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Week of 13 March 2026

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TECHNICAL

OCCUPATIONAL

Occupational exposure to microplastics and heavy metals: a workstation-based study across small-scale, medium-scale, and large-scale plastic manufacturing in Nagpur, India

Environmental science and pollution research international 2026 Mar 07 · 7 Mar 2026

In India, a large number of workers in plastic manufacturing industries may be exposed to airborne microplastics (MPs). However, data on occupational exposure levels remain limited. This study aimed to assess occupational exposure to MPs in small, medium, and large-scale plastic manufacturing industries in Nagpur, India. Nagpur, a major industrial hub, provided a representative setting for evaluating such exposures across diverse industry scales. Airborne respirable samples ($n = 30$; 10 per industry type) were collected during 8-h work shifts using a Sidekick-51MTX dust sampler. Respirable dust collected on PVC filter papers was analyzed for MPs using stereomicroscopy for visualization, fluorescence microscopy for quantification, and ATR-FTIR spectroscopy for polymer characterization. The highest airborne microplastic concentration was observed in medium-scale industries (43 ± 8 particles/m³), followed by small-scale (38 ± 10 particles/m³) and large-scale industries (30 ± 10 particles/m³) for time-weighted average (TWA₈) in shifts. The corresponding filter-based counts were 12 ± 5.8 , 13.7 ± 6.5 , and 9.5 ± 4.9 , respectively. MPs exhibited fibres and fragments, mostly < 1 mm, with fiber lengths ranging from 21 to 1353 μ m. Trace elements (Pb, Cd, As, Hg, Ni) were analyzed using hot block digestion (NIOSH 7303 method) and were within permissible limits under the Factories Act, 1948. This study shows the presence and characteristics of airborne microplastics across plastic manufacturing industries, along with associated occupational exposure to trace elements, and provides baseline information for future studies in Indian settings.

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Evaluating occupational exposures to the graphene family of nanomaterials: Implications for worker safety and health

Journal of occupational and environmental hygiene 2026 Mar 06 · 6 Mar 2026

Graphene, a two-dimensional carbon-based nanomaterial, has garnered significant attention due to its exceptional physical and chemical properties, leading to its widespread application in various industries. However, the increasing utilization of this class of materials, also referred to as the graphene family of nanomaterials (GFNs), raises potential concerns regarding occupational exposures and health risks for workers. This study aimed to evaluate occupational exposures to GFNs across 11 primary and secondary manufacturing facilities operating in the U.S. A total of 44

workers participated in the study, with paired personal air samples collected for elemental carbon (EC) analysis at both the respirable and inhalable aerosol size fractions. The results revealed exposures with respirable EC concentrations ranging from <0.01 to 1825.23 $\mu\text{g}/\text{m}^3$ with a geometric mean (GM) of 2.01 $\mu\text{g}/\text{m}^3$ and inhalable concentrations from 0.01 to 6327.10 $\mu\text{g}/\text{m}^3$ with a GM of 12.63 $\mu\text{g}/\text{m}^3$. Notably, 38% of respirable samples exceeded a suggested occupational exposure band (OEB) of <10 $\mu\text{g}/\text{m}^3$ established from a recent publication for GFNs, while 53% of inhalable samples exceeded the OEB. Primary manufacturing facilities that produce GFNs generally exhibited higher inhalable exposure levels compared to secondary manufacturers, likely due to the handling of larger quantities of dry powdered materials. Additionally, the use of engineering controls and personal protective equipment varied widely among facilities, impacting exposure levels. This study represents a crucial step in understanding any potential occupational risks associated with U.S. GFN exposures.

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CHEMICAL EFFECTS

Evaluation of inhalation and dermal exposure to VOCs and SVOCs from commercial nebulizers in the pediatric population

Inhalation toxicology 2026 Mar 08 · 8 Mar 2026

MATERIALS AND METHODS: Five nebulizers were assessed by analyzing emissions from individual components and from complete system configurations. VOC and SVOC emissions were quantified and short-term exposure (20 minutes) was assessed for infants and children. Estimated exposure levels were compared with toxicological reference values, including inhalation Derived No-Effect Levels (DNELs), to evaluate potential health risks via inhalation and dermal contact.

