CHEMWATCH

Bulletin Board

Contents

MAY. 05, 2025

(click on page numbers for links)

CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

CHEMICAL EFFECTS

Lead systemic toxicity: a persistent problem for health

2025-04-24

Lead (Pb) has been used by humans since prehistoric times to make tools due to its malleability and durability. The Roman Empire, the Industrial Revolution, and the introduction of Pb in gasoline during the 1920s contributed to increased environmental concentrations. Pb toxicity led to its removal from gasoline after several decades. However, Pb continues to be emitted from various anthropogenic sources, including but not limited to batteries, mining, foundries, smelting, e-waste recycling, and painting. Pb remains an environmental concern, as no established safe concentration for human health has been identified. Children are more susceptible to the absorption and poisoning of Pb. Occupational exposure to Pb poses a significant risk to workers and individuals living near lead industries. The primary routes of exposure are inhalation and ingestion, and bioaccumulation and biomagnification through the food chain are major sources of human exposure. This review aims to provide an overview of Pb and its systemic toxicity of Pb, including its effects on the lungs, blood, liver, kidneys, and nervous, cardiovascular, and reproductive systems. Since Pb is classified as a probable carcinogen for humans, the article also addresses genotoxicity and cancer risk. Furthermore, it reviews the most researched mechanisms of toxicity, including calcium mimicry, oxidative stress, and inflammation, along with other less-studied mechanisms. Nevertheless, the authors emphasize the importance of exploring less examined cells, tissues, and mechanisms to deepen the understanding of Pb toxicity at various concentrations, particularly in cases of chronic low-level Pb exposure, to develop better prevention and treatment strategies for lead poisoning.

Authors: Gonzalez-Villalva Adriana, Rojas-Lemus Marcela, López-Valdez Nelly, Bizarro-Nevares Patricia, Morales-Ricardes Guadalupe, Casarrubias-Tabarez Brenda, Cervantes-Valencia Maria Eugenia, Ustarroz-Cano Martha, García-Peláez Isabel, T I Fortoul

Full Source: Toxicology 2025 Apr 24:154163. doi: 10.1016/j.tox.2025.154163.

CHEMWATCH
Bulletin Board
Technical
MAY. 05, 2025

The importance of blood trace elements in the biomonitoring of agrochemicals exposure and effects on DNA and epigenetic alterations

2025-04-15

Background: Pesticides and trace element exposure can cause serious health outcomes. Brazil is a leading agrochemical user(kg/ha). This study aimed to assess DNA damage and epigenetic alterations due to agrochemical exposure in farmers from southern Brazil.

Methods: One hundred and twelve farmers (male and female) with different exposure to agrochemicals were studied: group 1, farmers who handled agrochemicals extensively during the month of sample collection (n=44), and group 2 (n=68), who did not. Lifestyle and occupational information questionnaires were applied. Biomonitoring was performed by evaluating cholinesterase activity, trace element levels in blood, buccal micronucleus cytome assay (BMCyt) in buccal cells, telomere lenght and epigenetic alterations.

Results: Cholinesterase activity showed no significant difference between groups. Blood trace elements such as As, Cr, Ni and V were above reference values, indicating excessive exposure. Strong correlations between trace elements suggested a common source of exposure. Group 1 had higher frequencies of micronuclei, nuclear buds, binucleated, and cell alterations, biomerkers for DNA damage and cytotoxicity. Global DNA methylation was higher in group 1 and correlated with Cr, Ni and Be. Telomere length was negatively correlated with age, Cr and Ni.

Conclusions: Farmers exhibited mutagenicity, telomere lenght and epigenetic alteration associeated with exposure to toxic trace elements, including important carcinogens. Moreover, the results demonstrated the importance of quantified trace elements as exposure biomarkers and the BMCyt assay, as a biomonitoring tool to evaluate agrochemical exposure. Limitations included the characterization of groups obtained through self-reporting and the absence of a non-exposed group.

