

# Bulletin Board

## Contents

MAR. 15, 2024

(click on page numbers for links)

### CHEMICAL EFFECTS

Manganese accumulation in red blood cells as a biomarker of manganese exposure and neurotoxicity ..... 3

Contamination of aquatic ecosystems by persistent organic pollutants (POPs) originating from landfills in Canada and the United States: A rapid scoping review ..... 3

### ENVIRONMENTAL RESEARCH

Associations of environmental cadmium exposure with kidney damage: Exploring mediating DNA methylation sites in Chinese adults ..... 4

Associations of prenatal ambient air pollution exposures with asthma in middle childhood ..... 5

Fine-tuning the use of moss transplants to map pollution by Potentially Toxic Elements (PTEs) in urban areas ..... 6

### PHARMACEUTICAL/TOXICOLOGY

Evidence for chromium crosses blood brain barrier from the hypothalamus in chromium mice model ..... 7

Impact of electronic cigarette usage on the onset of respiratory symptoms and COPD among Chinese adults ..... 8

### OCCUPATIONAL

Ascertaining sensitive exposure biomarkers of various Metal(loid)s to embryo implantation ..... 9

Maternal exposure to deltamethrin during pregnancy and lactation impairs neurodevelopment of male offspring ..... 10

Multi-scenario PM2.5 distribution and dynamic exposure assessment of university community residents: Development and application of intelligent health risk management system integrated low-cost sensors ..... 10

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## Bulletin Board

## Technical

MAR. 15, 2024

## CHEMICAL EFFECTS

**Manganese accumulation in red blood cells as a biomarker of manganese exposure and neurotoxicity**

2024-03-08

Although overexposure to manganese (Mn) is known to cause neurotoxic damage, effective exposure markers for assessing Mn loading in Mn-exposed workers are lacking. Here, we construct a Mn-exposed rat model to perform correlation analysis between Mn-induced neurological damage and Mn levels in various biological samples. We combine this analysis with epidemiological investigation to assess whether Mn concentrations in red blood cells (MnRBCs) and urine (MnU) can be used as valid exposure markers. The results show that Mn exposure resulted in neurotoxic damage in rats and that MnRBCs correlated well with neurological damage, showing potential as a novel Mn exposure biomarker. These findings provide a basis for health monitoring of Mn-exposed workers and the development of more appropriate biological exposure limits.

Authors: Xuedan Deng, Yonghua Guo, Xiaofei Jin, Huifang Si, Kai Dai, Meng Deng, Jing He, Changfu Hao, Wu Yao

Full Source: *Neurotoxicology* 2024 Mar 8;50:161-813X(24)00023-8. doi: 10.1016/j.neuro.2024.03.003.

**Contamination of aquatic ecosystems by persistent organic pollutants (POPs) originating from landfills in Canada and the United States: A rapid scoping review**

2024-03-08

Persistent organic pollutants (POPs) are organic chemical substances that threaten human health and the planet's ecosystems due to their toxicity and their ability to remain intact for a long time, wide distribution throughout the environment, and accumulation and magnification in living organisms through the food chain. Discarded products from landfills and dumpsites are potential sources of POPs due to their persistence for several decades and constant release to surrounding environment. POPs in aquatic systems signal input predominantly from landfills, wastewater treatment plants, sewage, and urban runoff, suggesting a research gap to guide policies to address these unabated releases. This scoping review aims to rapidly identify the key concepts underpinning the containment, translation, and migration of POPs in Canadian and US landfill leachate. The review targeted multidisciplinary perspectives on the topic and spanned forensic biology, environmental sciences, chemistry, and geology.

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## Bulletin Board

## Technical

MAR. 15, 2024

Contaminated municipal solid waste (MSW) landfill characteristics, as reported by government agencies in Canada and the US, were synthesized and harmonized to illustrate the geographical scope of MSW landfills releasing POPs into the surrounding environment. The knowledge and data gaps summarized in this study highlight the need to address the inadvertent release of POPs from Canadian and US landfills, particularly in consideration of dated and degrading landfill infrastructure, the proximity of marginalized people, and the implications of climate change on the countries' more vulnerable landscapes. This review is applicable to the development of future studies that aim to guide environmental protective policies.

Authors: Cory Ochs, Kaitlyn Garrison, Priyam Saxena, Kristen Romme, Atanu Sarkar

Full Source: *The Science of the total environment* 2024 Mar 8;171490. doi: 10.1016/j.scitotenv.2024.171490.

