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CHEMICAL EFFECTS

Bone mass density following developmental exposures to perfluoroalkyl substances (PFAS): a longitudinal cohort study

2022-11-19

Background: Environmental exposures to industrial chemicals, including perfluoroalkyl substances (PFAS), may play a role in bone development and future risk of osteoporosis. However, as prospective evidence is limited, the role of developmental PFAS exposures in bone density changes in childhood is unclear. The objective of this study was to estimate associations between serum-PFAS concentrations measured in infancy and early childhood and areal bone mineral density (aBMD) measured at age 9 years in a birth cohort of children from the Faroe Islands.

Methods: We prospectively measured concentrations of five PFAS in cord serum and serum collected at 18 months, 5 years and 9 years, and conducted whole-body DXA scans at the 9-year clinical visit. Our study included 366 mother-child pairs with DXA scans and at least one PFAS measurement. We estimated covariate-adjusted associations of individual PFAS concentrations with age-, sex- and height-adjusted aBMD z-scores using multivariable regression models and applied formal mediation analysis to estimate the possible impact of by several measures of body composition. We also evaluated whether associations were modified by child sex.

Results: We found PFAS exposures in childhood to be negatively associated with aBMD z-scores, with the strongest association seen for perfluorononanoic acid (PFNA) at age 5 years. A doubling in age-5 PFNA was associated with a 0.15 decrease in aBMD z-score (95% CI: - 0.26, -0.039). The PFNA-aBMD association was significantly stronger in males than females, although effect modification by sex was not significant for other PFAS exposures. Results from the mediation analysis suggested that any potential associations between aBMD and 18-month PFAS concentrations may be mediated by total body fat and BMI, although most estimated total effects for PFAS exposures at age 18 months were non-significant. PFAS exposures at age 9 were not associated with age-9 aBMD z-scores.

Conclusions: The PFAS-aBMD associations identified in this and previous studies suggest that bone may be a target tissue for PFAS. Pediatric bone density has been demonstrated to strongly track through young adulthood and possibly beyond; therefore, these prospective results may have important public health implications.

Background: Environmental exposures to industrial chemicals, including perfluoroalkyl substances (PFAS), may play a role in bone development and future risk of osteoporosis.

Authors: Annelise Blomberg, Jann Mortensen, Pál Weihe, Philippe Grandjean

Full Source: Environmental Health. 2022 Nov 19;21(1):113. doi: 10.1186/s12940-022-00929-w.

Triphenylmethane dye (C52H54N4O12) is potentially a hazardous substance in edible freshwater fish at trace level: toxicity, hematology, biochemistry, antioxidants, and molecular docking evaluation study

2022-11-19

Malachite green (C52H54N4O12) is a synthetic dye that is used in textile industries as a colorant and in aquaculture sectors to contain microbial damage. Aquatic contamination of malachite green (MG) has been reported globally. Fish is the highest trophic organism among aquatic inhabitants, highly sensitive to waterborne contaminants (metals, coloring agents, etc.). Toxicity of waterborne chemicals on nontarget organisms can be determined by assessing biomarkers. Assessing blood parameters and tissue antioxidants (enzymatic and nonenzymatic) is useful to evaluate MG toxicity. To initiate the MG toxicity data for freshwater fish (Cyprinus carpio), the median lethal toxicity was primarily evaluated. Then, hematological, blood biochemical (glucose, protein, and cholesterol) and tissue biochemical (amino acids, lipids), and vital tissue (gills, liver, and kidney) antioxidant capacity (CAT, LPO, GST, GR, POxy, vitamin C, and GSH) of C. carpio were analyzed under acute (LC50-96 h) and sublethal (Treatment I-1/10th and Treatment II-1/5th LC50-96 h) exposure periods (28 days). Molecular docking for MG with hemoglobin was also obtained. Biomarkers examined were affected in the MG-treated groups with respect to the control group. Significant changes ($p < 0.05$) were observed in hematology (Hb, RBCs, and WBCs), glucose, proteins, lipids and tissue CAT, LPO, and GST activities under acute MG exposure. In sublethal treatment groups, biomarkers studied were significant ($p < 0.05$) throughout the study period. The potential for MG binding to hemoglobin was tested in this study. MG is potentially a multiorgan toxicant. Literally a chemical that is harmful to the aquatic environment if safety is concerned.

