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Week of 22 May 2026

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Toxic Metal Exposure and Biomarkers of Neurotoxic Effects: A Study in Metal Recycling Workers

Neurotoxicology 2026 May 15:114:103469 · 15 May 2026

BACKGROUND: Occupational exposure to toxic metals is a critical global health concern, particularly in the metal scrap recycling industry where simultaneous exposure to complex mixtures is common. Chronic exposure to these mixtures can disrupt redox homeostasis and trigger neuronal injury; however, human data on biomarkers reflecting early neural alterations in asymptomatic populations remain limited.

AIMS: This study evaluates biomarkers of neurotoxic effects in male recycling workers by measuring a comprehensive panel of neuronal and glial injury markers measure biomarkers indicative of possible neural damage associated with chronic toxic metal exposure.

STUDY DESIGN: Cross-sectional study **METHODS:** The study included 123 male subjects: 62 recycling workers employed in a metal scrap recovery facility (exposed group) and 61 healthy controls. Blood and urine concentrations of lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni), copper (Cu), manganese (Mn), cobalt (Co), iron (Fe), arsenic (As), and selenium (Se) were quantified using inductively coupled plasma mass spectrometry (ICP-MS). Serum levels of S100B, Neuron-specific enolase (NSE), Microtubule-associated protein 2 (MAP2), glial fibrillary acidic protein (GFAP), Myelin basic protein (MBP), and Calprotectin (CALPRO) were measured by ELISA. Statistical associations were examined using correlation and multivariate regression analyses.

RESULTS: Recycling workers exhibited markedly higher concentrations of Pb, Mn, Cd, Ni, Cu, Cr, Co, and Fe, alongside significantly decreased Se levels ($p < 0.001$), indicating substantial toxic metal overload and antioxidant depletion. Correspondingly, serum levels of S100B, NSE, MAP2, and GFAP were significantly elevated in the exposed group ($p < 0.001$), indicating subclinical neuronal and astroglial stress rather than established disease. Multivariate regression identified Pb, Fe, Cr, and Co as the most consistent independent predictors of biomarker alterations, with the NSE model demonstrating the highest explanatory power.

CONCLUSION: Chronic occupational exposure to toxic metal mixtures is associated with significant alterations in neuronal biomarkers indicative of possible neurotoxic damage in an asymptomatic population, reflecting preclinical neural stress rather than established disease. The inverse relationship between selenium and neuronal injury markers suggests a potential protective role, although this requires further confirmation. These findings support the use of an integrated multi-biomarker approach as a sensitive early warning tool for monitoring neurotoxic risks in industrial populations.

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Asbestos-Related Respiratory Diseases in Spain: Insights From the Spanish Registry

American journal of industrial medicine 2026 May 17 · 17 May 2026

INTRODUCTION: Although many Spanish workers have been exposed to asbestos, asbestos-related diseases (ARD) have not been widely reported in this country. The aim of the present study was to analyze the data recorded in the Spanish Registry of asbestos-derived diseases.

METHODS: A retrospective observational study was conducted based on data reported between September 19, 2018, and May 15, 2023, covering 11 Spanish autonomous communities. Variables included demographic data, type of exposure, symptoms, pulmonary function tests, radiological studies, and initial and follow-up diagnoses.

RESULTS: One thousand seven hundred and twenty-one cases were reported, with a mean age of 75.2 years. The majority were men (96.7%) and were smokers or former smokers (78.8%). Occupational exposure accounted for 98.3% of cases, mainly in the naval sector (70%). Pleural plaques were the most prevalent diagnosis (82.1%), followed by asbestosis (14.9%) and lung cancer (11%). During follow-up, 181 new diagnoses were made, including lung cancer (23.76%) and mesothelioma (11.6%). The overall mortality rate was 13.4%, with lung cancer being the leading cause of death.

CONCLUSIONS: This study provides a first overview of ARD in Spain. The most notable findings are the importance of shipyards as a source of exposure, the predominance of pleural plaques and the number of new diagnoses made during the follow-up, and the need for continuous surveillance and early diagnosis to mitigate asbestos-related adverse effects.

