm, ABS and PLA showed number concentrations of 7.6×10^4particles/cm^3 and 2.5×10^4 particles/cm^3, respectively. On the other hand, when ventilation (ACH= 14.4/h) was operated,ABS and PLA decreased to 4.0×10^4 particles/cm^3 and 1.1×10^4 particles /cm^3, respectively. It corresponds to 1% and

20% of the concentration of 3D-printers performed in the same chamber, respectively. One thing to note is that the 3D pen is more difficult to seal than the 3D printer, is used near the breathing zone, and is recently used a lot by children. At the conference presentation, the results of metals, ions, VOCs, and aldehydes will be presented as well as the emission rate per unit time.

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Human biomonitoring reference values and characteristics of Phthalate exposure in the general population of Taiwan: Taiwan Environmental Survey for Toxicants 2013–2016

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Abstract

We aimed to establish the urinary levels and RVs of phthalate metabolites and identify exposure characteristics among Taiwan's population. We enrolled 1857 participants 7 years of age and older from the Taiwan Environmental Survey for Toxicants (TESTs) conducted during 2013–2016. Levels of 11 phthalate metabolites in each participant's urine samples were determined using liquid chromatography–tandem mass spectrometry. For all phthalate metabolites except for mono-methyl phthalate (MMP), mono-ethyl phthalate (MEP), and mono-ethylhexyl phthalate (MEHP), urinary median levels were significantly higher in the 7-17-year old group than in the ≧18-year-old group. For most phthalate metabolites and in the general population, the geometric mean decreased with increasing age. Median levels of MEP (19.55 μg/L), mono-benzyl phthalate (MBzP) (2.11 μg/L), mono-(2-ethyl-5- hydroxyhexyl) phthalate (MEHHP) (22.82 μg/L), mono-(2-ethyl- 5-hydroxyhexyl) phthalate (MEOHP) (16.08 μg/L), ΣDibutyl phthalate metabolites (ΣDBPm) (0.17 nmol/mL), Σdi-(2-ethylhexyl) phthalate metabolites (ΣDEHPm) (0.29 nmol/mL) were higher in participants from central Taiwan than those from other areas. The median level of DBP (ΣDBPm: 0.20 nmol/mL) was significantly higher in participants from harbor areas than those from other urbanization groups. We concluded that phthalate exposure of the general population in Taiwan varies by sex, age, region, and urbanization level. Exposure by the 7– 17-year-old group to DMP, DBP, and DEHP in Taiwan remains higher than that of youth from other

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A study of the particulate matter and carbon monoxide in small-sized pottery studio.

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Abstract

The pottery process is generally performed by grinding and mixing a clay, shaping and drying, glazing, firing, and post-treatment. However, it has not been known very well that potters may be exposed to various particulate and gaseous materials in these processes. Therefore, this study aims to measure and evaluate the exposure level of particulate matter for each of the work processes, and carbon monoxide generated in the process of the ceramic firing in small-sized pottery studio.
The measurement was taken by collecting personal samples of potters and area samples(kiln room, glaze workbench, and pottery wheel workbench) at a pottery studio in South Korea. We measured total dust and respiratory dust, and carbon monoxide was also measured near the peepholes of the electric kiln. In addition, SMPS and OPS were installed to calculate the particle number concentrations.

The overall concentration distribution of local and individual samples measured in three pottery workshops is shown in Table 3. The GM of TSP, RSP, and RCS, except for background concentration was 120.89 ug/m3, 42.86 ug/m3, 5.34 ug/m3. The CO concentration for the electric oxidation kiln (when oxidation firing) with both average and maximum concentrations of 3.55 ppm and 23.7 ppm, respectively. In the future, it is necessary to screen the relatively high-exposed workplace by performing a comparative evaluation between ceramic studios with various working environments.

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Cumulative Risk Assessment and Exposure Characteristics of Parabens in the General Taiwanese using Multiple Approaches

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Abstract

Introduction: Parabens are well known preservatives in pharmaceuticals and personal care products. We aimed to identify the exposure characteristics and estimate the cumulative risk of four parabens in the adults and minors of the Taiwanese population.

Method: We used urine samples, included 271 adults and 95 minors from Taiwan Environmental Survey for Toxicants 2013, and analyzed for four urinary parabens including methyl paraben (MeP), ethyl paraben (EtP), propyl paraben (PrP), butyl paraben (BuP) by using ultraperformance liquid chromatography–tandem mass spectrometry. We used health-based

guidance value (HBGV) and the antiandrogenic-based of parabens to calculate the hazard index (HI) for cumulative risk assessment.

Results: MeP and PrP were most abundant compounds, regardless of age or sex. Adults had a higher geometric mean (GM) level of four parabens than minors (adults: MeP, 381.7; PrP, 108.6; EtP 39.6 and BuP 6.3 ng/mL; minors: MeP, 65.7; PrP, 7.9, EtP, 2.6 and BuP 2.2 ng/mL). After adjustment for confounding factors, participants who used a higher number of personal care products had a significantly higher risk with higher concentrations of PrP (above 75th %tile) [adjusted odds ratio (aOR): 1.78, 1.01–3.15] and BuP [aOR: 1.80, 1.04–3.11]. However, the median and 95th percentile HI (the sum of the corresponding HQs of each paraben) was as 1.10 and 4.39-fold higher than safety level. In general, the HQ of PrP accounted for 90% of the individual's HI.

Conclusion: Our results indicate omnipresent exposure to parabens among the Taiwanese had caused a substantial risk.

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Urinary Concentrations of Phthalate and Alternative Plasticizer Metabolites of patients with chronic kidney disease before and after COVID-19

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Abstract

Phthalates are used as plastic plasticizers and exposed through various pathways such as oral intake and inhalation. Plasticizers are metabolized in the body and excreted through urine. As for patients with chronic kidney disease (CKD), the level of excreted metabolites is different from that of the general population. This study was to determine the exposure level of phthalates and alternative plasticizers in CKD patients before and after COVID-19.

Subjects were CKD patients before (BC, n=203) and after COVID-19 (AC, n=307). Three urine samples were obtained at 3-month intervals from AC group (n=842). Samples were pretreated by solid phase extraction (SPE), and 37 metabolites of phthalate and alternative plasticizers were analyzed using UPLC- MS/MS.

As a result, geometric mean of urinary concentrations of metabolites for BC and AC group were 38.16 μg/L and 27.92 μg/L for ΣDEHP, 1.62 μg/L and 3.27 μg/L for ΣDEHTP, 1.05 μg/L and 1.86 μg/L for ΣDINP, and 1.49 μg/L and 1.63 μg/L for ΣDEHA. As a result of ΣDEHP metabolites decreased, and the others increased after COVID-19.

The sum of all metabolite concentration were reduced after COVID-19. It seems that exposure to dust, the main source of exposure to phthalates, decreased due to wearing a mask for protecting COVID-19, or there were changes in lifestyle.

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Exposure Profiles of Emergent Metals: Taiwan Environmental Survey for Toxicants 2013-16.

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Abstract

Some hazardous metals were classified as human carcinogens and the low-dose exposure is still a concern. However, no information on exposure levels was conducted systemically of multiple metals in Asia using human biomonitoring. We aimed to establish reference Values and Exposure Profiles of Emergent Metals using the Taiwan Environmental Survey for Toxicants (TESTs) 2013-2016. A total of 1,871 Taiwanese (aged 7-97 years old) were recruited. Inductively coupled plasma-mass spectrometry was used to determine the concentrations of urinary Cr, Mn, Co, Ni, Cu, Zn, Ga, As (total), Se, Sr, Cd, In, Tl, and Pb. A questionnaire survey was applied to obtain individual demographic characteristics. We found that the median levels of urinary Cu, Zn, and Pb in males (Cu: 11.53; Zn: 449.61; Pb: 0.87 μg/L) were significantly higher than in females (Cu: 10.00; Zn: 347.06; Pb: 0.76 μg/L,). On the contrary, Co and Cd were significantly lower in male (Co: 0.27; Cd: 0.61 μg/L) than in female (Co: 0.40; Cd: 0.64 μg/L).

Only urinary Cd levels in adults (0.69 μg/L) were significantly higher than in minors (0.49 μg/L, $p<0.001$). The median levels of urinary Cd, Pb, and As were significantly higher in suburban (0.68 μg/L), rural (50.29 μg/L), industrial area (0.92 μg/L), and harbor areas (94.12 μg/L), respectively than the other regions. We concluded that the urinary levels of certain metals exposure in the general Taiwanese varied by gender, age, region, and urbanization.

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Comparison of exposure to VOCs in offices and homes during remote work.

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Abstract

In Finland, working remotely has become more common in recent years. The aim of this study was to evaluate working conditions and exposures at home and compare those in office environments offered the employer. The remote home offices (n=71) were selected voluntary basis among office workers in university, a city, bank and two research institutes. Environmental conditions, T, RH, air exchange rate, and concentrations of CO2 and volatile organic compounds were measured from workers home and office. VOC samples were collected into Tenax TA® adsorbent tubes and analyzed with a TD-GC-MS equipment during the normal working day.

The results showed differences between home and office environments. The averages of CO2 concentrations were 830 ppm and 540 ppm at home and workplace offices, respectively. Correspondingly the average concentrations of TVOCs were 200 µg/m3 and 33 µg/m3. These differences are explained partly by lower ventilation rate in homes than offices, 0,32 vs. 2.2 dm3/s/m2. At home offices the workers exposed to more complex mixtures and significantly higher concentrations of VOCs (average number of quantifiable VOCs 45, concentration ranges 35-1300 µg/m3) than at office environments (n=18, 2-370 µg/m3). The most abundant compounds at home environments were terpenes and aldehydes. Decamethylcyclopentasiloxane (max conc. 1200 µg/m3) was commonly present at homes (80%) and but less (max 33 µg/m3) in offices (13%). The results revealed that there are more individual sources for VOCs (e.g. consumer product, cosmetics) at home environment than at offices, and also more efficient ventilation dilutes the concentrations in offices lowering the exposure.

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Seasonal changes of urinary concentration of non-phthalate alternative plasticizer metabolites

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Abstract

Phthalate plasticizers have been widely used due to their excellent effect of softening plastics, but alternative plasticizers having a similar chemical structure have been developed and used due to endocrine disorders. Therefore, our purpose was to determine the level of metabolite of non-phthalate alternative plasticizers in human urine.

From 48 households, urine samples were collected 5 times (n=618). Urine samples were prepared by solid phase extraction (SPE) and analyzed using UPLC-MS/MS. Target compounds were 17 metabolites of 5 non-phthalate alternative plasticizers.

As a result, the sum of geometric mean concentration of metabolites (∑GM) showed differences by season in the order of summer(21.56 ng/mL), winter(20.40 ng/mL), and fall(17.66 ng/mL). And when comparing ∑GM by family member, the urinary concentration of children in metabolites were higher than that of adults. The concentrations were in the order of child(31.16 ng/mL), father(22.57 ng/mL), and mother(21.08 ng/mL).

Seasonal differences in urinary metabolite concentrations appear to be due to seasonal changes in lifestyle and behavioral factors. And the fact that the urine concentration of children in the family was higher than that of adults was consistent with previous studies. Based on this study, it is necessary to identify the exposure level and exposure source of the detailed alternative plasticizer.

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Surveillance of indoor air quality in residents' houses following health complaints in Luxembourg

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Abstract

Luxembourg has an indoor pollution surveillance program entering into action after health complaints. Comprising the collection of air, dust and surface samples in residents' houses. We performed exploratory analysis in our database, to evaluate the prevalence of (1) (very) volatile organic compounds ((v)VOCs) and (2) microorganisms in households, and to estimate the (3) risks of life- long exposure to selected (v)VOCs on the health of adult population.

The database included 715 indoor air samples of (v)VOCs from 159 different households and 251 samples for microorganism identification from 43 different households.

1. Higher levels of (v)VOCs were observed for methylisothiazolinone (GM: 1.2μg/m^3, P90: 4.0μg/m^3), benzene (GM: 2.7μg/m^3, P90: 8.0μg/m^3), formaldehyde (GM: 11.9μg/m^3, P90: 55.5μg/m^3), and limonene (GM: 10.3μg/m^3, P90: 81.7μg/m^3).
2. Microorganisms evaluation showed that concentrations of fungi were up to 10 times higher indoors than outdoors in 75% of the houses visited (especially for Aspergillus flavus, A. fumigatus and molds of Cladosporium and Penicillium genera). In addition, a relative humidity level higher than 60% was observed in 50% of houses.
3. Naphthalene presented the highest estimated cancer risk (148 expected additional cases per million individuals exposed to GM level), followed by benzene (79 expected cases), whilst estimated risk for 1,4- dichlorobenzene was much lower (3 expected cases).

Observed (v)VOCs and microorganisms levels were similar to neighboring countries. Our health impact assessment has identified some health risks associated with the observed (v)VOCs concentrations. Results show the major public health importance of having a surveillance systems in place.

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Identification of the contributing factors and analyses of their significance on the level of bioaerosols in indoor air within public-use facilities

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Abstract

[Introduction]

Health concerns exposed to hazardous biological agents have increased within public-use facilities, particularly due to their high utilization. We explored to identify contributing factors related to the level of total airborne bacteria (TAB) and airborne mold and analyzed their significant impact on the concentration in indoor air

[Methods]

Air samplings for TAB and mold were performed from July 2021 to April 2022 in several public-use facilities classified into four categories; A) used by the susceptible or vulnerable populations, B) public transport, C) stead temperature maintained, and D) cooking available. Other variables such as temperature, relative humidity (RH), sampling time (morning/afternoon), and the number of people occupied in indoor were measured as well. Logarithmic data were used for statistical

analyses due to their non-normality. Multiple regression analyses were performed for determining the statistical significance of contributing variables.

[Results]

Multiple regression analyses showed that B and C facilities have higher concentrations compared to other facilities and a significant correlation between temperature, RH and airborne mold was observed statistically. In addition, temperature, RH, and the number of people occupied in indoor showed a significant positive correlation with TAB.

[Conclusion]

Our findings suggest that management of temperature and RH would be effective for controlling the level of bioaerosols in public-use facilities. In addition, customized measures may be necessary for different kinds of facilities.

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Occupational environments as potential hotspots for azole resistance

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Abstract

Objective: To claim attention for azole resistance in the occupational environment.

Methods: Azole resistance was screened at one Waste sorting industry (WSI) in Filtering Respiratory Protection devices (FRPD) (N=120), and at Firefighters' Headquarters (FFH), by sampling Electrostatic dust cloths (EDC), swabs, settled dust, mops and cleaning cloths. Azole-supplemented Sabouraud (SAB) media was used, according with the EUCAST norm.

Results:

At WSI, the most prevalent fungi were Penicillium sp. in FRPD’s interior layers (48.6% itraconazole), and Aspergillus sp. in FRPD’s exhalation valves (75.0% itraconazole). Aspergillus section Nigri was the most prevalent in interior layers (64.1% SAB; 87.9% itraconazole; 40.0% voriconazole) followed by section Fumigati (30.7% SAB; 12.1% itraconazole; 54.5% voriconazole), with five more sections identified. In exhalation valves, six Aspergillus sections were identified,

the most prevalent being section Flavi (82.0% SAB; 11.1% itraconazole) and Fumigati (15.8% SAB; 44.4% itraconazole; 66.7% voriconazole).

At FFH, 0.1% to 1.1% Aspergillus sp. was observed, mostly in EDC (3.4% itraconazole; 3.2% voriconazole), and filters (0.03% itraconazole). Six Aspergillus sections were observed on SAB (80.6% Candidi: 8.9% Fumigati; 3.3% Nidulantes; 3.3% Circumdati; 2.9% Nigri; 1.2% Flavi), itraconazole (100% Fumigati), and voriconazole (97.1% Fumigati; 2.9% Nidulantes). Considering the MIC cutoff values of >2 μg/ml for amphotericin B, itraconazole or voriconazole, and > 0.25 μg/ml for posaconazole, 36% Fumigati isolates could be considered resistant. One Fumigati isolate recovered from FRPD carried the TR34/L98H mutation and was reported to be pan-azole-resistant

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Ethylparaben exposure from breastfeeding: Findings from an Intervention study of lactating mother-child pairs

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Abstract

Parabens are widely used as preservatives in personal care products (PCPs) and food. An intervention study was conducted to explore parabens exposure sources to mothers and to examine breastfeeding as a potential pathway to their children. Thirty pairs of mother-child were recruited for a 5-day intervention study. Basic PCPs and cooking sauces containing negligible parabens were provided for three days. Urines from mother and child and breast milk were collected before and after the three-day intervention. Seven types of parabens and two metabolites (urine only) were analyzed using LC-MSMS. A mixed-effect model was employed to assess the effect of PCP use and diet on paraben exposures.
Ethyl paraben (EtP) concentrations in mother's urine decreased by 67.5% (95% CI: -87.1, -17.9) after the intervention. Cooking sauces were identified as possible sources of EtP. A positive association between EtP among mother's urine and breast milk was observed (r=0.38, p= 0.04). Detection rates of EtP from breast milk and child's urine also decreased from 43.3% to 13.8% and 60.7% to 32.1%, respectively. EtP in child's urine was greater when EtP was detected in breastmilk. Meanwhile, a decrease in metabolites of methylparaben (MeP) and EtP was not observed. This study presented that diet can be a significant exposure source of EtP for mothers and EtP in breast milk could be associated with child's exposure.
Further studies are warranted to evaluate the major sources of paraben exposure and the contribution of breastfeeding to child's paraben exposures.

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Development of Autonomous and Real-time Biosurveillance and Response System in Indoor

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Abstract

We aimed to develop real-time biosurveillance and response system to manage biologically hazardous agents (BHAs).

The development of biosurveillance and response system proceeded following strategies; 1) Development of BHAs monitoring and response technology, 2) Development of BHAs management technology, 3) Establishment, operation, and identification of BHAs monitoring and response platform.

1. The development of the monitoring system proceeded by investigating the prior cases, and by constructing a DB platform of bioaerosols. In addition, a technology for identifying vulnerable spots for bioaerosol in facilities was developed through measurements of bioaerosols and the numerical model, and a system to respond to BHAs was established by setting response action through cooperation with a disinfection service company.
2. We established environmental monitoring system in several facilities for intensive management and selected species of bacteria and mold based on their hazard and frequency. In addition, environmental monitoring and response scenarios were presented considering the level and characteristics of bioaerosol.
3. Finally, we operated the test-bed for the demonstration of the stability and validation of the system. The monitoring infrastructure for BHAs monitoring and response platform for different kinds of facilities was established based on environmental response and monitoring scenarios.

In this study, we suggested strategies for the development of biosurveillance response technologies and platforms in public-use to manage BHAs. The results of this study will contribute to the prevention of infectious and environmental diseases caused by BHAs.

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Distribution of Indoor Air Bioaerosols in Public-use Facilities

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Abstract

Introduction: The Institute of Medicine and WHO have announced that exposure to fungi and bacteria is very involved in asthma and worsening symptoms. The mutual influence between the environment and health continues to increase, and in particular, the use of multi-use facilities and public facilities where an unspecified number of people are concentrated is feared to increase the threat of harmful microorganisms. Therefore, the purpose of this study is to determine the distribution of bioaerosols(total airborne bacteria, airborne mold) in public-use facilities.

Methods: Public-use facilities in 25 groups were selected as indoor measurement facilities. Indoor bioaerosols were measured three times in a row using the collision method according to the indoor air quality test criteria, and the temperature and humidity were also measured at each measurement.

Results and Discussion: Looking at the overall distribution of bioaerosols concentration in public-use facilities, it is monitored that no facility exceeds the maintenance and recommendation standards. However, some facilities exceeded the standard, and in particular, the number of facilities exceeded by daycare centers was higher than that of other facilities. In addition, it appears that there are quite a few excess facilities such as elderly care facilities, postpartum care centers, academies, and PC rooms. And facilities with a high concentration of total airborne bacteria are found to have a high concentration of airborne mold. Unexpectedly, it can be seen that facilities located underground (underground stations, funeral halls, etc.) have low concentrations of suspended microorganisms.

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Exploration of bisphenols exposure sources by relating urinary excreted mass to time-activities for seven consecutive days

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Abstract

Bisphenols (BPs) are endocrine disrupting chemicals. This study aimed to explore the possible exposure sources through relating urinary bisphenols to time-activities.

Twelve adults were recruited in 2015. Participants were asked answering a questionnaire for well-known BPs exposure sources and to collect all urine void for seven consecutive days. The total

volume of urine and collection time was recorded. During the period, time-activity diaries were recorded with 10- min intervals, which contained all consumed foods, activities, transportation, and locations. A total of 401 urine samples were analysed for eight BPs using LCMSMS. Urinary excreted mass derived from the concentration and volume was related to the questionnaire and time activity diaries from each individual to identify associating exposure sources and activities to each peak exposures or trends of BPs.

The BPA and BPS were detected in more than 70% of urine while the other bisphenols were in less than 15%. Median concentrations (25-75th) of BPA and BPS were 0.48 (<LOQ-1.11) and 0.08 (0.04-0.20) ng/ml, respectively. Well-known sources of BPs seemed not related to excretion mass of BPA or BPS. Meanwhile, laundry, facial washing and cleansing were frequently observed as potential sources of BPA or BPS. Specific sources of exposure contributing to BPA or BPS exposure were ointment, bandages, and newspaper. Plastering wallpaper or floor materials, demolishing wooden construction materials, and farming and trimming crops were newly identified as suspicious behaviors relating to BPs exposures from this study. Intervention studies would be necessary to confirm these activities as potential

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Measurement of skin moisture content and transepidermal water loss on the body of atopic dermatitis

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Abstract

Background

Real-time monitoring of the skin moisture content could be an effective prevention and management of symptoms of patients with atopic dermatitis (AD).

Objective

We explored to establish database for the moisture levels from skin of AD patients and to analyze the correlation between symptoms and water content on skin.

Methods

We measured the levels of transepidermal water loss (TEWL) using AF200 AquaFlux and moisture content using Corneometer on 15 body areas for 128 children under the age of 13 (100 patients with AD and 28 in the control group (CG)). Patients also were assessed by a pediatric

allergist using the SCORing Atopic Dermatitis (SCORAD). Correlation analyses were performed between SCORAD index, presence of lesions, water content and water loss in body areas after adjusting age and gender.

Results and Conclusion

TEWL of the AD (27.98±19.71) was significantly higher ($P<0.005$) than that of the CG(24.52±18.09). There were significant differences in both TEWL and moisture content according to the presence of lesions. In addition, our results demonstrate low level of water content and high water loss rate in the intertriginous areas (especially wrist, ankle, front of elbow, back of knee) regardless of the presence of lesions. TEWL is a critical indicator to monitor skin abnormalities of patients with AD rather than moisture content. Our findings would be used as background information for clinical applications and self-prevention in near future.

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Using standard proton transfer reaction time-of-flight mass spectrometry (PTR- ToF-MS) to assess worker exposure to products used in garages

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Abstract

Models that predict workers' exposures to hazardous chemicals at workplaces are usually calibrated and validated with personal exposure measurements at workplaces, which are either task-based or full-shift. While such measurements allow assessing average time-weighted exposures, they are not suited to gain information about how an exposure situation develops during an application. This question is especially important for applications that consist of spraying or wiping followed by evaporation of solvents as it is the case for painting or cleaning. To gain a better understanding of the exposure during such processes, a measurement method with a higher time resolution is required. In this study, we investigate the potential of proton transfer reaction time-of-flight mass spectrometry (PTR-ToF-MS) to measure the evaporation of garage products in real time during their application. Many products used in workshops, such as paints, thinners, or lubricants, contain hazardous volatile components that can pose a health risk if inhaled. Since most products used in workshops are mixtures, it is not sufficient to know the vapor pressure of the components in pure form to determine the exposure, but the vapor pressures

of the components in the mixture is required. We therefore complement the application monitoring by vapor pressure measurements of the products again using PTR-ToF-MS. The results of the exposure measurements with PTR-ToF-MS are compared with the maximum permissible concentrations from the safety data sheets for each product used in this measurement campaign and with the results from exposure models currently recommended by ECHA (European chemical agency).

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Wood shavings: From an occupational problem in sawmills to a food safety concern in poultries

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Abstract

One health is a collaborative, multisectoral, and transdisciplinary approach, aiming to achieve optimal health outcomes recognizing the interconnection between humans, animals, and their shared environment. Traditionally, the One health approach considered infectious diseases that can be spread between animals and humans and food represents an important driver in the context of One Health, uniting the three aspects: agents could infect animals, that could be introduced in the food chain and reaching humans through the environment, affecting their health. The composition of airborne microflora in sawmills varies greatly depending on the type of wood being processed and the manufacturing technology used. Thus, the workers occupational exposure to microbial contamination and, consequently, the potential health effects, are also dependent of the type of wood. In addition, wood dust is not only a “sawmill occupational problem”, since wood shavings that come from the sawmills occupational environment are commonly used as animal bedding in poultries. In fact, bedding materials may play a crucial role on pathogens development and mycotoxins contamination, being the wood shavings, one of the potential pollutants affecting poultry production. Additionaly, the frequent use of azole fungicides by the wood industry may promote fungal resistance strains, not only in this setting but also in others where wood shavings are applied. The use of wood-based litter might contribute to a potential risk of zoonosis in poultry production, affecting not only the animals health but also

workers and consumers health. Thus, further investigation concerning microbiological contamination is mandatory, to allow the risk management.

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Children's indoor exposure to air pollutants at Hispanic Households

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Abstract

Indoor air pollution is a major concern for environmental health. It has been more of a concern as we spend more time indoors due to the pandemic. There is also less knowledge of environmental exposures from minority communities, and this is also true for Hispanic children. Therefore, this study was designed to assess indoor air pollution exposure of children at Hispanic households. Monitoring of PM2.5, PM10, black carbon, and nitrogen oxides were conducted by pDR-1500 (Thermo Scientific Inc.), Sidepak AM520 (TSI Inc.), microaethalometer (Aeth Labs), and Ogawa passive sampler, respectively in 24 households in the greater Philadelphia region from November 2020 to March 2021. About four-day long monitoring took place at each of the households. A survey was also used to assess general information on the households. We found high particulate levels at the households. Nitrogen oxide levels were higher at the households with gas stoves than the electric stoves. Detailed findings assessing the status of indoor air quality, influence of proximity to households, and household conditions on indoor air quality will be presented.

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Comparison of chemical risk assessment of the Seirich software with expert judgment

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Abstract

SEIRICH is a chemical risk assessment tool developed in France in 2015 by the National Research and Safety Institute (INRS). It aims to harmonize the existing methods for assessing chemical risks in work environments and to ensure consistency among preventive actions. Seirich relies on a control banding method for chemical risk assessment. The aim of this work is to validate the results of this software with real life data, in order to reinforce, improve and extend its use. The chemical risk matrix (1) is a list of 88 real work situations representing workers' exposure to different types chemical hazards. They were evaluated by 21 experts according to the Delphi technique. The work situations were also evaluated by SEIRICH and the two evaluations were then compared. A situation is considered "coherent" when the SEIRICH score is within the uncertainty range of the

experts' score. Finally, each incoherent situation was studied to understand the origin of the inconsistency. The scores of 54% of the situations (n=48) are coherent between SEIRICH and the experts, 17% of them have a higher SEIRICH score than the experts, and 29% have a lower SEIRICH score than the experts. The analysis of the incoherent situations showed that the software was more conservative when hazards are respiratory sensitizers, and when protective measures exist. In contrast, Seirich was less conservative for assessing the risk of the chemicals emitted during processes (i.e. welding fumes and particles). This work identified the main limitations of Seirich that will allow to make improvements.