Malachite green (C52H54N4O12) is a synthetic dye that is used in textile industries as a colorant and in aquaculture sectors to contain microbial damage.

Authors: Rama-Krishnan Poopal, Rajan Ashwini, Mathan Ramesh, Bin Li, Zongming Ren

Full Source: Environmental science and pollution research international. 2022 Nov 19. doi: 10.1007/s11356-022-24206-y.

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Factors associated with elevated Per- and Polyfluoroalkyl substances serum levels in older adults

2022-09

Per- and Polyfluoroalkyl substances (PFAS) are highly persistent synthetic chemicals that have been produced for more than seven decades. This study examined 6,018 eligible older adults (aged≥ 60 years) using the National Health and Nutrition Examination Survey (NHANES), to assess seven PFAS by sociodemographic and water source data to (a) determine factors most linked with elevated PFAS levels and (b) evaluate the differences by race and ethnicity. The results of this study indicated that among older adults, PFAS levels were more elevated in men than women ($p < 0.05$), non-Hispanic Blacks than other ethnicities ($p < 0.05$), among those using well water ($p < 0.05$), and those with lower education ($p < 0.05$). Income was not a significant factor among this group. These findings offer insight into the factors associated with elevated PFAS levels in older adults. With this knowledge, it is necessary to target education about PFAS among the most vulnerable.

Authors: Emmanuel Obeng-Gyasi

Full Source: Aging Health Research. 2022 Sep;2(3):100086. doi: 10.1016/j.ahr.2022.100086.

Urinary volatile organic compound metabolites and reduced lung function in U.S. adults

2022-11-10

Background: Volatile organic compounds (VOCs) are associated with adverse respiratory outcomes at high occupational exposures. However, whether exposure levels found in the general population have similar effects is unknown.

Methods: We analyzed data on 1342 adult participants in the 2011-2012 National Health and Nutrition Examination Survey aged ≥18 years old who had urinary VOC metabolites and spirometry measurements available. Linear regression models adjusting for covariates were fitted to estimate the associations of VOC exposures levels and spirometry outcomes, while accounting for survey design and sampling weights to generate nationally representative estimates.

Results: The urinary metabolites for xylene, acrylamide, acrolein, 1,3-butadiene, cyanide, toluene, 1-bromopropane, acrylonitrile, propylene oxide, styrene, ethylbenzene, and crotonaldehyde in our analysis were all detected in >75% of participants. Forced expiratory volume in 1 s (FEV1) to forced vital capacity (FVC) ratio % was lower with urinary metabolites

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of acrylamide (β: -2.65, 95% CI: -4.32, -0.98), acrylonitrile (β: -1.02, 95% CI: -2.01, -0.03), and styrene (β: -3.13, 95% CI: -5.35, -0.90). FEV1% predicted was lower with the urinary metabolites of acrolein (β: -7.77, 95% CI: -13.29, -2.25), acrylonitrile (β: -2.05, 95% CI: -3.77, -0.34), propylene oxide (β: -2.90, 95% CI: -5.50, -0.32), and styrene (β: -4.41, 95% CI: -6.97, -1.85).

Conclusions: This is the first study of a representative sample of the U.S. adult population to reveal associations of acrylonitrile, propylene oxide, and styrene urinary metabolites with reduced lung function at non-occupational exposures. Results also support previous evidence of acrylamide and acrolein's association with adverse respiratory outcomes.

Authors: Angelico Mendy, Sara Burcham, Ashley L Merianos, Tesfaye B Mersha, E Melinda Mahabee-Gittens, Aimin Chen, Kimberley Yolton

Full Source: Respiratory medicine. 2022 Nov 10;205:107053. doi: 10.1016/j.rmed.2022.107053.

