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CHEMICAL EFFECTS

Understanding the Role of Persistent Organic Pollutants and Stress in the Association between Proximity to the World Trade Center Disaster and Birth Outcomes

2022-02-11

Fetal growth is affected by exposure to both prenatal stress and environmental contaminants. The attacks on the World Trade Center (WTC) resulted in exposure to chemicals and psychological stress amongst New York City residents. We measured prenatal maternal stress and exposure to persistent organic pollutants (polybrominated diphenyl ethers, polychlorinated biphenyls, and polychlorinated dibenzo-p-dioxins (PCDDs)) in 108 participants from a Columbia University WTC birth cohort. Principal component (PC) analyses were conducted to characterize the mixture of exposure to the three groups of chemicals. We evaluated the associations between geographical exposures (proximity to the WTC disaster) and both chemical exposures (PCs) and stress (demoralization). We then evaluated the effect these exposures (PCs and stress) had on previously reported associations between geographical WTC exposure and birth outcomes (birth weight and birth length) in this study population to understand their individual roles in the observed associations. Geographical exposure via proximity to the WTC was associated with the PC reflecting higher PCDD exposure (PC3) ($\beta = 0.60$, 95% CI: 0.03, 1.18 for living/working within 2 miles of the WTC; and $\beta = 0.73$, 95% CI = 0.08, 1.38 for living within 2 miles of WTC). Previously reported reductions in birth weight and length associated with WTC proximity ($\beta = -215.2$, 95% CI: -416.2, -14.3 and $\beta = -1.47$, 95% CI: -2.6, -0.34, respectively) were attenuated and no longer significant for birth weight ($\beta = -156.4$, 95% CI: -358.2, 45.4) after adjusting for PC3, suggesting that PCDDs may act as partial mediators in this previously observed association. The results of this study can help focus future research on the long-term health effects of these prenatally exposed populations.

Authors: Miranda J Spratlen, Frederica P Perera, Andreas Sjodin, Yuyan Wang, Julie B Herbstman, Leonardo Trasande

Full Source: International journal of environmental research and public health 2022 Feb 11;19(4):2008. doi: 10.3390/ijerph19042008.

Fetal growth is affected by exposure to both prenatal stress and environmental contaminants.

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Time to Break the "Lock-In" Impediments to Chemicals Management

2022-03-19

Despite enormous national, regional, and global efforts on chemical management, the widespread use of hazardous chemicals continues in many parts of the world even after decades of there being well-known risks to public and/or ecosystem health. This continued supply and use, despite strong evidence of negative impacts, is not unique to chemicals management. In the field of climate change, the concept of "lock-in" has been used to explain the complex interactions among economic, social, technological, and political dynamics that reinforce global reliance on the extraction and use of fossil fuels. Learning from carbon "lock-in" phenomena, this Perspective explores the challenges of chemicals management from the perspective of lock-in through three case studies: paraquat, perfluorooctanesulfonic acid (PFOS), and asbestos. These case studies illustrate that most current chemicals management frameworks fail to address the concerns arising from this complex interplay by not involving all relevant stakeholder groups that are part of lock-in, from producers to consumers. This results in a relatively narrow consideration (e.g., only demand but not supply) of the effectiveness and consequences of regulations. We submit that to break lock-in and address the global threat of chemical pollution, current approaches to managing hazardous chemicals should be broadened to take a comprehensive approach to understanding and managing factors contributing to lock-in, notably both supply and demand on national and international scales.

Authors: Jonathan Blumenthal, Miriam L Diamond, Matthew Hoffmann, Zhanyun Wang

Full Source: Environmental science & technology 2022 Mar 19. doi: 10.1021/acs.est.1c06615.