RESULTS: All tested components emitted VOCs, with the highest concentrations detected in masks and whole-system configurations. Some identified compounds, including toluene, styrene, siloxane D4, and 2-ethylhexanoic acid, are suspected or recognized reproductive toxicants. Although measured levels were very low, inhalation represents a potential exposure route warranting a precautionary approach. Phenol, a suspected mutagen, reached concentrations up to 65.9 $\mu\text{g}/\text{m}^3$, corresponding to 11.7% of the inhalation DNEL for a 20-minute exposure in infants and children. Dermal exposure levels were very low compared with toxicological reference values. Nevertheless, compounds such as benzyl alcohol and 2-ethylhexyl acrylate, both recognized as EU-classified skin sensitizers, were detected. Cyclic siloxanes D5, D6, and D7 were also detected, with D6 showing the highest dermal intake. As these siloxanes are classified as Persistent, Bioaccumulative and Toxic (PBT) in the EU, long-term effects from bioaccumulation and environmental persistence should be considered.

DISCUSSION AND CONCLUSIONS: Although measured VOC and SVOC concentrations were low and below established toxicological thresholds, these findings underscore the need for preventive measures, particularly for sensitive populations such as infants and children. Inhalation appears to be the most relevant exposure pathway during use, while dermal exposure, though minimal, may contribute to sensitization risks. The presence of PBT-classified siloxanes further emphasizes the need to consider long-term human health and environmental implications. Overall, these findings support the implementation of preventive strategies and continued monitoring of material emissions in medical devices intended for vulnerable users.

OBJECTIVE: Nebulizers are medical devices that convert liquid solutions, such as saline or medication, into aerosols for direct airway delivery. Their effectiveness relies on interfaces, typically made from polymeric materials containing additives to enhance functionality and durability. This study aimed to characterize emissions of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) from different components of five nebulizers, considering two exposure routes: inhalation and dermal contact.

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Transcriptomics-Guided Outcome Prediction (T-GOP) for Ecotoxicity Assessment: A Proof-of-Concept Study of PFOS Alternative OBS Disrupting Zebrafish Neurotransmitter Homeostasis and Cognition

Environmental science & technology 2026 Mar 06 · 6 Mar 2026

Transcriptomics provides mechanistic insights into chemical toxicity and serves as a hypothesis-generating tool for prioritizing potential adverse outcomes. Here, we introduced a transcriptomics-guided outcome prediction (T-GOP) framework, a hypothesis-informed approach that uses transcriptomic enrichment to prioritize end points for targeted experimental validation. As a case study, the ecotoxicological effects of the PFOS alternative, sodium p-perfluorooctanesulfonate (OBS), were evaluated. After 28 days of exposure to environmentally relevant OBS concentrations (0.1, 1.0, and 10 µg/L), adult zebrafish accumulated OBS in the brain (363-2364 µg/kg), triggering extensive transcriptional reprogramming with 61, 134, and 1026 differentially expressed genes at the respective exposure levels. Transcriptomic analysis implicated disruption of neurotransmitter pathways, which was confirmed by targeted metabolomics, revealing profound alterations in dopaminergic and serotonergic systems. These neurochemical perturbations coincided with concentration-dependent downregulation of essential neuronal genes (e.g., *bdnf*, *syn2a*, and *elavl3*), increased acetylcholinesterase (AChE) activity, and brain histopathological changes. At the highest concentration, T-maze assays revealed increased memory latency, consistent with cognitive impairment as an apical outcome of the observed upstream perturbations. Benchmark concentration modeling indicated neurotoxic responses with BMC10 values ranging from 0.03 to 8.97 µg/L, with corresponding 95% credible intervals (BMCL10-BMCU10) of 0.01-20.04 µg/L. Overall, this proof-of-concept framework provides evidence for the neurotoxicity of OBS and highlights its potential environmental risk.

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Low-level arsenic species exposure and plasma lncRNA signature in healthy Chinese adults: A profile and functional analysis

Ecotoxicology and environmental safety 2026 Mar 06:313:119978 · 6 Mar 2026

Chronic exposure to arsenic (As) is known to disrupt epigenetic regulation. However, the relationship of arsenic species and methylation capacity with circulating long non-coding RNAs (lncRNAs) remains poorly understood. We investigated the associations of urinary arsenic species and arsenic methylation capacity with 1362 plasma lncRNAs in 160 Chinese adults from the community-dwelling population. Arsenate [As(V)] was inversely associated with five lncRNAs, while the primary methylation index (PMI) was positively related to eight lncRNAs (FDR < 0.15). Tissue specificity analysis using the Genotype-Tissue Expression (GTEx) database revealed enriched expression of

these lncRNAs in As-targeted organs, such as skin and kidney. Notably, plasma levels of lncRNA AATBC were associated with the expression in leukocytes of itself and adjacent genes ($P < 0.05$), suggesting that leukocytes may be its source or target. The identified lncRNAs were primarily involved in oxidative stress, inflammation, and carcinogenesis pathways. Significant association between the identified lncRNAs and lipid damage biomarker 8-iso-prostaglandin F 2α (8-isoPGF 2α) was further confirmed our findings. Overall, these results identified novel genome-wide changes in lncRNAs within plasma and leukocytes, offering new mechanistic insights into the epigenetic regulation underlying the health hazards of chronic low-level arsenic exposure.