ENVIRONMENTAL RESEARCH

Long-term residential exposure to source-specific particulate matter and incidence of diabetes mellitus - A cohort study in northern Sweden

2022-11-16

Diabetes mellitus (DM) incidence have been assessed in connection with air pollution exposure in several studies; however, few have investigated associations with source-specific local emissions. This study aims to estimate the risk of DM incidence associated with source-specific air pollution in a Swedish cohort with relatively low exposure. Individuals in the Västerbotten intervention programme cohort were followed until either a DM diagnosis or initiation of treatment with glucose-lowering medication occurred. Dispersion models with high spatial resolution were used to estimate annual mean concentrations of particulate matter (PM) with aerodynamic diameter ≤10 μm (PM10) and ≤2.5 μm (PM2.5) at individual addresses. Hazard ratios were estimated using Cox regression models in relation to moving averages 1-5 years preceding the outcome. During the study period, 1479 incident cases of DM were observed during 261,703 person-years of follow-up. Increased incidence of DM was observed in association with PM10 (4% [95% CI: 54-137%] per 10 μg/m3), PM10-traffic (2% [95% CI: 6-11%] per 1 μg/m3) and PM2.5-exhaust (11% [95% CI: 39-103%] per 1 μg/m3). A negative association was found for both PM2.5 (-18% [95% CI: 99-66%] per 5 μg/m3), but only in the 2nd exposure tertile (-10% [95% CI: 25-9%] compared to the first tertile), and

Diabetes mellitus (DM) incidence have been assessed in connection with air pollution exposure in several studies; however, few have investigated associations with source-specific local emissions.

PM2.5-woodburning (-30% [95% CI: 49-4%] per 1 µg/m3). In two-pollutant models including PM2.5-woodburning, there was an 11% [95% CI: 11-38%], 6% [95% CI: 16-34%], 13% [95% CI: 7-36%] and 17% [95% CI: 4-41%] higher risk in the 3rd tertile of PM10, PM2.5, PM10-traffic and PM2.5-exhaust, respectively, compared to the 1st. Although the results lacked in precision they are generally in line with the current evidence detailing particulate matter air pollution from traffic as an environmental risk factor for DM.

Authors: Johan N Sommar, David Segersson, Erin Flanagan, Anna Oudin

Full Source: Environmental research. 2022 Nov 16;114833. doi: 10.1016/j.envres.2022.114833.

Consequences of exposure to pollutants on respiratory health: From genetic correlations to causal relationships

2022-11-17

Modern society grew rapidly over the last few decades and this led to an alarming increase in air pollutants and a worsening of the human health, especially in relation to the respiratory system. Indeed, chronic respiratory diseases were the third main cause of death in 2017, with over 3 million of deaths. Furthermore, the pollution has considerable consequences both for burden medical expenses and environmental. However, the mechanisms linking pollutants to the onset of these diseases remain unclear. Thus, in this study we addressed this problem through the United Kingdom BioBank database, analyzing 170 genome-wide association studies (103 related to respiratory diseases and 67 related to pollutants). We analyzed the genetic correlations and causal relationships of these traits, leveraging the summary statistics and bioinformatics packages such as Linkage Disequilibrium Score Regression and Latent Causal Variable. We obtained 158 significant genetic correlations and subsequently we analyzed them through the Latent Causal Variable analysis, obtaining 20 significant causal relationships. The most significant were between "Workplace full of chemicals or other fumes: Sometimes" and "Condition that has ever been diagnosed by a doctor: Asthma" and between "Workplace very dusty: Sometimes" and "Condition that has ever been diagnosed by a doctor: Emphysema or chronic bronchitis". Finally, we identified single nucleotide polymorphisms independently associated with sveral pollutants to analyze the genes and pathways that could be involved in the onset of the aforementioned respiratory system disorders and that could be useful clinical target. This study highlighted how crucial are the air condition of the working environments and the type of transport used in the onset of respiratory-related morbidity. Based on that,

Modern society grew rapidly over the last few decades and this led to an alarming increase in air pollutants and a worsening of the human health, especially in relation to the respiratory system.