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Do certain nasal microbiome characteristics correlate to viral or MRSA susceptibility in dairy workers?

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James Seidel Biography

James Seidel is in his fourth year as a PhD student in the Industrial Hygiene Program at Colorado State University. Mr. Seidel's research is focused on understanding the dynamics of biological and chemical exposures in vulnerable populations, worker microbiome, and potential interventions. He is currently investigating bioaerosol exposures in dairy workers and chronic kidney disease of unknown origin in sugarcane cutters in Guatemala. Outside of work, James enjoys golfing, spending time outside with his girlfriend Suman, and playing chess.

Abstract

Livestock workers are exposed to bioaerosols comprised of diverse bacterial and viral constituents. Consequently, opportune pathogens present in these bioaerosols may infect workers. Pathogens identified at dairy farms include influenzas (e.g., the novel influenza D virus), coronaviruses, livestock- and community-associated methicillin-resistant staphylococcus aureus (MRSA). The nasal microbiome in livestock workers may play a role in the carriage of pathogens. Here, we analyzed 237 nasal lavage samples from 31 dairy workers to determine the carriage of Influenzas A, C, and D, methicillin- susceptible staphylococcus aureus (MSSA), and MRSA. Using Illumina technology, we characterized participants' nasal microbiome, specifically bacterial communities. Amplicon sequence variants were constructed using a GreenGenes pre-trained classifier. Diversity metrics based on pathogens of interest were performed using QIIME2's core-metrics pipeline. Analysis of the nasal lavages revealed 2.5% were positive for Influenza A, 1.3% positive for Influenza C, 17.3% positive for Influenza D, 1.3% positive for MRSA, and 32.5% positive for MSSA. Alpha diversity was explored using Shannon Diversity Index, and pairwise Kruskal-Wallis comparisons of lavages found no significant differences in alpha diversity based on individual

pathogens. PERMANOVA based on weighted UniFrac distances was performed to determine differences in beta diversity. A significant difference (p=0.01) in beta diversity was observed between lavages testing positive and negative for MSSA. We demonstrate that: pathogens occupy the nares of dairy workers during their shift, and a greater taxonomic diversity may confer protection against MSSA infection/carriage. Planned analysis of lavages should elicit a deeper understanding of the nasal microbiome characteristics that protect workers.

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ASSESSMENT OF THE SEALING EFFICACY OF A NOVEL GLOVE-SLEEVE CONNECTOR VERSUS REGULARLY USED TAPE

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Abstract

Activated Charcoal Cloth (ACC) patches can be used to evaluate the ingress of chemicals through personal protective equipment (PPEs), such as gloves and full bodysuits. In this study, we aim to evaluate the efficacy of the novel AlphaTec Glove Connector® to seal disposable chemical gloves with protective sleeves compared to a regular used ChemTape®. In an exposure chamber (300L), ACC patches were placed on the hand, wrist and underarm of a mannequin underneath gloves (Latex, Nitrile, Neoprene and Laminated gloves or Barrier), connection devices (connector or tape) and sleeves (AlphaTec3000®, 4000® and 5000®). We used a toluene spray as an exposure scenario (40mins exposure; 0.9mL/min rate; four sprays of 10sec) and found that the Barrier protected the best, followed by Nitrile, Neoprene and Latex. Our data also showed that a hermetic seal and perfect fit of the connecting device is important to avoid ingress via the interface between different PPEs. In case of a good seal, a glove with a high protection level, such as the Barrier, would protect the hand area (0.18mg/cm2) even though connected to a sleeve with a low protection level, AlphaTec3000® (4.65mg/cm2) but also inversely when a glove with a low protection level such as Latex (3.99mg/cm2) is connected to a sleeve with a high protection level, AlphaTec5000® (1.88mg/cm2). In conclusion, we found that combinations of PPEs with different levels of protection can influence each other when the hermetic seal is insufficient and in this set-up, the sealing of the tape was superior to the connector.

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Laboratory evaluation of Low-Cost Optical Particle Counters for occupational respirable exposure measurements

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Abstract

Direct-reading, time-resolved devices, offer a unique insight into the temporal and spatial distribution of airborne particles. They can provide a comprehensive picture of changes in concentration of airborne particles in occupational settings and therefore can be used help to investigate failures in engineering control systems as well as identify exposures driven by working procedures and methods.

In recent years, new developments have led to the commercialisation of low- cost optical-based sensors, which provide particle matter (PM) mass concentrations including PM2.5 and PM10 for environmental monitoring. TNO (Netherlands), NIOSH (USA), and HSE (UK) are investigating their application to occupational settings with the aim to produce guidelines for calibration and use.

This study evaluated the performance and accuracy of six commercially available low-cost sensors (Airbeam 2, Airveda, Omni Awair, OPC-N3, OPC-R1 and PATS+), in calm air test chambers, against reference devices including an Aerodynamic Particle Sizer (APS 3320), GK2.69 respirable cyclones, and pDR-1500 photometers (equipped with a respirable cyclone on the inlet and an integrated filter).
Several factors were considered: type of dust (particles having different size distribution, shape and refractive index), within- and between-device variations and exposure pattern (peak and constant concentrations). The devices were subjected to relatively high respirable concentrations (greater than 1 mg/m3) in addition to low concentrations. This presentation will present the results of the laboratory testing with focus on their accuracy, response, and calibration for quantitative exposure measurements. The low-cost sensor devices are also being deployed in the workplace for further evaluation and practicality of use.

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Risk Factors for Asthma - Epidemiological methods for ranking exposure factors

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Abstract

Asthma represents a significant disease burden, especially for children. Risk factors for asthma are diverse, including genetic, personal and early-life environmental exposures. Ecological epidemiological methods, using regional aggregate data, may assist in the systematic identification and ranking of risk factors relating to exposure.

In an unpublished ecological study, child asthma lifetime prevalence and period prevalence (dependent variables) were surveyed, with data from 73% of the South Australian 4-5 year old child population captured. Review of asthma risk factors identified more than 70 factors. Regional aggregate data linked to the survey afforded 53 exposure factors encompassing 114 independent variables. A cross-disciplinary collaborative approach explored these data and designed the statistical workup. Analyses incorporated univariate, bivariate statistics, and multiple linear regression with regression diagnostics.

We now report that four key personal and environmental exposure factors explained 62.5% of the variance for lifetime prevalence namely hay fever, Middle-Eastern ethnicity, mean minimum winter temperatures and 'colds'. For period prevalence 53.3% of the variance was explained by SEIFA Index, hay fever, the use of evaporative air conditioners, cockroach bait sales and average winter precipitation.

In the 20-year period since the original study was conducted, there has been limited progress in examination of such a broad range of factors using this approach. Its current day relevance assists future research directions in the exposure science of asthma risk factors, including prospective cohort studies with appropriate exposure assessments. It also aids in understanding ,and accounting for, confounders. It further highlights the value of cross-disciplinary collaboration in exposure science.

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Exposure assessment using low-cost sensor for policy development

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Abstract

Air pollution reduction strategies are developed to reduce the impact of air pollution on human health. However, without an understanding of air pollution exposure levels, it becomes difficult to assess its impact.

Punjab is an agrarian state known for its rice production. However, stubble burning is a major challenge. Stubble from the Rabi & Kharif crops are being burned in huge quantities, the impact of which can be seen in the neighboring states during the winter season. The adjoining state of Delhi faces increased PM2.5 concentration levels due to these farm fires.

The study conducted low-cost sensor (LCS) monitoring in 5 districts of Punjab to measure PM2.5 covering urban, & rural areas. The LCS network was established in the month of March 2022 to collect long-term high-resolution spatiotemporal variations of PM2.5 & understand the impact of

stubble burning exposure on humans & the ambient air quality levels. The estimates of human exposure are crucial in understanding the risks these pollutants pose and for designing and implementing strategies to control and limit these risks.

This generated data helped 1) understand the air quality trend (hourly, daily, & monthly data), 2) understand & compute indoor-outdoor PM2.5 ratios using the paired sensors, 3) investigate the impact of stubble burning on indoor and ambient PM2.5 levels, 4) estimate PM2.5 inhalation doses, & 5) develop a state-level air pollution strategy for Punjab

The LCS network will also aid in 1) understanding hyperlocal air quality levels, 2) generating data awareness and capacity building of citizen groups, & 3) developing policies at the city level.

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Hybrid machine learning method to estimate PM2.5 for the deadliest wildfire in California

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Abstract

Estimating PM2.5 levels while considering the impact of wildfire smoke has been challenging due to the lack of ground monitoring coverage near the smoke plumes. We aim to estimate the total PM2.5 concentration during the Camp Fire episode, the deadliest wildland fire in California history. Our hybrid machine learning model combines Geostationary Operational Environmental Satellite-16 (GOES-16)'s high temporal resolution to achieve hourly predictions, and oversampling techniques (Synthetic Minority Oversampling Technique, SMOTE) to reduce model underestimation at high PM2.5 levels, meteorological fields at 3 km resolution from the High-Resolution Rapid Refresh model and land-use variables. The model's output variable PM2.5 is obtained from the calibrated low-cost sensor data (PurpleAir) with regulatory monitor measurements (Air Quality System, AQS). We created a modeling grid at 3x5 km2 spatial resolution for spatial alignment of all model parameters, and our study region includes 40,578 grid cells. Some of the input parameters with high variability are decomposed into low and high-frequency components using Daubechies wavelet transform. Based on the measure of feature importance, the important components are recognized. The pre-processed data is trained using the random forest. The results show that the hybrid model wavelet-random forest (WRF) is reliable with R^2 =0.82 and RMSE = 15.27μg/m3 for predicting hourly PM2.5 during severe pollution episodes.

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Determination of glyphosate in indoor settled dust by hydrophilic interaction liquid chromatography with tandem mass spectrometry and implication for human exposure

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Abstract

The widespread application of glyphosate results in the contamination of outdoor environmental compartments,such as air and soil, which can then contaminate indoor environments. In this case, studying dust contamination appears to be important especially in the context of children's exposure. Indeed, children are more vulnerable firstly because they are more exposed than adults (ingestion of larger quantities of dust) and secondly because they may be more sensitive to the effects of environmental pollutants (developing organism).

A new specific analytical method was developed, using hydrophilic interaction liquid chromatography with tandem mass spectrometry (HILIC/MS/MS), to measure polar pesticides such as glyphosate, aminomethylphosphonic acid (AMPA), and glufosinate in indoor dust with a low limit of quantification (25 ng/g). Dust from vacuum cleaner bags from sixty rural and urban homes (Britany, France) was analyzed. All samples contained glyphosate (median 1675 ng/g for rural homes (n=29), 457 ng/g for urban homes (n=31)), more than 90% of dust samples contained AMPA, and none contained glufosinate. Concentrations of glyphosate were influenced by rural or urban settng, proximity to crops, and use of weed killers on driveways or lawns.

Exposure to glyphosate from indoor dust ingestion was less than 1% of the dietary intake, for adults as for children. This value may be underestimated because the high limit of quantitation for glyphosate concentration in the food analysis method likely led to an overestimation of the dose from food.

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A novel model to characterize source contributions of chemical contamination of surface water sources used as drinking water: a case study with 1,4-dioxane

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Abstract

1,4-Dioxane is a persistent and mobile organic chemical considered to be a likely human carcinogen by the U.S. Environmental Protection Agency. It is currently used in several industrial applications and occurs as an unintended byproduct of ethoxylated surfactants in some personal-care products such as detergents and soaps. Both sources may contribute to the contamination of surface water, and subsequently drinking water, by either direct release (in the case of industrial sources) or following down the drain (DTD) disposal and release of wastewater treatment effluent. However, 1,4-dioxane concentrations in the source water of different water treatment plants may vary significantly. To help understand and predict 1,4-dioxane water concentrations and proportional sources of contamination at water systems, we present EWISRD-XL(Estimating Water Industrial Surface Release and Down the Drain in Excel, pronounced "E-WIZARD-XL"), a simple, static, mass-balance model coded in MS Excel. This model is parameterized using measured or predicted values of 1,4-dioxane released from DTD or industrial sources, surface water flow information, and information about the flows and populations served by wastewater treatment plants. In two case studies in the US State of North Carolina, model predicted concentrations were within a factor of 10 of values measured at water treatment plants.

EWISRD-XL is currently under development for use by the USEPA Office of Pollution Prevention and Toxics for a supplemental risk evaluation of 1,4-dioxane. The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.

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Air Pollution Constituents that Influence the Frequency and Severity of Children's Asthma Exacerbations

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Abstract

Asthma exacerbations are responsible for 1.8 million emergency room visits and 0.4 million hospitalizations in the USA each year, constituting a major public health problem and economic burden. We measured personal exposure to air pollution in a cohort of exacerbation prone asthmatic children (n = 120, pre-COVID) in Denver, Colorado. Our goal is to

identify the air pollution constituents that influence exacerbation frequency and severity. The personal and indoor exposure measures included PM10 mass concentration and black carbon (BC), tobacco smoke (ETS), brown carbon (BrC), endotoxin, and 1,3 beta-glucan measured by the MicroPEM; NO2 and O3 concentrations from Ogawa passive samplers; and allergens from questionnaires. Exhaled nitric oxide (FeNO), spirometry, and CASI score assessed lung inflammation. Personal-indoor pollutant correlations followed established trends: personal PM10 greater than indoor and weakly correlated whereas personal-indoor NO2 levels are strongly correlated. Mean PM10 and ETS exposures did not vary by season. BC was higher in the winter and BrC was lower in spring compared to other seasons. The hourly average PM10 concentrations demonstrated seasonal variations, especially in the magnitude of peak exposures. Peak PM10 exposures always occurred in the afternoon or evening with fall > summer = winter > spring. From the surveys, the presence of a dog in the home was associated with greater allergic inflammation and asthma severity.
Preliminary analyses suggest personal PM10 and NO2 concentrations, but not indoor, are associated with higher FeNO. Final air pollution exposure and asthma severity associations will be presented.

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High resolution consumer product use data from Black women and Latinas collected using a smartphone app: Taking Stock Study

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Abstract

Black women and Latinas compared to White women have higher exposures to certain consumer product chemicals. Differences in product use, partially driven by socio-cultural factors, may contribute to exposure inequities. However, the lack of data on product use by women of color makes it difficult to connect product use patterns with exposure and health disparities. Using a newly developed smartphone app, 70 Black women and Latinas enrolled in a community-based participatory research study in South Los Angeles collected detailed product use information over one week. The app allows users to create a product inventory that includes the product brand and name, location of purchase, and photos of the front and ingredient list on the back of the product, which was used to create an ingredient database. Women logged >1000 products using the app; some women logged over 50 products/week. On average, women used 11 products/day. The most popular product types were personal care products, including soaps, lotions, and toothpaste, followed by cleaning products and cosmetics. Black women used more personal care, hair, and

intimate care products whereas Latinas used more cosmetics and cleaning products on a daily basis. There was substantial diversity in brands used; for example, over 51 brands of lotions were logged by 48 users. Ingredient data were used in personalized study reports. We demonstrated that a smartphone app is an agile tool for community- engaged research and an efficient method for collecting detailed product use data, which can support development of strategies to reduce exposures.

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Advancing the science of exposure assessment of low molecular weight components in polymer matrices

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Limited, Principal Consultant

Abstract

Current models for determination of migration of substances from plastics are based upon the Piringer model. Recent advances in model development have shown that the Piringer model describes steady- state conditions well but that diffusion within the polymer limits migration under most realistic use and exposure conditions which are not at steady-state. This new exposure science may provide an opportunity to advance both human health and environmental exposure and risk assessments from a wide range of structural matrices including polymers, micro and macro-plastics, metals and
alloys. Regulation of polymers under REACH is imminent and will require the development of guidance documents on the exposure assessment of low molecular weight components from solid, insoluble polymers. In addition, food contact regulations and associated guidance relating to repeated use and short contact conditions require updating to reflect recent scientific developments. Furthermore, greater understanding of exposure from macro- and micro-plastics is needed to inform on the risk assessment of these materials. In this context, ECETOC, EuPC, Cefic LRI and PlasticsEurope organised a workshop with the objectives of (1) Recognising the state of the science on experimental and computational modelling of the release of Low Molecular Weight Compounds from polymers; (2) Sharing cross-sector expertise on available models/methods and recent developments for exposure assessment of low molecular weight components in polymer matrices and (3) Identifying areas of research and development. This poster will present learnings from the workshop and proposals for future related research both for human and environmental exposures.

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Exposure to air pollution impaired semen quality in a preconception cohort, but no evidence for impact on sex of the offspring.

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Abstract

Previous analyses have identified higher odds of impaired semen quality with increased exposure to air pollution during the period of spermatogenesis. Earlier analysis of data from our preconception cohort additionally found that particulate exposure during early-phase spermatogenesis was associated with increased odds of impaired semen quality (<30% normal heads). In this analysis we evaluated the relationship between semen quality parameters and offspring sex at live birth among 103 live births with semen quality data for the father within a preconception cohort of 183 couples. The goal was to explore a possible relationship between particulate air pollution and secondary sex ratio through the pathway of semen quality. There was no difference in mean or median semen quality parameters by sex of the offspring in linear regression analyses. In Poisson regression with semen quality parameters categorized by WHO clinical cutpoints, there was also no association with sex of the offspring. This result is similar to previous analyses in a different preconception cohort and suggests that semen quality measures are not associated with sex of offspring among individuals that conceive naturally.

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Nasal Epithelial Lining Fluid as a Quick and Non-invasive Sampling Method to Detect Exposure to and Effects of E-cigarettes on the Respiratory Mucosa

Catalina Cobos-Uribe[1], Yun-Chung Hsiao[2], Alexis Payton[3], Chih-Wei Liu[4], Carole Robinette[5], Noelle Knight[6], Alayna Tackett[7], Kun Lu[8], Julia Rager[9], Meghan Rebuli[10,11]
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Abstract

E-cigarettes are electronic devices that deliver a complex aerosol mixture to the airways of users. E-cigarettes are a major concern for respiratory health in adolescents and young adults who have widely adopted their use. The majority of our understanding of the effects of e-cigarettes have come from studying e-liquids or the aerosol emissions from devices, but we know little about which constituents land on and directly interact with the respiratory mucosa. Additionally, these mixtures are not well regulated and many contain potentially hazardous constituents that can vary between device and e- liquid type. To better understand the constituents affecting the airway and to inform regulatory agencies on their effects, we have optimized a nasal mucosal sampling technique for use with high resolution mass spectrometry for detection of exposure and simultaneous analysis of respiratory immune outcomes via ELISA, proteomics, and metabolomics. In a pilot study, we obtained nasal epithelial lining fluid (NELF) samples using Leukosorb strips from healthy e-cigarette users and non- smokers. We detected changes in immune mediators, short chain fatty acids, sphingolipids, and other biological mediators by exposure and sex and detected differences in chemical exposure, such as nicotine and it's metabolites, glycerin, pesticides, and pharmaceutical drugs. Together, these results indicate that the NELF is a valuable collection method that can be used to assess a variety of airborne chemical exposures and associated respiratory effects. Additional data also demonstrates utility of this sampling tool for subject in-home self-sampling, as necessitated by COVID-19 pandemic related research restrictions.

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Towards an Integrative Risk Assessment: Adverse Outcome Pathway (AOP) and effect biomarker project for OECD WPHA and WPEA

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Abstract

Accounting for risks associated with combined exposures to unintentional chemical mixtures remains one of the most daunting challenges in environmental risk assessment. In concept, effect biomarkers can be used to elucidate relationships between exposure to environmental chemicals and their mixtures with associated health outcomes, by addressing the effects of both known and unknown components in an integrative way. However, the translation of magnitude of impact on an effect biomarker into an increased probability or severity of an adverse outcome is lacking.

Over the last decade, the Mode of Action/Adverse Outcome Pathway (MoA/AOP) framework has been increasingly used to assemble evidence linking biological changes measured at molecular, cellular, or biochemical level to adverse effects on human health or the environment. Where evidence is sufficient, quantitative understanding of the relationships between key events can allow for quantitative or semi- quantitative translation of a measured change in an effect biomarker into an estimated risk of adverse outcome.

An upcoming project coordinated with Organization for Economic Cooperation and Development (OECD) Working Parties on Hazard Assessment (WPHA) and Exposure Assessment (WPEA) intends to explore ways to bridge exposure and effect assessments using knowledge organized via the MoA/AOP framework. A systematic approach, based on questionnaires, expert judgment and case studies, establishing the relevance of effect-biomarkers will enable their use in single substance and mixture risk assessments, leading to adjustments options for mixture assessment factor (MAF) with reduced uncertainty, increased protection level by addressing unknown mixtures, and will also contribute
to reducing unnecessary animal testing.

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Inhalation and Dermal Exposures in Additive Manufacturing

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Abstract

Additive Manufacturing (AM) constitutes a rapidly emerging technology whose exposures and risks have not been thoroughly characterized, making appropriate risk management very challenging. Existing research has focused upon fused deposition modeling, but much of the most innovative and promising research being done in this field makes greater use of other AM methods, including vat photopolymerization and binder jetting. Very little information is available regarding exposures or controls for these AM technologies. This study characterized airborne emissions and surface contamination during tasks associated with binder jetting and vat photopolymerization in a field research laboratory environment, and examined available engineering controls. Real-

time detection and integrated methods were used to detect and quantify particulates, metals, aerosols from nanometer to 20 µm, acrylate monomers, and volatile organics. This data will enable us to better understand employee exposures during AM and recommend optimal controls. In this session, we will review the printing technologies and discuss the characterization of hazards identified. We will present the methods of data collection that were used to characterize inhalation exposures, dermal exposures, and room ventilation rates. We will review the preliminary findings, while showing the applicability of the research to other environments.

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Application of metabolite measurements to estimate geographic variations in VOC exposures

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Abstract

Measurement of VOC urinary metabolites is often utilized as a proxy for exposure to parent VOC compounds. However, use of metabolite measurements to understand small-scale spatial variations in VOC exposure and identify potential sources has been limited by low geographic density of measurements. Therefore, we measured VOC metabolites among participants in a geographically concentrated urban setting to assess spatial distribution and clustering of exposure.

We measured 16 anthropogenic VOC metabolites and creatinine among 725 geographically concentrated participants in an urban neighborhood primarily composed of single-family residential homes. We performed statistical principal component analysis (PCA) clustering with varimax rotation. To examine the high-resolution spatial variation of metabolite and PCA principal components, we geocoded each participant, standardized for creatine, and applied an optimized spatial interpolation for metabolite values and principal components. We employed the Getis-Ord General G statistic to identify significantly high and low spatial clusters of metabolite values. All analyses were repeated among smokers and non-smokers.

We observed highly varied spatial patterns of exposure, where metabolites with parent compounds such as toluene, xylene, and propylene oxide displayed coherent geographic trends. No pattern was observed with metabolites of acrylamide, crotonaldehyde, and acrylonitrile. PCA principal components among all participants were largely driven by exposure to tobacco smoke. When the 5 principal components of nonsmokers were assessed, each displayed coherent geographic patterns and significant clusters.

Results demonstrate the efficacy of geographic mapping of VOC exposure, potentially applicable to other urban cohorts and efficacious for identification of previously unknown sources and geographic variations in exposure.

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How exposure data in environmental justice communities can impact policy to improve health and well-being: Recent progress in Detroit, Michigan

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Abstract

Environmental justice communities often experience high pollutant exposure, elevated rates of adverse health effects, and poor quality of life. Typically, income, educational attainment, access to services, and political engagement in these communities are below norms. Exposure data can be a powerful lever to motivate, engage, and influence the public and policy makers. However, such data must be coupled with environmental health literacy among stakeholders, and science-based and actionable recommendations, to support policies and actions that ultimately improve public health. Such pathways to action are complex and years in the making, but applications are increasing at city and neighborhood scales, responding to local needs, availability of low cost sensors, and continuing deficiencies in regulatory frameworks at regional and national levels. We discuss progress in Detroit, Michigan, USA, focusing on the use of black carbon (BC) and noise (SPL) data to effect policy. The 'Motor City's' legacy of industry and commerce includes major pollutant sources, such as automobile manufacturing, refineries, coke ovens, steel production, fabricators, and freight and logistics centers. Most of these facilities are located in southwest Detroit along the Canadian border, which is one of nation's busiest international crossings, with 9,000 heavy duty trucks crossing daily. Much of this area is Hispanic or African-American, and residential areas are interspersed among industry. We describe the use of BC and SPL data collected at fixed ambient sites, indoors and outdoors of residences, and with a mobile platform, and its linkage to mitigation actions including truck routing, permitting, and building improvements.

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Urban exposome and climate change: the URBANOME paradigm

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Abstract

The current state of play in the climate policy debate focuses on two key aspects: the relevance and proper extent of mitigation measures in order to avoid crossing the point of no return; and the necessity for adaptation measures considering the very different socio-economic state and dynamics across the globe. In this light, URBANOME (urban exposome) aims at promoting urban health and wellbeing, through systematically integrating health concerns in urban policies (including the ones related to climate change mitigation and adaptation measures) and the activities of urban citizens, on the basis of detailed and comprehensive evidence on environmental health determinants, the spatial distribution of these in the city, and the social distribution of their impact among different population groups, accounting for different lifestyles and behaviours. Thus, URBANOME brings together the complete set of environmental, social, and functional features of a city through Urban Living Labs. Making use of the exposome for comprehensive health risk assessment on the population scale requires the development of advanced statistical and biochemical/pathology models based on a combination of environmental (also using sensors) and high dimensional biological data, enhanced by machine learning and big data analytics. In addition, agent-based models help capture the changing socioeconomic dynamics that influence societal vulnerability to climate-induced health stress. Considering the change in environmental pressure and human exposure to health stressors linked to climate change would allow us to construct the climate exposome: namely, the exposome of human population subgroups considering the climate change aspects relevant to the human lifespan.

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Hormone receptor bioactivities of complex mixtures of known and suspect chemicals in personal silicone wristband samples worn in office buildings

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Abstract

People are chronically exposed to hundreds of chemicals from building materials and consumer products, and many of these chemicals are hormone-disrupting. Because of the complexity of our exposures, we need to develop and employ methods that assess complex mixtures of both

identified and unidentified chemicals. In this study, office workers in the USA, UK, China, and India wore silicone wristband samplers only during work hours for about four weekdays to pinpoint their exposures in office buildings. We then analyzed the wristbands of 243 participants for 99 identified semi-volatile organic chemicals and over 1,000 suspect chemical features. We also conducted human hormone receptor activation assays (CALUX) using extracts of one-fifth wristband pieces to quantify how much the total chemical mixtures collected on wristbands interfered with estrogen, androgen, and thyroid hormone receptors in human cells. Of 23 unworn wristband field blanks, nearly all were below assay detection limits. We found that every participant's sample exhibited hormonal bioactivity towards at least one receptor. In preliminary Bayesian kernel machine regression (BKMR) models adjusted for country and sex, the concentrations of 28 frequently detected, identified chemicals in the wristbands contributed to strong overall mixture effects on the hormonal bioactivities of those wristband extracts. For example, 99% of the wristband extracts exhibited thyroid hormone receptor beta suppression, and there was a significant 25% increase in thyroid hormone receptor suppression associated with a joint increase in the chemical concentrations from their 50th to 75th percentiles. We identified several individual chemical components driving overall chemical mixture effects.

