CHEMWATCH

# Bulletin Board

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## CHEMICAL EFFECTS

### Toxic mechanism on phenanthrene-induced cytotoxicity, oxidative stress and activity changes of superoxide dismutase and catalase in earthworm (Eisenia foetida): A combined molecular and cellular study

2021-06-09

Phenanthrene (PHE) is an important organic compound, which is widespread in the soil environment and exhibits potential threats to soil organisms. Toxic effects of PHE to earthworms have been extensively studied, but toxic mechanisms on PHE-induced cytotoxicity and oxidative stress at the molecular and cellular levels have not been reported yet. Therefore, we explored the cytotoxicity and oxidative stress caused by PHE in earthworm coelomocytes and the interaction mechanism between PHE and the major antioxidant enzymes SOD/CAT. It was shown that high-dose PHE exposure induced the intracellular reactive oxygen species (ROS) generation, mediated lipid peroxidation, reduced total antioxidant capacity (T-AOC) in coelomocytes, and triggered oxidative stress, thus resulted in a strong cytotoxicity at higher concentrations (0.6-1.0 mg/L). The intracellular SOD/CAT activity in cells after PHE exposure were congruent with that in molecular levels, which the activity of SOD enhanced and CAT inhibited. Spectroscopic studies showed the SOD/CAT protein skeleton and secondary structure, as well as the micro-environment of aromatic amino acids were changed after PHE binding. Molecular docking indicated PHE preferentially docked to the surface of SOD. However, the key residues Tyr 357, His 74, and Asn 147 for activity were in the binding pocket, indicating PHE more likely to dock to the active center of CAT. In addition, H-bonding and hydrophobic force were the primary driving force in the binding interaction between PHE and SOD/CAT. This study indicates that PHE can induce cytotoxicity and oxidative damage to coelomocytes and unearthes the potential effects of PHE on earthworms.

Authors: Falin He, Qiang Liu, Mingyang Jing, Jingqiang Wan, Chengqian Huo, Wansong Zong, Jingchun Tang, Rutao Liu

Full Source: Journal of hazardous materials 2021 Jun 9;418:126302. doi: 10.1016/j.jhazmat.2021.126302.

Phenanthrene (PHE) is an important organic compound, which is widespread in the soil environment and exhibits potential threats to soil organisms.



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### Impact of environmental chemicals on craniofacial skeletal development: Insights from investigations using zebrafish embryos

2021-06-07

Craniofacial skeletal anomalies are among the most common structural birth defects around the world. Various studies using human populations and experimental animals have shown that genetic and environmental factors play significant roles in the causation and progression of these anomalies. Environmental factors, such as teratogens and toxin mixtures, induce craniofacial anomalies are gaining heightened attention. Among experimental investigations, the use of the zebrafish (Danio rerio) has been increasing. A major reason for the increased use is that the zebrafish boast a simple craniofacial structure, and facial morphogenesis is readily observed due to external fertilization and transparent embryo, making it a valuable platform to screen and identify environmental factors involved in the etiology of craniofacial skeletal malformation. This review provides an update on harmful effects from exposure to environmental chemicals, involving metallic elements, nanoparticles, persistent organic pollutants, pesticides and pharmaceutical formulations on craniofacial skeletal development in zebrafish embryos. The collected data provide a better understanding for induction of craniofacial skeletal anomalies and for development of better prevention strategies.

Authors: Wenlong Huang, Tianjie Wu, William W Au, Kusheng Wu

Full Source: Environmental pollution (Barking, Essex : 1987) 2021 Jun 7;286:117541. doi: 10.1016/j.envpol.2021.117541.

Craniofacial skeletal anomalies are among the most common structural birth defects around the world.