Comparison of modes of action between fish, cell and mitochondrial toxicity based on toxicity correlation, excess toxicity and QSAR for class-based compounds

2022-03-17

Mitochondria are significant targets in cells for many environmental chemicals. Mitochondrial damage and dysfunction can lead to apoptosis and death of fish. The objectives of this study were to compare the modes of action (MOAs) between fish, cell and mitochondrial toxicity. To achieve the goal, toxicity correlation, excess toxicity and quantitative structure-activity relationship (QSAR) were investigated between these

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three toxicity endpoints for a wide range of compounds. Results showed that fish toxicity is well correlated to cytotoxicity, but overall fish toxicity is relatively greater than the cytotoxicity. On the other hand, fish or cell toxicity is poorly related to mitochondrial toxicity, suggesting some compounds share same toxic mechanism but some not. The excess toxicity calculated from toxicity ratio (TR) shows that specifically-acting compounds in cytotoxicity, such as insecticides, fungicides, herbicides, dyes and medications used to treat cancer, depression, heart failure and blood pressure, are active compounds in mitochondrial toxicity. However, the less inert compounds identified in fish and cell toxicity exhibit greatly mitochondrial toxicity. QSAR models reveal that fish or cell toxicity is closely related to the chemical hydrophobicity, ionization, energy of lowest unoccupied molecular orbital, hydrogen bonding potential and stability. These descriptors reflect chemical bio-uptake, reactivity and interaction with target receptors. On the other hand, binomial model reveals that mitochondrial toxicity is closely related to the chemical hydrophobicity and polarizability/dipolarity, indicating bio-uptake and Van der Waals interaction play key roles in mitochondrial toxicity. Theoretical equations have been used to explain the toxicity correlation, excess toxicity and QSAR for fish, cell and mitochondrial toxicity. Above results suggest that cytotoxicity can serve as a surrogate for fish toxicity and be used in the safety evaluation of organic pollutants in aqueous environment, but not mitochondrial toxicity, although some compounds share same modes of action between fish or cell toxicity and mitochondrial toxicity.

Authors: Shuo Wang, Xiao Zhang, Bingxin Gui, Xiaotian Xu, Limin Su, Yuan H Zhao, Christopher J Martyniuk

Full Source: Toxicology 2022 Mar 17;470:153155. doi: 10.1016/j.tox.2022.153155.

ENVIRONMENTAL RESEARCH

An Alternative Strategy for Screening and Confirmation of 330 Pesticides in Ground- and Surface Water Using Liquid Chromatography Tandem Mass Spectrometry

2022-03-14

The presence of pesticide residues in water is a huge worldwide concern. In this paper we described the development and validation of a new liquid chromatography tandem mass spectrometric (LC-MS/MS) method for both screening and quantification of pesticides in water samples. In the sample preparation stage, the samples were buffered to pH 7.0 and pre-

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concentrated on polymeric-based cartridges via solid-phase extraction (SPE). Highly sensitive detection was carried out with mobile phases containing only 5 mM ammonium formate (pH of 6.8) as an eluent additive and using only positive ionization mode in MS/MS instrument. Hence, only 200-fold sample enrichment was required to set a screening detection limit (SDL) and reporting limit (RL) of 10 ng/L. The confirmatory method was validated at 10 and 100 ng/L spiking levels. The apparent recoveries obtained from the matrix-matched calibration (5-500 ng/L) were within the acceptable range (60-120%), also the precision (relative standard deviation, RSD) was not higher than 20%. During the development, 480 pesticides were tested and 330 compounds fulfilled the requirements of validation. The method was successfully applied to proficiency test samples to evaluate its accuracy. Moreover, the method robustness test was carried out using higher sample volume (500 mL) followed by automated SPE enrichment. Finally, the method was used to analyze 20 real samples, in which some compounds were detected around 10 ng/L, but never exceeded the assay maximum level.

Authors: Edgár Tóth, Ádám Tölgyesi, Andrea Simon, Mária Bálint, Xingmao Ma, Virender K Sharma

Full Source: Molecules (Basel, Switzerland) 2022 Mar 14;27(6):1872. doi: 10.3390/molecules27061872.