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we also suggested some interventions, in order to improve quality life and develop new and eco-friendly society and life style, such as improving indoor air circulation, the use of public transport and urban reforestation.

Authors: Salvatore D'Antona, Isabella Castiglioni, Danilo Porro, Claudia Cava

Full Source: PLoS One. 2022 Nov 17;17(11):e0277235. doi: 10.1371/journal.pone.0277235. eCollection 2022.

PHARMACEUTICAL/TOXICOLOGY

The associations of particulate matter short-term exposure and serum lipids are modified by vitamin D status: A panel study of young healthy adults

2022-11-15

Particulate matter (PM) exposure is associated to the adverse change in blood lipids. Vitamin D is beneficial to lipid metabolism, but whether vitamin D levels modifies the impact of air pollutants on lipids is unclear. The purpose of the study was to investigate if vitamin D modifies the associations of PM and serum lipids in young healthy people. From December 2017 to January 2018, a panel study with five once weekly follow-ups was conducted on 88 healthy adults aged 21.09 (1.08) (mean (SD)) years on average in Guangzhou, China. We measured serum lipids, serum 25-hydroxyvitamin D (25(OH)D) concentrations (440 blood samples in total), mass concentrations of particulate matter with diameters ≤2.5 µm (PM2.5), ≤1.0 µm (PM1.0), and ≤0.5 µm (PM0.5), and number concentrations of particulate matter with diameters ≤0.2 µm (PN0.2) and ≤0.1 µm (PN0.1) at each follow-up. Linear mixed-effect models were applied to assess the interaction of vitamin D and size-fractionated PM short-term exposure on four lipid metrics. We found the interactions between 25(OH)D and size-fractionated PM exposure on blood lipids in different lags (lag 3 days and 4 days). An interquartile range increase in PM2.5, PM1.0, PM0.5 were significantly associated with increments of 12.30%, 12.99%, and 13.66% in triglycerides (TGs) at lag 4 days at vitamin D levels <15 ng/mL group, respectively. Similar results were found for PN0.2, PN0.1 and low-density lipoprotein cholesterol (LDL-C). All the associations between size-fractionated PM and blood lipids were found null statistically significant in vitamin D levels ≥15 ng/mL group.

Authors: Jia-Min Li, Han-Yu Yang, Si-Han Wu, Shyamali C Dharmage, Bin Jalaludin, Luke D Knibbs, Michael S Bloom, Yuming Guo, Lidia Morawska,

Particulate matter (PM) exposure is associated to the adverse change in blood lipids.

Joachim Heinrich, Yim Steve Hung Lam, Li-Zi Lin, Xiao-Wen Zeng, Bo-Yi Yang 1, Gong-Bo Chen, Ru-Qing Liu, Guang-Hui Dong, Li-Wen Hu
Full Source: Environmental pollution. 2022 Nov 15;120686. doi: 10.1016/j.envpol.2022.120686.

Assessment of risks, implications, and opportunities of waterborne neurotoxic pesticides

2023-03

Pesticides are a well-known family of chemicals that have contaminated water systems globally. Four common subfamilies of pesticides include organochlorines, organophosphates, pyrethroids, and carbamate insecticides which have been shown to adversely affect the human nervous system. Studies have shown a link between pesticide exposure and decreased viability, proliferation, migration, and differentiation of murine neural stem cells. Besides human exposure directly through water systems, additional factors such as pesticide bioaccumulation, biomagnification and potential synergism due to co-exposure to other environmental contaminants must be considered. A possible avenue to investigate the molecular mechanisms and biomolecules impacted by the various classes of pesticides includes the field of -omics. Discovery of the precise molecular mechanisms behind pesticide-mediated neurodegenerative disorders may facilitate development of targeted therapeutics. Likewise, discovery of pesticide biodegradation pathways may enable novel approaches for water system bioremediation using genetically engineered microorganisms. In this mini-review, we discuss recently established harmful impacts of various categories of pesticides on the nervous system and the application of -omics field for discovery, validation, and mitigation of pesticide neurotoxicity.