Authors: Ingrid M Flesch, Shanda A Cattani, Daiane Domingues, Caroline P Peruzzi, Paula Rohr, Ana Letícia H Garcia, Rafael Moreira, Mariele F Charão, Juliana Da Silva, Gabriela Göethel, Marcelo Arbo, Adriana Gioda, Tatiana Saint-Pierre, Natália Brucker, Solange C Garcia

Full Source: Journal of trace elements in medicine and biology: organ of the Society for Minerals and Trace Elements (GMS) 2025 Apr 15:89:127647. doi: 10.1016/j.jtemb.2025.127647.

Cumulative environmental exposures and metabolic syndrome: A study of heavy metals and volatile organic compounds

2025-04-25

Background: Metabolic Syndrome (MetS), a condition affecting over one-third of the U.S. population, heightens the risk of cardiovascular disease, Type 2 diabetes, and premature mortality. While individual links between heavy metals (HM), volatile organic compounds (VOC), and MetS have been established, the impact when these environmental toxins are combined remains unclear and unexplored. This study investigates how simultaneous exposure to HMs and VOCs influences the risk of MetS.
Methods: Weighted Quantile Sum regression and Bayesian kernel Machine Regression were performed on data from 6603 participants in the National Health and Nutrition Examination Survey (2011-2020) to determine the impact of HMs and VOCs detected in urine on MetS. Further analyses were performed for individuals placed in subgroups based on age, sex, race/ethnicity, and monthly poverty level index.
Results: The analyses reveal that combined exposure to HMs and VOCs is associated with an increased risk of MetS; in particular, exposure to cadmium, tin, N-acetyl-S-(N-methyl carbamoyl)-L-cysteine, and N-acetyl-S-(2-carboxyethyl)-L-cysteine significantly elevates the risk of developing MetS. Younger adults (18-50 years), men, Hispanics and non-Hispanic whites, and those with a monthly poverty index > 1.3 (higher socioeconomic status) emerged as the most vulnerable groups.
Conclusion: These findings emphasize an urgent need to address and tackle the cumulative impact of environmental toxins through a shift in public health efforts to go beyond investigating isolated exposures to address real-world chemical exposures. By understanding these cumulative risks, we can begin to mitigate them and pave the way for more effective interventions, especially for at-risk populations.

Authors: Brooke Scardino, Destyn Dicharry, Akshat Agrawal, Diensn Xing, Md Mostafizur Rahman Bhuiyan, Md Shenuarin Bhuiyan, Oren Rom, Steven A Conrad, John A Vanchiere, A Wayne Orr, Christopher G Kevil, Mohammad Alfrad Nobel Bhuiyan

Full Source: Ecotoxicology and environmental safety 2025 Apr 25:297:118238. doi: 10.1016/j.ecoenv.2025.118238.

CHEMWATCH
Bulletin Board
Technical
MAY. 05, 2025

ENVIRONMENTAL RESEARCH

Heavy Metals in Particulate Matter-Trends and Impacts on Environment

2025-03-25

Heavy metals represent a class of pollutants detected at concentrations lower than 10 ppm in different matrices that are intensively monitored due to having a major impact on human health. Industrial activities including mining, agriculture, and transport, determine their presence in different environments. Corrosion phenomena of various installations, volcanic eruptions, or atmospheric deposition on the soil surface and in water can contaminate the respective environments. Atmospheric pollutants in the form of suspended dust particles with diameters below 10 microns are predominantly composed of different metallic species from Cd, Cr, Cu, Ni, etc. This paper presents a review of the main sources and types of heavy metals present in the atmosphere in the composition of particulate matter (PM), highlighting the main mechanisms of occurrence and detection techniques, including the impact on bio-geo-chemical processes in the soil and food chain, in close correlation with their impact on environment and human health. The purpose of this review is to highlight the current level of knowledge regarding the global situation of heavy metals in PM and to identify gaps as targets for future research.