The Effects of Wastewater Treatment Plant Failure on the Gulf of Gdansk (Southern Baltic Sea)

2022-02-11

In August 2019 and during August/September 2020, the main collection system of the Wastewater Treatment Plant (WWTP) in Warsaw, Poland, malfunctioned. During that system failure, over 4.8 million m³ of untreated wastewater was dropped directly into the Vistula River in just a few days. It is currently considered as one of the largest known failures of WWTP worldwide. In order to assess the environmental impact, water samples were collected from 2 spots at the Vistula river estuary (406 and 415 km from the discharge location, respectively), and 4 spots at the Gulf of Gdansk, situated on the southern shore of the Baltic Sea. The sampling was conducted before the wastewater wave reached the Vistula river's mouth, followed by daily sampling during 21 days after the malfunction occurred. The study showed the decline in water quality at the Vistula river estuary and the Baltic shore waters as the wave of wastewater reached those points, despite being situated over 400 km downstream from the place of the accident. Those changes included the reduction in the dissolved oxygen content (by 0.69-fold at its peak), the increase in Total Organic

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Carbon (TOC) (by 1.28-fold at its peak), nitrate-nitrogen (N-NO₃) (by 1.68-fold at its peak), phosphorous (P) (by 2.41-fold at its peak), conductivity (by 16.8-fold at its peak), and Chemical Oxygen Demand (COD) (by 1.84-fold). In the samples from the Vistula river, the decline in water quality was seen as incidental and lasted 2-3 days. Subsequently, the levels of physical and chemical parameters returned to the levels from before the accident. However, the changes in the Gulf of Gdańsk lasted significantly longer, especially on the West side of the Vistula river, where, even after 21 days from the initial accident, some parameters remained altered.

Authors: Marta Jaskulak, Maksymilian Sotomski, Małgorzata Michalska, Roman Marks, Katarzyna Zorena

Full Source: International journal of environmental research and public health 2022 Feb 11;19(4):2048. doi: 10.3390/ijerph19042048.

PHARMACEUTICAL/TOXICOLOGY

Associations between prenatal exposure to perfluoroalkyl substances, hypomethylation of MEST imprinted gene and birth outcomes

2022-03-21

Prenatal perfluoroalkyl substance (PFAS) exposure has been linked to adverse birth outcomes, but the underlying mechanism has yet to be elucidated. DNA methylation changes in mesoderm-specific transcript (MEST) imprinted gene may be a mechanism of the prenatal exposure effects of PFASs on fetal growth. The aim was to investigate the prenatal PFASs exposure effects on DNA methylation changes in MEST imprinted gene involved in fetal growth. Among 486 mother-infant pairs from the Taiwan Birth Panel Study, PFASs and DNA methylation levels at 5 CpG sites of MEST promoter region were measured in cord blood. Univariable and multivariable linear regressions were performed to estimate the associations between prenatal PFAS exposure, MEST DNA methylation levels, and child birth outcomes. Mediation analysis was performed to examine the potential pathway of MEST methylation between PFASs and birth outcomes. We found that higher prenatal perfluorooctyl sulfonate (PFOS) exposure was significantly associated with lower methylation levels at 5 CpG sites of MEST promoter region (an adjusted β range: -1.56, -2.22). Significant negative associations were also found between MEST methylation levels and child birth weight. Furthermore, the associations between PFOS and perfluorooctanoic acid (PFOA) exposure and MEST methylation levels were more profound in girls than in boys. The mediated

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effect of average MEST methylation level between PFOS exposure and birth weight was 18.26 (95% CI = 2.06, 40.15; $p = 0.014$). The direct effect of PFOS exposure to birth weight independent to average MEST methylation level was -93.15 (95% CI = -170.53, -17.84; $p = 0.018$). In conclusion, our results suggest that prenatal PFAS exposure, especially PFOS, is associated with lower methylation levels at MEST promoter region, which not only leverages the role of imprinted gene in ensuring the integrity of fetal growth but also provides a potential mechanism for evaluating the prenatal exposure effect.

Authors: Mei-Sheng Ku, Wen-Chi Pan, Yen-Tsung Huang, Wu-Shiun Hsieh, Yi-Hsiang Hsu, Pau-Chung Chen, Chen-Yu Liu

Full Source: Environmental pollution (Barking, Essex : 1987) 2022 Mar 21;119183. doi: 10.1016/j.envpol.2022.119183.