Authors: Delaram Dara, Andrei P Drabovich
Full Source: Journal of Environmental Science (China). 2023 Mar;125:735-741. doi: 10.1016/j.jes.2022.03.033.

Pesticides are a well-known family of chemicals that have contaminated water systems globally.

Genetic risk modifies the effect of long-term fine particulate matter exposure on coronary artery disease

2022-11-10

Background: Although both environmental and genetic factors were linked to coronary artery disease (CAD), the extent to which the association of air pollution exposure with CAD can be influenced by genetic risk was not well understood.

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Methods: A total of 41,149 participants recruited from the project of Prediction for Atherosclerotic Cardiovascular Disease Risk in China (China-PAR) were included. Genetic risk scores of CAD were constructed based on 540 genetic variants. Long-term PM2.5 exposures were assessed by adopting satellite-based PM2.5 estimations at 1-km resolution. We used stratified Cox proportional hazards regression model to examine the impact of PM2.5 exposure and genetic risk on CAD risk, and further analyzed modification effect of genetic predisposition on association between PM2.5 exposure and CAD risk.
Results: During a median of 13.01 years of follow-up, 1,373 incident CAD events were observed. Long-term PM2.5 exposure significantly increased CAD risk, and the hazard ratios (HRs) [95% confidence intervals (CIs)] were 1.27 (1.05-1.54) and 1.95 (1.57-2.42) among intermediate and high PM2.5 exposure groups compared to low PM2.5 exposure group. The relative risks of CAD were 40% (HR: 1.40, 95%CI: 1.18-1.66) and 133% (HR: 2.33, 95%CI: 1.94-2.79) higher among individuals at intermediate and high genetic risk than those at low genetic risk. Compared with individuals with both low genetic risk and low PM2.5 exposure, those with high genetic risk and high PM2.5 exposure had highest CAD risk, with HR of 4.37 (95%CI: 3.13-6.11). We observed significant multiplicative ($P < 0.001$) and additive interaction [relative excess risk due to interaction (95%CI): 2.75 (1.32-4.20); attributable proportion due to interaction (95%CI): 0.56 (0.42-0.70)] between genetic risk and PM2.5 exposure on CAD.
Conclusion: This study provided evidence that long-term PM2.5 exposure might increase CAD risk, especially among people at high genetic risk. Our findings highlighted the importance of taking strategies on air quality improvement to cardiovascular disease prevention.

Authors: Jinyue Li, Fengchao Liang, Fangchao Liu, Jianxin Li, Keyong Huang, Xueli Yang, Shufeng Chen, Jie Cao, Chong Shen, Liancheng Zhao, Ying Li, Dongsheng Hu, Wending Wang, Jianbin Wu, Jianfeng Huang, Xiangfeng Lu, Dongfeng Gu
Full Source: Environment international. 2022 Nov 10;170:107624. doi: 10.1016/j.envint.2022.107624

OCCUPATIONAL

The effect of occupational exposure to welding fumes on trachea, bronchus and lung cancer: A systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury

2022-10-13

Background: The World Health Organization (WHO) and the International Labour Organization (ILO) are the producers of the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury (WHO/ILO Joint Estimates). Welding fumes have been classified as carcinogenic to humans (Group 1) by the WHO International Agency for Research on Cancer (IARC) in IARC Monograph 118; this assessment found sufficient evidence from studies in humans that welding fumes are a cause of lung cancer. In this article, we present a systematic review and meta-analysis of parameters for estimating the number of deaths and disability-adjusted life years from trachea, bronchus, and lung cancer attributable to occupational exposure to welding fumes, to inform the development of WHO/ILO Joint Estimates on this burden of disease (if considered feasible).

Objectives: We aimed to systematically review and meta-analyse estimates of the effect of any (or high) occupational exposure to welding fumes, compared with no (or low) occupational exposure to welding fumes, on trachea, bronchus, and lung cancer (three outcomes: prevalence, incidence, and mortality).