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Seasonal variation of exposure factors of children's products by gender and age

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Abstract

Children may be exposed to harmful chemicals from children's products. Accurate exposure factors of children's products are critical for exposure assessment of children's products. The aim of this study was to determine exposure factors of children's products by gender, age and season.

By proportional quota sampling, survey of 10,000 children aged 0 to 12 was conducted twice in summer and winter. The children's age groups were divided into four groups: infant (0-2 years old), toddler (3-6), lower-grade kid (7-9), and higher-grade kid (10-12). Exposure factors to product usage patterns such as use rate, use frequency, and use time of 58 children's products were collected.

The exposure factors of some children's products showed seasonal difference. Twenty-six of the 58 products showed significant differences in use rate, use frequency, and use time. Beach ball showed the largest difference in use rate, and wet wipe showed the largest difference in use frequency, and picnic mat showed the largest difference in use time. Six products had

statistical difference in exposure factors by gender. Baby mobile and handkerchief showed the largest difference in use frequency by gender.
Thirty-five products had statistical difference in exposure factors by age. Ball and pencil showed the largest difference in use time by age.

This study provided national representative exposure factors of the 58 children's products by gender, age and season. More accurate exposure assessment could be conducted with the specific exposure factors.

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Impacts of the choice of distance measurement method on estimates of access to point-based resources

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Abstract

Background: Lack of access to resources such as medical facilities and grocery stores is related to poor health outcomes and inequities, particularly in an environmental justice framework. There can be substantial differences in quantifying "access" to such resources, depending on the geospatial method used to generate distance estimates.

Methods: We compared three methods for calculating distance to the nearest grocery store to illustrate differential access at the census block-group level in the Atlanta metropolitan area, including: Euclidean distance estimation, service areas incorporating roadways and other factors, and cost distance for every point on the map.

Results: We found notable differences in access across the three estimation techniques, implying a high potential for exposure misclassification by estimation method. There was a lack of nuanced exposure in the highest- and lowest-access areas using the Euclidean distance method. We found an Intraclass Correlation Coefficient (ICC) of 0.69 (0.65, 0.73), indicating moderate agreement between estimation methods.

Conclusions: As compared with Euclidean distance, service areas and cost distance may represent a more meaningful characterization of "access" to resources. Each method has tradeoffs in computational resources required versus potential improvement in exposure classification. Careful consideration of the method used for determining "access" will reduce subsequent misclassifications.

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Urban dynamics and COVID-19 transmission

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Abstract

Pandemic evolution prediction has started to become particularly complex, as a result of the various parameters, including (a) the non-pharmacological interventions (such as social distancing, extensive testing, self-testing), (b) the pharmacological interventions (vaccination), (c) the effect of seasonality (d) the different transmissibility, disease severity and reinfection capacity of the various new strains. On the other hand, climate change (CC) itself, including the respective changes in temperature, humidity and UV radiation, has a direct impact on COVID-19 transmission and severity. At the same time, CC mitigation (e.g. promotion of public transport) and adaptation (e.g. use of biomass burning vs air conditioning for space heating) measures, as well as the use of technological advances such as indoor air purifiers, have a direct impact on COVID-19 transmissibility modifiers related to urban dynamics such as mobility patterns and social distancing measures. Accounting for all of the above, and having in mind the decision-making support to the national health system over the COVID-19 pandemic, a multi-modal computational tool (called CORE: COVID Risk Evaluation model) for evaluating the COVID-19 epidemic health risk in Greece, Italy and USA has been developed, able to access the impact of various pharmacological and non-pharmacological interventions, as well as the impacts of CC mitigation and adaptation measures. For defining the contact matrix among the various population groups, accounting for their sociodemographic profiles (i.e. age, income, education), as well as the impact of targeted social distancing measures an Agent-Based Modelling (ABM) has been employed.

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Exploring the urbanome in real life

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Abstract

The urbanome comprises all the environmental factors to which people living in cities are exposed, namely air pollution, pollen, molds, UV, noise, green spaces, vegetation, lack of exercise, reduced access to health services etc. These stressors are at the origin of several chronic diseases (respiratory, cardiovascular, metabolic, mental, etc.). At the same time, their levels are greatly impacted by climate change (CC) adaptation and mitigation measures, while CC itself amplifies the severity of the health impacts through various direct pathways such as heat waves or changes in the humidity and the UV radiation, and the cascade of inflammatory mechanisms that are initiated.

The advancement of mobile technology, sensors, and the "internet of things" bring exciting opportunities to explore the urbanome and its health impact. We will present the development and application of personal sensors for environmental parameters (e.g., for some air pollutants, noise, UV, etc.) and the way these are impacted by respective CC adaptation and mitigation measures modifiers, as well as the connected medical devices to assess respiratory health. The associated limitations and challenges of accessing such an amount of personal data will be presented in selected case studies in large EU urban areas, accounting for both short and long-term health effects. This will showcase the advantage of modelling long-term exposure to multiple urban-related environmental factors for understanding the impacts of CC in human health, and the way these impacts are distributed in relation to sociodemographic population characteristics.

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Human biomonitoring strategy for exposure assessment during the remediation works in an old industrial site polluted by solvents

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Abstract

Human biomonitoring (HBM) is an important tool to determine the actual exposure by analyzing concentrations of the substances or their metabolites in the body.

We investigated workers exposed to volatile organic compounds (VOCs) in an occupational setting by means of HBM in urine, integrated with air exposure measurements.

Exposed workers (n=57) were recruited during remediation actions in an old industrial site polluted by VOCs, from December 2019 until June 2020. Pre- and post-shift urine samples were collected together with continuous air monitoring for total VOCs using PIDs. Urinary concentration of methylhippuric acid; S-phenyl mercapturic acid; muconic acid; mandelic acid; phenylglycoxylic acid; trichloroacetic acid; o- cresol acid; hippuric acid were determined. Information about the performed tasks and personal protective equipment (PPE) were also collected.

Among the targeted metabolites, o-cresol urinary levels were lower in the period before Covid-19 outbreak, ranging from 0.08 to 0.51 mg/g creat, while, after the Covid-19 restriction, the concentration found ranged from 0.34 to 0.55 mg/g creat. However, the analyses of air samples have shown a higher VOCs concentration (1.72 – 33.98 ug/m3) in the first period, compared with the second period (1.5 – 12.03 ug/m3). These findings have been associated with an improper use of PPEs by the workers after the Covid-19 outbreak. We observed substantial differences at group level when there were unexpected solvent exposure peaks in combination with a new team of workers that came on-site after outbreak.

HBM is a highly relevant tool for occupational exposure and risk assessment, highlighting differences in working conditions.

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Modeling Personal PM2.5 Exposures within Multiple Microenvironments

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Abstract

Background: Personal PM2.5 exposure is determined by multiple complex sources, microenvironments, and behaviors; however, it is difficult to measure in large population health studies due to cost and burden. Therefore, an exposure model that can accurately predict personal exposure in all its complexity would help fill this gap.

Methods: We collected 48-hr integrated personal PM2.5 samples from 213 pregnant women participating in the MADRES cohort in Los Angeles, CA. We used the Air Pollutants Exposure (APEX) model to predict personal PM2.5 exposure in five major microenvironments during 2016-2020 for a simulated population of 500 women resembling the larger environmental health disparities population that MADRES reflects. We ran APEX under five scenarios with increasing contributions of indoor sources and more refined ventilation parameters and compared the distribution of its estimates to personal measurements.

Results: Overall, estimated daily personal PM2.5 exposures across all scenarios ranged from mean (SD)
9.5 (5) to 10.7 (6) μg/m3 and were significantly lower than measurements (23.3 (19) μg/m3). The scenario with home ventilation parameter and cooking using a gas stove best reproduced the range of personal measurements. Estimated exposures were highly correlated with ambient PM2.5 (Spearman r=0.83) and In-Residence microenvironmental exposure (r=0.54).

Conclusions: Our results suggest that APEX can be helpful to simulate population exposures to personal PM2.5 of outdoor origin, but a wider set of more representative and up-to-date inputs (i.e., time- activities, indoor sources) is needed to fully capture the complex factors that contribute to total personal PM2.5 exposure across microenvironments.

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Assessing the impact of environmental stressors on physical and mental health: A multi-modal big data perspective of the URBANOME approach

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Abstract

Monitoring and modeling of environmental stressors for the assessment of health-related outcome measures provide evidence-based feedback to policy makers and stakeholders at the urban

level. In this context, the objective of this article is to communicate the findings deliverd by the URBANOME approach, tested in nine European living labs. URBANOME approach stems from citizen science & participatory design principles for proposing a modular intervention design. Based on the Quadruple Helix model, multiple stakeholders from the local ecosystem are engaged in Urban Living Lab activities, following co-creation approach to create a mixed intervention, fusing their preferred urban scale activities combined with individual training. The co-creation procedure involves the selection & implementation/testing of urban scale activities (planting, gardening, improving and exploiting green/blue spaces, organizing social events). These are fused with individual level interventions involving cognitive, physical and mental health training. In this context, tools like the SmartHypnos mobile application are used for sleep quality and mental health assessment. It offers the feasibility for objectively estimating the participant's mobility and activity, geospatial and mood tracking. Overall, a recommendation system, based on decision treses, is employed to provide tailored suggestions for improving sleep quality and mental health. Citizens are involved in the Urban Living Labs co-design interventions, piloting and assessing results. A set of core outcome measures in terms of physical and mental health, quality of life, and further enhanced by a detailed cardiorespiratory clinical and neurophysiological assessment is introduced.

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Validation of real time sensors for workplace measurements using the BeCOH Workplace Atmosphere Multisampler (WAM)

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Abstract

Time-resolved and real-time sensors for particulate matter, volatiles or gases offer an appealing potential for occupational exposure assessment. As opposed to traditionally used sampling techniques with off line analysis, most of these sensors were not primarily designed for assessment of workplace exposure. Yet, national laws and regulations require the procedures used for evaluating workers exposure to chemical agents to provide reliable and valid results for OELV compliance and for the provision of acceptable control strategies. The basic requirements for measurement procedures are listed in international standards (ISO 20581:2016 and EN 482:2021) and the procedures for validation in a series of dedicated standards for different types of measurements and the appearance of the chemical agents (e.g. aerosol, mist, volatile, etc.).

An important step in the validation process consists of the evaluation of sensor performance in realistic workplace atmospheres. For this purpose, BeCOH has developed the Workplace Atmosphere Multisampler (WAM), a portable tool that allows comparing 12 samplers or sampling techniques in a single run. The WAM consists of a motor block, a pump deck, pump shields, and a 12-position sampling crown. It is operated at a speed high enough to guarantee that equal aerosol is provided to every sampler. All sampling pumps are shielded by decks to minimize air flow interferences.

This contribution aims to give an overview of the requirements for validation of sensors for workplace atmospheres and show how the WAM was used in different studies to assess the performance of samplers and sensors for different chemical agents.435

Particle Size Distribution and Toxicity of Airborne Exposure to Clean Fuel Cooking Emissions

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Abstract

Globally, about 2.6 billion people continue to rely upon biomass fuels to meet their household energy needs. Electrification of rural areas is slowly increasing, but the cost of electricity relative to household income makes induction cooking impossible for the most at-risk groups. Liquified petroleum gas (LPG), a fossil fuel, is a stopgap measure to promote clean cooking until electricity is universally available and affordable.

We measured aerosol emissions (SMPS, APS, MicroPEM, MSP PEM) during modified water boiling tests with 2 clean fuel stoves, LPG (60:40 butane:propane) and methanol (95%). The tests were performed in a simulated kitchen at ambient conditions (RTP, NC). Human bronchial epithelial cells (16HBE14o) were exposed to the cooking emissions (4 hours) at the air-liquid interface using an in vitro exposure chamber (Celtox). An ambient air Celtox concurrently exposed cells to ambient air for comparison.

Particle emissions were primarily in the ultrafine range (<100nm); the LPG peak occurred at 25nm and the methanol peak at 16nm. In all cases, cytotoxicity was greater in cells exposed to cooking emissions than ambient air. Exposure to LPG emissions led to a borderline significant increase in cell death over methanol emissions on a per particle basis (p=0.061). There was no difference in expression of IL-6, IL-8, COX-2, or HMOX1 between cells exposed to cooking emissions and ambient air. However, cells exposed to LPG emissions showed a statistically significant increase in expression of ALDH1A3 when compared to ambient air (p=0.004) and methanol emissions (p=0.006), indicating likely aldehyde formation during LPG combustion.

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Does short-term measurement outcomes describe long-term exposure levels? Lessons learned from whole-body vibration exposure assessment

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Abstract

Whole-body vibration (WBV) exposure among motorcycle riders were examined for its variability in vibration levels, and to explore how short-term measurement outcomes might be used to estimate longer-term exposure levels. Real-time monitoring data were collected from three motorcycles during various road trips. Each trip was taken by the same driver, and the real-time monitoring data were collected according to the standard method suggested by ISO-2631-1(1997). Frequency-weighted acceleration values were measured from x-, y- and z-directions and calculated for tri-axial acceleration value (a_{wv}), and the results were recorded every 0.1 seconds. From each road trip measurement, the overall root-mean-squared vibration value (a_{rns}) was also calculated. The measurement records were plotted over time to assess the variability in exposure levels around the a_{rms} value. In addition, the arms was recalculated by randomly selecting only a portion of the record to see how results might vary. The results suggested that awv varied greatly over time during road trip. The awv levels from motorcycles approximated a bi-modal distribution, with lower awv levels below 0.4 m/s^2 under idling condition; in contrast, the a_{wv} value varied from 0.4 to over 3 m/s^2 depending on travel speed and road conditions. The a_{wv} values measured during road trip fitted a log-normal distribution with geometric standard deviation at about 1.6. By taking partial records as samples for estimating the overall a_{rms}, the results were more than 50% likely to be underestimated. Real-time monitoring records can help assess the variability in exposure levels, and longer measurement time is preferred.

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The Subway Air Quality Initiative: Informing Strategies to Improve Subway Air Quality

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Abstract

Subway air quality is an ongoing public health concern. High mass concentrations of subway PM2.5 have resulted in calls for its mitigation. While PM2.5 and PM10 standards exist for some subways, implementing similar standards would pose a challenge for many systems. Research studies on improving subway air quality suggest that the development of effective and efficient air quality solutions require the assessment of a system's PM concentrations, trends, and sources.

To this end, the Subway Air Quality Initiative (SAQI) was conducted from 2018-2020 to measure PM2.5 on the platforms and trains of the two main subway lines in Toronto, Canada. This study provided several insights into the nature of subway air pollution. A 30% line-wide reduction of PM2.5 was observed with the modernization of rolling stock. An operational issue causing an increase in the rate of friction brake use and wheel flats resulted in a line-wide, 50% increase in PM2.5. The use of a track bed vacuum car did not impact platform PM2.5. A newly opened subway line attained PM2.5 levels similar to an adjacent older section within 1 year of operation. Finally, a source apportionment analysis estimated that >95% of PM2.5 is generated from the system itself. Overall, SAQI has emphasized the relationship between the operation and air quality of a system, the efficacy of reducing the rate of PM emission versus increasing the rate of PM removal, and the challenges of translating knowledge to public transit authorities.

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Exposure contrasts of pregnant women during the Household Air Pollution Intervention Network randomized controlled trial

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Abstract

Although exposure to $PM_{2.5}$ from solid fuel combustion is estimated to result in 2-3 million premature deaths annually, household energy interventions have had limited success reducing exposures to levels thought to provide substantive health benefits. Here we report exposure contrasts achieved by a liquified petroleum gas (LPG) intervention for 3195 pregnant women in the Household Air Pollution Intervention Network (HAPIN) randomized controlled trial in Guatemala, India, Peru, and Rwanda. 24-hr exposures to $PM_{2.5}$, carbon monoxide (CO), and black carbon (BC) were measured once before intervention and twice thereafter (aligned with trimester), with a 10% subsample having double the number of measures. Exposure contrasts were estimated by comparing intervention and control arms, and by using linear mixed-effect models to estimate changes in intervention-arm exposures. Median post-randomization exposures of $PM_{2.5}$ in the intervention arm were 66% lower than the control arm at the first follow-up (71.5 versus 24.1 μg/m^3) and 64% lower during the second follow-up (69.5 versus 23.7 μg/m^3). Exposures were similarly lower in the intervention arm for CO and BC (61-68%), consistent over time, and similar across study sites. 69% of the intervention-arm $PM_{2.5}$ samples were below the WHO Interim Target 1 of 35 μg/m^3, indicating the trial's success in reducing exposures to relatively low levels compared to many household air pollution interventions. Analysis of the 10% subsample with

additional measurements show similar exposure estimates compared to the standard monitoring, suggesting the less intensive monitoring provided reasonable estimates of participants' longer-term exposures.

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Sero-prevalence antibody surveillance for COVID-19 exposure assessment; Changes in nucleocapsid (N) and spike protein (S) antibodies in a general United States population-based sample during the first year of the COVID-19 pandemic.

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Abstract

Antibody surveillance is an important tool for tracking trends in past infections across diverse populations. At the start of the COVID-19 pandemic in the United States, diagnostic testing was limited with many asymptomatic and thus undetected cases raising concern amongst public health officials. This study includes adults and children (≥12 years old) recruited from a statewide sample of past 2014-2020 Survey of the Health of Wisconsin (SHOW) participants. SHOW, partnered with the Wisconsin Department of Health Services and the Wisconsin State Laboratory of Hygiene to conduct longitudinal antibody surveillance for nucleocapsid (N) antibody (WAVE I-III) and spike protein (S) (WAVE III only) detection. Three WAVES of sample collection were completed in the summer, fall, and early spring of 2020-202. Within the statewide probability sample, weighted estimates increased from 1.6% (95% CI:0.6-2.5%), to 6.8% (95% CI:4.3-9.4%) in WAVE II and to 11.4% (95% CI:8.2, 14.6%) in WAVE III. Longitudinal trends in seroprevalence match the statewide case counts. Local seroprevalence showed variation by state health region with increasing prevalence among higher income (>200% poverty income ratio), and rural health regions of the state seeing the highest increase in COVID-19 prevalence over time. Significant disparities in prevalence by racial and ethnic groups also exist. Among the 77 individuals reporting past infections in WAVE III, Among 77 WAVE III, 67% had detectable N and S antibodies, 22% had S-only antibodies and 10% had no detectable antibodies. General population-based findings lay the foundation for future research into longer-term immunity, health impacts, and population-level disparities.

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Sources of Personal PM2.5 Exposure in the MADRES Pregnancy Cohort

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Abstract

Background: Particulate matter air pollution with aerodynamic diameter <2.5 µm (PM2.5) is a mixture whose chemical composition and toxicity varies based on its major sources. Identifying and quantifying sources contributing to personal PM2.5 exposure is important for recommending strategies to effectively reduce exposures especially in vulnerable populations.

Methods: We collected 48-hr integrated personal PM2.5 samples on 37mm Pall Teflo filters from 212 low-income predominantly Hispanic/Latina pregnant women participating in the MADRES cohort in Los Angeles, CA. We analyzed the filters for PM2.5 mass, elemental composition, and optical carbon fractions. We used the EPA Positive Matrix Factorization (PMF) model to resolve major sources and quantify their contributions to total mass. We further conducted bivariate analyses to confirm source identities and expected trends in the PMF-predicted source contributions.

Results: Mean (SD) personal PM2.5 mass concentration was 22.3 (16.6) µg/m3. We identified six major sources (with major loading species in profiles and % contribution to total mass) as follows: secondhand smoking (brown carbon, environmental tobacco smoke, 64.2%), crustal (Al, Ca, Si, 12.6%), fuel oil (Ni, V, 11.4%), aged sea salt (Na, Mg, S, 4.8%), fresh sea salt (Na, Cl, 4.5%), and traffic (black carbon, Zn, 2.4%). In total, 76.8% of the mass came from indoor sources and 23.2% from outdoor sources, and 48% of the variability in PM2.5 mass was explained.

Conclusions: Our findings emphasize the variety of sources and complex factors that impact personal exposures of pregnant women in Los Angeles, CA.

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Developing a Fine-Scale Exposure Nature Index for the State of Massachusetts in the United States

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Abstract

Exposure to nature can have direct and indirect benefits to human health through ecosystem services. Many health studies assess nature exposure using a single exposure at a time which could miss cumulative and synergistic nature impacts. Here we present a fine-scale nature exposure metric at the census-tract level for the state of Massachusetts that incorporates multiple aspects of nature. We derived thirteen individual metrics at the census-tract level to capture various aspects of nature: greenness, parks and recreation, tree canopy, bluespace, and impervious surfaces. Variable inclusion was assessed using correlations. As a first step in the development of our Nature Index, we conducted a Principal Component Analysis (PCA) with a varimax rotation, to determine the number of components retained to maximize the explained variance using Eigenvalue ≥ 1. A complete dataset of 1,453 census tracts were included. The PCA retained two components, explaining a total variance of 64% using eight of the thirteen metrics meeting the inclusion criteria. Component 1 conceptually measured natural landscapes (greenness, tree canopy, percent impervious, and bluespace), and Component 2 measured park and recreation proximity (distance to trails and parks, number of parks, and park area). In our PCA, we reduced the number of variables that measure nature exposure from eight individual metrics to two components measuring natural landscapes and park and recreation proximity. Although individual metrics are important to consider when assessing the relationship between nature and health, results from a multidimensional approach can consider how these aspects of nature work simultaneously to impact health.

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Comparing creatinine and osmolality adjustment for urinary dilution in case- cohort studies of urine cadmium and cardiovascular disease endpoints

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Abstract

Assays of urine biomarkers require adjustment for urinary dilution. Creatinine is commonly used, however, osmolality may be less susceptible to muscle catabolism. We compared epidemiologic findings adjusting for urine dilution using creatinine and osmolality. Among 19,394 never smokers (aged 50-64) in the Danish Diet Cancer and Health Cohort we randomly selected a subcohort of 600 males and 600 females. We identified 958 heart failure (HF) cases, 809 acute myocardial infarction (AMI) cases, and 534 stroke cases in ~20 years of follow-up. We quantified cadmium, creatinine, and osmolality in baseline urine samples. Using an unweighted case-cohort approach, we estimated adjusted hazard ratios (aHR) in Cox proportional hazards models with age as the time axis. Participants had relatively low concentrations of urinary cadmium, as expected for never smokers (median = 0.20; 25th, 75th = 0.13, 0.32 mg cadmium/g creatinine). For all endpoints, results were similar regardless of whether we statistically adjusted for or standardized cadmium by creatinine or osmolality. For example, for HF, results with creatinine vs osmolality standardization when comparing the upper versus lowest quartile: creatinine: aHR = 1.29; 95% CI: 0.95 – 1.75; osmolality: aHR = 1.15; 95% CI: 0.87 – 1.53; and per interquartile range increment in cadmium: creatinine: aHR = 1.11; 95% CI: 1.02 – 1.21; osmolality: aHR = 1.10; 95% CI: 1.01 – 1.21. Results for stroke and AMI will also be reported, along with additional strategies of urine dilution adjustment. Estimated associations between urine cadmium and cardiovascular disease were robust to different approaches to adjusting for urinary dilution.

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Addressing the scarcity of Florida farmworker data: Using geographic information systems to assess vulnerability in H-2A and migrant labor camp housing

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Abstract

The H-2A program allows U.S. employers and labor contractors who meet specific regulatory requirements to bring foreign nationals to the U.S. to fill temporary or seasonal farmworker positions. Three of the top five states with the highest number of H-2A agricultural guest-workers are in the southeastern coastal areas of Florida, North Carolina, and Georgia. Florida, from 2017-2020, had the highest number of H-2A workers petitioned with 40,018 workers (2017), 51,681 (2018), 67,137 (2019), and 67,802 (2020). Each of these employer-granted H-2A certifications and migrant labor camp (MLC) permit holders are obligated to provide housing to their workers, with H-2A receiving housing at no cost. Florida housing camps/sites have not been adequately researched

and this study aims to explore farmworker housing within an ecological context that is underrepresented in the literature. Geographic information systems (GIS) techniques were utilized to map 32 H-2A/MLC farmworker housing locations granted certifications. Rural/suburban housing camps/sites were assessed for public transportation and health access vulnerability across sixteen counties. All locations were hard-to-reach due to rurality or location along unpaved roads within housing encampment grounds obstructed from view by tall hedges, trees, buildings, and fences. Each received an unsatisfactory inspection in 2021-2022, with multiple violations providing further evidence of farmworker inequities. Findings suggest area disadvantage, residential isolation, limited healthcare access and limitations for broader social inclusion. This assessment underscores the need for strategies to eliminate disparities among Florida farmworker populations and a stronger understanding of the mental and physical health implications associated with neighborhood factors.

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Relationship between Urine Creatinine and Urine Osmolality in Spot Samples among Men and Women in the Danish Diet Cancer and Health Cohort

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Abstract

Assays of urine biomarkers often use urine creatinine to account for urinary dilution, even though creatinine levels are influenced by underlying physiology and muscle catabolism. Urine osmolality—a measure of dissolved particles including ions, glucose, and urea—is thought to provide a more robust marker of urinary dilution but is seldom measured. The relationship between urine osmolality and creatinine is not well understood. We calculated correlation coefficients between urine creatinine and osmolality among 1375 members of a subcohort of the Danish Diet, Cancer, and Health Cohort, and within different subgroups. We used linear regression to relate creatinine with osmolality, and a lasso selection procedure to identify other variables that explain remaining variability in osmolality. Spearman correlation between urine creatinine and osmolality was strong overall ($\rho = 0.90$; 95% CI: 0.89–0.91) and in most subgroups. Linear regression showed that urine creatinine explained 60% of the variability in urine osmolality, with another 9% explained by urine thallium (Tl), cesium (Cs), and strontium (Sr).

Urinary creatinine and osmolality are strongly correlated, although urine Tl, Cs, and Sr might help supplement urine creatinine for purposes of urine dilution adjustment when osmolality is not available.