Maternal exposure to cadmium during pregnancy is associated with changes in DNA methylation that are persistent at 9 years of age

2022-03-22

Background: Cadmium (Cd) exposure during gestation has been associated with altered DNA methylation at birth, but it is not known if the changes in methylation persist into childhood. Objectives: To evaluate whether gestational Cd-related changes of DNA methylation persist from birth to 9 years of age. Methods: We studied mother-child dyads in a longitudinal cohort in rural Bangladesh. Cadmium concentrations in maternal blood (erythrocyte fraction; Ery-Cd) at gestational week 14 and in child urine (U-Cd, long-term exposure marker) at 9 years were measured using inductively coupled plasma mass spectrometry. The epigenome-wide DNA methylation was measured in mononuclear cells (PBMcs) prepared from cord blood and peripheral blood at 9 years in 71 children (hereafter referred to as the explorative group) by Infinium HumanMethylation450K BeadChip. Replication of one differentially methylated region (DMR; 9 CpG sites) was performed in PBMcs of 160 9-year-old children (validation group) by EpiTyper MALDI-TOF mass spectrometry. Results: The median maternal Ery-Cd concentration was 1.24 $\mu\text{g}/\text{kg}$ (range 0.35, 4.55) in the explorative group and 0.83 $\mu\text{g}/\text{kg}$ (0.08, 2.97) in the validation group. The median U-Cd concentration in the 9-year-old children was 0.26 $\mu\text{g}/\text{L}$ (0.09, 1.06) in the explorative group and 0.32 $\mu\text{g}/\text{L}$ (0.07, 1.33) in the validation group. In the explorative group, we identified ten DMRs, both in cord blood and in PBMcs at 9 years, that were associated with maternal Ery-Cd. Eight out of the ten DMRs were hypomethylated and three of the hypomethylated

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DMRs were located in the HLA region on chromosome 6. One of the DMRs (hypomethylated) in the HLA region (upstream of the zinc finger protein 57 homolog, ZFP57 gene) was replicated in the validation group, and we found that it was hypomethylated in relation to maternal Ery-Cd, but not child U-Cd. **Conclusion:** Gestational exposure to Cd appears to be associated with regional changes, especially hypomethylated, in DNA methylation that linger from birth up to prepubertal age.

Authors: Anda R Gliga, Annachiara Malin Igra, Alexander Hellberg, Karin Engström, Rubhana Raqib, Anisur Rahman, Marie Vahter, Maria Kippler, Karin Broberg

Full Source: Environment international 2022 Mar 22;163:107188. doi: 10.1016/j.envint.2022.107188.

OCCUPATIONAL

Associations between Acute Exposures to PM 2.5 and Carbon Dioxide Indoors and Cognitive Function in Office Workers: A Multicountry Longitudinal Prospective Observational Study

2021-09

Despite evidence of the air pollution effects on cognitive function, little is known about the acute impact of indoor air pollution on cognitive function among the working-age population. We aimed to understand whether cognitive function was associated with real-time indoor concentrations of particulate matter (PM_{2.5}) and carbon dioxide (CO₂). We conducted a prospective observational longitudinal study among 302 office workers in urban commercial buildings located in six countries (China, India, Mexico, Thailand, the United States of America, and the United Kingdom). For 12 months, assessed cognitive function using the Stroop color-word test and Addition-Subtraction test (ADD) via a mobile research app. We found that higher PM_{2.5} and lower ventilation rates, as assessed by CO₂ concentration, were associated with slower response times and reduced accuracy (fewer correct responses per minute) on the Stroop and ADD for 8 out of 10 test metrics. Each interquartile (IQR) increase in PM_{2.5} (IQR=8.8 µg/m³) was associated with a 0.82% (95%CI: 0.42, 1.21) increase in Stroop response time, a 6.18% (95% CI: 2.08, 10.3) increase in Stroop interference time, a 0.7% (95% CI: -1.38, -0.01) decrease in Stroop throughput, and a 1.51% (95% CI: -2.65, -0.37) decrease in ADD throughput. For CO₂, an IQR increase (IQR=315ppm) was associated with a

Despite evidence of the air pollution effects on cognitive function, little is known about the acute impact of indoor air pollution on cognitive function among the working-age population.