## ENVIRONMENTAL RESEARCH

**Associations of environmental cadmium exposure with kidney damage: Exploring mediating DNA methylation sites in Chinese adults**

2024-03-08

Environmental exposure is widely recognized as the primary sources of Cadmium (Cd) in the human body, and exposure to Cd is associated with kidney damage in adults. Nevertheless, the role of DNA methylation in Cd-induced kidney damage remains unclear. This study aimed to investigate the epigenome-wide association of environmental Cd-related DNA methylation changes with kidney damage. We included 300 non-smoking adults from the China in 2019. DNA methylation profiles were measured with Illumina Infinium MethylationEPIC BeadChip array. Linear mixed-effect model was employed to estimate the effects of urinary Cd with DNA methylation. Differentially methylated positions (DMPs) associated with urinary Cd were then tested for the association with kidney damage indicators. The mediation analysis was further applied to explore the potential DNA methylation based mediators. The prediction model was developed using a logistic regression model, and used 1000 bootstrap resampling for the internal validation. We identified 27 Cd-related DMPs mapped to 20 genes after the adjustment of false-discovery-rate for multiple testing among non-smoking adults. 17 DMPs were found to be associated with both urinary Cd and kidney damage, and 14 of these

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## Bulletin Board

## Technical

MAR. 15, 2024

DMPs were newly identified within the Chinese. Mediation analysis revealed that DNA methylation of cg26907612 and cg16848624 mediated the Cd-related reduced kidney damage. In addition, ten variables were selected using the LASSO regression analysis and were utilized to develop the prediction model. It found that the nomogram model predicted the risk of kidney damage caused by environmental Cd with a corrected C-index of 0.779. Our findings revealed novel DMPs associated with both environmental Cd exposure and kidney damage among non-smoking adults, and developed an easy-to-use nomogram-illustrated model using these novel DMPs. These findings could provide a theoretical basis for formulating prevention and control strategies for kidney damage from the perspective of environmental pollution and epigenetic regulation.

Authors: Yuan Wei, Xiaochen Wang, Qi Sun, Wanying Shi, Wenli Zhang, Xu Gao, Yawei Li, Ruiting Hao, Xiaojie Dong, Chen Chen, Kangning Cao, Weilong Jiang, Zhengxiong Yang, Ying Zhu, Yuebin Lv, Dongqun Xv, Juan Li, Xiaoming Shi

Full Source: Environmental research 2024 Mar 8:118667. doi: 10.1016/j.envres.2024.118667.

### Associations of prenatal ambient air pollution exposures with asthma in middle childhood

2024-03-08

We examined associations between prenatal fine particulate matter (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>), and ozone (O<sub>3</sub>) exposures and child respiratory outcomes through age 8-9 years in 1279 ECHO-PATHWAYS Consortium mother-child dyads. We averaged spatiotemporally modeled air pollutant exposures during four fetal lung development phases: pseudoglandular (5-16 weeks), canalicular (16-24 weeks), sacular (24-36 weeks), and alveolar (36+ weeks). We estimated adjusted relative risks (RR) for current asthma at age 8-9 and asthma with recent exacerbation or atopic disease, and odds ratios (OR) for wheezing trajectories using modified Poisson and multinomial logistic regression, respectively. Effect modification by child sex, maternal asthma, and prenatal environmental tobacco smoke was explored. Across all outcomes, 95% confidence intervals (CI) included the null for all estimates of associations between prenatal air pollution exposures and respiratory outcomes. Pseudoglandular PM<sub>2.5</sub> exposure modestly increased risk of current asthma (RR<sub>adj</sub> = 1.15, 95% CI: 0.88-1.51); canalicular PM<sub>2.5</sub> exposure modestly increased risk of asthma with recent exacerbation (RR<sub>adj</sub> = 1.26, 95% CI: 0.86-1.86) and persistent wheezing (OR<sub>adj</sub> = 1.28, 95% CI: 0.86-1.89). Similar findings were observed for O<sub>3</sub>, but not NO<sub>2</sub>, and associations

## Bulletin Board

## Technical

MAR. 15, 2024

were strengthened among mothers without asthma. While not statistically distinguishable from the null, trends in effect estimates suggest some adverse associations of early pregnancy air pollution exposures with child respiratory conditions, warranting confirmation in larger samples.