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Analytical sampling method for chemotherapeutic surface contamination in occupational settings

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Abstract

Chemotherapy drugs can persist on surfaces in cancer clinics, resulting in potentially hazardous exposures to healthcare workers and caregivers. Literature reports this drug contamination has the potential to travel out of oncology clinics to care facilities and homes of chemotherapy patients; however, the extent of this surface contamination is unclear. This project focuses on the development of a new liquid chromatography-mass spectrometry method for the simultaneous detection of multiple chemotherapies to test for potential surface contamination. The method was developed for six commonly used chemotherapy drugs: doxorubicin, cyclophosphamide, methotrexate, 5-fluorouracil, paclitaxel, and etoposide. The parent ion and corresponding fragment ions for each drug were determined using direct infusion mass spectrometry for their characterization and quantitation. The developed method was tested by spiking 0.25μg of the chemotherapy drugs onto stainless steel plates, simulating clinical surfaces. An aliquot of the samples was injected onto a triple quadrupole mass spectrometer using a ZorbaxSB C18 with a linear gradient and electrospray ionization. The drug recoveries ranged from 45-80%. Calibration curves were obtained by analyzing increasing amounts of drugs combined with set amounts of labeled internals standards to calculate the limits of detection (0.002 to 0.17 ng/mL) and limits of quantitation (0.010 to 0.71 ng/mL). Finally, our method wiped surfaces in an oncology treatment room at the University of Minnesota Veterinary Medical Center, where doxorubicin and cyclophosphamide are administered to veterinary patients. The method identified traces of these drugs, supporting the ability to precisely detect contamination by these drugs in an occupational setting.

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A Two-step Modeling Approach to Generate High Spatial Resolution Exposure Estimates from Coarse Regulatory Monitoring Data

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Abstract

BACKGROUND: Random-forest is a powerful algorithm in estimating air-pollutant concentrations but requires considerable training data. We developed a two-step modeling approach for predicting PM2.5 and NO2 in areas with limited monitoring data.

METHODS: Rochester, NY and Pittsburgh, PA were the study areas of a pregnancy-cohort study. In the first-step, regional models for PM2.5 and NO2 were developed. Daily concentrations from all Air Quality System sites within the two states were obtained as the response variable. Satellite data, meteorological, and land-use variables were included as predictors. In the second-step, short-term measurements using low-cost sensors were used in external validation in each city. Using backward selection, variables with potential emission-heterogeneity were gradually eliminated from the first-step models. This process was repeated until the final models had the highest R2 in explaining the local monitoring data.

RESULTS: Full models for PM2.5 and NO2 explained > 90% of the regional spatiotemporal variability. Four variables were eliminated in the Rochester model for PM2.5; compared with the full model, the average R2 and RMSE of the area-specific external validation improved from 0.43 and 5.10 μg to 0.65 and 2.83 μg. For the Pittsburgh-NO2 reduced model, six variables were removed, and the average R2 and RMSE of the area-specific external validation improved from 0.34 and 6.34 ppb to 0.43 and 4.20 ppb.

CONCLUSIONS: A two-step approach could be used to develop random-forest models for air pollution in areas with limited regulatory monitoring stations. The incorporation of local low-cost sensor measurements can improve the reliability of regional models.

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Levels and Determinants of Lipid- Adjusted Polychlorinated Biphenyls in Northern Canada

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Abstract

Biomonitoring projects were completed between 2016-2019 to assess analyte exposures including polychlorinated biphenyl levels (PCBs) in First Nation communities from the Northwest Territories (NWT) and Yukon. A community research agreement was established, and blood samples (n=328) were analyzed for fatty acids (DHA+EPA) and PCB levels. Results were lipid-normalized and summary statistics (e.g., geometric means (GMs), percentiles, detection limits) were generated. Statistical analyses were completed for PCBs with a limit of detection greater than 50%. PCB level and certain variables (e.g., sex, smoking status, region) significantly differed. PCB levels

between men and women differed. For example, in the Dehcho region, Arochlor1260 GM PCB levels were 1.76-fold significantly higher in men compared to women. Significant associations ($p<0.05$) were found between PCB levels and age and omega-3 fatty acids. The strongest correlation with age in the Sahtu region is PCB180 (Spearman's rho 0.906). PCB levels appeared highest in the Sahtú and Dehcho regions of the NWT and lower in Old Crow, Yukon. Further, PCB levels appeared generally lower than or similar to other national biomonitoring data with the exception of participants aged 60-79 years, whose lipid-adjusted biomarkers for select PCB congeners (e.g., PCB187, 194, 201) appeared significantly higher (up to 1.67-fold) in the Dehcho. Similar patterns with more PCB congeners (e.g., PCB 146, 153, 163) were found in the Sahtú region. These results will add to human biomonitoring data in Arctic and subarctic regions in Canada. Future research will explore sources of PCB exposure including traditional food dietary patterns.

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Exploring the health impacts of extreme heat and drought in Nigeria

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Abstract

Background: Extreme weather events, such as heat waves and droughts, are climate-related challenges of concern in Nigeria, Africa's most populous country. The objective of this study was to examine the health impacts of extreme heat and drought in a sample of Nigerian residents.

Methods: We conducted a cross-sectional study of 327 Nigerian residents. Participants were surveyed about their perceptions of and experiences related to extreme heat temperatures and drought. We evaluated physical health, mental health, and financial impacts using descriptive statistics and multivariable regression analyses.

Results: The sample included residents from 35 Nigerian states. Approximately 60% of the sample was male, and the median age was 33 years (range 18-67). More than one-third of participants (35.5%) believed that higher temperatures were occurring more often in their village or town, and more than half (51%) believed that droughts were occurring more often. Physical health and financial impacts during extreme heat and drought were more commonly reported than mental health impacts.
Approximately 30% of participants reported negative physical health impacts, 26% reported negative financial impacts, and 17% reported negative mental health impacts. Negative

financial impacts during droughts were associated with both physical ($p < 0.01$) and mental ($p < 0.001$) health impacts, after adjusting for age, gender, general health status, and household income.

Conclusions: Drought-related financial stress may be associated with adverse physical and mental health. A better understanding of drought-related impacts and the factors that influence them are needed to inform the public health response to extreme heat and drought in Nigeria.

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Longitudinal Assessment of Pesticide Exposure Levels Among Farmworkers in a Conventional versus Organic Grape Field.

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Abstract

The common use of organophosphate (OPs) and pyrethroid (PYRs) insecticides in Mexico represents a potential risk for farmworkers' health. Yet, there are no studies that have evaluated longitudinal pesticide exposures of Mexican migrant farmworkers working in a conventional versus an organic field.

The objective of this study was to determine and compare the pesticide exposures among grape field workers at the pre-harvest and late-harvest seasons. Also, to assess pesticide exposure differences among workers in a certified organic area versus a conventional area and a reference group.

We conducted a longitudinal study, where we recruited 73 grape field workers (excluded pesticide applicators), of whom 34 were randomly selected to work in an organic certified area and 39 to work in a conventional area. We also enrolled 24 office workers within the same region, as a reference group. Urine samples were collected from all workers and analyzed for multiple urinary pesticide metabolites OPs (e.g., chlorpyrifos, parathion) and PYRs (e.g., permethrin, cypermethrin, cyfluthrin) for all workers. For farmworkers, sampling was conducted at two timepoints, at the pre-harvest and during the late- harvest season. Statistical models were applied to compare differences between groups.

We found that most urinary OPs and PYRs metabolites increased significantly from the pre-harvest to the late-harvest season among farmworkers. Farmworkers in the conventional field had

significantly higher pesticide levels than farmworkers in the organic field at late-harvest. Our results showed the farmworkers in this region are exposed to pesticides at higher levels during the harvest season than non-farmworkers and other studies.

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Smoke exposure biomarker to differentiate between combusted and non- combusted product use

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Abstract

A commonly used biomarker for classifying cigarette smoking status is serum or urinary cotinine. However, cotinine does not differentiate between combustible and noncombustible tobacco products users. The increasing use of noncombustible tobacco product drives the need for a complementary biomarker for distinguishing cigarette smokers from users of noncombustible tobacco products.

Acrylonitrile is one of the primary constituents of tobacco smoke and is classified as a potential human carcinogen. In humans, acrylonitrile metabolizes to 2-cyanoethyl mercapturic acid (2CyEMA) via glutathione metabolic pathway. We measured urinary 2CyEMA cutoff concentrations for smoking status classification based on the representative sampling of the U.S. population (NHANES 2011-2016, the special smoker subset, ages >20). We found that urinary 2CyEMA is a selective smoke biomarker and effectively distinguishes cigarette users from the users of other noncombustible tobacco products, including ecigarettes. Using urinary 2CyEMA in conjunction with serum cotinine can unequivocally evaluate smoke exposure related to the use of combustible and noncombustible tobacco products.

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PM2.5 concentration and composition in subway systems in the Northeastern United States

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Abstract

Subways are integral parts of the infrastructure of urban centers around the world. Many studies have demonstrated subways have PM2.5 concentrations that are several times ambient concentrations.

Real-time and gravimetric PM2.5 concentrations were evaluated at 71 stations across 12 transit lines in the Philadelphia, Boston, Port Authority Trans-Hudson (PATH-NYC/NJ) and Metropolitan Transit Authority (MTA-NYC) of New York City, and Washington, DC subway systems. PM2.5 composition was determined by XRF, OC/EC analysis, and a synchrotron beam.

PM2.5 concentrations at underground stations were several times higher than at aboveground stations. Significant inter-transit system and inter-station differences in PM2.5 concentrations were observed. The highest mean concentration was observed at a PATH-NYC/NJ station, 1,020 µg/m3, including two 1-hour values of approximately 1,700 µg/m3. Iron contributed at 30% - 60% of PM2.5 with organic carbon and other metals making up the rest. Most of the iron was in the Fe+3+ state and in mineral forms associated with rust.

The major finding of our research is that PM2.5 concentrations are elevated in underground subway stations compared to ambient and other transit aboveground settings. Importantly, exposure to these elevated PM2.5 concentrations may prove a health risk for both commuters and transit workers who spend multiple hours underground each workshift. For effective remediation purposes, further research is needed to evaluate the potential toxicological effects of subway particles as well asl health studies in workers and commuters.

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Evaluation of real-time personal carbon monoxide (CO) exposure levels in the multi-country Household Air Pollution Intervention Network (HAPIN) liquified petroleum gas (LPG) stove and fuel intervention trial

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Abstract

Background: Household air pollution studies commonly use 24-hour average CO averages as exposure metrics. Here, we explore shorter averaging times and metrics and compare them with WHO Air Quality Guidelines (AQGs) (15-minute: 87.3ppm; 60-minute: 30.6 ppm; 8-hour: 8.7 ppm), which have important health implications in addition to the 24-hour guideline of 3.5 ppm.

Design: The HAPIN trial evaluated health effects of an intervention package of liquefied petroleum gas stove, free fuel, and behavioral messaging provided to ~3,200 pregnant women in Guatemala, India, Peru, and Rwanda. As part of HAPIN's exposure assessment, we measured personal CO exposure using the Lascar EL-CO-USB. We logged CO exposures for 24-hours at one-minute intervals for mothers and children. Using rolling averages, we determined the frequency of exceedances of WHO AQGs for 15- minute, 60-minute, 8-hour, and 24-hour time weighted averages. We estimated rolling average maternal exposures at baseline, prior to stove intervention delivery when all households use traditional biomass stoves.

Results: Some of the short-term guidelines were exceeded more frequently (9%, 17%, and 17% for the 15-minute, 60-minute, and 8-hour targets, respectively) compared to the 24-hour target (13%), indicating the importance of shorter-term exposures driven by cooking events. There was also substantial heterogeneity across sites, with various guidelines being most frequently exceeded in Peru (13-26%) and Rwanda (14-27%), and least commonly in Guatemala (2-10%) and India (5-9%).

Conclusions: HAPIN provides a unique dataset to explore the potential importance of short-term CO exposure using real-time data and highlights heterogeneity in shorter-term exposures at four HAPIN countries.

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Glycidol Mercapturate: A Biomarker Selective for E-Cigarette Exposure?

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Abstract

Abstract: Despite the continued popularity of e-cigarettes, their long-term health effects and specifically the cardiovascular and pulmonary disease risks remain unknown. Because acute exposure to e- cigarettes increases heart rate and blood pressure and induces endothelial dysfunction in both animal models and humans, we hypothesized that cardiovascular dysfunction is due to reactive aldehydes such as formaldehyde and acrolein that are generated in e-cigarette aerosols. These aldehydes are known products of heating and degradation of solvents propylene glycol:vegetable glycerin (PG:VG) present in e-liquids. Following acute exposure of mice to a mixture of PG:VG or to e-cigarette-derived aerosols, urinary excretion of both acrolein and glycidol metabolites - 3-hydroxypropylmercapturic acid (3HPMA) and 2,3-dihydroxypropylmercapturic acid (23HPMA), respectively – were detected by UPLC-MS/MS. Similarly, in humans, the acute use of e-cigarettes led to an increase in the urinary levels of 23HPMA, but not of 3HPMA. To confirm these metabolites were from e-cig solvents, specifically VG, mice were exposed to aerosols derived from PG:VG containing 13C3-VG, and then urinary 13C-enriched metabolites, i.e., 13C3-3HPMA and 13C3-23HPMA, were detected by UPLC-MS/MS. These stable isotope tracing experiments provide further evidence that thermal decomposition of VG in the e-liquid leads to generation of acrolein and glycidol. Moreover, the generally lower operating temperature of e- cigarettes appears to foster greater formation and/or longevity of glycidol. Thus, these findings support the potential that 23HPMA may be a relatively specific biomarker of e-cigarette use.

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Results of a school based intervention to reduce community impacts of aviation emissions

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Abstract

The Healthy Air, Healthy Schools Study was established in January 2020 to better understand the impacts of ultrafine particles (UFP) on indoor air quality in communities surrounding Seattle-Tacoma (Sea-Tac) International Airport. Multipollutant measurements were collected indoor and outdoor at five participating school locations to calculate infiltration indoors. The schools participating in this project were located within a 7-mile radius of Sea-Tac Airport and within 0.5 miles of an active flight path. Infiltration rates of total UFP particles, particles of aircraft origin and particles of heavy duty truck origin were estimated to be 54% [47%, 59%], 41% [38, 56%] and 74% [71%, 79%] respectively. Portable HEPA cleaners were an effective short-term intervention to

improve the air quality in classroom environments, reducing the ultrafine particles to approximately 1/10th of that measured outside. This study is unique in focusing on UFP in school settings and demonstrating through multivariate methods that the UFP measured in the classroom space is primarily of outdoor origin. Phase 2 of this project aims to evaluate the benefit to student health and academic performance of improved air quality and reduced outdoor origin UFP in schools.

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Propylene glycol as a specific biomarker for e-cigarette use – showcase of a novel Orbitrap-MS MS-based exposomics approach

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Abstract

New available tobacco products include e-cigarettes (ECs), heated tobacco products (HTPs) and oral tobacco/nicotine delivery products (OT). To understand risk reduction potential for smokers switching to ECs, longitudinal studies are needed. Measurement of nicotine (and metabolites) is not enough to ensure compliance. We conducted a controlled study with 10 sole users of different products: smokers, EC, HTP, OT, nicotine replacement therapy (NRT), and non-users. We developed an untargeted method by LC coupled to high resolution MS to identify and differentiate urinary exposome of each product user groups. Sulfate and glucuronide conjugates of propylene glycol (PG) were elevated in EC vapers' urine compared to other groups. A targeted LC-MS/MS method to quantify PG in urine and plasma was validated according to FDA guidelines, with 97 to 101% accuracy and variability below 10% CV throughout the calibration range (0.1-150 mg/L). Mean PG concentrations in vapers were 95.4 mg/24h in urine and 8.4 mg/L in plasma, significantly elevated compared to smokers, users of HTPs, OT, NRT, and non-users (1.5-3.3 mg/24h urine and 0.1-0.2 mg/L plasma). Additionally, PG in vaper's urine was significantly correlated with PG intake based on e-liquid used (Spearman rs = 0.98), urinary total nicotine equivalents (rs = 0.66), and moderately correlated to plasma Cotinine (rs = 0.35), emphasizing the high specificity of PG as a biomarker of exposure (BoE) for EC consumption. We therefore suggest the use of PG as BoE in urine and/or plasma to monitor EC use compliance in exposure assessments.

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Beauty and Auto Small Businesses Maneuver the Multi-faceted Risks of the COVID-19 Pandemic

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Abstract

Background: With the coronavirus pandemic, beauty salons and auto shops interested in understanding individual exposure to volatile organic compounds (VOCs) shifted priorities quickly to deal with a new invisible risk in the air. Workers in these small businesses now have new barriers resulting from their essential worker status and the economic impacts of U.S. federal and state guidelines.

Aims: This study explores competing risk perceptions regarding COVID-19, economic impacts, and disinfectant exposures of workers at small business beauty salons and auto shops in Tucson, Arizona.

Methods: We designed a cross-sectional survey to understand small business impacts and barriers associated with the COVID-19 pandemic. This survey was used to asses the competing risk perception regarding COVID-19 transmissions, vaccination status, financial hardships, and disinfection exposures. We tested how perceptions about risk categories vary across different groups using statistical models.

Results: Sixty-four individuals representing owners, managers, and employees responded to the survey between June 8, 2021, and February 16, 2022. The most pronounced differences in perceived risk were between the vaccinated and unvaccinated respondents for “not getting the COVID vaccine” ($p = 0.001$), with the vaccinated finding it a higher risk. Disinfection risks were perceived as low by the vaccinated, while for the unvaccinated, it was riskier. Generally, economic risks were ranked high regardless of vaccination status.

Conclusions: Future messaging targeting these small businesses should focus on intervention-hesitant individuals to increase their perceived risk of not getting the COVID-19 vaccine.

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Identifying heating stove events and their relation to indoor and personal $PM_{2.5}$ concentrations: an algorithm and machine learning-based approach

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Abstract

Approximately 85% of rural households in China burn solid fuel for household heating which generates hazardous air pollution and is a leading environmental risk factor for disease. Despite well-established impacts of indoor air pollution and temperature on human health, household heating behaviors are poorly understood. Understanding heating behavior is useful for characterizing air pollution exposure. We deployed stove use monitors to measure the short-term (24-h) and long-term (heating season duration) temperature of coal and biomass stoves in approximately 300 households across 50 villages in rural Beijing during two heating seasons (November-May of 2020-2022). We identified heating stove use events (i.e., time the stove was actively delivering heat to the environment) using two methods. We first established empirical heating criteria based on hand-coded identification of stove use events. In the second approach, we

used the hand-coded events as a training set for an Extreme Gradient Boosting (XGBoost) machine learning model to identify events. We compared the algorithm and machine learning approaches in terms of their ability to identify heating events based on sensitivity, specificity, and Brier score. Additionally, we evaluated the relationship between identified stove use and indoor and personal exposure to air pollution concentrations measured as part of the larger impact evaluation of a policy being implemented throughout Beijing to replace household coal heating with electric heating. Our study provides insight into the effectiveness of two tools for identifying stove use events, as well as how stove use can influence air pollution concentrations.

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"That's going to affect us and our environment sooner or later": developing a youth-informed conceptual model of urban environmental health though Photovoice

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Abstract

Background: Children are among the most susceptible groups to environmental health exposures. Despite their increased vulnerability, children's knowledge, experiences, and voices are often underutilized in environmental health research. Photovoice is a participatory action research method that examines and elevates the lived experiences of study participants. The objective of this study was to utilize Photovoice to explore the environmental health perceptions of urban, low-income youth in St. Louis, Missouri, USA.

Methods: We engaged 20 low-income children, ages 10-12 years, about their environmental health perceptions through Photovoice. Youth took photographs regarding how the environment impacts their health and later discussed the photos in small focus groups. Interviews lasted approximately 60 minutes and were recorded, transcribed, and analyzed by means of thematic analysis. Recurrent themes and categories were identified to inform the development of a conceptual model.

Results: Five major themes emerged from the data: environmental health exposures, environmental health sentiment, environmental health outcomes, environmental health interest, and environmental health solutions.

Conclusions: Photovoice is a feasible and effective method for developing a youth-informed conceptual model of environment and health. This conceptual model can be used to inform future efforts to promote the environmental health and well-being of low-income children in urban communities.

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Comparisons of the Enhanced Children's MicroPEM features for personal PM2.5 exposure assessment in the Household Air Pollution Intervention Network (HAPIN) trial, Guatemala

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Abstract

Background: The Enhanced Children's MicroPEM (ECM) was the main instrument for measuring fine particulate matter (PM2.5) in the multi-country Household Air Pollution Intervention Network (HAPIN) trial. Instruments previously used for personal exposure measurement have often been heavy and noisy. The ECM is lightweight, quiet, and captures both an integrated gravimetric sample and real-time (nephelometric) PM2.5 concentration data. Validation of the ECM to date is limited. The objective of this study was to assess the correlation and agreement between two collocated ECMs on gravimetric and nephelometric data.

Methods: We conducted personal exposure measurements with two collocated ECMs (worn by the same person at the same time) in a subset of pregnant women from the HAPIN trial Guatemala site. Twenty-four-hour average PM2.5 concentrations for the gravimetric (n=126) and nephelometric (n=125) samples were compared from collocated devices. We calculated intraclass correlation coefficients (ICC), this method reflects correlation and agreement between measurements. We also determined if mean differences were statistically different for each fuel type group: liquified petroleum gas (LPG) and biomass.

Results: The range of PM2.5 concentrations were 17.7 – 725.5 (mean=128.45) and 9.71 – 93.34 (mean=26.5) for biomass and LPG groups, respectively. ICC values were high for both gravimetric (ICC=0.93, root mean square error (RMSE)=33.6) and nephelometric (ICC=0.97, RMSE=27.5) collocations. Mean differences among type of fuel were not statistically different for gravimetric (p=0.75) nor nephelometric (p=0.61) measurements.

Conclusion: There is high reliability between collocated ECMs for both gravimetric and nephelometric comparisons at both biomass and LPG groups.

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Analyzing the Equity Impacts of Emission Reduction Interventions for Transportation Systems in the Northeastern United States

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Abstract

Fossil-fuel powered vehicles in the United States are a major focus of climate change mitigation efforts, given that the transportation sector is the largest contributor to the country's greenhouse gas emissions. Actions to mitigate these emissions also have important implications for local traffic-related air pollution. These pollutants often disproportionately impact lower income communities and communities of color. In this study, we evaluated the impacts of a set of hypothetical interventions to reduce transportation emissions in the Northeast and Mid-Atlantic United States, considering aggregate health benefits as well as implications for equity. Our emission reduction interventions were co- designed with members of environmental justice organizations from the region. We modeled the air pollution implications of each scenario using an emissions and air quality modeling platform (MOVES- SMOKE-CMAQ with application of the Decoupled Direct Method) to characterize air pollution sensitivities across source sectors and geographic locations. We compared concentration patterns of fine particulate matter ($PM_{2.5}$) between baseline and post-intervention using multiple quantitative inequality indicators from the peer-reviewed literature that were responsive to interests of environmental justice organizations. Our analyses indicate that emission control interventions that targeted urban public transportation infrastructure led to the greatest reductions in air pollution exposure inequalities between race and ethnicity groups across the region. Modeling platforms that quantify exposure and health co-benefits of climate mitigation strategies in high spatial detail with an explicit emphasis on equity, including through collaboration with organizations from impacted communities, can provide insight about optimal policies responsive to environmental justice concerns.

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Characterizing High Throughput Toxicokinetics for Chemical Decision Making

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Abstract

Toxicokinetics provides critical information linking external chemical exposures to internal tissue concentrations, persistence in the body, and route of elimination. Unfortunately, most chemicals in commerce and the environment lack toxicokinetic data. Since 2017 a series of international workshops on Accelerating the Pace of Chemical Risk Assessment (APCRA) regularly have examined how new approach methodologies (NAMs) can transform the regulatory evaluation of chemicals. This APCRA case study describes a framework for decision makers to make use of high throughput toxicokinetics (HTTK). HTTK combines chemical-specific *in vitro* measures of TK with reproducible, transparent, and open- source TK models that place data generated by NAMs in a public health risk context and enhance interpretation of biomonitoring data. We are developing a tiered, two-dimensional framework that contrasts the decision context against chemical-specific considerations. Model complexity (for example, physiological processes described) is constrained by the limited data available to calibrate and test the TK models to justify assumptions and establish accuracy. Different levels of certainty are needed for prioritization, risk evaluation, and for protecting susceptible populations. We are organizing what can be measured and modeled with HTTK, while describing the decision context, applicable chemistry, scientific motivation, impact on models, and existence and appropriateness of quantitative structure-property relationship (QSPR) models. The resulting framework, examples, and check lists are intended to serve as a guide to regulators who are interested in knowing when and where HTTK might be used for chemical safety decision making. *This abstract does not necessarily reflect any official agency or organization policy.*

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Not all vaping is the same: Differential effects of exposure to vaping nicotine versus cannabis

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Abstract

Electronic vaping products emerged in the late 1990s as an alternative mode of cannabis use. Cannabis vaporizers were typically large devices that heated dried cannabis herb. In early 2000s, smaller portable vaporizers emerged as 'e-cigarettes' and those vaping products and have become the most popular mode of nicotine administration. E-cigarettes heat nicotine in a solution rather than from dried tobacco leaf, as was the case for the early vaporizers that utilized dried cannabis. Recently, vaporizers in the cannabis market have followed a similar transition, with greater use of liquid cannabis extracts. While smoking cannabis remains the most common method of use, alternative modes of delivery, such as the use of vaping devices, are becoming increasingly popular. This is expected to further expand as cannabis and tobacco companies partner to benefit from vaping technology. Aerosols emitted from vaping products contain not only psychologically active substances like nicotine and cannabinoids (primarily THC and CBD), but also many known respiratory toxicants and irritants, including volatile carbonyls (e.g., formaldehyde, acetaldehyde, acrolein). Many chemical constituents involved in vaping nicotine and cannabinoids are similar, and others are very different, lending importance to considering these issues in the context of understanding patterns of exposure and health consequences of vaping both substances. Potential health consequences of inhaling chemicals emitted from nicotine-containing vaping devices may be similar or different than those associated from inhaling cannabinoid-containing products. This presentation will aim to compare side-by-side the key differences and similarities of vaporized cannabis versus nicotine.

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PAH exposure biomarkers and health effects among petroleum depot workers in Pakistan

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Abstract

At petroleum oil and lubricants (POL) depots, PAH exposure is a major health concern. In Pakistan, scanty data is available for workers exposed to PAHs and related health risks. This study has assessed PAHs exposure in three categories; labours, firemen and watch men in POL depots who remain in extreme contact with POL products. Biomarker system approach was used as a proxy measure of PAH exposure indicator and subsequent health risk assessment. Serum benzo[a]pyrene values (2.4 to 6.5 ng ml^{-1}) and indeno[1,2,3-cd]pyrene among exposed workers are found significantly higher ($p<0.01$) than unexposed controls. The former was highest in

firemen whereas concentration of latter was detected in maximum for labor followed by fireman and watchman. Variation of serum BaP in 'Watchman' was narrow than 'Labor' due to less work duration and their fewer number compared to Labor. Significantly higher cases for respiratory, renal, cardiovascular and neurasthenic illness were found 16.2%, 34.1%, 31.6%, and 35 % respectively among exposed cohorts. Logistic regression revealed increased serum benzo[a]pyrene associated with respiratory illness with (OR=4.60, 95%CI=1.928-10.981), and neurasthenic symptoms (OR=3.18, 95%CI=1.473-6.877). Population attributable risk (PAR) was calculated for nature of job among POL depot workers and exposure related cardiovascular diseases. The study concludes that petroleum related occupations in Pakistan are severely neglected in terms of their exposure assessment to chemicals and health risk analysis hence a continuous monitoring system needs to be established for such occupations..