### Silica Nanoparticles Induce Hepatotoxicity by Triggering Oxidative Damage, Apoptosis, and Bax-Bcl2 Signaling Pathway

2021-06-10

The increase in the usage of silica nanoparticles (SiNPs) in the industrial and medical fields has raised concerns about their possible adverse effects on human health. The present study aimed to investigate the potential adverse effects of SiNPs at daily doses of 25 and 100 mg/kg body weight intraperitoneally (i.p.) for 28 consecutive days on markers of liver damage in adult male rats. Results revealed that SiNPs induced a marked increase in serum markers of liver damage, including lactate dehydrogenase (LDH), alanine aminotransferase (ALAT), and aspartate aminotransferase (ASAT). SiNPs also induced an elevation of reactive oxygen species (ROS) production in liver, along with an increase in oxidative stress markers (NO,

MDA, PCO, and H2O2), and a decrease in antioxidant enzyme activities (CAT, SOD, and GPx). Quantitative real-time PCR showed that SiNPs also induced upregulation of pro-apoptotic gene expression (including Bax, p53, Caspase-9/3) and downregulation of anti-apoptotic factors Bcl-2. Moreover, histopathological analysis revealed that SiNPs induced hepatocyte alterations, which was accompanied by sinusoidal dilatation, Kupffer cell hyperplasia, and the presence of inflammatory cells in the liver. Taken together, these data showed that SiNPs trigger hepatic damage through ROS-activated caspase signaling pathway, which plays a fundamental role in SiNP-induced apoptosis in the liver.
Authors: Bakhta Aouey, Khadija Boukholda, Brahim Gargouri, Harsharan S Bhatia, Abdelraheim Attaai, Mohamed Kebieche, Michèle Bouchard, Hamadi Fetoui
Full Source: Biological trace element research 2021 Jun 10. doi: 10.1007/s12011-021-02774-3.

## ENVIRONMENTAL RESEARCH

### Microplastics as an emerging source of particulate air pollution: A critical review

2021-05-28

Accumulation of plastic litter exerts pressure on the environment.

Accumulation of plastic litter exerts pressure on the environment. Microplastics (MPs) pollution has become a universal challenge due to the overexploitation of plastic products and unsystematic dumping of plastic waste. Initial studies on MPs and their implications had been confined to aquatic and terrestrial ecosystems, but recent research has also focused on MPs in the air. Their impacts on urban air quality and atmospheric transport to pristine habitats have emerged to be a serious concern. However, the extent and the significance of impacts of airborne particulate matter (PM) MPs on human health are not clearly understood. Further, the influence of airborne MPs on indoor and outdoor air quality remains unknown. We highlight the human health impacts of airborne PM-MPs with a special focus on the occupational safety of the industry workers, their possible influence on Air Quality Index (AQI), their potential exposure, and accumulation in the canopy/arboreal, above-canopy and atmospheric (aerial) habitats. The present review emphasizes the data limitations and knowledge gaps on the atmospheric transport and contribution of particulate plastics to the worsening of overall urban air quality and throws critical perspectives on whether atmospheric MPs pollution is trivial or an actual matter of concern.
Authors: Srinidhi Sridharan, Manish Kumar, Lal Singh, Nanthi S Bolan, Mahua Saha
Full Source: Journal of hazardous materials 2021 May 28;418:126245. doi: 10.1016/j.jhazmat.2021.126245.



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## OCCUPATIONAL

### Evaluation of Exposure to Toluene and Xylene in Gasoline Station Workers

2021-05-20

The main volatile organic compounds found at gasoline stations are benzene, toluene, ethylbenzene, and xylene isomers (BTEX).

The main volatile organic compounds found at gasoline stations are benzene, toluene, ethylbenzene, and xylene isomers (BTEX). They cause several harmful effects on human health. Regulatory Norm 7 (1978) provides that, in Brazil, biological monitoring of toluene and xylene is carried out by measuring the urinary metabolites hippuric acid (HA) and methylhippuric acid (MHA), respectively. The objective of this study was to assess the exposure to toluene and xylene and to identify related signs and symptoms in gasoline station workers. A cross-sectional epidemiological study was conducted with workers occupationally exposed to fuels. These gasoline station workers were divided into two groups: 94 workers exposed mainly by inhalation (convenience store workers (CSWs)) and 181 workers exposed by inhalation and dermal route (filling station attendants (FSAs)). A comparison group was formed by 119 workers not occupationally exposed to fuels (office workers (OWs)). Workers exposed to fuels had higher average levels of these exposure biomarkers (HA and MHA), which were also higher in convenience store workers than in filling station attendants. In addition, individuals exposed to the solvents present in gasoline had altered mood/depression, cramps, dizziness, drowsiness, headaches, irritability/nervousness, weakness, weight loss, and other symptoms more frequently and had higher urinary levels of HA and MHA compared to the comparison group. Gasoline station workers showed high levels of HA and MHA, reflecting high occupational exposure to the solvents toluene and xylene present in gasoline, demonstrating that changes in the current legislation and in the