Authors: Marnie F Hazlehurst, Kecia N Carroll, Paul E Moore, Adam A Szpiro, Margaret A Adgent, Logan C Dearborn, Allison R Sherris, Christine T Loftus, Yu Ni, Qi Zhao, Emily S Barrett, Ruby H N Nguyen, Shanna H Swan, Rosalind J Wright, Nicole R Bush, Sheela Sathyanarayana, Kaja Z LeWinn, Catherine J Karr

Full Source: International journal of hygiene and environmental health 2024 Mar 8:258:114333. doi: 10.1016/j.ijheh.2024.114333.

### Fine-tuning the use of moss transplants to map pollution by Potentially Toxic Elements (PTEs) in urban areas

2024-03-08

Mosspheres are a kind of moss transplants which offer a novel approach for detecting atmospheric pollution using devitalized mosses, as they reflect the atmospheric deposition of certain elements and polycyclic hydrocarbons. However, due to the unique features of the mosspheres such as the low elemental concentrations in the cultured material, the data treatment needs to be different from that of conventional biomonitoring studies. In this article, our objectives are to identify the best parameter for expressing the levels of chemical elements accumulated by mosspheres, and to apply a recently developed method to assess the probability of pollution of each sample and of the study area. To do this, we used data from a study in which 81 mosspheres were exposed in a medium-sized city in southwestern Europe. Comparing different pollution indices, we selected the enrichment rate (ER) as the most useful, as it is resilient to fluctuations in the initial concentrations and takes into account the time factor, allowing for greater comparability among studies. Then, we determined that the statistical distribution of the ERs of most elements fitted a normal distribution, showing that most samples did not differ significantly from the background concentrations for these elements. On the other hand, for Ni, Pb and Zn there was a subpopulation of samples above background values. In these cases, we determined the probability of pollution of each sample. Finally, we used indicator kriging to calculate the probability of pollution across the study area, identifying the polluted areas, which for some elements match the distribution of the main

We examined associations between prenatal fine particulate matter (PM<sub>2.5</sub>), nitrogen dioxide (NO<sub>2</sub>), and ozone (O<sub>3</sub>) exposures and child respiratory outcomes through age 8-9 years in 1279 ECHO-PATHWAYS Consortium mother-child dyads.

Mosspheres are a kind of moss transplants which offer a novel approach for detecting atmospheric pollution using devitalized mosses, as they reflect the atmospheric deposition of certain elements and polycyclic hydrocarbons.

## Bulletin Board

## Technical

MAR. 15, 2024

industries and highways, indicating that this is a suitable protocol to map elemental pollution in urban areas.

Authors: Antón Vázquez-Arias, Pablo Giráldez, Javier Martínez-Abaigar, Encarnación Núñez-Olivera, Jesús R Aboal, J Ángel Fernández

Full Source: The Science of the total environment 2024 Mar 8:171601. doi: 10.1016/j.scitotenv.2024.171601.

## PHARMACEUTICAL/TOXICOLOGY

## Evidence for chromium crosses blood brain barrier from the hypothalamus in chromium mice model

2024-03-08

It has been shown that exposure to hexavalent Chromium, Cr (VI), via nasal cavity can have neurotoxicological effects and induces behavioral impairment due to the fact that blood brain barrier (BBB) does not cover olfactory bulb. But whether Cr (VI) can cross the BBB and have a toxicological effect in central nervous system (CNS) remains unclear. Therefore, we investigated the effects of Cr (VI) on mice treated with different concentrations and exposure time (14 days and 28 days) of Cr (VI) via intraperitoneal injection. Results revealed that Cr accumulated in hypothalamus (HY) in a timely dependent manner. Much severer neuropathologies was observed in the group of mice exposed to Cr (VI) for 28 days than that for 14 days. Gliosis, neuronal morphological abnormalities, synaptic degeneration, BBB disruption and neuronal number loss were observed in HY. In terms of mechanism, the Nrf2 related antioxidant stress signaling dysfunction and activated NF-κB related inflammatory pathway were observed in HY of Cr (VI) intoxication mice. And these neuropathologies and signaling defects appeared in a timely dependent manner. Taking together, we proved that Cr (VI) can enter HY due to weaker BBB in HY and HY is the most vulnerable CNS region to Cr (VI) exposure. The concentration of Cr in HY increased along with time. The accumulated Cr in HY can cause BBB disruption, neuronal morphological abnormalities, synaptic degeneration and gliosis through Nrf2 and NF-κB signaling pathway. This finding improves our understanding of the neurological dysfunctions observed in individuals who have occupational

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## Bulletin Board

## Technical

MAR. 15, 2024

exposure to Cr (VI) and provided potential therapeutic targets to treat neurotoxicological pathologies induced by Cr (VI).