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Adverse Birth Outcomes Related to NO2 and PM Exposure: European Systematic Review and Meta-Analysis

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Abstract

There is a growing number of international studies on the association between ambient air pollution and adverse pregnancy outcomes, and this systematic review and meta-analysis have been conducted focusing on European countries, to assess the crucial public health issue of this suspected association in this geographical area. A systematic literature search has been performed on all European epidemiological studies published up until 1 April 2020, on the association between maternal exposure during pregnancy to nitrogen dioxide (NO2) or particular matter (PM) and the risk of adverse birth outcomes, including low birth weight (LBW) and preterm birth (PTB). Fourteen articles were included in the systematic review and nine of them were included in the meta-analysis. Our meta-analysis was conducted for 2 combinations of NO2 exposure related to birth weight and PTB. Our systematic review revealed that the risk of LBW increases with the increase of air pollution exposure during the whole pregnancy. Our meta-analysis found that birth weight decreases with NO2 increase (pooled beta = −13.63, 95% CI (−28.03, 0.77)) and the risk of PTB increase for 10 μg/m3 increase in NO2 (pooled OR = 1.07 (0.90, 1.28)). However, the results were not statistically significant. Our findings support the main international results, suggesting that increased air pollution exposure during pregnancy might contribute to adverse birth outcomes, especially LBW. Further studies, well-focused on European countries, are called to resolve the limitations which could affect the strength of association such as the exposure assessment, the critical windows of exposure during pregnancy, etc.

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The effect of puff topography and device type on toxicant emissions from electronic cigarettes

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Abstract

The wide variety of electronic cigarette (EC) types, rapid introduction of new EC devices to the market, and a wide range of EC use patterns, e.g., puff duration and puff volume, make it difficult to establish standardized sampling and analysis protocols for testing EC. In this study, we investigated the relative importance of e-cigarette design, power output, liquid composition, puff topography on e-cigarette emissions of carbonyl compounds, carbon monoxide (CO), and nicotine. Four popular e-cigarette devices representing the most common e-cigarette types (e.g., cig-a-like, top-coil, 'mod', and 'pod') were tested. Under the tested vaping conditions, a top-coil device generated the highest amounts of formaldehyde and CO. A 'pod' type device (i.e., JUUL) emitted the highest amounts of nicotine, while generating the lowest levels of carbonyl and CO as compared to other tested e-cigarettes. Emissions increased nearly linearly with puff duration, while puff flow had a relatively small effect. Flavored e-liquids generated more carbonyls and CO than unflavored liquids. Carbonyl concentrations and CO in e-cigarette aerosols were found to be well correlated. While e-cigarettes emitted generally less CO and carbonyls than conventional cigarettes, daily carbonyl exposures from e-cigarette use could still exceed acute exposure limits, with the top-coil device potentially posing more harm than conventional cigarettes.

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What a Mix! Volatile Organic Compounds and Worker Exposure in Beauty Salon Small Businesses in Tucson, Arizona

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Abstract

Background: Beauty salon small businesses use products that contain volatile organic compounds (VOCs), which are harmful to human health. These businesses employ many low-wage workers that have gaps in health insurance coverage and lack access to general health screenings. More investigations need to quantify worker exposure to the specific compounds in these workplace environments.

Aims: The project aims to characterize worker exposure to VOCs in beauty salons in Tucson, Arizona. Because studies in the past focused on nail salons, we need to understand the beauty salon setting, where different services and products are applied, and yet greater health outcomes have been documented.

Methods: Community health workers recruited ten beauty salons. Personal VOC exposure was measured using a photo-ionization detector to estimate real-time data at 20-second intervals. Additionally, 70 specific VOC concentrations were estimated using a Summa canister, and business characteristics were collected. Statistical models were used to evaluate the impact of VOC exposure between and within shop factors.

Results: Mixed models show more variation in VOC concentrations between salons than within work shifts: the variance between salons is 3.6 times higher. The same mixed model also shows salon activity is significantly associated with VOC concentrations, $p=0.0009$. However, the effect size of activity is small. The percentage of total VOCs detected by the stationary summa canister ranged from 4% to 67%. Additional compounds were also identified.

Conclusions: This study can transform how individuals in beauty salons understand and potentially reduce exposures to specific VOCs in their workplace air.

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Exposure of adolescents to heavy metals, persistent organic pollutants (POPs), and rapidly excreted toxic substances in Sweden – the national survey Riksmaten Adolescents 2016-17

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Abstract

Background:

Adolescence is a period of significant physiological changes, and likely a sensitive window to chemical exposure. Nevertheless, few nation-wide population-based studies on adolescent body burdens of chemicals have been published. In the national survey Riksmaten Adolescents (RMA) 2016-17 heavy metals, chlorinated/brominated/fluorinated POPs were analyzed in blood and serum, and metabolites of phthalates/phthalate alternatives, phosphorous flame retardants, polycyclic aromatic hydrocarbons, and pesticides, along with bisphenols, biocides/preservatives/antioxidants and UV filters in urine (N=1082, ages 11-19). The aim is to characterize the chemical body burdens in relation to published biomonitoring health-based guidance values (HBGV).

Results & Discussion:

Differences in geometric mean concentrations were less than 3-fold in comparison to those observed among adolescents in NHANES (USA 2015-16) and GerES V (Germany 2014-17). Notable exceptions were brominated diphenyl ethers (PBDEs) with >7-fold lower mean concentrations, and biocide triclosan and UV-filter benzophenone-3 with >15-fold lower mean concentrations compared to NHANES. Exceedances of the most conservative HBGVs were observed for aluminum (26% of subjects), perfluorooctanesulfonic acid (PFOS) (19%), perfluorooctanoic acid (12%), lead (12%), MnBP (dibutyl phthalate metabolite, 5%), hexachlorobenzene (HCB) (3.1%) and 3-PBA (pyrethroid metabolite, 2.2%). Males showed a higher proportion of exceedances than females for lead, HCB and PFOS, otherwise no gender-related differences in exceedances were observed.

Conclusion:

Industrialized countries with similarly high standards of living, with some exceptions, show comparable average body burdens of a variety of toxic chemicals among adolescents from the general population. The exceedances of HBGVs show that further efforts to limit chemical exposure are warranted.

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Increased risk for prenatal exposure to mercury due to climate change: Possible control through human biomonitoring and fish consumption advice for pregnancy

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Abstract

Climate change (CC) increases the risk of human exposure to mercury, by impacting its cycle in the environment through multiple mechanisms, including (a) the increased mobility in the environment through water runoff and groundwater recharge (b) the increased rate of biotransformation of inorganic mercury forms to the most toxic methylmercury resulting from higher environmental temperatures and
(c) the minimum sea surface temperature is the most important factor impacting distribution and migration patterns for all species, resulting in the consumption of larger fish species characterized by higher biomagnification levels.

Considering that fish consumption by pregnant women results in higher foetal exposure to mercury, but at the same time provides essential nutrients for optimal brain development, the benefits can outweigh the risks if suitable dietary advice is provided during pregnancy, yet many countries lack standard practices to inform pregnant women in an appropriate way. To address this gap, a harmonized dietary intervention study (HBM4EU-MOM) was implemented in five coastal European countries (Cyprus, Greece, Portugal, Spain, Iceland). ~130 pregnant women per country provided hair samples for mercury biomonitoring and extensive information about their fish consumption and preferences. Based on the identified exposure levels, and accounting for the various mercury sources and socioeconomic exposure determinants, targeted fish consumption advice was communicated and the exposure was reassessed at

≥12 weeks after the provision of advice, resulting in significantly decreased mercury exposure, without to reduce intake of fish related essential nutrients. Overall, the study results provide evidence for targeted interventions, addressing directly the CC-originated impacts.

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Nicotine and THC intake from single substance use and co-administration of marijuana and tobacco with a loose-leaf vaporizer

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Abstract

Objective: to examine differences in tetrahydrocannabinol (THC) and nicotine intake from administering marijuana only, tobacco only, and a mixture of marijuana and tobacco using a PAX-3 loose-leaf vaporizer. Methods: Eight healthy adult dual users of marijuana and tobacco participated in a 3-arm within-subject study in a hospital research ward. During each arm, participants were administered 3 standardized puffs (5-s puff, 10-s breath hold, every 45 seconds) of marijuana only, tobacco only, or a combination of both with a PAX-3 followed by 6 hours of abstinence. The average amount of substances consumed (mean ± SD) was greater during use of the mixture (26±8 mg) and marijuana only (21±2 mg) compared to tobacco only (16±3 mg) ($p=0.03$). Mean maximum plasma THC concentration (Cmax) was higher during use of the mixture (25.7±14.0 ng/mL) than with marijuana only (10.1±6.1 ng/mL) ($p<0.01$). Similarly, mean plasma nicotine Cmax was higher with the mixture (1.6±0.7 ng/mL) than with tobacco only (0.6±0.3 ng/mL) ($p<0.01$). Heart rate was more elevated with the mixture compared to tobacco only ($p<0.01$) and not different with marijuana only. Finally, participants self-reported greater "high" with the mixture and marijuana only than tobacco only. While there was no difference in "high" between the mixture and marijuana only, participants "liked" the mixture more than marijuana only or tobacco only. Conclusion: This small proof-of-concept study suggests that vaping a mixture of marijuana and tobacco leads to greater systemic exposure to THC and nicotine than when vaped alone.

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A study protocol to explore the social effects of environmental exposure and lifestyle behaviours on adverse pregnancy outcome: an overview of pregnant women cohort study

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Abstract

A growing number of international studies have highlighted the adverse consequences of lived experience in the first 1000 days of early life on the probability of stillbirth, child mortality, and healthy development during both childhood and adulthood. The aim of our project is to explore the relationships between exposome characteristics and the health status of pregnant women and their newborns. Specifically, we study the relationships between the social inequality of adverse pregnancy outcomes and exposure to atmospheric pollution and pregnancy lifestyle.

This is a cohort study of pregnant women, involving on university hospital across two sites in the Eurometropolis of Strasbourg. The researchers collect data on outcomes and individual characteristics from registries, clinical records data, and questionnaires. Participants are being recruited from first- trimester antenatal ultrasound examinations; each woman meeting our inclusion criteria enters the cohort at the end of the first trimester. Study participants receive three online questionnaires covering socio-demographic characteristics, travel behaviour patterns, and lifestyle. The level of personal exposure to air pollution is characterized using a dynamic spatio-temporal trajectory model that describes the main daily movements of pregnant women and the time spent in each place frequented. Univariate, multilevel, and bayesian models will be used to investigate the relationships between exposome characteristics and the health status of pregnant women and their newborns.

Ethics and dissemination Research approved by the Commission de Protection des Personnes Ile de France VI on 9 December 2020 and the Agence Nationale de Sécurité du Médicament was informed of it on 15 December 2020.

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Optimization and Process Design Tools for estimation of weekly exposure to air pollution integrating travel patterns during pregnancy

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Abstract

A growing number of international studies have highlighted that exposure to air pollution contributes substantially to the burden of preterm birth and infant death. Several other epidemiological studies have also suggested associations between air pollutants concentrations and adverse birth outcomes including low birth weight and preterm birth. To do so, researchers need to estimate exposure levels to air pollution throughout everyday life. In the literature, the most commonly used estimate is based on home address only or taking into account, in

addition, the work address. Several studies have shown the importance of daily mobility in the estimate of exposure to outdoor air pollutants.

In this context, we developed an R procedure that estimates individual exposures by combining home addresses, several important places, and itineraries of the principal mobility during a week. It supplies researchers a useful tool to calculate individual daily exposition to air pollutants weighting by the time spent at each of the most frequented locations (work, residential address, etc.) and while commuting. This task requires the calculation of travel time matrices or the examination of multimodal transport routes.

This procedure is structured in three parts: the first part is to create a network, the second allows to estimate main itineraries of the daily mobility and the last one tries to reconstitute the level of air pollution exposure. One main advantage of the tool is that the procedure can be used with different spatial scales and for any air pollutant.

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Exposure to Metals from Electronic Cigarette Use – data from the EMIT study

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Abstract

The rapid evolution of e-cigarette products warrants constant surveillance of the differences in exposure across device generations – MODs, PODs, disposable PODs (d-PODs). We will summarize metal aerosol concentrations by device type (MODs, PODs, d-PODs) and popular flavors, and present blood metal concentrations by type of device and user behaviors. Methods: We collected aerosol from 137 MODs, 67 PODs, and 23 d-PODs, and blood and behavior data from 17 MOD, 24 POD, 10 smokers, 14 dual (smoker and e-cig) users, and 30 non-user controls. Metals (As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn) in aerosol and blood samples were measured using ICP-MS. Chi-squared for categorical variables, ANOVA for continuous variables, and linear regressions were used to assess relationships between variables and groups. Results: All metal concentrations except for Zn were statistically significantly higher in aerosols of MODs compared to PODs and d-PODs. By POD flavor, Cu, Fe, and Ni were 85-98% higher in tobacco than in mint flavored aerosols, and As concentrations were statistically significantly higher in tobacco than mint-flavored d-PODs. Never smokers and younger users were more likely to use higher nicotine concentration than former smokers. Significant differences in blood were found between user groups for Cd, Mn, Ni, and Zn. Cr and Ni in MOD users were significantly higher than POD and nonusers.

Conclusion: Overall, MODs and tobacco flavored aerosols generate higher metal concentrations. Differences in user behaviors and device type determine exposure to certain metals. Blood Cd, Mn, Ni, and Zn were associated with user group.

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When to Sound an Alarm: Contaminants of Emerging Concern

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Abstract

Contaminants of Emerging Concern (CECs) are of increasing interest, especially in circumstances where little empirical or modeled data are available to understand factors that influence potential risk. CECs can cover a wide range of agents (e.g., chemical, biological, radiological) environmental media and chemistries. Local, regional, tribal, and federal governments are challenged with ways to systematically identify, monitor and manage any potential risks associated with CECs. The U.S. Environmental Protection Agency (EPA) is working to develop a technical framework to expedite the Agency's response to potential CECs. Additionally, EPA is working with other U.S. federal partners under the auspices of National Defense Authorization Act of 2020 to coordinate on research and data gaps for addressing CECs, especially in water.

This presentation will cover a technical framework, called Screening Risk of Emerging Contaminants (SIREN), that the EPA may use to help identify situations for wider agency mobilization on addressing a CEC. Factors to consider include potential hazards, exposure, persistence, bioaccumulation and cross- media impacts. The presentation will provide overview perspectives from coordinated federal discussions on important research gaps for CECs, what research is currently underway to evaluate them (e.g., on analytical methods, occurrence, source, transport, eco and health risks), and a basic structure for how to begin identifying and evaluating CECs.

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Lessons learned: How a Wastewater Based Epidemiology academic initiative was migrated to a County public health laboratory to allow a focus on surveillance of SARS-CoV-2 in underserved communities

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Abstract

Wastewater Based Epidemiology (WBE) can be used as a rapid, sensitive, and cost-efficient surveillance system for detecting SARS-CoV-2 in cities, neighborhoods, campuses, and buildings. For two years, Loma Linda University's (LLU) laboratory refined a qPCR protocol using WBE to detect as few as 100 gene copies per 1 liter of wastewater from campus buildings. Samples are collected from specific locations on campus while maintaining an active comparison to twice weekly composite samples from the San Bernardino wastewater treatment facility. San Bernardino County Department of Public Health (SBCDPH) partnered with San Bernardino Municipal Water District (SBMWD) and the LLU content expert team to mobilize WBE as a sustainable surveillance protocol with SBCDPH's laboratory. For a sustainable program and seamless data pipeline, SBC will be equipped to handle a larger volume of wastewater samples from underserved neighborhoods and congregate living facilities. This presentation describes the transition process and activation of an environmental surveillance protocol. The sampling, partners, laboratory protocols, GIS strategy, and data pipeline are described. The need for WBE surveillance is justified by mapping the disparity of vaccine coverage and testing for SARS-CoV-2 among underserved communities. The Healthy Places Index (HPI) and CDC's Social Vulnerability Index (SVI) were used to investigate the spatial correlation of testing disparity with social vulnerability. This study showed how WBE was successfully incorporated as a routine surveillance tool for SBCDPH.Further research will optimize the identification of SARS-CoV-2 variants using genome sequencing.

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Towards characterizing the galaxies of biosolids chemical classes across the chemical universe

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Abstract

Chemical contaminants in wastewater may accumulate in biosolids, and screening these for potential risk to human and ecological health is important for mitigating adverse outcomes. Thus, biosolids are of interest for high-throughput (HT) risk-based screening and prioritization of chemicals. Risk-based screening and prioritization requires estimates of chemical concentrations in biosolids, but such data are limited, necessitating the need for an HT machine-

learning consensus model to predict biosolids chemical occurrence. Limited training data also raise concerns about the model's domain of applicability in chemical space.

The National Sewage Sludge Surveys (NSSS) of 1988, 2001, and 2009 are our main sources of biosolids chemical concentration data. We characterized the chemical classes represented by the 744 analytes from these surveys using a publicly available chemical hierarchy tool, ClassyFire, and compared them to the chemical classes of compounds on the Toxic Substances Control Act (TSCA) Chemical Substances Inventory and to the "universe" of chemical classes defined by ClassyFire.

Average pairwise Jaccard similarity between TSCA and NSSS labels was 0.14, similar to the average Jaccard similarity between pairs of TSCA labels. NSSS chemical classes are effectively a subset of TSCA chemical classes. Our results are important not only for determining the domain of applicability for the consensus model, but also for identifying emerging trends of chemical classes that may warrant attention in future sewage sludge surveys.

The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. EPA.

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Developing a Predictive Model for Chemical Excretion in Urine

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Abstract

Most pharmacokinetic models use creatinine correction as a default approach to adjust urine biomarker levels, which assumes clearance by glomerular filtration. Recent work has highlighted two potential limitations of this approach. First, creatinine excretion is not perfectly constant for any given person, and creatinine concentration is therefore not exactly (inversely) proportional to urine output. Second, some chemicals are believed to be excreted (at least partially) by passive diffusion; urinary concentrations of these chemicals are independent of changing urine output and should therefore not be corrected using creatinine concentrations (or any other correction factor). Here, we examined the correlation of creatinine concentration and urine output with metabolite concentration using all individuals from 3 cohorts of the CDC's National Health and Nutrition Examination Survey (NHANES). Based on these correlations, chemicals were clustered into 2 urine elimination groups (glomerular filtration and passive diffusion). With this cluster labeling, a random

forest model was constructed using structural features (ToxPrints). The preliminary model achieved an out-of-bag error of 14.78% (training AUC = 86.12%). The model was then used to classify the expected dominant route of elimination for all chemicals in the Toxic Substances Control Act (TSCA) active list. This model can serve as a high- throughput, first-pass method to determine how to handle urine concentrations of various chemicals in pharmacokinetic modelling. There is currently no broadly accepted guidance on how to treat urine data, meaning this model may also serve as a first step toward establishing that guidance. This abstract does not reflect U.S. EPA policy.

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Emerging methods of heat exposure and physiological heat strain assessment for agricultural and construction workers and implications for intervention evaluation and policy

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Abstract

Workers in agriculture and construction have high rates of heat-related illness morbidity and mortality and are at risk of traumatic injuries and acute kidney injury associated with heat exposure and dehydration. Accurate heat stress and physiologic heat strain assessment are needed for etiological research and intervention evaluation. We describe the benefits and limitations of different heat exposure assessment methods, from personal ambient heat exposure assessment to modeled meteorological approaches, from our work with agriculture and construction populations in Washington State, US. We also present benefits and limitations of different physiologic heat strain assessment approaches, from ingestible core body temperature sensors to less invasive core body temperature estimation algorithms. We focus on recent work among outdoor agricultural workers to validate an extended Kalman filter approach (Buller et al., 2013) for estimating core body temperature (CBT) from an initializing temperature and continuous heart rate against CBT from ingestible core body temperature sensors (overall CBT bias [limits of agreement] −0.14 [±0.76]°C). Finally, implications of different exposure assessment approaches are discussed in the context of occupational heat rule policy development.

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Assessing heat where we live, work and play- two case studies in urban communities and rural workplaces.

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Abstract

Heat is the combination of temperature, humidity, and physical activity. In a cohort of workers, we collected continuous measurements of core body temperature (Tc), heart rate (HR), physical activity, and wet bulb globe temperature (WBGT) among 569 participants of the MesoAmerican Nephropathy Occupational Study (MANOS) in January 2018 – May 2018. Participants were recruited in various job tasks across five industries in El Salvador and Nicaragua: sugarcane, corn, plantain, brickmaking, and construction. We examined heat and heat strain among these workers to assess occupational exposures in relation to recommended exposure levels meant to protect worker health. In Massachusetts, a team of 22 residents and nearly as many university and community-based researchers on the Chelsea & East Boston Heat study (C-HEAT) characterized heat across two urban heat islands, using low-cost sensors that captured location, temperature, relative humidity, heart rate, sleep quality, and physical activity through the summer 2020. Half of these participants participated in Photovoice in summer 2021 documenting facilitators and barriers to coping with heat. In both seasons we captured ambient temperature and humidity via outdoor sensors to identify hot and cool pockets within the heat islands. Youth also participated in a surface temperature monitoring campaign focused on bus stops and playgrounds. The results of both studies are being used to inform policies and interventions to reduce heat exposure among vulnerable populations.

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Heat exposure and heat strain assessment for male and female sugarcane workers

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Abstract

Chronic exposure to high temperatures and recurrent dehydration may contribute to acute kidney injury and the development of chronic kidney disease (CKD). There is a need to better characterize climate- related changes in heat exposure using endpoints at the individual level in workers populations at-risk for kidney injury, specifically agriculture workers laboring in hot climates. We initiated monitoring for heat stress and heat strain among female and male sugarcane workers employed at a sugarcane company in Southwest Guatemala. Over the course of three monitoring sessions during the 6-month harvest (2021-2022), we measured individual-level external heat and relative humidity using a small, wireless sensor (Hygrochron™ iButtons, model DS1923, Maxim Integrated, San Jose, CA) that attached to a vest and recorded data at 2-minute intervals. Female workers wore the iButtons both on their rest days and work days. For the male workers, we also monitored their core body temperature using a pill- sized ingestible capsule telemetric sensor (Bodycap e-Celsius Performance®, Caen, France). Male workers ingested the pill prior to their work shift. Core temperatures were measured at 2-minute intervals. We demonstrate the feasibility of using wearable sensors to measure individual-level changes in temperature and

the corresponding risk of kidney injury in a sample of workers during the work shift and during their rest days in their communities. We describe the personal heat monitoring data and

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Heat exposure assessment in urban and rural areas and disparities across populations

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Abstract

Extreme heat events result in increases in mortality and morbidity. Developing effective prevention strategies for heat-related illness is critical as heat events are increasing in frequency and duration. We have compared methods for measuring extreme heat events using conventional weather station data, satellite-derived estimates, and neighborhood level monitoring across urban and rural areas of Alabama, USA. Through a community-academic partnership, we characterized heat exposures by deploying temperature/humidity monitors at 112 sites over 4 summers and recruited 180 participants, including City of Birmingham groundskeepers, to wear a temperature sensor for a week. Individual-level measures demonstrate a greater maximum heat index experienced by participants than predicted by nearby weather stations or thermometers placed within neighborhoods. We also compared heat-health behaviors in 2020 to previous summers and found heat-related illness risk mitigation strategies, including the use of cooling centers, public recreational areas, and green spaces, were utilized less due to safety concerns amid the COVID-19 pandemic. Overall, our results show area-level influences of personal exposure estimates and heat-health behaviors are likely important drivers of risk of heat- related illness.

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A Novel Method to Explore the Impact of Architectural Design on Biological and Non-Biological Components of the Indoor Exposome

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Abstract

In an age of rapid urbanization where inhabitants spend upwards of 90% of their time indoors, the relationships between building and HVAC design, chemical emissions into the air (e.g., building materials, furnishings), and indoor microbiome dynamics have emerged as significant factors in the complex field of Indoor Environmental Quality (IEQ). Although the literature presenting

causal mechanisms between individual factors of IEQ and human health outcomes is still evolving, multidisciplinary experimental approaches have begun to uncover interactions between air quality, environmental microbiomes, and specific human health outcomes. With this effort in mind, a need has emerged to utilize methods capable of capturing sufficient complexity in both air quality and microbial metrics and explore how these factors individually and together may be influenced by building and HVAC design. This study institutes a novel dual application of a passive sampling surface - polydimethylsiloxane (PDMS) - that can be subsequently processed using paired metagenomic and chemical analyses. These interdisciplinary methods promise far greater access to heterogeneous data types and resolution across biological (microbiome) and chemical (organic contaminant) data. Here we present a pilot study in which two forms of PDMS alongside swabbed petri dishes were deployed throughout a single building (an outdoor terrace, a high-occupancy office space, and a building- integrated greenhouse) and co-analyzed for microbial and chemical exposure. The resulting chemical (PDMS) and metagenomic (PDMS/swabs) analyses indicate this proposed method could make significant contributions towards a more complete understanding of environmental exposures and provide context for potential impacts to human health metrics.

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COMPLIANCE STRATEGIES FOR ENVIRONMENTAL RELATED EXPOSURE STUDIES: EVIDENCE FROM THE GRAPHS EXPOSURE STUDY IN GHANA

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Abstract

Wearing compliance with personal air monitors is critical to avoid exposure misclassification in studies where behavior in relation to strong point sources (e.g., dirty cookstoves) strongly influences exposure. Personal air monitors (e.g., RTI microPEM and Access Sensor Technologies UPASv2+) can have a built-in accelerometer allowing an objective measure of when the monitor is moved and time- worn. The current work is in the context of following the mothers

and children of the Ghana Randomized Air Pollution and Health Study (GRAPHS), a birth cohort of rural families where the mothers are the primary cooks. Wearing compliance at multiple time points in the study was very good but variable through age 4. However, wearing compliance at age 7/8 declined, prompting the study to be paused for time needed for community re-sensitization and obtaining IRB approval in relation to a conditional incentive. The conditional incentives deemed relevant and not coercive for participants that would wear the monitor on average > 10 hrs/day over 48 hrs were a bar of soap (mother) and a reusable water bottle (child). Prior to implementing the conditional incentive, ~75% of the 148 participants (mother and children) wore the air monitor less than 10 hrs a day. After the conditional incentive was initiated, ~75% of 410 participants (to date) wore the device > 10 hrs per day with only ~10% wearing the monitor for less than 6.4 hrs per day. Community sensitization alongside the implementation of conditional incentives significantly improved the distribution of wearing personal air monitors in rural settings.