Authors: Ecaterina Matei, Maria Râpă, Ileana Mariana Mateș, Anca-Florentina Popescu, Alexandra Bădiceanu, Alexandru Ioan Balint, Cristina Ileana Covaliu-Mierlă

Full Source: Molecules (Basel, Switzerland) 2025 Mar 25;30(7):1455. doi: 10.3390/molecules30071455.

Long-term exposure to particulate air pollution associated with the progression of type 2 diabetes mellitus in China: effect size and urban-rural disparities

2025-04-26

Background: Recent Western studies link long-term particulate matter (PM) exposure to type 2 diabetes mellitus (T2DM) progression, but little is known for low- and middle-income countries. This study aimed to estimate the relationship between PM exposure and T2DM progression in China, and also assess urban-rural disparities.
Methods: Using 7-year cohort data of 1.3 million Chinese over 40, a multistate model estimated the associations of PM exposure with T2DM progression. Covariates included demographics, socioeconomic status,

health behaviors, medication, and meteorological factors. Sub-sample analyses were done for rural and urban areas.
Results: For participants exposed to high levels of PM 2.5, the 5-year absolute risks of developing T2DM and its complications were 4.31% (95% CI: 4.22-4.40) and 31.04% (95% CI: 29.97-32.08), respectively. In the low- PM 2.5 -exposure group, these risks were 3.82% (95% CI: 3.74-3.91) and 30.55% (95% CI: 29.43-31.65). For each 10 μg/m3 increase in PM 2.5 exposure, the HRs (95% CI) for the progression from no T2DM diagnosis to a T2DM diagnosis were 1.13 (1.13-1.14), and for the progression from T2DM to the development of T2DM complications were 1.04 (1.03-1.06). Moreover, the HRs (95% CI) for mortality risk were 1.09 (1.08-1.09) for participants without T2DM, 1.06 (1.00-1.14) for those with T2DM, and 1.10 (1.05-1.16) for those with T2DM complications. Similar associations were observed for other PM-related metrics. In rural areas, PM exposure was more strongly associated with the progression from T2DM and its complications to death. Conversely, in urban areas, PM exposure had a stronger association with the progression from a non-T2DM state to a formal T2DM diagnosis. Urban residents are exposed to higher levels of toxic components like heavy metals, potentially increasing T2DM risk, yet urban healthcare infrastructure offers protection against T2DM-related mortality.
Conclusions: PM exposure is significantly associated with T2DM progression. Urban areas should focus on primary prevention, while rural areas need to improve secondary and tertiary prevention like healthcare services.
Authors: Mengxiao Hu, Xiaowei Hao, Yunquan Zhang, Xiaofeng Sun, Meng Zhang, Jingyi Zhao, Qing Wang
Full Source: BMC public health 2025 Apr 26;25(1):1565. doi: 10.1186/s12889-025-22394-z.

Examining the Environmental Ramifications of Asbestos Fiber Movement Through the Water-Soil Continuum: A Review

2025-03-26
The environmental pollution potential of asbestos products is a worldwide health issue, but their dissemination through the water-soil continuum is often an overlooked aspect. Similarly, the behavior of asbestos fibers released from the products is still not fully understood, although our knowledge is based on studies concerning their mineralogical characteristics, health effects, and waste disposal. It has been claimed and contradicted that asbestos harm is only found in air and humans.

CHEMWATCH
Bulletin Board
Technical
MAY. 05, 2025

Asbestos fibers are found not only in industrial settings but also through the industrial use of asbestos cement products, which has contributed to asbestos emissions and its movement in water and soil. Asbestos fibers are diverse in their physicochemical properties, and this diversity has a significant influence on their behavior in the environment. Recent research has confirmed that asbestos can be transported by water and spread to other parts of the environment. However, the mechanisms underlying this, such as the settling of fibers, their attachment to soil particles, or their movement in groundwater, as well as the environmental and health implications, require further investigation. This paper examines the process and impact of asbestos contamination in the interconnected water, soil, and plant environmental sectors, providing a systematic review of the latest literature.
Authors: Gergely Zoltán Macher, András Torma, Dóra Beke
Full Source: International journal of environmental research and public health 2025 Mar 26;22(4):505. doi: 10.3390/ijerph22040505.