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ENVIRONMENTAL RESEARCH

Assessing the Influence of Proximity to Mining Sites on Water Contamination by Pb, Hg, Cd, and As

Bulletin of environmental contamination and toxicology 2026 Mar 07;116(3) · 7 Mar 2026

Water, an essential element for sustaining life, is increasingly threatened by contamination from anthropogenic activities. Mining plays a key role in mobilizing naturally occurring heavy metals from the Earth's crust into surrounding ecosystems. However, few studies have quantitatively assessed how proximity to mines affects heavy metal levels in local drinking water sources. This study evaluated the influence of distance from an active mining site on heavy metal (Pb, Hg, Cd, As) concentrations in drinking water. Sixty samples were collected from three zones located 0-5 km, 5-15 km, and 15-30 km away and analyzed using inductively coupled plasma-optical emission spectrometry (ICP-OES). Significant differences were found among zones for As ($p < 0.001$, $H = 48.490$), Cd ($p < 0.001$, $F = 12.454$), and Hg ($p < 0.001$, $H = 33.173$), while Pb showed no significant variation ($p = 0.181$). Mean As (24.56-1249.89 $\mu\text{g/L}$), Cd (1.83-8.89 $\mu\text{g/L}$), and Hg (1.59-4.75 $\mu\text{g/L}$) levels exceeded WHO/BIS drinking water limits, whereas Pb remained within acceptable ranges ($< 10 \mu\text{g/L}$). The findings suggest that mining activities contribute substantially to heavy metal enrichment in nearby drinking water sources. Regular monitoring and strict control measures are essential to safeguard water quality, particularly in communities located close to mining operations.

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Relationship between microplastics in stool, diet, and inflammatory markers in healthy Japanese individuals

Environmental health and preventive medicine 2026:31:17 · 12 Mar 2026

BACKGROUND: Exposure to microplastics (MPs) can have adverse gastrointestinal effects by inducing inflammation and oxidative stress. The types of MPs in stool vary with the dietary intake. However, how MPs in the intestinal tract influence the inflammatory cytokine levels in the gastrointestinal tract in healthy individuals remains unclear, particularly in Japan, characterized by a high intake of vegetables and seafood. In this study, we investigated the relationship between food intake, stool MPs, and inflammatory markers in healthy Japanese individuals, and estimated the sources of the stool MPs.

METHODS: Twenty-two participants completed a questionnaire on daily food intake for 7 days. Thereafter, stool samples were collected to examine MP density via Fourier-transform infrared spectrophotometry. On day 8, blood samples were collected and analyzed for serum oxidative stress markers and cytokine levels. Next, the effect of total stool MP particle density (Low vs. High) on oxidative stress markers and cytokines levels was analyzed.

RESULTS: The median total MP particle density of the participants (median age: 44 years) was 7.20 MP particles per g of stool. Seafood intake was higher in the High MP group than in the Low MP group, with a Mann-Whitney U test yielding $p = 0.035$ for seafood intake. However, after the false discovery rate (FDR) correction, this effect was not significant. Nevertheless, the effect size for seafood intake was large, suggesting an association with MP level. Relative to the Low MP group, the High MP group showed significantly higher thymic stromal lymphopoietin (TSLP) levels (odds ratio: 13.5; 95% confidence interval: 0.99-183, $p = 0.050$). The analysis further revealed that the seafood consumed by the High MP group contained significant amounts of polyethylene (PE) and polypropylene (PP), MPs commonly used in plastic packaging (PE, $p = 0.028$; PP, $p = 0.053$).

CONCLUSION: This study showed that stool MP particle density is likely associated with seafood intake and the TSLP level, implying that excessive MP intake may adversely affect human health. Therefore, measures to reduce MP exposure are urgently required.