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High-resolution mass spectrometric characterization of *in utero* exposure to World Trade Center (WTC) dust and associated chemicals

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Abstract

Pregnant women who lived or worked near the World Trade Center (WTC) on September 11, 2001 experienced several chemical exposures with potential adverse consequences for health and development. However, no study has characterized the chemical profile of biospecimens from pregnant women who were exposed. We characterized small molecules in cord blood samples from the Columbia WTC birth cohort using liquid chromatography coupled to a Thermo Orbitrap HFX mass spectrometer.
We analyzed samples from women who indicated being exposed or unexposed to WTC dust through a questionnaire (n = 16 each). Using principal component analysis, we determined: 1) the relationship between cord blood small molecules and exposure, 2) the metabolic pathways associated with exposure, and 3) the correlation between the cord blood small molecules and maternal blood levels of dioxins and perfluorinated compounds (PFCs). Principal components

(PCs) 1-5 explained 44.6% of the variance. PC3 and PC4 were borderline significant with exposure (odds ratio (OR) = 0.86, $p = 0.071$ and OR = 1.13, $p = 0.079$, respectively). From pathway analyses, the features loading onto PC3 and PC4 enriched for lipid and terpenoid metabolic pathways, and PC4 also enriched steroid and vitamin D3 metabolic pathways. PC4 was positively correlated with PFCs in the exposed group and negatively correlated with them in the unexposed group. We also identified several unknown features that were strongly correlated with maternal blood PFCs and dioxins. These efforts will ultimately help us uncover potential WTC-related health effects in prenatally exposed children that may have previously gone undetected.

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Flame retardant biomarker changes with furniture replacement

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Abstract

In 2014, California updated its upholstered furniture flammability standard, making compliance possible without the use of chemical flame retardants (FRs). Since upholstered furniture can be a major source of FR exposures, this change provided an opportunity to examine whether body burdens of FRs could be decreased by replacing older furniture. In a study initiated in 2015 to examine dust and biomarker levels of FRs, 23 participants replaced old furniture or foam in their main living area with new items with a TB117-2013 label, specifying the lack of chemical FRs. Participants provided urine and blood prior to furniture replacement and one year after replacement. We also collected samples from a comparison group with similar demographics (n=28) over the same time frame. Serum samples were analyzed for polybrominated diphenyl ethers (PBDEs) and urine samples for metabolites of organophosphate FRs (OPFRs). To account for differing lengths of time between initial sample collection and furniture replacement as well as the long half-lives of PBDEs, half-times of changes in serum PBDEs were compared between groups. PBDE-47, -99, and -100 were eliminated at 2-2.5 times greater rate in the furniture replacement group. Half-times for PBDE-153, a less prominent component of PentaPBDE mixtures, were comparable between groups. For OPFR metabolites, which have short half-lives, absolute changes in concentrations were calculated. Differences between groups were largely non- significant, with some OPFRs increasing less significantly in the comparison group than the furniture replacement group. Overall, these results indicate how updated flammability standards have an impact on FR exposures.

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Characterizing real-time $PM_{2.5}$ exposure and association with blood pressure among pregnant women using biomass or liquified petroleum gas (LPG) cookstove in rural India

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Abstract

Background: Sub-daily peak exposure to household air pollution (HAP) from biomass burning may cause health impacts. Leveraging real-time $PM_{2.5}$ exposure measurements from the Household Air Pollution Intervention Network (HAPIN) trial among 799 pregnant women in India, we characterize acute exposures and their association with blood pressure (BP).

Methods: Three real-time exposure measurements were captured during pregnancy per participant (n = 2216). A peak exposure was defined as concentrations above the 75th percentile value for a given sample lasting > 3 minutes. We summarized the total peak exposure time (minutes), the proportion of peak exposure time (%), and the number of peaks within each 24-hour monitoring period. Mixed models assessed the association between these metrics and BP, controlling for gestational age, BMI, maternal age, and education.

Results: All peak metrics were similar between intervention and control groups at baseline when participants used primarily biomass. 24-hour total peak exposure time and the proportion of peak exposure time were moderately correlated with 24-hour average $PM_{2.5}$ concentrations (Spearman's $\rho = 0.5$). The correlations were higher among LPG users (intervention) post-randomization. We observed positive associations between total peak exposure time or proportion of peak exposure time and BP in the LPG group, though the 24-hour average $PM_{2.5}$ concentration was not associated with BP. We did not observe similar trends among controls using biomass or across the entire study population.

Conclusions: This study is among the first to characterize peak exposures to HAP using real-time $PM_{2.5}$ measurements and to use these metrics to understand associations with BP.

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Characterizing PM2.5 levels in a school network of Purple Air Monitors in rural communities in Ghana

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Abstract

Ambient air pollution data are extremely lacking in resource limited countries. Low cost sensors (LCS) are being promoted to fill this gap but primarily for cities. We report on a school-based LCS network for rural communities. Our objectives are to augment exposure assessment in the context of an ongoing study examining child lung development trajectories in the Ghana Randomized Air Pollution and Health (GRAPHs) cohort and assess the feasibility of school-based monitoring in rural resource limited communities. The network consists of Purple Air SDII (PA) monitors at the Kintampo Health Research Center (KHRC) and the school location within each community (currently 31 of 35 GRAPHs communities). A school is typically located at the edge of each community. For power and security, the PA is normally deployed outside of the head teacher's office. Our approach to adjustment of the PA data currently relies on gravimetric correction from colocation with E-samplers (Met One Instruments) that collect 2-week filters at the KHRC center (continuously) and occasional multiday E-sampler deployments in communities. Problems encountered include data gaps due to theft of SD memory cards and unreliable power, the latter resulting in pivoting to 3 solar powered deployments and 4 deployments in other parts of the community. Preliminary analysis found no significant differences in concentrations between schools that cook lunch on site and those that do not. School-based monitoring with LCS appears to be a promising approach to measuring ambient concentrations in rural communities. Calibration of LCS in rural settings remains a central challenge.

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Exposure to 4-dichlorophenoxyacetic acid and 2,5-dichlorophenoxyacetic acid is associated with increased levels of inflammatory nasal cytokines among children with asthma.

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Abstract

Dichlorophenols (DCPs) are recognized endocrine disruptors found in a variety of consumer and industry products, including mothballs, deodorizers, and chlorinated drinking water. Some DCPs are also used as intermediates in herbicide production. While some DCPs have been linked to prevalence of allergies and respiratory diseases, including asthma, data remain sparse. We examined associations between metabolites (2,4-dichlorophenol; 2,4-D and 2,5-dichlorophenol; 2,5-D) of two DCPs (2,4- dichlorophenoxyacetic acid, 2,5-dichlorophenoxyacetic acid) measured in spot urine samples and inflammatory cytokines and chemokines measured in nasal epithelial lavage fluid among 84 children with asthma, 8-17 years old, in Baltimore. Inflammatory cytokines produced in the nasal epithelium are suspected to play an important role in airway inflammation pathways associated with asthma and have been linked with allergic responses and asthma. We used multivariable linear regression models and adjusted for age, sex, race/ethnicity, income and household smoking. 2,4-DCP and 2,5-DCP were detected in 93% and 99% of samples, respectively. 2,4-DCP- and 2,5-DCP- creatinine corrected concentrations were positively associated with granulocyte-macrophage colony-stimulating factor ([MF1] β=0.1, p= 0.004 and β=0.25, p=0.01, respectively), inflammatory cytokine IL-6 (β=0.22, p=0.02 and β=0.25, p=0.05, respectively), macrophage inflammatory protein 1α - MIP-1α (β=0.15, p=0.04 and β=0.31, p=0.003, respectively), and MIP-1β (β=0.21, p=0.02 and β=0.32, p= 0.01, respectively). Preliminary findings suggest that exposure to these dichlorophenols may be linked to inflammatory responses as measured in the upper respiratory airways among children with asthma. Future studies are warranted to explore these associations further and assess potential mechanistic pathways by which DCPs could impact respiratory health.

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Spatial pattern in four urban stressors: movement, exposure and the impacts of future developments

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Abstract

Cities promote access to services and opportunities, but are also a main source of pollution, disease and fear of crime, often linked to urban form. Although Health Impact Assessments can help reduce the impact of urban interventions, quantitative methods that consider spatial and temporal scales are still lacking. This study is novel in using machine-learning models to predict four stressors (noise, heat, solar radiation and crime) across an entire city, both in the present and after 12 urban developments were incorporated. Origin-destination models were used at 5000 locations to quantify cumulative exposure at the origin, and on daily walks up to 400m, 1600m and 2400m. Patterns of exposure differed markedly across the city and between stressors:

correlations at origins ranged from -0.01 (solar radiation vs crime) to 0.48 (heat vs crime). Stressor levels experienced by individuals that walked were related to exposure at origins, but the similarity decreased as the distance walked increased and depended on the stressor. The impact of future developments also depended on the stressor and the distance walked. For example, heat levels increased at only 10.3% of origins but 46.1% for walked distances of 2400m. In contrast, crime increased at 50.9% of origins but 46.9% for individuals walking 2400m. Developments caused an increase in three/four stressors at 11.6% of origins, indicating the importance of assessing multiple stressors simultaneously. The spatial variability among stressors supports the need for a spatially-explicit approach to modelling environmental and health impacts, and to assessing the impact of new interventions.

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Personal exposures to fine particulate matter (PM2.5), carbon monoxide (CO), and black carbon (BC) among pregnant participants in the multi-country Household Air Pollution Intervention Network (HAPIN) trial

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Abstract

Background: The HAPIN trial assessed personal 24-hour $PM_{2.5}$, BC, and CO exposure in India, Guatemala, Peru, and Rwanda in ~3,200 households. At each site, half of the study participants were

randomly selected to receive an LPG stove and fuel while the balance continued cooking using biomass for three total repeated measures. Although $PM_{2.5}$ is commonly attributed to adverse health, different pollutants have different health effects, determining the correlations and ratios of $PM_{2.5}$ to BC, and CO helps expand exposure assessment knowledge.

Methods: $PM_{2.5}$ was measured with Enhanced Children's microPEM, BC was estimated using SootScan OT-21, and CO was measured using Lascar EL-CO-USB. Spearman's Rho was used for correlations.
Wilcoxon Rank-Sum Test and Tukey's HSD were used for CO:$PM_{2.5}$ and BC:$PM_{2.5}$ mass ratio significance testing, respectively.

Results: We analyzed 7,673, 7,165, and 7,943 valid PM2.5, BC, and CO observations, respectively. Correlations between CO and $PM_{2.5}$ were higher for the biomass arm (.47) than the LPG arm (.05). BC and $PM_{2.5}$ correlations were strong in both biomass (.80) and LPG (.66) arms. CO:$PM_{2.5}$ mass ratios were reduced significantly from biomass to LPG, but medians varied by country (Guatemala= 12, 7; Rwanda= 11, 7; Peru= 35, 32; India= 11, 1). BC:$PM_{2.5}$ ratios were not significantly different between biomass and LPG arms with similarities between countries.

Conclusions: We found that location and stove/fuel type influence pollutant correlations and mass ratios, indicating the importance of considering the choice of pollutant(s) assessed when designing studies of health impacts.

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Embedding Physics-Guided Principles in Ensemble Neural Networks for Predicting Nitrogen Oxides at High Spatiotemporal Resolution

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Abstract

High-accuracy estimation of air pollutant concentrations such as nitrogen oxides is critical for evaluation of health effects, and backtracking and monitoring of air pollutants. Significant advances in machine learning, remote sensing, and geospatial modeling tools have enabled researchers to build highly spatiotemporally resolved air pollution prediction models. However, to date, purely data-driven machine learning methods have not explicitly incorporated physical mechanisms for guiding and constraining model solutions to reproduce known dynamics of air pollutants. This can result in over- fitting, inaccuracy, and poor generalizability. In this work, based on full residual deep base networks, we incorporate a physical advection-diffusion mechanism and constraints to guide model optimization, which guarantees physically meaningful predictions. With this mesh-free ensemble guided method, we reconstructed spatiotemporal variation in nitrogen oxides at high resolution and also reduced prediction uncertainty and variability, resulting in overall lower exposure measurement error and high generalization (R2 of 0.94-0.95 in site-based independent testing). We demonstrate that physics-guided approaches contribute important improvements over other state-of-the-art machine learning methods relying only on data by approximately 22-31% in R2 of site testing. Our framework can be applied to other air pollutants and environmental agents that involve complex spatiotemporal variations and that are inherently governed by important physical and chemical dynamics.

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Citizen mapping: a tool for engagement and improving neighborhood air quality estimates

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Abstract

Citizen science and activism is often critical to successfully turning the results of local air quality studies into lasting change. One means of increasing citizen involvement in air quality projects is for the community to be involved in the collection of quantitative monitoring data and qualitative environmental data. The value of qualitative data is sometimes overlooked in studies that focus on assessing pollutant concentrations, however, this local knowledge can provide unique insight on community sources of air pollution. In this study, we use multiple land use regression (LUR) models to quantify the impact of including local knowledge, in addition to more traditional geospatial datasets. To build the monitoring dataset, we deploy 13 low-cost sensors in a Vancouver, BC neighborhood with a history of community organizing and an interest in their exposure to air pollution. With this finer scale monitoring network, we collect data on $PM_{2.5}$, CO, NO, NO_2, and O_3 for a 6-month period and use the data to create a traditional LUR. Through engagement with community members, including a community workshop to identify and map local air pollution sources such as construction sites and where trucks idle, we will build a second LUR that incorporates community knowledge as a feature. We will compare the results of both models

and attempt to quantify the value added by including local knowledge in air quality modeling. We expect that the inclusion of local knowledge will improve our concentration estimates from LUR modeling and increase community engagement around air quality.

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A Generalizable Framework for Managing Sensor Deployments in Exposure Health Studies.

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Abstract

Sensors are commonly used to measure the environment and physiology of participants in exposure health studies. These studies have varied designs that require use of various sensors capable of recording different measurements, often temporarily and spatially differentiated, and for potentially thousands of participants. These sensors undergo multiple steps for use—development, pre-calibration, deployment, operational processes (retrieval, post-calibration, cleaning, repair) and then re- deployment. In addition, many sensors require continuous monitoring to ensure their proper operation and ongoing capture of quality measurements. Successful completion of sensor-based exposure health studies therefore requires a seamless transfer of measurement/research data and device information defining new roles for sensor engineers and information technology experts in addition traditional teams of environmental scientists, epidemiologists, coordinators, and statisticians.

In our Exposure Health Informatics Ecosystem, we developed a common-metadata specification that organizes sensor deployment information. Next, we developed EpiFi, a data acquisition pipeline that brings IoT to health research by providing robustness to applications needed by different study designs. Together, they harmonize incoming sensor data and process secure data streams for protected/ compliant cloud storage. Using information requirements of exposure health scientists, we extended the EPiFi output to be presented on web-based visual 'dashboard'. This customizable dashboard includes aggregate, study-level (sensors operational etc.,) and sensor-level information (activity, deployment status, last data transmission etc., and managerial reports based on user roles (PI, coordinator, engineer). Here, we present results from Environmental influences on Child Health Outcomes ECHO) supported projects where we use this approach to manage over 300 sensor deployments.

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Source-specific intake fractions for ambient primary and secondary PM2.5 in 96 global cities

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Abstract

Intake fraction (iF) is a common metric for the damage caused by an emission source per unit emission and can be an important tool for informing pollution reduction efforts, but for many global cities, no source-specific intake fraction estimates exist. Here, we determine intake fractions for PM2.5 by emission source type for 96 global cities. We use spatial data from OpenStreetMap and other sources to downscale the Community Emissions Data System (CEDS) global inventory of emissions of PM2.5 and precursor pollutants, yielding global-through-urban-scale emissions estimates. We use the Intervention Model for Air Pollution (InMAP) to estimate the atmospheric transport, transformation and removal of the resulting PM2.5, determining iF for 14 emission source sectors. Among these cities, we find that iFs of emissions of PM2.5 and its precursors vary widely (μ=5.9 ppm, σ=5.6). On average, iF increases by 41% when including exposure outside the city in addition to within it. The source types with highest iF also vary by city. Commercial, population and buildings are commonly the top three sources (average iF=11.0, 10.1, and 9.9 ppm, respectively). We expect our results can be useful as a screening tool for public health policy options.

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Developing an exposure burden score for chemical mixtures using item response theory, with applications to PFAS mixtures

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Abstract

Background: Few methods exist to quantify total exposure burden to chemical mixtures independent of a health outcome. A summary metric could be useful for biomonitoring, risk assessment, health risk calculators, and mediation models. Our aims were to develop a novel exposure burden score method for chemical mixtures, and apply it to estimate exposure burden to PFAS mixtures and its association with cardio-metabolic outcomes.

Methods: We applied item response theory (IRT) to biomonitoring data from 1915 children and adults aged 12-80 years old in the 2017-2018 National Health and Nutrition Examination Survey (NHANES) to quantify a latent PFAS burden score, using serum concentrations of 8 measured PFAS biomarkers. We used linear regression to estimate associations (average differences and 95% confidence intervals [CIs]) of the PFAS burden score with cardio-metabolic outcomes, including total cholesterol, and compared our findings to results using summed PFAS concentrations (a more traditional approach) as the exposure metric.

Results: PFAS burden scores and summed PFAS concentrations had moderate-high correlation (ρ = 0.75). An interquartile range (IQR) increase in the PFAS burden score or PFAS summed concentrations was associated with an 8.6 mg/dL (5.2, 11.9) and 2.4 mg/dL (0.5, 4.2) greater total cholesterol concentration, respectively. Compared to the PFAS burden score, associations for summed PFAS concentrations were generally closer to the null, and this was confirmed in a secondary, validation analysis of another NHANES cycle.

Discussion: We provide a calculator (https://pfasburden.shinyapps.io/app_pfas_burden/) enabling researchers to estimate PFAS burden scores based on US population exposure reference ranges.

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Association between Tobacco Smoke Exposure and Dental Caries in Children - an Umbrella Review

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Abstract

Dental caries is among the most common chronic diseases of childhood affecting more than 573 million children globally. The adverse effects of tobacco use and exposure to tobacco smoke on developing fetus and prevalence of caries in children have led to a hypothesized causal association between them. Several systematic reviews have examined tobacco smoke as a risk factor for dental caries but with inconsistent conclusions and methodology. We aimed to systematically appraise published evidence on effect of smoking, and passive smoke exposure on risk of caries in children. We searched PubMed, EMBASE, Web of Science, Google Scholar, JBI Database of Systematic Reviews, Cochrane Database of Systematic Reviews and screened references of relevant articles. We included systematic reviews / meta-analyses which have assessed tobacco smoke exposure either via questionnaires addressed to parents or measured cotinine levels. We calculated summary effect estimates, 95% confidence intervals, heterogeneity, 95% prediction interval, small study effects, and excess significance biases.

Methodological and reporting quality of included studies was assessed with AMSTAR 2 tool. We identified 628 articles, of which 11 were eligible for inclusion. Overall, there was an association for maternal smoking during pregnancy (OR = 1.52, 95% CI=1.39–1.87) and prenatal passive tobacco exposure (OR = 1.79, 95% CI=1.45–2.05). Though, evidence suggests maternal smoking and prenatal and early life tobacco smoke exposure is associated with caries risk, this relationship could be affected by other confounding factors. Prospective studies differentiating pre- and post-natal exposure while controlling for key confounders are needed to identify windows of susceptibility.

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Silicone wristbands to detect tobacco-specific carcinogen exposure in chldren: correlations with urinary biomarkers

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Abstract

Children are particularly vulnerable to exposure to secondhand smoke (SHS), which contains multiple carcinogens. However, there is limited information on the exposure to tobacco-related toxicants from e- cigarettes (EC). Research is needed to better understand the properties of the silicone wristband (SWBs) to assess exposures to SHS and toxicants released from EC among children. We investigated differences in chemical exposures between three groups of children, those exposed to secondhand tobacco smoke from conventional cigarettes (CC), those exposed to secondhand vapor from electronic cigarettes (EC), and children living with non-users of either of these products (NS). Urine samples were collected from children (n=53) who wore SWBs for 7 days and for 2 days. We measured urinary concentrations of 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL), a known biomarker of a tobacco-specific carcinogen. SWBs samples were analyzed for nicotine, cotinine, and tobacco-specific nitrosamines (TSNAs) levels. Levels of NNAL were significantly higher ($p<0.001$) in the urine of children exposed to secondhand CC (med: 17.5 pg/ml) compared to secondhand EC (med: 4.5 pg/ml) or children living with NS (med: 1.1 pg/ml). Similarly, the levels of cotinine, nicotine, and TNSAs detected by SWBs were significantly higher in the CC group and EC in comparison to NS. Urinary NNAL levels were significantly correlated with the nicotine (rho = 0.88) and cotinine detected in SWBs (rho = 0.93), all $p<0.001$. Our results indicate that children are exposed to tobacco related carcinogens not only when living with CC users or EC users, but also NS.

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Phthalate mixtures and insulin resistance: An item response theory approach to quantify exposure burden to phthalate mixtures

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Abstract

Aim: To introduce a novel scoring method for quantifying exposure burden to phthalate metabolites, and estimate associations between phthalate burden and insulin resistance in US adults.

Methods: Using phhalate metabolite concentrations from N=3474 adults aged 20-60 years in the 2013- 2018 US National Health and Nutrition Examination Survey (NHANES), we applied item response theory (IRT) to quantify latent phthalate exposure burden from 12 phthalate metabolites. Phthalate metabolite concentrations were adjusted for urinary creatinine using a covariate-adjusted standardization method. We compared several measurement models (uni-dimensional, correlated factors, bifactor model) for phthalate burden. Adjusted differences and 95% confidence intervals were estimated for phthalate burden and Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), adjusted for age, gender, race/ethnicity, ratio of family income to poverty, BMI, serum cotinine, percentage of total daily energy intake from ultra-processed foods, creatinine, and NHANES survey cycle. We compared our findings to results in models using molar sums of phthalate metabolites instead of phthalate burden.

Results: The model with three correlated factors (low molecular weight phthalate burden, high molecular weight phthalate burden and DEHP phthalate burden) yielded optimal fit and interpretability. An interquartile (IQR) increase in the DEHP burden was associated with 0.079 (95% CI [0.001, 0.157]) increase in log HOMA-IR. We did not find significant association between molar sums of phthalates (low molecular weight, high molecular weight, DEHP) and HOMA-IR.

Conclusion: We demonstrated use of IRT to quantify latent exposure burden to phthalate mixtures, which may be more sensitive to associations with health outcomes than using molar sums.

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Novel Sampling Methods to Evaluate Exposures to Indoor Thirdhand Smoke Contaminants During COVID-19 Pandemic :A Community Engagement Approach

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Abstract

The quality of the indoor environment affects human health, especially among vulnerable groups such as children. One concerning exposure is to thirdhand smoke, (THS) the toxic and carcinogenic residue of tobacco smoking in indoor environments. THS lingers in dust and on surfaces after smoking has ended. As the world shut down during the COVID-19 pandemic, field research projects that involved research assistants sampling inside participants homes were halted. Innovative and practical exposure measurement methods are needed for environmental health studies going forward. We developed self- collection sampling kits to measure THS contaminants in house dust, surfaces, air, and personal exposures. Sampling kits were dropped off directly to participants' front door (n=20). The self-collection instructions were provided in a written and a video format in English and Spanish. Silicone wristband kits, surface wipe kits, and a powerful wand vacuum cleaner with a barrier to mark area to be vacuumed were provided, as well as handwipe and urine collection kits. As a methodology validation, a trained research specialist collected additional samples side-by-side to the self-collected samples. After collection, samples were chemically analyzed for nicotine and other organic contaminants related to THS in our laboratory. Participants were able to successfully collect all sample types. We found higher levels of THS markers inside of homes where smoked had occurred in the past compared to homes where smoking had never been reported. This study presented feasible sampling protocols and tools and demonstrated how participants can actively participate in the self-collection of samples to evaluate exposures.

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Indoor air quality in affordable multi-family housing: contributions of outdoor pollution and lack of compartmentalization between units

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Abstract

Introduction: In Massachusetts, >50% of affordable housing is located within 200 m of highways. Residing in proximity of busy roadways is associated with adverse health effects. Building envelope and ventilation systems can provide a degree of protection from outdoor-generated air pollution and energy conservation measures often come at the expense of exacerbating exposures to indoor generated pollution. Our objective was to measure indoor air quality (IAQ) in multi-family buildings with different ventilation systems design, and quantify benefits derived from use of varying degrees of filtration (no filters, MERV8 and MERV10).

Methods: Study participants recruited from affordable residential buildings in Somerville (MA) are surveyed on ventilation practices and perceived IAQ and comfort. In a subset of units (currently 20 units in four buildings), indoor air quality was monitored continuously for 2-4 weeks

for ultrafine particles, PM2.5, CO2, temperature, and relative humidity. We also monitored unoccupied units and common spaces (hallways), and on the roof adjacent to ventilation system intakes.

Results: Pollutants of outdoor origin infiltrate indoors; however, cooking and infiltration from common spaces contribute as much as 3 times more pollution compared to infiltration of outdoor pollution. Also, while indoor air quality was generally better in MERV10 buildings with isolated ventilation system for each unit, infiltration of common-space air (and airborne pollutants) was observed in all units even in the LEED certified buildings we studied.

Conclusion: Multi-family building designs should consider air handling of common indoor spaces and better compartmentalization in addition to outdoor air filtration to improve IAQ.

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Application of an Ambient Air Calibration for In-home Monitoring using Low- Cost Sensors

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Abstract

During the COVID-19 pandemic, in-home air quality monitoring for epidemiologic studies was limited to protect the health of participants and staff. One approach that enabled low-contact air quality monitoring was the use of low-cost sensor technologies, which can be prone to bias if not properly calibrated. The Purple Air device has gained popularity for particulate matter (PM) monitoring for both ambient and indoor air quality. We previously evaluated a sensor by the same manufacturer (Plantower) as is used inside the Purple Air in the laboratory and then deployed an ambient network of ~45 custom devices using the sensor in Baltimore, MD, USA. A novel calibration was developed to account for factors that can bias the PM estimation from that sensor. The goal for this study was to evaluate the accuracy of the Purple Air monitor to estimate weekly averaged $PM_{2.5}$ concentrations in participant homes, as compared to a gravimetric,

filter-based sample. Samples were collected in 54 houses among participants from three on-going studies in Baltimore, including those that allowed and did not allow smoking indoors. Weekly average $PM_{2.5}$ concentrations ranged from 2-206 μg/m^3. We found that although the correlation was high between the sensor estimate and the gravimetric concentration for the standard and novel calibrations (R^2>0.85), applying our calibration equation based on ambient measurements reduced the root mean square error (RMSE) from 106 μg/m^3 (assuming the CF=1 built-in calibration) to 26 μg/m^3. Among households with $PM_{2.5}$<100 μg/m^3 (N=45) the RMSE decreased to 10 μg/m^3.

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The role of local air pollution in asthma morbidity disparity in Austin, TX

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Abstract

Unequal exposure to outdoor air pollution has been implicated in persistent racial/ethnic disparities in asthma morbidity in the United States. Regulatory interventions could benefit from additional quantification of the effect of intraurban pollution disparity on differential health outcomes by race/ethnicity. Previous work has shown that within Travis County (Austin, TX), asthma-related Emergency Department (ED) visit rates are significantly higher among Black and Latinx children than White children (238, 74, and 29 per 10,000 person-years, respectively), and census tract racial and ethnic composition explains 33% of tract-to-tract variability. We investigate the role of air pollution in these disparities, as census tract concentrations of multiple air pollutants (NO_2, $PM_{2.5}$, PM_{10}, and SO_2) show positive correlation with census tract share of Black and Latinx residents. We find that each of these pollutants is associated with significantly higher ED visit rates, and their inclusion in a multivariate model reduces the association between neighborhood racial and ethnic composition and asthma ED visit incidence rates. We also find significant positive interaction effects between $PM_{2.5}$ and SO_2 for the total population, suggesting that sources that co-emit these pollutants may have disproportionate impacts.
These findings align with recent evidence of composition-dependent PM health effects and invite further investigation of the implications of source-specific toxicity for racial/ethnic health disparity.