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CHEMICAL EFFECTS

Co-Exposure to PFAS, PFAS Alternatives, and Metals and Liver Function in Chinese Adults

Environmental pollution (Barking, Essex : 1987) 2026 May 15 · 15 May 2026

PER: and polyfluoroalkyl substances (PFAS) and their alternatives are recognized environmental hepatotoxins, yet their combined effects with metals on liver health in human populations remain underexplored. This study measured serum levels of 13 PFAS (including legacy and emerging alternatives such as Cl-PFESAs) and plasma levels of 25 metals, and evaluated their individual and joint associations with five liver function biomarkers (ALT, AST, ALP, GGT, and DBIL) among 1,263 adults in Guangzhou, China. Generalized additive models (GAMs) revealed that most individual pollutants were positively associated with liver function biomarkers, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), and direct bilirubin (DBIL). Advanced Bayesian kernel machine regression (A-BKMR) analyses, employed to assess the joint associations of these complex mixtures, further demonstrated significant positive associations between the overall mixture of PFAS, alternatives, and metals and these biomarkers. Crucially, PFOS and PFHpS among the PFAS, alongside Pb, Cd, Tl, Zn, and Fe among the metals, were identified as the primary

contributors to the observed mixture effect. These findings provide additional epidemiological evidence that co-exposure to PFAS (including emerging alternatives) and metals is adversely associated with liver health, highlighting the importance of assessing complex environmental mixtures. Further population-based studies are warranted, including studies measuring metals in matrices other than plasma, to validate these associations and elucidate underlying biological pathways.

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An exploratory study on exposure to bisphenol A analogues and breast cancer risk

Environment international 2026 May 12:212:110301 · 12 May 2026

Endocrine disrupting compounds (EDCs) such as Bisphenol A (BPA) and its structural analogues are widely used in consumer products and have raised concerns due to their potential to disrupt hormonal balances and promote carcinogenic processes. In this study, total urinary concentrations of BPA and its analogue compounds were quantified in a Canadian breast cancer case-control group of premenopausal women. A robust and validated analytical method involving extraction, clean-up, and LC-MS/MS analysis was developed to accurately measure 15 bisphenols in urine, including BPA, BPS, BPF, and BPE. The detection frequency was high for BPA (99%) and its analogues (BPS, BPF, BPE), with BPA concentrations being the highest overall. Levels of BPA and BPS were higher in breast cancer cases (BPA: 1.75 ug/L; BPS: 0.40 ug/L) relative to healthy controls (BPA: 1.35 ug/L; BPS: 0.29 ug/L). When considering the specific gravity (SG) - standardized BPS data a small, but significant difference is observed between breast cancer case and control women, particularly in women from the control group who had lower BPS SG levels [adjusted least squares means = 0.29, (95% CI: 0.21, 0.40)] compared to women diagnosed with breast cancer [adjusted least squares means = 0.48, 95% CI: (0.33, 0.68); $p = 0.0462$]. The results suggest that chronic exposure to BPA and structurally related compounds is prevalent, and the subtle differences in bisphenol concentration between cases and controls underscore the need for further investigation into the complex associations between bisphenol analogues and breast cancer risks.

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ENVIRONMENTAL RESEARCH

Differential prevalence of PFAS, PCBs and pesticides in liver of hunted game

Environmental science and pollution research international 2026 May 15 · 15 May 2026

Free foraging game animals are constantly exposed to environmental pollutants and can therefore serve as bioindicators for these substances. However, they can also pose a health risk to humans if polluted meat of wild game animals enters the food chain. We analysed 219 potentially critical pollutants in 164 liver samples of hunted wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*) from north-eastern Germany. Overall, 24 pollutants were detected and 16 of them were detected quantitatively. PCBs, PFAS and rodenticides were more frequent and present in far higher concentrations in wild boar than in roe deer. Only for rodenticides can it be assumed that there is no health risk for the game animals; otherwise, no statement can be made due to a lack of reference data. Risks for human consumers of liver arise from concentrations in wild boar liver exceeding the

tolerable weekly intake for PFAS by up to 17 times and in individual cases the acute reference dose for brodifacoum by up to 485%. In contrast, the health risk of eating game meat is usually negligible, as chemical residues generally accumulate in the liver and less in muscle tissue. The significance of up to 12 co-occurring residues for animal and human health is still an open research issue.