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Health risk assessment of nitrate and fluoride in groundwater across 10 Nigerian states

Environmental geochemistry and health 2026 Mar 08;48(5) · 8 Mar 2026

Nitrate and Fluoride are both useful and deadly at varying concentrations, hence the need for continuous monitoring. The cancer risk associated with nitrate is yet to be investigated in Nigerian waters. This study assessed the human health risks associated with groundwater usage by adults, teenagers, children, and infants across Lagos, Ogun, Oyo, Osun, Ekiti, Ondo, Imo, Ebonyi, Delta, and the Federal Capital Territory through oral and dermal exposures. A total of 623 groundwater samples (537 hand-dug wells and 86 boreholes) were analyzed for nitrate and fluoride using standard procedures. Fluoride concentrations ranged from 1.25 ± 0.07 to 8.47 ± 3.19 mg/L, with most samples exceeding national and international water quality guidelines of 1.5 mg/L. Nitrate levels were generally within safe limits (2.50 ± 0.14 - 13.37 ± 0.48 mg/L), except in Delta communities (Kurutie, Kunukunuma, Okerenkoko), where values exceeded 50 mg/L, suggesting contamination from anthropogenic activities. Risk assessment showed oral ingestion as the primary exposure pathway while dermal risk was negligible. The Hazard Quotient for fluoride via ingestion ($HQ > 1$) indicated significant non-cancer risks for all age groups (0.846-8.997) while for nitrate it was negligible in all communities except for Kurutie (1.827-2.690), Kunukunuma (1.645-2.423), and Okerenkoko (1.639-2.413). The Mean Cancer Risk (MCR) values for nitrate exceeded the USEPA threshold (1×10^{-6}) across all age groups, with Delta State hotspots reaching 10⁻³. Findings demonstrate that groundwater in the region poses both non-cancer and cancer risks, underscoring the urgent need for intervention strategies such as defluoridation, denitrification, and safe alternative provision.

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Inhibition of PADI2-mediated vimentin citrullination alleviates silica-induced pulmonary fibrosis in mice

Particle and fibre toxicology 2026 Mar 08 · 8 Mar 2026

Silicosis remains a critical occupational health concern worldwide, lacking effective treatments due to unclear mechanisms. In this study, we investigated the citrullinated proteomic profile and its effects in mice exposed to silica. Our findings demonstrated elevated levels of citrullinated peptides and citrullinated vimentin (Cit-Vim) in silicotic mice and silica-treated macrophages, regulated by peptidylarginine deiminase (PADI2). Unlike vimentin, Cit-Vim amplified the production of tumor necrosis factor- α (TNF- α), Interleukin-6 (IL-6), and IL-1 β in silica-treated macrophages through interaction with Toll-like receptor 4 (TLR4) signaling. RNA sequencing revealed that early growth response protein 1 (EGR1) is a target of PADI2, with Cit-Vim inducing lung inflammation via EGR1 signaling. Pharmacological inhibition or genetic knockout of Padi2 attenuated silica-induced lung inflammation and fibrosis. These findings suggest that targeting PADI2 may represent a novel therapeutic strategy of silicosis.

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Multistress in a changing world: Impacts of pollutant mixture and temperature on stress response, endocrine system, and detoxification mechanisms in the freshwater gastropod *Physa acuta* (Draparnaud, 1805)

Ecotoxicology and environmental safety 2026 Mar 05:312:119977 · 5 Mar 2026

Aquatic ecosystems are vulnerable to climate change and pollution, with individual pollutants and combinations of anthropogenic compounds having a significant impact on them. Mixtures lead to complex interactions with additional stress from climate change, exacerbating temperature increases. Traditional toxicity approaches may not effectively capture the impacts and interactions of these factors, which can put the aquatic invertebrate populations at risk. Therefore, to closely mimic environmental conditions, adults of the freshwater gastropod *Physa acuta* were exposed to mixtures of three well-known pollutants: Bisphenol A (BPA), Endosulfan (End), and Cadmium (Cd), mimicking the IPCC warming scenario 3 (middle of the road: 2.7°C by 2100) at 18°C and 20.5°C. Samples were collected for gene expression analysis by retrotranscription and Real-Time PCR at 1, 7, and 21 days. Three relevant biological processes - stress response, endocrine regulation, and detoxification mechanisms - were evaluated by analyzing the transcriptional activity of ten genes. Modulation of mRNA levels showed a significant influence of temperature on gene activity, with more pronounced acclimation responses at 18°C compared to 20.5°C. Exposure to Cd and End had the most significant impact, while BPA only showed effects in combination with the two other chemicals. This study shows that mixtures elicit complex and unpredictable responses at varying temperatures. Our findings underscore the importance of studying compound mixtures at different temperatures and highlight the need for standardized molecular toxicity assessments in complex environmental scenarios affected by global change. The information gathered will also benefit other species, helping identify biomarkers that are helpful in ecotoxicological analysis.

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