work environment are necessary to ensure better health protection for these workers.
Authors: Barbara R Geraldino, Rafaella F N Nunes, Juliana B Gomes, Katia S da Poça, Isabela Giardini, Paula V B Silva, Helen P Souza, Ubirani B Otero, Marcia Sarpa
Full Source: Advances in preventive medicine 2021 May 20;2021:5553633. doi: 10.1155/2021/5553633.

## Duration of exposure and educational level as predictors of occupational respiratory symptoms among adults in Ethiopia: A systematic review and meta-analysis

2021-05-20
Introduction: Occupational respiratory symptoms are manifestations of respiratory diseases because of exposure to dust or chemicals such as asbestos, silicon and aluminium in the workplace like cement factory, tannery, textile and/or street sweeping, all of which affect the health condition and productivity. In Ethiopia, several primary studies were conducted regarding the magnitude of occupational respiratory symptoms with the prevalence of 68.89% in street sweepers and associated factors with inconsistent results. This meta-analysis aimed to pool the prevalence of respiratory symptoms and their associated factors among Ethiopian adults working in different workplaces.
Methods: PubMed, African Journals Online, Google Scholar, Cochrane Library and Direct Google were systematically searched to identify primary studies. Two authors performed data abstraction and quality assessment for each included study independently. Cochran's Q-statistic and I2 (I-squared) statistic were used to check heterogeneity. DerSimonian and Laird random-effects models were used to estimate the pooled prevalence and associated factors of respiratory symptoms. Publication bias was checked by funnel plot and Egger's test, and also sensitivity analyses were performed. Results: Ten primary studies with 3441 study participants were included for the narrative synthesis and meta-analysis of the pooled prevalence of occupational respiratory symptoms. The pooled prevalence of overall occupational respiratory symptom was 54.58% (95% CI: 45.37-63.79). Dry cough was the most encountered respiratory symptom [34.93, 95% CI: 29.52-40.35], followed by breathlessness [28.67%, 95% CI: 20.13-37.22]. Work experience of over 5 years [OR = 2.24, 95% CI: 1.21-4.16] and educational level of Grade 8 and lower [OR = 1.28, 95% CI: 1.06-1.55] were significantly associated with occupational respiratory symptoms.

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Conclusion: In this review, the pooled prevalence of occupational respiratory symptoms was high. The findings of this study dictate the need for the implementation of workplace safety measures. Special attention is required to employees with lower educational level and longer duration of work experience.
Prospero registration: CRD42020176826.
Authors: Baye Dagnew, Zewudu Andualem, Dessie Abebaw Angaw, Kassahun Alemu Gelaye, Henok Dagne
Full Source: SAGE open medicine 2021 May 20;9:20503121211018121. doi: 10.1177/20503121211018121.