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Mapping organic air pollutants in Montreal, Canada using passive air samplers through a machine learning land use regression model

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Abstract

Our exposure to airborne organic pollutants is ubiquitous. Outdoor levels of these pollutants have not been well characterized due to challenges in traditional monitoring approaches. Conventional active air samplers require a power supply and are often larger in size, which limit sampling locations and the number of sampling sites. In contrast, passive samplers are lower-cost and can be easily deployed (magnetic clip), presenting opportunities to scale monitoring locations. The objective of this study was to demonstrate the utility of passive air samplers to collect hyperlocal exposure information of a broad range of organic pollutants across a major urban center. We deployed FreshAir stationary passive air samplers at 49 sites in Montreal, Canada and analyzed collected samplers using thermal desorption gas chromatography high resolution mass spectrometry. Twenty organic pollutants, including phthalates, pesticides, VOCs, PAHs, and organophosphate flame retardants, were detected using a targeted analysis approach; the detection frequency was >50% for 19 of these compounds. Using a non-targeted analysis of collected samples, >2000 compounds were identified, such as DEET (active ingredient in many repellent products), benzoic acid (an antimicrobial preservative in food), and chlorothalonil (a pesticide, with acute toxicity through inhalation). Furthermore, we adopted a machine learning approach to develop land use regression models across the study area for detected compound of concern. The combination of novel analytical and modeling exposure assessment approaches in this study provides an in-depth overview of the distribution of organic air pollutants in Montreal, Canada.

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PFAS in air: calibration of FreshAir wearable passive samplers for PFAS compounds and application in an urban US cohort

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are used in a variety of consumer products including food packaging materials, cookware, and personal care products. Evidence has shown PFAS to induce a wide range of adverse health effects. Previous studies have focused heavily on PFAS exposure through ingestion and dermal contacts. Volatilized PFAS in the air

have been detected increasingly in various indoor environments, resulting in the need to assess personal PFAS exposure via inhalation. Here, we evaluated 21 airborne PFAS using active (polydimethylsiloxane, or PDMS foam traps) and FreshAir passive (PDMS sorbent bars) samplers through a stationary-indoor calibration study. Samplers were analyzed using gas chromatography high resolution mass spectrometry. We observed a linear uptake trend for 4 fluorotelomer alcohols (FTOHs) and determined a generic sampling rate for calculating air concentrations using the passive sampler. Furthermore, we evaluated the differences in PFAS personal exposure using FreshAir samplers placed on chest, wrist, and shoe, worn by 32 participants in New Haven, CT. We detected 15 PFAS, dominated by FTOHs. Shoe samplers had higher abundance and broader coverage of PFAS exposures and correlated strongly with both chest and wrist samplers. In addition, seventeen PFAS features were identified based on PFAS fragment traces through non-targeted analysis, where 10 were above the blank filtering threshold, and 7 were unknown PFAS. Both targeted and non-targeted analysis showed shoe samplers can capture a broader panel of PFAS. Our results show promise in using the FreshAir passive sampler for assessing PFAS exposures in epidemiological and exposure science studies.

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Community Implementation of Low-Cost Indoor Filtration to Mitigate COVID-19 Transmission

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Abstract

As COVID-19 continues to spread globally and societies continue to lift many of the mitigation effort restrictions, there is a critical need for effective, accessible approaches to filter indoor air to mitigate COVID-19 transmission. Researchers have demonstrated that commercial HEPA air purifiers can effectively remove the size aerosols most associated with transmission of COVID-19, but these units can be cost prohibitive. Lower cost, commercially available air purifiers do not effectively remove the aerosols most responsible for the transmission of COVID-19. The Corsi-Rosenthal box filter is a DIY (do- it-yourself) solution that has the potential to fill this gap as it is cost-effective (~$75), energy efficient, and able to remove the aerosol size most associated with transmitting COVID-19. Lab-based analyses of Corsi-Rosenthal boxes have demonstrated their effectiveness.

A team comprised of researchers and clinicians from UConn's School of Engineering and School of Nursing and UConn Health's School of Medicine have deployed Corsi-Rosenthal

boxes throughout school and community spaces in Connecticut. Volunteers built these boxes during several volunteer build events, and first-year engineering students built 100 as part of their freshman engineering course. We will present the findings from (1) real world testing of the Corsi-Rosenthal boxes in active classroom settings, (2) modeling of the air circulation when using two Corsi-Rosenthal boxes on low speed, (3) analysis of the effectiveness of the course-based assignments for helping student achieve the course objectives, and (4) a summary of the community perception of the Corsi-Rosenthal boxes deployed in different indoor educational settings in Connecticut.

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Exploring the airborne exposome among children and adults from India, South Africa, China and the US using passive personal exposure samplers

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Abstract

We are exposed to a broad range of airborne environmental contaminants, including polycyclic aromatic hydrocarbons (PAHs), pesticides, and phthalates. These organic compounds are recognized to be linked to various adverse health outcomes. Wearable passive samplers, as an emerging exposure assessment tool, are lightweight, lower-cost, and do not inhibit mobility, allowing use in a range of age groups and locations internationally. The objective of this study was to use a wearable passive sampler to conduct a comparative assessment of exposures across the life course in different geographic regions. We deployed the FreshAir wristband with children (age < 18, n = 160) in rural regions of South Africa and urban areas of the US and adults (age > 18, n=356) in rural regions of India, urban centers in China and a mixture of urban/rural locations in the US. Through our targeted analysis (80 analytes spanning 16 chemical classes) we found phthalates and PAHs in all samplers. Non-targeted analysis revealed personal exposure to elevated levels of dichlorvos and DDT (pesticides used for control of mosquitos) for participants in China and South Africa. Fludioxonil, a fungicide often used indoors on furniture was found in most US participants. Microbial agents, including triclosan, were detected in almost all selected population groups. Furthermore, we conducted qualitative analysis to compare the chemical exposure variations by area classification (urban vs. rural), infrastructure

development (e.g., waste management), and age groups (children vs. adults). Finding from this study will serve as a valuable resource for health outcomes investigation and risk assessment.

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Improved Air Pollutant Estimates from Combined Modeling Frameworks

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Abstract

Populations in urban areas can be exposed to unhealthy levels of air pollution, and are therefore at a higher risk of developing respiratory and cardiovascular disease. Managing air pollution in urban areas is difficult because of the complex nature of pollutants in the urban atmosphere. Eulerian grid chemical transport models have been used to produce estimations of spatially and temporally distributed pollutant concentrations at the regional scale. These models may also provide estimations at some urban scales. However, the finest resolution cannot capture the spatiotemporal variability of air pollutants at local scales. We propose a hybrid modeling system to overcome this limitation of regional chemical transport models. We use the Comprehensive Air Quality Model with Extensions (CAMx), a common regional scale model used in the United States, to predict concentrations at a regional scale (12 x 12 km resolution) for the Contiguous United States. We further resolve these estimates using a reduced complexity model, InMAP, that uses grid adaptations to produce a variable horizontal resolution grid. The reduced complexity model provides higher spatial resolution, down to 1 km, in densely populated areas and lower resolution in more sparsely populated areas. This provides additional spatial resolution in the urban areas that experience more spatial heterogeneity in air pollutant concentrations. We use source-specific spatial surrogates to calculate the emissions in each grid cell.
The proposed approach is the first step toward understanding the spatial and temporal variability of air pollution in urban areas.

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Communicating the results of an indoor air quality intervention study targeting schools impacted by roadway and aircraft pollution sources

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Abstract

Reporting back results to participants is an integral part of community-engaged research. However, environmental exposure research lacks standard methodology and evaluation metrics for community engagement. The Healthy Air, Healthy Schools study was established to better

understand the impact of ultrafine particles (UFPs) on indoor air quality in communities surrounding Seattle-Tacoma International Airport (Sea-Tac). We measured and identified sources of indoor UFPs in five schools within a 7-mile radius of Sea-Tac. We found portable HEPA cleaners were an effective short-term intervention to improve air quality in classrooms. An important goal was communicating results to all study partners including school staff, school district administrators, and state legislators. This effort included the establishment of stakeholder advisories, effective communication strategies through key informant interviews, and report back materials and evaluation metrics. Final report back materials were tailored for a broad audience with differing levels of environmental health literacy. Contextualizing indoor UFP measurement materials proved challenging as they are not federally regulated or well-understood by the public. Report back success was evaluated using a pre/post-survey administered during meetings with a broad group of stakeholders and study partners. The survey was developed following a knowledge-attitude-behavior model to investigate if study participation improved community member's knowledge and awareness about air pollution in their communities and promoted actions to reduce exposure. This study uniquely focuses on UFP exposures in schools and risk communication with broad audiences to highlight the importance of considering the results' format, contextual information, and level of environmental health literacy in developing materials.

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Modeling of Household Fine Particulate Matter from Cook Stove Emissions in Cook Stove Pregnancy Cohort Study (CSPCS) in Bangladesh

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Abstract

Biomass burning for household cooking is an important contributor of both indoor and outdoor fine particulate matter ($PM_{2.5}$) air pollution, especially in low-/middle-income countries (LMICs). This study characterizes and models indoor $PM_{2.5}$ using data from 80 households in the Bangladesh Cook Stove Pregnancy Cohort Study (CSPCS). Continuous $PM_{2.5}$ monitoring was performed for three different seasons in each of these households for approximately 48 h (range 46 to 52 h) from April 2017 through March 2018. $PM_{2.5}$ concentrations were measured simultaneously in the kitchen, bedroom, and open space (locally called 'veranda') within the household. Structured questionnaires were applied to capture household-level variables. The

average cooking time $PM_{2.5}$ concentration in the kitchen was about 4-fold higher compared to $PM_{2.5}$ concentrations in the bedroom and veranda. Multivariate regression was used to build prediction models for cooking time $PM_{2.5}$ and 24-hr average $PM_{2.5}$ in the kitchen and 24-hrs, daytime, and nighttime average $PM_{2.5}$ in the bedroom based on the first two waves of data collection. Model performances were moderate to good, with 10-fold cross validated (CV) R^2 ranging from 0.52 to 0.76 when validated with 3rd wave data. The CV R^2 was highest for bedroom 24-hr average $PM_{2.5}$. $PM_{2.5}$ measured in kitchen, kitchen location and non-cooking sources of air pollution were significant predictors for bedroom $PM_{2.5}$ concentration. Our results suggest that kitchen in $PM_{2.5}$ along with household information can be used to predict room-specific $PM_{2.5}$ concentrations.

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Comparison of Filtration Efficiency and Pressure Drop between Certified Surgical Masks and Not Certified Surgical Masks

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Abstract

Result from the shortage of health masks due to outbreak of COVID-19 worldwide and sudden masks' production to meet the demands, markets are a mix of uncertified and certified health masks (e.g.
Surgical mask, Surgical N95). WHO have been recommending medical masks for specific subjects and how to wear the medical masks. As the uncertified medical(surgical) masks are also on sales now and many people use it, we tested two key performances; filtration efficiency, pressure drop. Both of them are directly connected to mask wearers' safety and health. We examined both 5 certified surgical masks and 5 uncertified surgical masks. Filtration efficiency was evaluated using NaCl particles. For the average of filtration efficiency, it was 84.6±16.4 % for 5 certified masks, and 72.5±27.5 % for 5 uncertified masks. But there was no significant difference between certified and not certified masks (Wilcoxon rank test, $p > 0.05$). For the average of pressure drop, it was 9.07±2.81 Pa for 5 certified masks, and 8.60±4.80 Pa for 5 uncertified masks. It also had no significant difference between certified and not certified masks (T- test, $p > 0.05$).

Here we show there were no significant differences for filtration efficiency and pressure drop between certified and not certified masks. Also, as there were large variations in filtration efficiency for each mask whether it is certified one or not, wearers may not trust the certified masks in markets. Further study needed. But still, continued efforts for wearing masks are needed to prevent the breakthrough infection.

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Differentiating Ultrafine and PM2.5 Exposure Patterns Through Personal Monitoring Using Wearable Sensors

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Abstract

Evidence from experimental toxicology studies suggest that ultrafine particles (UFP) play a significant role in particulate matter (PM) respiratory toxicity. However, this has not been validated in epidemiological settings mainly because accurate, directly measured exposure data are not readily available. Our on-going study includes a person-level exposure assessment of 30 asthmatic adolescents in Cincinnati, OH, using wearable UFP and PM2.5 sensors. Participants carried both UFP and PM2.5 sensors in a small backpack for 7 days. Our preliminary data from nine participants showed that the mean of hourly average UFP concentrations widely varied from 3000 to 23600 $\#/cm^3$ for number concentrations and from 65 to 2089 $\mu m^2/cm^3$ for surface area concentrations. The correlation between UFP and PM2.5 also varied in a wide range. When hourly average measurements were compared, Pearson correlation coefficients ranged from 0.110 to 0.667 with median of 0.366 for number-mass concentration, and from 0.147 to 0.959 with median of 0.510 for surface area – mass concentration.

With minute average data, Pearson correlation coefficients varied similarly. The degree of correlation and overall PM exposure levels did not appear to be significantly associated. The large variability in degrees of exposures and UFP-PM2.5 correlations suggested that individuals' UFP and PM2.5 exposure patterns are much different. Further examination of mobile app data (i.e., activity and GPS data) will improve the understanding of factors that cause differential exposure patterns. This novel research approach will provide insights into distinct and joint effects of varying size fractions of PM on lung function changes.

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Comparison of Chemical Components between Disclosed Components of Some Trigger type Inhalable Consumer Products in South Korea and its' Qualitative Analysis Results by GC-MSD

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Abstract

Korean Ministry of Environment(KMoE) has been operating chemical product databases system(Ecolife) so that consumers can obtain chemical information of consumer products. However, all ingredient disclosed products are limited and they have not been verified whether the ingredients are real or not. And related previous studies were rare. Therefore, this study presents results of qualitative analysis of 13 major trigger-type consumer products and examines component hazards and analysis methods through comparison with substances disclosed in the system. 13 trigger-type consumer products are selected as each product type presented in product exposure factors of KMoE through market survey from May to July 2021. The total number of chemicals in each DB was 377 for GC-MS Scan mode qualitative analysis and 109 for the disclosed ingredients on the system(retrieved from January 1 to 30 in 2022). Additional IARC carcinogens were also examined. For disclosed ingredients, only 2 out of 13 products detected and the ingredients on the remaining 11 products were not detected as a result of GC-MS. Among the undetected components, volatile and non-volatile components were presented.
Total 4 chemicals were detected. Linalool, Citronellol, Hexyl-cinnamal in bathroom products, and ethanol in furniture gloss products. Carcinogens have been detected from 11 products. 10 products contained carcinogen rating of 2A or higher. All carcinogen 1 were ethanol. All carcinogen 2A were dichloromethane. Inhalation risk for ethanol is negligible and for dichloromethane is dangerous. This study highlights need to cross-validate GC-Q/TOF and LC-Q/TOF for understanding for unknown components in products.

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Effects of long-term exposure to particle components on inpatient asthma hospitalizations among children and adults in the U.S. using Bayesian kernel machine regression (BKMR).

Bryan Vu[1], Xinye Qiu[1], Joel Schwartz[2]
[1]Harvard University, Research Fellow. [2]Harvard University, Professor

Abstract

Particulate matter has been documented to adversely affect asthma exacerbation. However, few studies have investigated the long-term exposure of particle components in conjunction with $PM_{2.5}$ and ozone to assess their individual and additive effects. We aim to utilize a Bayesian Kernel machine regression (BKMR) to assess the individual and join effects of air pollutants including 15 different particle components such as organic carbon (OC), elemental carbon (EC), copper (Cu), and zinc (Z), along with $PM_{2.5}$ and ozone, on counts of inpatient asthma hospitalizations for children ages 0 to 18 and adults ages 19 to 64 years. Inpatient records were collected from the State Inpatient Databases which included hospitals from 12 U.S. states ranging in years from 2000 through 2016. We also included temperature from Daymet and variables from the U.S. census to control for socio-economic status. All variables were aggregated to the annual level. We observed an increase of 0.44 (95%CI: 0.28,0.59), 1.24 (95%CI: 1.07,1.40), and 2.35 (95%CI: 2.17,2.52) in the number of children asthma inpatient hospitalizations each year at the 25th, 50th, and 75th percentiles of pollutant mixture, respectively. In adults, we observed an increase of 0.84 (95%CI: 0.63,1.04), 1.98 (95%CI: 1.78,2.19), and 3.27 (95%CI: 3.06,3.48) in the number of asthma inpatient hospitalizations each year at the 25th, 50th, and 75th percentiles of the pollutant mixture, respectively. Our results indicate that long-term exposure to pollutant mixtures result in increased asthma hospitalizations in both children and adults, and daily measurements of particle components data is needed to assess short-term exposure.

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Association between particle components and inpatient Parkinson's hospitalizations among people ages 40 years and up in the U.S. using Bayesian kernel machine regression (BKMR).

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Abstract

Recent studies have shown that air pollutants may have adverse effects on neurological disorders. However, few studies have investigated the long-term exposure of particle components in conjunction with $PM_{2.5}$ and ozone to assess their individual and additive effects on Parkinson's disease. We aim to utilize a Bayesian Kernel machine regression (BKMR) to assess the individual and join effects of air pollutants including 15 different particle components such as organic carbon (OC), elemental carbon (EC), copper (Cu), and zinc (Z), along with $PM_{2.5}$ and ozone, on counts of inpatient Parkinson's hospitalizations for adults ages 40 years and up. Inpatient records were collected from the State Inpatient Databases which included hospitals from 12 U.S. states ranging in years from 2000 through 2016. We also included temperature from Daymet and variables from the U.S. census to control for socio-economic status. All variables were aggregated to the annual level. We observed a decrease of 0.05 (95%CI: 0.03,-0.14), 0.04 (95%CI: 0.05,-0.14),

and an increase of 0.03 (95%CI: -0.07,0.12) in the number of Parkinson's inpatient hospitalizations each year at the 25th, 50th, and 75th percentiles of pollutant mixture, respectively. At the 90th and 95th percentile, there is a significant increase of 0.12 (95%CI: 0.01,0.22) and 0.17 (95%CI: 0.06,0.28) annual Parkinson's hospitalizations, respectively. Our results contribute to the growing body of literature on air pollution and neurological disorders.

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Effects of long-term exposure of particle components on inpatient stroke hospitalizations in U.S. adults ages 40 years and up using Bayesian kernel machine regression (BKMR).

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Abstract

Air pollutants, including $PM_{2.5}$, have been shown to adversely affect health; however, few studies have investigated the long-term exposure of particle components in conjunction with $PM_{2.5}$ and ozone to assess their individual and additive effects on cerebrovascular incidents such as stroke. We aim to utilize a Bayesian Kernel machine regression (BKMR) to assess the individual and join effects of air pollutants including 15 different particle components such as organic carbon (OC), elemental carbon (EC), copper (Cu), and zinc (Z), along with $PM_{2.5}$ and ozone, on counts of inpatient Parkinson's hospitalizations for adults ages 40 years and up. Inpatient records were collected from the State Inpatient Databases which included hospitals from 12 U.S. states ranging in years from 2000 through 2016. We also included temperature from Daymet and variables from the U.S. census to control for socio-economic status. All variables were aggregated to the annual level. We observed a significant increase of 2.00 (95%CI: 1.72,2.29), 5.87 (95%CI: 5.57,6.16), and 9.81 (95%CI: 9.51,10.12) in the number of inpatient stroke hospitalizations each year at the 25th, 50th, and 75th percentiles of pollutant mixture, respectively. Our results indicate that the mixture of pollutants greatly contribute to the increase in the number of stroke hospitalizations each year and that the effects of short-term exposures of particle components on stroke hospitalizations should be assessed next.

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Characteristics of Mask-wearing and Evaluation of the Performance of Uncertified Masks in Korea and Indonesia

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Abstract

Many countries are obliged to wear a mask due to COVID-19. However, mask types and how to wear a mask are not regulated. The aims of the study were to understand mask-wearing behaviors in Korea and Indonesia and to evaluate performance of uncertified masks available in Korea and Indonesia by standards of Korea (KF94 and KF80) and USA (N95).

Mask types and mask-wearing behaviors were observed in cafés, supermarkets, underground shopping malls, streets in Korea, and in traditional markets, streets, parking lots, beaches, jogging tracks in Indonesia. Observation was conducted for 10 minutes and repeated 30~50 times in each place. Filtration efficiency and facial inhalation resistance tests for certification methods of Korea and USA were conducted on 20 uncertified masks from Korea.

In Korea, people wore disposable masks mostly in August 2020, but KF masks were the dominant type since October 2020. Most people wore the masks appropriately except cafés. From December 2021 to January 2022, Indonesia's dominant type was dental mask, except cotton mask in traditional market. Most people in Indonesia wore the masks appropriately overall. All 20 masks in Korea were not complied with KF94, but 16 masks and 17 masks were not complied with KF80 and N95, respectively.

With COVID-19, Korean used uncertified mask earlier but certified mask later. Indonesian used more uncertified masks. Since most uncertified masks from Korea were not complied with Korea and US standards, protection from aerosol could be limited with use of those uncertified masks.

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Evaluating predictions of ELAPSE and Google Air View-based mixed-effects LUR models for air pollution in Copenhagen, Denmark

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Abstract

We aimed to evaluate a) predictions of Google Air View-based mixed-effects land use regression (G-LUR) models for 2018-2020, and of ELAPSE-project LUR models for 2010 in Copenhagen, Denmark, and b) agreement of predictions between these two models. We analyzed concentrations and Spearman correlations of ultra-fine particles (UFP), nitrogen dioxide (NO_2), and black carbon (BC) by G-LUR models that predicted AP across ~30,000 street segments, and of NO2, BC, and fine particulate matter ($PM_{2.5}$) by ELAPSE models that predicted 2010 concentrations at 100m spatial resolution (ELAPSE10). Using annual mean data

for 2010 and 2019 monitored at regulatory network stations, 2019 predictions were estimated for ELAPSE (ELAPSE19) NO_2 and $PM_{2.5}$. According to the G-LUR predictions, the long-term mean (SD) was 14,120 (8,849) particles/cm³ for UFP, 16.8 (8.3) μg/m³ for NO2, and 1.1 (0.4) μg/m³ for BC. According to the ELAPSE19 predictions, these were 21 (3.4) μg/m³ for NO2, and 11 (1.3) μg/m³ for PM2.5. The mean (SD) for BC was 1.6 (0.3) μg/m³ based on ELAPSE10. The correlation amongst predictions was highest between BC and NO2 (0.79 for G-LUR; 0.64 for ELAPSE). Between G-LUR and ELAPSE predictions, the highest correlation was for G-LUR NO2 and ELAPSE BC (0.64). The estimates between the two models were moderately correlated. AP is a public health concern in Copenhagen, Denmark. There was moderate correlation between BC and NO_2 predicted by both models. The moderate correlation between G-LUR and ELAPSE predictions suggests that spatial patterns have been fairly stable over 10-years.

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Investigating Population Exposure Assignment Methods for Air Pollution from Google Street View Polyline Data in Copenhagen, Denmark

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Abstract

Various methods exist for linkage of Google-Street-View (GSV) vector data with populations. While rasterization or near-analysis are possible methods, multiple streets often surround residences; thus, a composite value can be assigned for geo-locations. We aimed to identify best geospatial method for exposure assignment from such data. Long-term mean AP [ultra-fine particles (UFP), nitrogen dioxide (NO_2), and black carbon (BC)] predictions across 30,312 streets (length = 15-60 m) were obtained from GSV-based mixed-effects LUR models developed for Copenhagen, Denmark. A near-analysis was used where Euclidean distances between each residence (out of ~77,000) and surrounding streets were calculated, nearest street was identified, and its AP values were assigned. Predictions were also assigned to mid-street centroid; using a systematic algorithm data were split to train (24,061; ~80%) and test sets (3,031; ~10%). Spatial averaging (SA), inverse distance weighting (IDW), ordinary kriging (OK), and natural neighbor (NN) models with multiple configurations for weighting and cell-size were developed. The coefficient of determination (R^2) and RMSE were calculated on the test sets. Overall, 9 SA, 27 IDW, 45 OK, and 3 NN models were developed. NN with a cell-size of 15m was the best performing model. The R^2 and RMSE for NN on the test sets were, respectively, 0.92 and 2543 pt/cm³ for UFP, 0.87 and 3.1 μg/m³ for NO_2, and 0.88 and 0.15 μg/m³ for BC. The Spearman correlations between residential predictions from NN and near-analysis assignment method were above 0.93.

Although high correlation was observed for NN and near-analysis, the latter overestimated the concentrations.

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Exposures to particulate matter associated metals during Pregnancy and their effects on birth outcomes

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Abstract

Exposure to air pollution has been linked with poor birth out-comes and become a major concern nowadays especially in India. We investigated the association between air pollutants and birth outcomes with special reference to particulate matter (PM) associated metals exposures in the Agra region. The birth cohort consisted of 200 singleton births in 2018-2019 and statistical data included residential address, gestational age, sex, birth date and order parental age and education of the mother. The total metals contribution in placenta of women was higher in pre-term cases (55%) as compared to full-term (45%). Cd and Pb metal concentration level was found to be higher in pre-terms cases (Cd: 14% and Pb: 18 %) than full-term cases (Cd: 8% and Pb: 14 %). Amongst the metals concentration of Cd was found to be highest in pre-term deliveries while in case of full-term Cd have least concentration, thus, Cd plays a vital role and may be one of the factors which is responsible for pre-term deliveries. The frequency distribution of birth weight inferred that full-term deliveries have normal (>2500 gm, mean±: 2762±36) baby weight while pre-term cases were observed lower (< 2500 gm, mean±:2353±42). Relationship between air pollutants and pre-term deliveries indicated that a large number of pre-term cases were significantly observed when the higher level of PM2.5. PM2.5 and metal exposure during pregnancy has been identified as a possible risk factor contributing to preterm birth which decline of gestational age (<37 weeks) and birth weight (<2500 gm).

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An exploratory study of occupational chemical exposures and biomarkers of early biological effect among hairdressers and office workers.