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0.85% (95% CI: 0.32, 1.39) increase in Stroop response time, a 7.88% (95% CI: 2.08, 13.86) increase in Stroop interference time, a 1.32% (95% CI: -2.3, -0.38) decrease in Stroop throughput, and a 1.13% (95% CI: 0.18, 2.11) increase in ADD response time. A sensitivity analysis showed significant association between PM_{2.5} in four out of five cognitive test performance metrics only at levels above 12 µg/m³. Enhanced filtration and higher ventilation rates that exceed current minimum targets are essential public health strategies that may improve employee productivity.

Authors: Jose Guillermo Cedeño Laurent, Piers MacNaughton, Emily Jones, Anna S Young, Maya Bliss, Skye Flanigan, Jose Vallarino, Ling Jyh Chen, Xiaodong Cao, Joseph G Allen

Full Source: Environmental research letters : ERL [Web site] 2021 Sep;16(9):094047. doi: 10.1088/1748-9326/ac1bd8.

Workers' compensation reported injuries among distillery industry workers, 2010-2019

2022-03-25

Background: The objective of this study was to identify the most frequent type, nature, and cause of work-related injuries among distillery workers and the contributing factors for these events to target interventions to reduce injuries. **Methods:** Workers' compensation first reports of injury (FROI) from the years 2010 through 2019 were obtained. Variables were created for "occupational category" and "cause of injury" for evaluation of the injurious events. The ratchet circular scan test was used to assess seasonal variation in injury, and kernel density estimation to assess rates of injury by calendar year. **Results:** A total of 974 FROIs were recorded over these 10 years; 908 of the injuries resulted in lost time, 65 resulted in no lost time, and 1 resulted in a fatality. The most common injuries reported were strains or tears, lacerations, and contusions (33.4%, 14.7%, and 13.5%, respectively). The most frequent anatomical sites of injury were the shoulders, fingers, and low back area (11.8%, 11.4%, and 8.9%, respectively). Barreling operation activities experienced the greatest frequency of work-related injury at 28.5% of all FROIs. A seasonal peak of injuries was observed during May and June. **Conclusions:** Implementing ergonomic and safety solutions for transportation and work tasks associated with barreling operations may significantly reduce the rate of work-related injuries in distillery workers. Injury prevention interventions should particularly target strain or tear injuries caused by repetitive motion or bodily reaction and overexertion.

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Contact with objects or machinery accounted for one-third of distillery industry FROIs.

Authors: Mira Mirzaian, Wayne Sanderson, Steven Browning, Terry Bunn

Full Source: American journal of industrial medicine 2022 Mar 25. doi: 10.1002/ajim.23350.

Occupational exposome: An organisational model

2022-03

This article describes the concept of occupational exposome in highlighting the value of the concept in understanding the complexity of workplace exposures and their determinants. An organizational approach to the occupational exposome is proposed. The organizational approach is intended, from an interdisciplinary perspective, to broaden the levels of analysis of the exposures (whether they are) of the individual to the work situation (individual or collective), the work situation in the workshop or in the service, the company and the socio-economic environment of the company, the socio-economic environment of the company to the Society as a whole. The organizational approach of the occupational exposome helps to broaden the spectrum of health risk assessment and to promote a comprehensive and integrated approach to the prevention of arduousness at work and occupational wear and tear.

Authors: Yves Roquelaure, Danièle Luce, Alexis Descatha, Nathalie Bonvallot, Bertrand Porro, Fabien Coutarel

Full Source: Medecine sciences : M/S 2022 Mar;38(3):288-293. doi: 10.1051/medsci/2022022.

This article describes the concept of occupational exposome in highlighting the value of the concept in understanding the complexity of workplace exposures and their determinants.