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Statewide hydrogeochemical assessment of groundwater in Kerala using multivariate analysis: health risk implications of fluoride and nitrate

Environmental geochemistry and health 2026 May 16;48(8) · 16 May 2026

The spatial variability of groundwater quality in Kerala, driven by anthropogenic activities and saline intrusion, poses a significant environmental challenge. This study conducts a comprehensive hydrogeochemical analysis of 342 groundwater samples from 14 districts of Kerala, using 13 parameters from Central Groundwater Board data. Multivariate techniques, including Principal Component Analysis (PCA) and Karl Pearson's Correlation, alongside Piper and Schoeller diagrams, were employed to identify the various geochemical processes and dominant hydrochemical facies. PCA attributes 67.62% of variance to geogenic and anthropogenic factors. Elevated nitrate concentrations (max: 153 mg/L) indicate dominant anthropogenic influences, whereas fluoride levels (max: 2 mg/L) largely reflect geogenic controls on groundwater chemistry. Results indicate that groundwater pH ranges from 3.79 to 9.85, reflecting acidic to alkaline conditions, with electrical conductivity (29-2996 $\mu\text{S}/\text{cm}$) suggesting low salt enrichment. Dominant cations (Na^+ , Ca^{2+}) and anions (HCO_3^- , Cl^-) reveal Ca- HCO_3 and mixed Ca. Na- HCO_3 as prevalent facies, driven by carbonate and silicate weathering. Health Risk Assessment indicated that adults constitute the most vulnerable group based on the cumulative Total Hazard Index (THI), with values ranging from 0.01 to 4.35, followed by children (0.01-4.17) and infants (0.005-1.78). The findings of the study will guide policymakers in addressing Kerala's groundwater quality crisis and developing sustainable remediation strategies.

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Wildfire smoke exposure and school absences in New York City Public Schools, 2011-2019

Environment international 2026 May 13:212:110299 · 13 May 2026

Climate change is intensifying wildfire frequency and severity across North America, degrading air quality in urban areas far from fire sources. While the direct health effects of wildfire smoke are well-documented, associations with educational outcomes remain poorly characterized. We conducted a time-stratified case-crossover study linking 2.11 million school-days from 1,443 New York City (NYC) public elementary, middle, and high schools over the 2011-2012 to 2018-2019 academic years with tract-level wildfire smoke fine particulate matter (PM_{2.5}) estimates, meteorological data, and school-level sociodemographic characteristics, using date-clustered inference to estimate associations between daily smoke exposure and absence rates. Stratified analyses examined variation by school level, and effect modification was tested by racial/ethnic composition, free/reduced-price lunch eligibility, English language learner status, and tree canopy cover. Economic impacts were estimated using the US Environmental Protection Agency Benefits Mapping and Analysis Program (BenMAP). Wildfire smoke was associated with higher absence rates

on the day of exposure (rate ratio [RR] = 1.12; 95% CI: 1.02-1.23). Associations were statistically significant for elementary (RR = 1.18, 95% CI: 1.03-1.34) and middle schools (RR = 1.14, 95% CI: 1.03-1.27) but not high schools (RR = 1.06, 95% CI: 0.96-1.18). We did not detect significant effect modification by school-level demographic factors or tree canopy cover, though the limited number of unique smoke dates constrains subgroup power. Economic costs were \$86.5 million annually for the NYC public school system (95% CI: \$26.2-\$150.5 million). These findings indicate heightened vulnerability among elementary and middle school students and support school-wide mitigation during smoke events, including improved air filtration, real-time air quality monitoring, and evidence-based activity modification protocols.