## Exposure to Bioaerosols During Fish Processing on Board Norwegian Fishing Trawlers

2021-06-10
Objectives: The main objective was to gain more knowledge on exposure to bioaerosols in the processing area on board fishing trawlers.
Methods: Exposure sampling was carried out during the work shifts when processing fish in the processing area on board five deep-sea fishing trawlers (trawlers 1-5). Exposure samples were collected from 64 fishermen breathing zone and from stationary sampling stations on board five deep-sea fishing trawlers (1-5). Trawlers 2, 3, and 4 were old ships, not originally built for on board processing of the catch. Trawlers 1 and 5 were relatively new and built to accommodate processing machineries. On trawlers 1-4 round fish was produced; the head and entrails were removed before the fishes were frozen in blocks. Trawler 5 had the most extensive processing, producing fish fillets. Samples were analysed for total protein, trypsin activity, parvalbumin, and endotoxin. One side analysis of variance and Kruskal-Wallis H test were used to compare levels of exposure on the different trawlers.
Results: Personal exposure to total protein were higher on the three oldest trawlers (2, 3, and 4) compared with the two new trawlers (1 and 5). Highest activity of trypsin was detected on the four trawlers producing round fish (1-4). Parvalbumin was detected in 58% of samples from the fillet-trawler (5) compared with 13% of samples from the four trawlers producing round fish. The highest level of endotoxin was detected when using high-pressure water during cleaning machines and floors in the processing area.
Conclusions: Fishermen in the processing area on board Norwegian trawlers are exposed to airborne bioaerosols as proteins, trypsin, fish

Objectives: The main objective was to gain more knowledge on exposure to bioaerosols in the processing area on board fishing trawlers.

allergen parvalbumin, and endotoxin. Levels varied between trawlers and type of production.
Authors: Cecilie T Heidelberg, Berit Bang, Marte R Thomassen, Sandip D Kamath, Thimo Ruethers, Andreas L Lopata, Anne M Madsen, Mariann Sandsund, Lisbeth Aasmoe
Full Source: Annals of work exposures and health 2021 Jun 10;wxaa104. doi: 10.1093/annweh/wxaa104.

## Association of short-term fine particulate matter exposure with pulmonary function in populations at intermediate to high-risk of cardiovascular disease: A panel study in three Chinese cities

2021-06-08
Background: Decline in pulmonary function contributes to increasing cardiovascular disease (CVD) risk. Although adverse effects of short-term exposure to fine particulate matter (PM2.5) on pulmonary function have been recognized in healthy people or patients with respiratory disease, these results were not well illustrated among people with elevated CVD risk.
Materials and methods: A panel study was conducted in three Chinese cities with three repeated visits among populations at intermediate to high-risk of CVD, defined as treated hypertension patients or those with blood pressure ≥ 130/80 mmHg, who met any of the three conditions including abdominal obesity, dyslipidemia, and diabetes mellitus. Individualized PM2.5 exposure and pulmonary function were measured during each seasonal visit. Linear mixed-effect models were applied to analyze the associations of PM2.5 concentrations with pulmonary function indicators, including forced expiratory volume in 1 s (FEV1), FEV1/forced vital capacity (FVC), maximal mid-expiratory flow (MMF), and peak expiratory flow (PEF).
Results: Short-term PM2.5 exposure was significantly associated with decreased pulmonary function and an increment of 10 μg/m3 in PM2.5 concentrations during lag 12-24 hour was associated with declines of 41.7 ml/s (95% confidence interval [CI]: 7.7-75.7), 0.35% (95% CI: 0.01, 0.69), and 20.9 ml/s (95% CI: 0.5-41.3) for PEF, FEV1/FVC, and MMF, respectively. Results from stratified and sensitivity analyses were generally similar with the overall findings, while the adverse effects of PM2.5 on pulmonary functions were more pronounced in those who were physically inactive.
Conclusions: This study first identified short-term exposure to PM2.5 was associated with impaired pulmonary function and physical activity might attenuate the adverse effects of PM2.5 among populations at intermediate

Background: Decline in pulmonary function contributes to increasing cardiovascular disease (CVD) risk.



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to high-risk of CVD. These findings provide new robust evidence on health effects of air pollution and call for effective prevention measures among people at CVD risk.
Authors: Han Ma, Fangchao Liu, Xueli Yang, Qiong Liu, Xinyan Wang, Xiaolong Xing, Zhennan Lin, Jie Cao, Jianxin Li, Keyong Huang, Weili Yan, Tingting Liu, Meng Fan, Shufeng Chen, Xiangfeng Lu, Dongfeng Gu, Jianfeng Huang
Full Source: Ecotoxicology and environmental safety 2021 Jun 8;220:112397. doi: 10.1016/j.ecoenv.2021.112397.