Authors: Jiuyang Ding, Baofei Sun, Yingdong Gao, Juan Zheng, Changyou Liu, Jian Huang, Nannan Jia, Xianglin Pei, Xueyu Jiang, Shanshan Hu, Bing Xia, Yunle Meng, Zhuhui Dai, Xiaolan Qi, Jiawen Wang

Full Source: Ecotoxicology and environmental safety 2024 Mar 8:273:116179. doi: 10.1016/j.ecoenv.2024.116179.

## Impact of electronic cigarette usage on the onset of respiratory symptoms and COPD among Chinese adults

2024-03-07

The prevalence of dual usage and the relatively low cessation rate among e-cigarette (EC) users suggest that ECs have not demonstrated significant effectiveness as a smoking cessation tool. Furthermore, there has been a substantial increase in the prevalence of EC usage in recent years. Therefore, the objective of this study is to investigate the association between EC use and the incidence of respiratory symptoms and chronic obstructive pulmonary disease (COPD). A total of 10,326 participants aged between 20 and 55 years, without any respiratory diseases or COPD, were recruited for the study. These individuals attended employee physical examinations conducted at 16 public hospitals in Hebei province, China from 2015 to 2020. Logistic regression models were utilized to assess the association between EC use and the risk of respiratory symptoms and COPD using risk ratios along with their corresponding 95% confidence intervals. Restricted cubic spline functions were employed to investigate the dose-response non-linear relationship. The robustness of the logistic regression models was evaluated through subgroup analyses, and sensitivity analyses. During the 5-year follow-up period, a total of 1071 incident cases of respiratory symptoms and 146 incident cases of COPD were identified in this cohort study. After adjusting for relevant confounding factors, EC users demonstrated a respective increase in the risk of reporting respiratory symptoms and COPD by 28% and 8%. Furthermore, dual users who used both ECs and combustible cigarettes exhibited an elevated risk of incident respiratory symptoms and COPD by 41% and 18%, respectively, compared to those who had never used non-users of any cigarette products. The association between daily EC consumption and the development of respiratory symptoms, as well as COPD, demonstrated a significant J-shaped pattern. The potential adverse association between the consumption of ECs, particularly when used in combination with combustible cigarettes, and the development of respiratory symptoms and COPD necessitates careful consideration.

The prevalence of dual usage and the relatively low cessation rate among e-cigarette (EC) users suggest that ECs have not demonstrated significant effectiveness as a smoking cessation tool.

## Bulletin Board

## Technical

MAR. 15, 2024

Policy makers should approach ECs cautiously as a prospective smoking cessation tool.

Authors: Beibei Song, Honglin Li, Huiran Zhang, Libin Jiao, Siyu Wu  
Full Source: Scientific reports 2024 Mar 7;14(1):5598. doi: 10.1038/s41598-024-56368-9.

## OCCUPATIONAL

### Ascertaining sensitive exposure biomarkers of various Metal(loid)s to embryo implantation

2024-03-08

Close relationships exist between metal(loid)s exposure and embryo implantation failure (EIF) from animal and epidemiological studies. However, there are still inconsistent results and lacking of sensitive metal(loid) exposure biomarkers associated with EIF risk. We aimed to ascertain sensitive metal(loid) biomarkers to EIF and provide potential biological explanations. Candidate metal(loid) biomarkers were measured in the female hair (FH), female serum (FS), and follicular fluid (FF) with various exposure time periods. An analytical framework was established by integrating epidemiological association results, comprehensive literature searching and knowledge-based adverse outcome pathway (AOP) networks. The sensitive biomarkers of metal(loid)s along with potential biological pathways to EIF were identified in this framework. Among the concerned 272 candidates, 45 metal(loid)s biomarkers across six time periods and three biomatrix were initially identified by single-metal(loid) analyses. Two biomarkers with counterfactual results according to literature summary results were excluded, and a total of five biomarkers were further determined from 43 remained candidates in mixture models. Finally, four sensitive metal(loid) biomarkers were eventually assessed by overlapping AOP networks information, including Se and Co in FH, and Fe and Zn in FS. AOP networks also identified key GO pathways and proteins involved in regulation of oxygen species biosynthetic, cell proliferation, and inflammatory response. Partial dependence results revealed Fe in FS and Co in FH at their low levels might be potential sensitive exposure levels for EIF. Our study provided a typical framework to screen the crucial metal(loid) biomarkers and ascertain that Se and Co in FH, and Fe and Zn in FS played an important role in embryo implantation.