PHARMACEUTICAL/TOXICOLOGY

Refining source-specific lung cancer risk assessment from PM2.5-bound PAHs: Integrating component-based potency factors and machine learning in Ningbo, China

2025-04-25
The component-based potency factor approach, combined with benzo[a] pyrene (BaP) unit risk values from the World Health Organization (WHO), is commonly used to assess lung excess cancer risk (LECR) from polycyclic aromatic hydrocarbons (PAHs). However, this method may overestimate LECR, particularly when highly carcinogenic PAHs are included. In this study, we employed BaP unit risk values from both the WHO and the Environmental Protection Agency (EPA) to estimate LECR in Ningbo, China, revealing that incorporating high-carcinogenic PAHs into the component-based potency factor approach, along with WHO unit risk factors, leads to an overestimation of LECR by more than tenfold. We identified a moderate PAH exposure risk level ($>1.0 \times 10^{-6}$) in Ningbo and used advanced machine learning (ML) algorithms, random forest (RF), extremely randomized trees (ERT), and extreme gradient boosting (XGBoost), to improve the accuracy of source-specific LECR assessments. ERT emerged as the most robust algorithm, identifying industrial emissions, coal combustion, and gasoline engine exhaust as the primary contributors to elevated LECR in Ningbo. This study underscores the need

for precise, source-specific LECR estimation to effectively mitigate PAH pollution and reduce lung cancer risks. By integrating ML techniques into risk assessment methodologies, we provide a robust framework for global application, enhancing public health protection. Our findings also highlight the importance of refining risk evaluation strategies and pave the way for future research to validate and adapt these models in diverse environmental settings.
Authors: Lord Famiyeh, Ke Chen, Fiseha Berhanu Tesema, Celeb Kelly, Dongsheng Ji, Hang Xiao, Lei Tong, Zongshuang Wang, Jun He
Full Source: Ecotoxicology and environmental safety 2025 Apr 25:297:118174. doi: 10.1016/j.ecoenv.2025.118174.

Evaluating inhalation risks and toxicological impacts of lithium-ion battery thermal runaway emissions

2025-04-19
The occurrence of thermal runaway (TR) events continues to rise as the need for lithium-ion batteries (LIB) for energy storage increases. However, the inhalation risks associated with LIB TR events remain widely unknown. The objective of this study was to evaluate the impact of LIB TR particulate emission exposures on primary small airway epithelial cells (SAEC). TR was triggered by subjecting lithium-ion cells to thermal abuse at different states of charge (SOC). Two different battery cathode chemistry compositions, namely, nickel manganese cobalt (NMC) or lithium iron phosphate (LFP) were evaluated. Aerosol monitoring and sampling instrumentation were employed followed by physicochemical particle characterization and inhalation dosimetry modeling. SAEC were treated with TR particulate emission extracts for 24 h and 7 days at doses representing a cumulative 1- and 5-year inhalation exposure. Following treatment, cellular viability, reactive oxygen species (ROS) production, and protein expression of DNA damage and epithelial mesenchymal transition (EMT) markers were assessed. TR particulate emissions consisted of ultrafine particles containing a variety of heavy metals. Cellular senescence was induced by NMC-derived TR extracts, but not LFP-derived TR extracts. SAEC treated with the 5-year dose of NMC-derived TR extract, induced significant ROS production. In cells treated with NMC-derived TR extract, regulators of DNA repair and cell cycle arrest were perturbed. Oxidative stress subsequently induced EMT, as SAEC treated with NMC-derived TR particulate emissions reduced E-cadherin expression and upregulated

CHEMWATCH
Bulletin Board
Technical
MAY. 05, 2025

Fascin and Vimentin expression. This study reveals the respiratory implications of TR particulate emissions and the role of battery chemistry.
Authors: Maureen Meister, Shaligram Sharma, Xiaojia He, Patrick S Chepaitis, Taryn Waddey, Mark Wilson, Vinay Premnath, Judith Jeevarajan, Marilyn Black, Christa Wright
Full Source: Environment international 2025 Apr 19:199:109466. doi: 10.1016/j.envint.2025.109466.