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Abstract

Office workers and hairdressers are exposed to a wide array of chemicals through products used in the workplace, including volatile organic compounds (VOCs) and phthalates which have been linked to a variety of adverse health effects. Oxidative stress has been shown to play a role in the development of diseases related to these exposures, however few studies have examined the

relationship between occupational chemical exposures and biomarkers of early biological effect. We conducted an exploratory occupational study examining associations between concentrations of chemical urinary biomarkers and biomarkers of oxidative stress (8-OHdG,8-isoprostane). We recruited two workgroup populations including 23 hairdressers and 17 office workers from the Maryland/DC metropolitan area. We quantified concentrations (ng/mL) of multiple chemical urinary biomarkers including 28 VOCs, using isotope dilution ultra-high performance liquid chromatography. Enzyme-linked immunosorbent assays (ELISA) were used to quantify 8-OHdG and 8-isoprostane (pg/mmol). Univariate linear regression was used to assess associations between concentrations of specific gravity corrected natural log-transformed VOC urinary biomarkers with concentrations of 8-OHdG and 8-isoprostane. Among hairdressers we found associations for 8-OHdG with N-acetyl-S-(N-methylcarbanoyl)-L-cysteine (ß=1.12, 95%CI: 0.23-2.00) and N-Acetyl-S-(1-cyano-2-hydroxyethyl)-L-cysteine (CYHA) (ß=:1.37, 95%CI: 0.90-1.84). Among office workers, we found associations for 8-OHdG with mandelic acid (ß=:1.15; 95%CI: 0.10, 2.19) and CYHA (ß=1.12; 95%CI:0.41,1.83). We also found associations for 8-isoprostane with 5-hydroxymethyl-2-furoic acid (ß=:0.31; 95%CI: 0.10, 0.52) and 5-hydroxymethyl-2-furoylglycine (HMFG) (ß=:0.28; 95%CI: 0.06, 0.51). This study represents a preliminary step in understanding biological pathways of occupational chemical exposures and their potential health effects among understudied workgroups.

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PFAS definitions and their implications: fluorinated pharmaceuticals as a case study

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Abstract

PFAS received their current name in a landmark paper by Buck et al in 2011. Since then, at least 8 additional definitions have been proposed, ranging in purpose from descriptive to regulatory. In considering definitions of PFAS, it is important to consider the identity of the unknown portion of extractable organic fluorine (EOF) in human serum, or what remains after the "traditional" PFAS are subtracted. For example, fluorine is incorporated into many pharmaceuticals to change properties such as pharmacokinetics. As some fluorinated pharmaceuticals are widely used, a key question then becomes how much of the unknown EOF is made up of such pharmaceuticals? Further do these count as PFAS under current definitions? We applied the nine identified PFAS definitions to a list of 360 fluorinated pharmaceuticals approved and used globally from 1954-2021. These definitions varied in their inclusiveness from 1% to 100% of organofluorine drugs with the most inclusive capturing widely used drugs such as Lipitor and Prozac. This emphasizes the need for PFAS definitions to be clear and related to their purpose. Very inclusive regulatory definitions will need to provide for exemptions such as essential uses. The presence of organofluorine drugs in

human serum may be less interesting for biomonitoring (except for unidentified EOF) but more important for surveillance of waste water and other media.

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How to find the working scope of PFAS?

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Abstract

Several PFAS definitions have been proposed over the last 15 years, with a trend to increasingly broad definitions, as illustrated by the new PFAS definition of the OECD published in 2021. However, there is no best definition of PFAS, but any PFAS definition is to be seen in relationship to its purpose. These purposes can be quite different and range from chemistry-focused classification schemes to policy- oriented rationales for including some organofluorine compounds in a regulation, and excluding others from this regulation. Regulatory and scientific aims and rationality are different and, therefore, it is important to understand (and discuss) the purpose of any definition of PFAS.

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Poly- and perfluoroalkyl substances as a class: relevant chemistry and properties

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Abstract

Poly- and perfluoroalkyl substances (PFAS) have attracted increasing public attention as class of emerging global contaminants of high concern. "PFAS" is itself a broad, general term that, across definitions, refers to a chemical class containing diverse molecular structures and physical, chemical and biological properties. PFAS can include high molecular weight polymers and low molecular weight non- polymers; neutral, anionic, cationic and zwitterionic substances; solids, liquids, and gases; highly reactive and non-reactive (inert) substances; soluble and insoluble substances; and volatile and involatile substances. Despite this high diversity, all PFAS are alike in that they contain perfluoroalkyl moieties that are extremely resistant to environmental and metabolic degradation. The vast majority of PFAS are therefore either non-degradable or transform ultimately into stable terminal transformation products, which are still PFAS. Given the complexity and diversity of PFAS, it can be a challenging task to characterize and categorize PFAS based on chemical structures in a coherent and consistent manner, in which such diversity must still be properly recognized and communicated in a clear, specific and descriptive manner.

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(Re)Defining PFAS: Development of OECD's Report on Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances

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Abstract

The OECD/UNEP PFC group worked from 2018 to 2021 to review the universe and terminology of per- and polyfluoroalkyl substances (PFAS) to provide recommendations and practical guidance on PFAS terminology to stakeholders. This effort built on the OECD 2018 PFAS list and recent non-target screening studies. The OECD/UNEP PFC group identified major gaps in the Buck et al. (2011) class definition in representing the universe of PFAS (e.g., omission of substances that have functional groups on both ends of the fully fluorinated carbon moiety (e.g., perfluoroalkyldicarboxylic acids) and put forth a revised, broadly inclusive PFAS definition. In this definition, which is based on molecular structure alone, PFAS are fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it). In other words, with a few noted exceptions, any chemical with at least a perfluorinated methyl group (−CF3) or a perfluorinated methylene group (−CF2−) is considered a PFAS. It is important to note that this group's decision to broaden the definition compared to Buck et al. is not connected to decisions on how PFAS should be grouped in regulatory and voluntary actions.

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Predict the Concentration of Natural Volatile Organic Compounds in Forest Atmosphere

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Abstract

We aimed to understand the correlation between the microclimate environment within a forest and NVOC (Natural volatile organic compounds) concentration and the concentration of NVOC more efficiently through the prediction model method. In this study, 380 samples were collected and analyzed to examine the characteristics of NVOC emitted from a birch forest. NVOC were analyzed in May and July 2019, and measurements were performed at three different locations. Using a pump and stainless- steel tube filled with Tenax-TA, 9 L of NVOC was collected at a speed of 150 mL/h. The analysis of NVOC composition in the forest showed that it comprised α-pinene 27% and camphor 10%. Evaluation of the correlation between the NVOC concentration and the microclimate in the forests showed that the concentration increased markedly with the increase in temperature

and humidity, and the concentration decreased with the increase in wind velocity. Nineteen substances in total including α- pinene and β-pinene were detected at high concentrations during the sunset. The results of the study site analysis presented a significant regression model with a R2 as high as 60.1%, confirming that the regression model of the concentration prediction of NVOC in birch forest has significant explanatory power.

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Statistical Evidence for Managing Forest Density in Consideration of Natural Volatile Organic Compounds

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Abstract

Rapid deforestation, coupled with the growing population seeking forest therapy, urges the necessity for research on how to maximize forests' therapeutic functions when cultivating damaged or unmanaged forests. This study was formulated to provide a basis for forest stand density management to maximize the therapeutic effects of forests with a focus on natural volatile organic compounds (NVOCs), a representative component of forest therapy through analysis of variance and regression analyses. The results of this study revealed all studied stand densities yield the highest total NVOC (TNVOC) emissions in summer, especially in the study site which has a forest density of 700/ha. In addition, treeless areas (0/ha) were found to have the most significant difference in average NVOC emissions when cultivated at a density of 700/ha. When managing forests with a density of 900/ha to 1000/ha, it has been shown that it is most desirable, in terms of therapeutic function efficiency, to control a density of 500/ha to 700/ha. Finally, regression equations for the five experimental sites with significant explanatory power were derived. Based on the results of the conducted analyses, 700/ha of forest density is recommended to maximize the therapeutic effects of forests, compared to other ranges of forest density.

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Refining Soil Sampling Methods for Asbestos

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Abstract

The environmental question being asked is : how do various soil sampling methods compare and how do these methods compare with activity-based sampling (ABS) results from the same location ? The EPA compared various methods of sampling and analysis of asbestos in soil

and air in attempt to develop recommended approaches for the improving of reproducibility of asbestos analysis in soil. The sensitivity, effectiveness, and reproducibility of each method was evaluated and compared with other methods. Performance Evaluate (PE) samples were used to provide an estimate of how effective each method works relative to a known quantity of asbestos in the sample.

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Low-cost sensors, an interesting alternative for air quality monitoring in developing countries

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Farid RAHAL Biography

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Abstract

In many developing countries, the monitoring of air quality is in a deplorable state, because this monitoring is a costly policy, which requires sufficient and sustainable financial means. Despite the investments made by several developing countries to acquire conventional air quality monitoring networks, these infrastructures are often inoperative after few years because their maintenance is expensive. Indeed, an economic barrier prevents the establishment of air pollution-monitoring networks in these countries. An alternative to the traditional air quality-monitoring infrastructure can potentially come from the increasing development of electrochemical sensor technologies for air quality monitoring.

Thus, we have developed low-cost analyzers of the main atmospheric pollutants, called APOMOS (Air Pollution Monitoring System) based on electrochemical sensors managed by microcontroller or nano- computer.

In order to validate the APOMOS system, the recorded measurements was compared with measurements taken by a conventional analyzer.

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Partitioned Particulate Data and Health Risk Quantification of Metal Content in Mixed Residential Areas of Northern India

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Abstract

The work presents the investigation of indoor air pollution through analysis of size segregated aerosol data (>2.5µm, 2.5-1.0µm, 1.0-0.5µm, 0.5-0.25µm) collected through SKC cascade impactor in varied residential homes of Agra, India. The study offered that lifestyle and indoor activities have a pronounced effect on particle mass concentration levels. Results depicted elevated concentration loading for smaller size particulates with elements varying in their partitioning behavior across different aerosol sizes. The calculated bioavailability index showed the importance of smaller size particles in a simulated lung environment. Higher non-carcinogenic (Hazard Quotient (HQ)) and carcinogenic (Excess Lifetime Cancer Risk (ELCR)) threats were embedded within Mn (HQ= 12) and Cr(VI) (ELCR= 1.21*10-3 (adults); 3.63*10- 4 (child)) in fine (PM1.0-2.5) and coarser (PM>2.5) fractions respectively. Results of this work provide insight into size segregated PM exposure and address the need for inclusive investigation of toxicity and control measures in establishing a safer indoor environment.

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Comparison of Dermal Risk Evaluation and Refined Dermal Exposure Assessment for Chlorinated Solvents

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Abstract

Background: The current dermal risk evaluations approach conducted by the U.S. EPA for the premanufacturing notification (PMN) process of industrial chemicals is very conservative. Specifically, the approach is based on open process, tier zero (or 2-hand contact), and not accounting for rapid evaporation of volatile solvents. The chlorinated chemical industry protects workers from the dermal exposure by implementing risk management measures which are not being incorporated in the EPA approach. Available approaches and models for dermal risk assessment could be used to enhance/refine the current practice.

Methods: The European Chemical Agency (ECHA) ECETOC Targeted Risk Assessment (TRA) and IHSkinPerm models were used to evaluate dermal exposure of carbon tetrachloride (CCl4) among workers at a chemical industrial site. The results were compared with those of the EPA approach.

Results: For the loading, unloading, and sampling tasks, the highest dermal exposure estimates among workers obtained from the refined models (TRA and IHSkinPerm) are >50 times lower compared to those from the EPA approach.

Discussion: Although the current EPA dermal risk evaluation approach accounts for volatility of chemicals and its impact on potential absorbed dose, other conservative defaults (contact area, duration, frequency) are still being used. There is opportunity for the EPA to further refine its current exposure assessment as a next tier approach that includes better characterization of closed process, closed loop samplers, and actual duration.

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Comparison of Nicotine Dependence and Biomarker Levels among Traditional Cigarette, Heat-Not-Burn Cigarette, and Liquid E-Cigarette Users: Results from the Think Study

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Abstract

This study aimed to compare Korean smokers' smoking-related biomarker levels by tobacco product type, including heat-not-burn cigarettes (HNBC), liquid e-cigarettes (EC), and traditional cigarettes (TC). Nicotine dependence levels were evaluated in Korean adult study participants including TC-, EC-, HNBC- only users and nonsmokers (n = 1586) from March 2019 to July 2019 in Seoul and Cheonan/Asan South Korea using the Fagerström Test Score. Additionally, urine samples (n = 832) were collected for the measurement of urinary nicotine, cotinine and NNAL. The median(interquartile range) nicotine dependence level was not different among the three types of smokers, being 3.0 (2.0-5.0) for TC- (n = 726), 3.0 (1.0-4.0) for EC- (n = 316), and 3.0 (2.0-4.0) for HNBC- (n = 377) only users. HNBC-only users presented similar biomarker levels compared to TC-only users, except for NNAL (HNBC: 14.5 (4.0-58.8) pg/mL, TC: 32.0 (4.0-69.6) pg/mL; p = 0.0106). TC and HNBC users showed increased urinary cotinine levels as early as the time after the first smoke of the day.

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Air Polluting Monitoring Using Mobile Sensors on Bicycle Commuters in New York City: Methods Development and Lessons Learned

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Abstract

Prior research shows that air pollution measurements collected through mobile air quality monitoring (AQM) can provide outdoor air pollution data at a high spatial resolution. Additionally, mobile AQM has been used to show intra and inter-neighbourhood variability, including within city blocks of the same neighbourhood (Apte et al., 2017, Padilla et al., 2021). This work builds on previous research on mobile AQM to test the applications of mobile monitoring data to generate hyperlocal insights using personal AQM data (PM2.5 and Black Carbon (BC)) collected via air monitors connected to bicycle commuters during their rides to and from home and work locations in New York City (NYC) taken over a four-year period from 2015 to 2020. We analyze the temporal trends (diurnal and seasonal), spatial distribution and heterogeneity of the measurements, and compared our empirical measurements with the New York City Community Air Survey (NYCCAS) seasonal modeled data (100m grid centroids) for the 4-year period, with a street coverage of 57%. Our results indicate limited temporal variability (diurnal and seasonal) in PM2.5 and BC and significant spatial variability across the coverage area. The mobile AQM approach presented in this analysis has the potential to be integrated with other air quality data (e.g. stationary monitors, satellite data) to generate hyperlocal insights to target areas for air pollution mitigation action in cities.

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Mechanistic Transmission Model for Evaluating the Risk and Control of Selected Communicable Respiratory Diseases in Indoor Environments

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Abstract

Communicable respiratory illnesses lead to excesses in mortality, morbidity, and expenses associated with health care, absence from work, and productivity. However, transmission pathways and control of airborne infectious diseases in indoor environments are poorly understood. Common mathematical approaches such as Wells-Riley are mostly focused on airborne transmission pathways and have not yet been applied in many realistic indoor settings. Herein, we developed a framework that combines stochastic Markov chain and negative exponential dose-response modeling with available empirical data to predict the transmission risk of several communicable respiratory infections including tuberculosis, measles, influenza, and COVID-19 in 20 typical indoor environments. Moreover, the effectiveness of three types of control strategies including increasing ventilation, adding portable air cleaners, and improving the air filters in the building HVAC systems were explored. The characteristics of each environment including floor area, ceiling height, occupational time, and occupant density were culled from various sources. Four types of activities including sitting/resting, and light, moderate, and heavy activities were considered. The results demonstrated that additional to the biological characteristics of pathogens, human activities, inter-zonal airflows, and physical properties of bio-aerosols can significantly impact the infection transmission risk and airborne transmission likely accounts for the majority of disease transmission in selected environments even for influenza and COVID-19. We also demonstrated that providing additional 0.75 cfm/ft^2 clean air delivery rate to selected indoor

environments could reduce the relative transmission risk of airborne infectious diseases in typical indoor environments between 33% and 72% depending on the type of the unit.

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Impacts of building and flood characteristics on mold growth and respiratory illnesses after Hurricane Ida

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Abstract

Mold growth is a common, yet overlooked indirect impact of floods, which adversely affect human respiratory health. There is currently a lack of understanding of interrelationships among flood characteristics, building and HVAC system properties, human behaviors, and vulnerability to mold, particularly in residential buildings. Hurricane Ida created a rare opportunity to study these interrelationships since it caused various flood intensity levels within a short timeframe and affected a wide range of communities with diverse demographics and respiratory illness prevalence. We investigated the aftermath of Hurricane Ida and collect critical data required for examining human respiratory health risks associated with mold growth in 50 water-damaged residential buildings in the Northeast and South regions of the U.S. A combination of online surveys, home inspections, and existing datasets was used to collect the required data. At the end of our analyses, we seek to understand (1) what flood characteristics, building and HVAC system properties, and human behaviors cause higher levels of mold growth in assessed buildings? (2) how does living in water-damaged buildings after natural disasters affect respiratory symptoms? and (3) what are the impacts of interventions, precaution measures, and remediation techniques in buildings on mold growth? The collected data and identified relationships can be used to guide building designers and occupational health scientists to establish resilient indoor environments, provide a foundation to develop flood-induced mold growth and asthma risk models, and assist public health officials and emergency managers to have a better understanding of indirect health-related impacts of floods.

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Wildland firefighters' occupational exposure – preliminary data of pre-fire season

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Abstract

With climate change, mean and extreme temperatures in Portugal have increased. Consequently, wildfires are occurring more frequently and on a greater scale. Smoke pollution due to forest fire events represents an important public health issue for the communities directly affected, particularly for the personnel engaged in firefighting operations. IARC has classified firefighting as potentially carcinogenic to humans, yet firefighter is among the least studied occupations. The main aim of the study is to characterize the exposure (before-, during and after-wildfire season) and identify a panel of (bio)markers for the surveillance of firefighters' health. In the 1st phase (pre-fire season) a group of wildland firefighters were enrolled in the study, 144 men and 29 women. Biological samples were collected and sociodemographic and occupational history were assessed via self-reported questionnaires. Our preliminary data indicate that most firefighters in the group were volunteers (83%) spending > 10 hours on their duties. Moreover, the majority reported being exposed to smoke, gases, and particles during their activities and to a lesser extent to solvents. Results from the micronucleus test in buccal cells showed that smoking and diet can be important variables. We expect to provide a new insight to better characterize firefighters' exposure and contribute to the implementation of health and safety measures in this sector. This work was supported by FCT/ MCTES and national funds under the grant PCIF/SSO/0017/2018. Filipa Esteves (PhD grant UI/BD/150783/2020) is supported by FCT and ESF and Joana Madureira (SFRH/BPD/115112/2016) is supported by FCT and ESF, through POCH.

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Cokriging using a low-cost sensor network to model spatial variation of brake and tire-wearmetals and oxidative stress potential in Southern California

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Abstract

Due to regulations and technological advancements reducing tailpipe emissions, an increasing proportion of emissions arise from brake and tire wear particulate matter (PM). PM from these non-tailpipe sources contains heavy metals capable of generating oxidative stress in the lung. Although important, these particles remain understudied because the high cost of actively collecting filter samples. Improvements in electrical engineering, internet connectivity, and an increased public concern over air pollution have led to a proliferation of dense low-cost air sensor networks

such as the PurpleAir monitors, which measure unspeciated fine particulate matter of various sizes. In this study, we collected and processed field measurements from 50 locations across the Los Angeles Metropolitan region of Ba, Zn, black carbon, reactive oxygen species concentration in the epithelial lining fluid, dithiothreitol (DTT) loss, and OH formation. We use a cokriging approach, incorporating PM2.5 data from the PurpleAir network as a secondary predictor variable and the speciated data from the field samples in a land-use regression (LUR) as an external drift. For most pollutant species, cokriging models produced more accurate predictions than an LUR model, which did not incorporate data from the PurpleAir monitors.
This finding suggests that low-cost sensors can enhance exposure predictions of pollutants that are costly to measure extensively in the field.

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Prenatal exposure to mercury: the Portuguese experience establishing a communication strategy to control exposure under the HBM4EU-mom project

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Abstract

Presently, in Europe the main source of human exposure to mercury is the consumption of seafood containing methylmercury. Portugal has the highest consumption of fishery and aquaculture products in the EU. The main target of methylmercury is the central nervous system and the prenatal period represents a period of greatest vulnerability. As such, Portugal has participated in the HBM4EU-mom project, a pilot randomized intervention study aiming to reduce methylmercury exposure of pregnant women in high seafood-consuming European countries, by providing recommendations for seafood consumption during pregnancy.

A total of 135 women have participated in phase 1 (first trimester) and 113 in phase 2 (≥12 weeks after), in Portugal. Participation in each phase involved answering a questionnaire on health, nutrition and lifestyle and providing a hair sample for measuring total mercury. Participants were randomly assigned to an intervention (received seafood consumption recommendations) or control group (standard care).

Portugal registered the highest mercury exposures when compared to the remaining European countries integrating the consortium, with a mean of 1.80µg/g. Mean total mercury level decreased to 1.53µg/g in Phase 2. The number of samples exceeding EFSA's health-based guidance value (1.8µg/g) decreased between the two phases, from 36% to 27%.

Results showed that it is possible to raise awareness about the health risks associated to mercury exposure, not compromising the consumption of seafood species low in mercury in accordance with the national dietary recommendations. This constitutes a significant contribution to minimize pre-natal methylmercury exposure, while ensuring the nutritional benefits of seafood consumption.

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Why Indoor Chemistry Matters: A National Academies Consensus Study

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Abstract

The indoor environment is a significant contributor to human chemical exposures and related health risks, and indoor chemistry plays an important role in driving and modifying exposure to many indoor pollutants. Despite recent rapid developments in this field of research, much of the chemical complexity and variability of indoor environments remains poorly understood. The National Academies of Sciences, Engineering, and Medicine (the National Academies) convened an ad hoc committee of 16 experts to conduct a consensus study examining the state of the science regarding chemicals in non-industrial indoor environments. This presentation will summarize findings of this work and the final committee report. These include emerging discoveries related to indoor chemistry and new findings about sources, reservoirs, transfer, and transformations of chemicals, and how these findings shine light on the link between chemical exposure, air quality, and human health. As such, this presentation will summarize recommendations regarding: 1) key implications of recent scientific research, including potential near- term opportunities for translating research findings into practice, and 2) opportunities for new scientific research in several priority areas critical to achieving a better understanding of the chemistry of the indoor environment and resulting adverse exposures. The committee noted opportunities for advancing this field of study by enhancing interdisciplinary collaboration and addressing methodological or technological barriers to research. The study's sponsors are the Environmental Protection Agency, the National Institute of Environmental Health Sciences, the Centers for Disease Control and Prevention, and the Alfred P. Sloan Foundation.

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Building consensus and standards for Global Positioning System (GPS) use, processing, analysis, and reporting in human health studies

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Abstract

The use of Global Positioning Systems (GPS) technology in exposure and health-related research has grown exponentially over the past decades. When worn by a participant, GPS can capture the totality of human mobility during an observation period. This information can then be linked to environmental data and other body-worn sensor data to create precise measures of what people are exposed to, how those exposures occur within daily activity spaces, and if exposures influence health outcomes and behaviors. Research that incorporates GPS is faced with several challenges and decision points throughout each phase of a study. These phases include study design, data collection, data processing, data analysis, and reporting of study

results. Currently there is no research community approved set of standards to follow for utilizing and reporting on GPS data use in human health studies. This makes it difficult to compare study results, as papers often omit important GPS data-related details. Here we present results from a systematic review of best practices for GPS use in human health studies with a focus on study design and data processing standards. Topics reviewed include device used, sampling frequency, sample size, wear protocols, determination of valid wear days and time, imputation, linkage protocols, and reporting on data loss. The review provides a starting point for development of community agreed upon processing and reporting standards. We will invite expert participation through survey and a Delphi consensus building process with the goal of submitting standards to the Equator Network for health research reporting.

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Distribution of Blood Nickel Levels and the association of health effects

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Abstract

Nickel can induce several adverse effects to human body. This study investigated the distribution of blood nickel and the associated health effects among the general population. First, we recruited 50 healthy participants who lived in Busan, Korea. Biological samples were collected 4 times - March, August in 2020 and June, November in 2021. Nickel levels were analyzed using inductively coupled plasma-mass spectrometer by the Dong-A University Environmental Center. Second, we analyzed the Korea National Health and Nutrition Examination survey for investigating the reference value and the association of health effects.

The GM of nickel levels showed the higher in March (blood: 1.169 ug/L, serum: 1.146 ug/L, urine: 1.893 ug/L). And the temporal variation had a significant effect on nickel levels in blood (p-value: 0.0017), serum (p-value: <0.0001), and urine (p-value: 0.0011). Intra-class correlations of blood nickel and urinary nickel were 1.4 %, 6.4 %, respectively. The GM of the blood nickel in Korea National Health and Nutrition Examination survey was 0.294 ug/L (women: 0.311 ug/L, men: 0.28 ug/L). And the level showed increasing trend with increasing age. The group diagnosed with renal failure (OR: 3.561, 95% CI: 1.121, 11.307) and anemia (OR: 4.028, 95% CI: 2.640, 6.144) showed the higher blood nickel than others. This study showed that temporal variation is much larger than personal variation in nickel level. Further study is required to investigate the main exposure sources in the specific season.

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Comparison of cadmium exposure and the associated renal function in environmental vulnerable areas – mine, refinery area

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Abstract

Abandoned metal mines and refineries are environmental vulnerable area. We investigated Cadmium exposures and the associated health effects in 4 vulnerable regions. From January to December in 2021, study subjects were recruited from two abandoned metal mine, refinery area, and control area. A total of 298 participants provided blood and urine samples, and questionnaire responses. Blood and urinary cadmium were measured using inductively coupled plasma-mass spectrometer, and renal function was evaluated urinary NAG and b2-MG, and eGFR calculated by the CDK-EPI equation.

The geometric mean of blood cadmium was higher in the abandoned metal mine A (1.37 μg/L), the abandoned metal mine B (1.93 μg/L), and the refinery (2.27 μg/L) than in the control (0.89 μg/L). The geometric mean of urinary cadmium was 2.87 μg/L, 2.46 μg/L, and 1.61 μg/L in the abandoned metal mine A, B, and refinery area, respectively, while that of control was 1.11 μg/L. Urinary cadmium levels increased with NAG, β2-MG, and decreasing eGFR. The OR of exceeding the reference value for NAG was 5.272 (95% CI: 2.71, 10.27) and for eGFR was 4.077 (95% CI: 1.531, 10.77). The cadmium levels of participants who lived in vulnerable areas was higher than the control. And there was an association between cadmium and renal function indicators. Therefore, molecular biological pathway for the association should be further studied.

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Building a Cumulative Impacts Research Agenda at the United States Environmental Protection Agency

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The United States Environmental Protection Agency (EPA) has made it a top priority to take decisive action to advance environmental justice and civil rights in its latest strategic plan. Cumulative impacts are the result of exposures to multiple chemical and non-chemical stressors from the built, natural, and social environments. A significant driver of health disparities in the United States are disproportionate exposures to pollution and environmental degradation exacerbated by racial, economic, and geographic characteristics of individuals and communities. Understanding and addressing cumulative impacts is critical to reducing

health disparities and inequities in these communities and local populations. Actions to address cumulative impacts will require accurate and realistic assessments of the combined effects from chemical and non-chemical stressors.

To support decision making at federal, state, tribal, and local levels, EPA's Office of Research and Development is embarking on an effort to strengthen the scientific foundation for assessing cumulative impacts. This presentation will introduce ISES participants to the EPA report on cumulative impacts research recommendations that launches this critical research agenda. These recommendations were developed based on a series of listening sessions and workshops to identify research gaps and barriers to conducting and translating research, and to establish a broad approach that builds knowledge to inform cumulative impact assessments. These recommendations inform research conducted by EPA through 2026 and beyond. (The views expressed are those of the authors and do not necessarily represent the views or the policies of the U.S. Environmental Protection Agency).