Authors: Mengyuan Ren, Tianxiang Wu, Shuo Yang, Ning Gao, Changxin Lan, Han Zhang, Weinan Lin, Shu Su, Lailai Yan, Lili Zhuang, Qun Lu, Jia Xu,

Close relationships exist between metal(loid)s exposure and embryo implantation failure (EIF) from animal and epidemiological studies.

## Bulletin Board

## Technical

MAR. 15, 2024

Bin Han, Zhipeng Bai, Fangang Meng, Yuanchen Chen, Bo Pan, Bin Wang, Xiaoxia Lu, Mingliang Fang  
Full Source: Environmental pollution (Barking, Essex : 1987) 2024 Mar 8:123679. doi: 10.1016/j.envpol.2024.123679.

### Maternal exposure to deltamethrin during pregnancy and lactation impairs neurodevelopment of male offspring

2024-03-09

Deltamethrin (DM) is a highly effective and widely used pyrethroid pesticide. It is an environmental factor affecting public and occupational health and exerts direct toxic effects on the central nervous system. As the major target organs for neurotoxicity of DM, the hippocampus and the cerebellum are critical to the learning and motor function. Pregnant Wistar rats were randomly divided into four groups and gavaged at doses of 0, 1, 4 or 10 mg/kg/d DM from gestational day (GD) 0 to postnatal day (PN) 21. The PC12 cells were selected to further verify the regulatory mechanisms of DM on the neurodevelopmental injury. We found that maternal exposure to DM caused learning, memory and motor dysfunction in male offspring. Maternal exposure to DM induced the decrease in the density of hippocampal dendritic spines in male offspring through the reduced expression of M1 mAChRs, which in turn reduced the mediated AKT/mTOR signaling pathway, contributing to the inhibition of dynamic changes of GluA1. Meanwhile, DM exposure inhibited the BDNF/TrkB signaling pathway, thereby reducing phosphorylation of stathmin and impairing cerebellar purkinje cell dendrite growth and development. Taken together, maternal exposure to DM during pregnancy and lactation could impair neurodevelopment of male offspring.

Authors: Fei Hao, Ye Bu, Shasha Huang, Wanqi Li, Huiwen Feng, Yuan Wang  
Full Source: Ecotoxicology and environmental safety 2024 Mar 9:274:116196. doi: 10.1016/j.ecoenv.2024.116196.

### Multi-scenario PM2.5 distribution and dynamic exposure assessment of university community residents: Development and application of intelligent health risk management system integrated low-cost sensors

2024-03-06

Exposure scenario and receptor behavior significantly affect PM2.5 exposure quantity of persons and resident groups, which in turn influenced indoor or outdoor air quality & health management. An Internet of Things (IoT) system, EnvironMax+, was developed to accurately

Deltamethrin (DM) is a highly effective and widely used pyrethroid pesticide.

# Bulletin Board

## Technical

MAR. 15, 2024

and conveniently assess residential dynamic PM<sub>2.5</sub> exposure state. A university community “QC”, as the application area, was divided into four exposure scenarios and five groups of residents. Low-cost mobile sensors and indoor/outdoor pollution migration (IOP) models jointly estimated multi-scenario real-time PM<sub>2.5</sub> concentrations. Questionnaire was used to investigate residents’ indoor activity characteristics. Mobile application (app) “Air health management (AHM)” could automatic collect residents’ activity trajectory. At last, multi-scenario daily exposure concentrations of each residents-group were obtained. The results showed that residential exposure scenario was the most important one, where residents spend about 60 % of their daily time. Closing window was the most significant behavior affecting indoor contamination. The annual average PM<sub>2.5</sub> concentration in the studied scenarios: residential scenario (RS) < public scenario (PS) < outdoor scenario (OS) < catering scenario (CS). Except for CS, the outdoor PM<sub>2.5</sub> in other scenarios was higher than indoor by 5-10 µg/m<sup>3</sup>. The multi-scenario population weighted annual average exposure concentration was 37.1 µg/m<sup>3</sup>, which was 78 % of the annual average outdoor concentration. The exposure concentration of 5 groups: cooks > outdoor workers > indoor workers > students > the elderly, related to their daily activity time proportion in different exposure scenario.

Authors: Changhong Ou, Fei Li, Jingdong Zhang, Pei Jiang, Wei Li, Shaojie Kong, Jinyuan Guo, Wenbo Fan, Junrui Zhao

Full Source: Environment international 2024 Mar 6:185:108539. doi: 10.1016/j.envint.2024.108539.