OCCUPATIONAL

Characterization of Background Exposures to Ethylene Oxide in the United States: A Reality Check on Theoretical Health Risks for Potentially Exposed Populations near Industrial Sources

2025-04-10
Ethylene oxide (EO) is an industrial chemical and sterilant that is released into ambient air from natural and unregulated anthropogenic sources that contribute to background exogenous exposure and from regulated industrial sources that contribute to additional exogenous exposure for near-facility populations. Metabolic processes contribute to substantial background endogenous exposures to EO, complicating the interpretation of the relation between total background exposure and the health significance of added industrial exogenous exposure. In 2021, Kirman and colleagues characterized the total and endogenous equivalent background concentrations for U.S. populations, which are substantially greater than the USEPA 2016 EO cancer reassessment risk-specific concentrations (0.00011-0.011 ppb), suggesting that the consideration of background exposure could be used as a reality check for the utility of the reassessment in managing EO risk for industrially exposed populations. New exposure biomarker data and background ambient concentration data for EO have become available since the 2021 assessment and are used here to refine the estimates of U.S. population total and endogenous equivalent background EO concentrations. Refined equivalent background concentrations as well as total equivalent exposure estimates for U.S. smokers provide context as to the health significance of near-industry population added exposure and a reality check for the utility of USEPA and

TCEQ risk-specific concentrations in managing and communicating EO risk.

Authors: Christopher R Kirman, Patrick J Sheehan, Abby A Li, James S Bus, Steave H Su, Pamela J Dopart, Heather N Watson, Emma E Moynihan, Rick Reiss

Full Source: International journal of environmental research and public health 2025 Apr 10;22(4):597. doi: 10.3390/ijerph22040597.

Hexavalent chromium and cellular senescence: A comprehensive analysis from chromate-exposed occupational population and chromate-inhaled mouse model

2025-04-22

Cellular senescence may predominantly drive the progression of early subclinical injury under conditions of low-dose, long-term occupational exposure. However, previous research has largely overlooked the cellular senescence induced by hexavalent chromium [Cr(VI)]. To bridge the gap, 304 workers from a chromate facility were enrolled, and a mouse model was used to confirm the effects of Cr(VI) on cellular senescence. A 2.7-fold increase in blood Cr was related to the changes of p53 [23.19 (13.06, 34.23)%], serum α-Klotho [11.45 (6.13, 17.04)%], adipsin [-14.11(-22.16, -5.24)%], leptin [-4.32(-6.99, -1.58)%] and resistin [-3.29(-5.54, -0.98)%]. There were significant correlations of blood Cr with DNA methylation of ELOVL2 and hTERT genes. Furthermore, methylation at hTERT Pos1, Pos2, Pos6, and Pos8 significantly mediated the relationship between blood Cr and p53. In the mouse model, we observed significantly higher mRNA expression levels of key genes in the p53/p21 and Rb/p16 pathways and senescence-associated β-galactosidase positive cell ratio in the exposed group. In conclusion, we found that p53 in human peripheral blood cells serves as a Cr(VI)-induced senescence biomarker, with α-Klotho upregulation and adipokines (adipsin, leptin, and resistin) downregulation indicating compensatory responses, as well as hTERT methylation partially mediating Cr(VI)-senescence association.

Authors: Zhiqiang Ji, Yali Zhang, Guiping Hu, Shiyi Hong, Zekang Su, Qiaojian Zhang, Li Wang, Tiancheng Wang, Shanfa Yu, Qian Bu, Fang Yuan, Xiaojun Zhu, Guang Jia

Full Source: Journal of hazardous materials 2025 Apr 22:493:138387. doi: 10.1016/j.jhazmat.2025.138387.