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PHARMACEUTICAL/TOXICOLOGY

Chemical speciation and release characteristics in different environments of heavy metals in thermally activated red mud

Journal of hazardous materials 2026 May 13:512:142380 · 13 May 2026

The potential environmental risk of heavy metals hinders the resource utilization of thermally activated red mud. This study employed modified BCR sequential extraction, leaching tests, and microstructural characterization to systematically investigate the effect of thermal activation (0-1200 °C) on heavy metal speciation, leaching behavior, and associated risk. Medium-temperature treatment (400-800 °C) markedly increased the bioavailability and leaching risk of Zn and Cr, with the acid-soluble Cr fraction reaching 74% at 800 °C. Leaching of all heavy metals peaked under acidic conditions at 40-50°C. Mechanistically, medium-temperature activation decomposed minerals and formed an interconnected mesoporous network, increasing surface area while creating efficient pathways for heavy metal migration, thereby elevating release risk. In contrast, ultra-high temperature sintering (≥1000 °C) induced densification through particle fusion and mineral recrystallization, destroying pore connectivity and effectively encapsulating heavy metals within a stable matrix. Therefore, safe utilization of thermally activated red mud requires avoiding acidic environments, whereas ultra-high temperature sintering offers an effective immobilization strategy. This study reveals element-specific speciation patterns, links heavy metal mobility to microstructural evolution, and identifies strongly acidic conditions and 40-50 °C as critical factors controlling release, providing systematic understanding and practical guidance for safe red mud utilization.

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Diagnostic correction based on toxicology: A case of combined dichlorvos (DDVP), ethanol, and pesticide co-solvent intoxication

Journal of forensic sciences 2026 May 16 · 16 May 2026

Organophosphate pesticides (OPs) are commonly encountered toxic substances in poisoning incidents, often associated with severe clinical symptoms. The diagnosis and treatment become more complicated, especially when mixed with other toxic substances, requiring detailed toxicological analysis to identify the involved agents. This report presents a case of mixed poisoning in a 37-year-old male who ingested 250 mL of 40% alcohol and was admitted with impaired consciousness, absent pupillary light reflexes, and severe metabolic acidosis, which did not improve

with initial treatment. Gas chromatography and gas chromatography-mass spectrometry analysis of the collected samples revealed dichlorvos (DDVP) in the gastric contents, along with 2,2-dichloroethanol, ethanol, butyl acetate, and isobutyl acetate in the blood. Following accurate diagnosis and targeted treatment, the patient's condition gradually improved. This case highlighted the critical role of toxicological testing in diagnosing complex poisoning, providing vital guidance for clinical management, and emphasizing the importance of collaboration between laboratory and clinical teams in the treatment of acute poisoning.

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Polystyrene nanoplastics induce ocular surface toxicity via endoplasmic reticulum stress

Ecotoxicology and environmental safety 2026 May 16:318:120277 · 16 May 2026

The increasing environmental burden of micro/nanoplastics (M/NPs) has heightened concerns about their potential threat to ocular health, yet the molecular mechanisms underlying M/NPs-induced ocular surface injury remain largely unclear. In this study, we investigated the ocular toxicity of polystyrene nanoplastics (PS-NPs) with a focus on the involvement of endoplasmic reticulum (ER) stress. A mouse ocular exposure model and a human corneal epithelial (HCE-T) cell model were established. Multi-level analyses demonstrated that PS-NPs exposure induced ocular surface toxicity in mice, characterized by diminished tear secretion and corneal epithelial damage. At the cellular level, PS-NPs were internalized by HCE-T cells and accumulated near the ER. Mechanistic investigations revealed that PS-NPs exposure was associated with the activation of the ER stress response, which was accompanied by disrupted redox homeostasis, NF- κ B-driven inflammatory activation, promoted apoptosis, and impaired epithelial barrier integrity. Notably, administration of the chemical chaperone 4-phenylbutyric acid (4-PBA), an ER stress inhibitor, substantially attenuated these adverse outcomes in vivo and in vitro. Together, this study establishes a significant association between PS-NPs exposure, ER stress activation, and ocular damage, identifying ER stress as a key and targetable cellular event in the toxicological response to NPs.

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