Data sources: We developed and published a protocol, applying the Navigation Guide as an organizing systematic review framework where feasible. We searched electronic databases for potentially relevant records from published and unpublished studies, including Medline, EMBASE, Web of Science, CENTRAL and CISDOC. We also searched grey literature databases, Internet search engines, and organizational websites; hand-searched reference lists of previous systematic reviews; and consulted additional experts.

Study eligibility and criteria: We included working-age (≥15 years) workers in the formal and informal economy in any Member State of WHO and/or ILO but excluded children (<15 years) and unpaid domestic workers. We included randomized controlled trials, cohort studies, case-control studies, and other non-randomized intervention studies with an estimate of the effect of any (or high) occupational exposure to welding fumes, compared with occupational exposure to no (or low) welding fumes, on trachea, bronchus, and lung cancer (prevalence, incidence, and mortality).

Background: The World Health Organization (WHO) and the International Labour Organization (ILO) are the producers of the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury (WHO/ILO Joint Estimates).

Study appraisal and synthesis methods: At least two review authors independently screened titles and abstracts against the eligibility criteria at a first review stage and full texts of potentially eligible records at a second stage, followed by extraction of data from qualifying studies. If studies reported odds ratios, these were converted to risk ratios (RRs). We combined all RRs using random-effects meta-analysis. Two or more review authors assessed the risk of bias, quality of evidence, and strength of evidence, using the Navigation Guide tools and approaches adapted to this project. Subgroup (e.g., by WHO region and sex) and sensitivity analyses (e.g., studies judged to be of "high"/"probably high" risk of bias compared with "low"/"probably low" risk of bias) were conducted.

Results: Forty-one records from 40 studies (29 case control studies and 11 cohort studies) met the inclusion criteria, comprising over 1,265,512 participants (≥22,761 females) in 21 countries in three WHO regions (Region of the Americas, European Region, and Western Pacific Region). The exposure and outcome were generally assessed by job title or self-report, and medical or administrative records, respectively. Across included studies, risk of bias was overall generally probably low/low, with risk judged high or probably high for several studies in the domains for misclassification bias and confounding. Our search identified no evidence on the outcome of having trachea, bronchus, and lung cancer (prevalence). Compared with no (or low) occupational exposure to welding fumes, any (or high) occupational exposure to welding fumes increased the risk of acquiring trachea, bronchus, and lung cancer (incidence) by an estimated 48 % (RR 1.48, 95 % confidence interval [CI] 1.29-1.70, 23 studies, 57,931 participants, I2 24 %; moderate quality of evidence). Compared with no (or low) occupational exposure to welding fumes, any (or high) occupational exposure to welding fumes increased the risk dying from trachea, bronchus, and lung cancer (mortality) by an estimated 27 % (RR 1.27, 95 % CI 1.04-1.56, 3 studies, 8,686 participants, I2 0 %; low quality of evidence). Our subgroup analyses found no evidence for difference by WHO region and sex. Sensitivity analyses supported the main analyses.

Conclusions: Overall, for incidence and mortality of trachea, bronchus, and lung cancer, we judged the existing body of evidence for human data as "sufficient evidence of harmfulness" and "limited evidence of harmfulness", respectively. Occupational exposure to welding fumes increased the risk of acquiring and dying from trachea, bronchus, and lung cancer. Producing estimates for the burden of trachea, bronchus, and lung cancer attributable to any (or high) occupational exposure to welding fumes appears evidence-based, and the pooled effect estimates presented in this systematic review could be used as input data for the

WHO/ILO Joint Estimates. PROTOCOL IDENTIFIER: https://doi.org/10.1016/j.envint.2020.106089.

Authors: Dana Loomis, Angel M Dzhambov, Natalie C Momen, Nicholas Chartres, Alexis Descatha, Neela Guha, Seong-Kyu Kang, Alberto Modenese, Rebecca L Morgan, Seoyeon Ahn, Martha S Martínez-Silveira, Siyu Zhang, Frank Pega

Full Source: Environ International 2022 Oct 13;170:107565. doi: 10.1016/j.envint.2022.107565.