# PHARAMACEUTICAL/TOXICOLOGY

## Perinatal exposure to a human relevant mixture of persistent organic pollutants: Effects on mammary gland development, ovarian folliculogenesis and liver in CD-1 mice

2021-06-10
The ability of persistent organic pollutants (POPs) with endocrine disrupting properties to interfere with the developing reproductive system is of increasing concern. POPs are transferred from dams to offspring and the high sensitivity of neonates to endocrine disturbances may be caused by underdeveloped systems of metabolism and excretion. The present study aimed to characterize the effect of in utero and lactational exposure to a human relevant mixture of POPs on the female mammary gland, ovarian folliculogenesis and liver function in CD-1 offspring mice. Dams were exposed to the mixture through the diet at Control, Low or High doses (representing 0x, 5000x and 100 000x human estimated daily intake levels, respectively) from weaning and throughout mating, gestation, and lactation. Perinatally exposed female offspring exhibited altered mammary gland development and a suppressed ovarian follicle maturation. Increased hepatic cytochrome P450 enzymatic activities indirectly indicated activation of nuclear receptors and potential generation of reactive products. Hepatocellular hypertrophy was observed from weaning until 30 weeks of age and could potentially lead to hepatotoxicity. Further studies should investigate the effects of human relevant mixtures of POPs on several hormones combined with female reproductive ability and liver function.
Authors: Silje Modahl Johanson, Erik Ropstad, Gunn Charlotte Østby, Mona Aleksandersen, Galia Zamaratskaia, Gudrun Seeberg Boge, Ruth

The ability of persistent organic pollutants (POPs) with endocrine disrupting properties to interfere with the developing reproductive system is of increasing concern.

Halsne, Cathrine Trangerud, Jan Ludvig Lyche, Hanne Friis Berntsen, Karin Elisabeth Zimmer, Steven Verhaegen
Full Source: PloS one 2021 Jun 10;16(6):e0252954. doi: 10.1371/journal.pone.0252954.

## Inactivation of common airborne antigens by perfluoroalkyl chemicals modulates early life allergic asthma

2021-06-15

Allergic asthma, driven by T helper 2 cell-mediated immune responses to common environmental antigens, remains the most common respiratory disease in children. Perfluorinated chemicals (PFCs) are environmental contaminants of great concern, because of their wide application, persistence in the environment, and bioaccumulation. PFCs associate with immunological disorders including asthma and attenuate immune responses to vaccines. The influence of PFCs on the immunological response to allergens during childhood is unknown. We report here that a major PFC, perfluorooctane sulfonate (PFOS), inactivates house dust mite (HDM) to dampen 5-wk-old, early weaned mice from developing HDM-induced allergic asthma. PFOS further attenuates the asthma protective effect of the microbial product lipopolysaccharide (LPS). We demonstrate that PFOS prevents desensitization of lung epithelia by LPS, thus abolishing the latter's protective effect. A close mechanistic study reveals that PFOS specifically binds the major HDM allergen Der p1 with high affinity as well as the lipid A moiety of LPS, leading to the inactivation of both antigens. Moreover, PFOS at physiological human (nanomolar) concentrations inactivates Der p1 from HDM and LPS in vitro, although higher doses did not cause further inactivation because of possible formation of PFOS aggregates. This PFOS-induced neutralization of LPS has been further validated in primary human cell models and extended to an in vivo bacterial infection mouse model. This study demonstrates that early life exposure of mice to a PFC blunts airway antigen bioactivity to modulate pulmonary inflammatory responses, which may adversely affect early pulmonary health.

Allergic asthma, driven by T helper 2 cell-mediated immune responses to common environmental antigens, remains the most common respiratory disease in children.

Authors: Mengjing Wang, Qianqian Li, Meifang Hou, Louisa L Y Chan, Meng Liu, Soo Kai Ter, Ting Dong, Yun Xia, Sanjay H Chotirmall, Mingliang Fang
Full Source: Proceedings of the National Academy of Sciences of the United States of America 2021 Jun 15;118(24):e2011957118. doi: 10.1073/pnas.2011957118.