CHEMWATCH

TECHNICAL

Week of 15 May 2026

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OCCUPATIONAL

Advancing PFAS Biomonitoring in Hair: Rapid Analytical Method and Global Comparison of US Exposure

Drug testing and analysis 2026 May 10 · 10 May 2026

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are synthetic chemicals used in a wide range of consumer and industrial products. Their chemical stability and resistance to degradation lead to environmental persistence, raising concerns about human exposure and health risks. Although PFAS have been extensively monitored in ecological and traditional biological matrices, limited research has studied their presence in human hair. This study aimed to evaluate PFAS exposure in a New York population and contribute to the growing evidence supporting hair as a viable matrix for PFAS biomonitoring. A quantitative LC-MS/MS method for PFOA, PFNA, and PFHpA in human hair was validated according to ANSI/ASB Standard 036 guidelines, demonstrating linearity across a calibration range of 0.3-25 pg/mg. Real-case hair samples (n = 26), collected from individuals living in New York, were analyzed using LC-MS/MS. PFHpA was detected in 100% of the samples, with a median concentration of 14.11 pg/mg. In contrast, PFOA and PFNA were detected in 30.8% and 7.7% of samples, respectively, with median concentrations of 0.15 pg/mg for both compounds. The New York cohort had a unique PFAS profile, with lower PFOA and PFNA detection than some Asian cohorts but higher PFHpA levels than European and Asian studies. These findings highlight ongoing human exposure to legacy and emerging PFAS, demonstrating the utility of hair as a tool for monitoring chemical exposure trends. This research underscores the importance of ongoing PFAS surveillance to inform environmental health initiatives, guide regulatory efforts, and protect populations at potential elevated risk due to occupation, geography, or socioeconomic factors.

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Modeling external exposure to pesticides in human populations: Developing an exposure scenario generator

Ecotoxicology and environmental safety 2026 May 08:318:120201 · 8 May 2026

Pesticides are a significant public health concern due to their widespread use. However, estimating population exposures remains challenging, given the need to integrate multiple exposure routes and scenarios. We developed the Pesticide Exposure Scenario Simulator (PESS) to estimate pesticide exposure across diverse population groups, including agricultural workers, residents living near treated fields, and individuals exposed through diet. PESS integrates three exposure modules (i.e., occupational, environmental, and dietary) to generate comprehensive distribution estimates. We applied PESS to assess exposure to three pesticides: endosulfan, mancozeb, and glyphosate,

representing different authorization statuses, and compared the results against urinary biomonitoring data and literature sources. Occupational exposure estimates were significantly higher under low protection scenarios, ranging from 1000 to 100,000 µg/kg body weight/hour, with median values between 3000 and 10,000 µg/kg body weight/hour. High protection measures reduced exposure by approximately three orders of magnitude, yielding median values around 10 µg/kg body weight/hour. Environmental exposure estimates near treated fields (10 m) ranged from 1E-14-0.01 µg/kg body weight/hour, decreasing to 1E-14-1E-05 at 250 m, with median values between 1E-08 and 1E-07. Dietary exposure estimates for adults ranged from 1E-06-0.1 µg/kg body weight/day, with median values between 1E-04 and 0.0005. Exposure across routes was harmonized using a daily-event framework, where short-duration occupational and environmental exposures (1 h) were treated as single daily events due to rapid pesticide dissipation in the atmosphere, and thus considered equivalent to daily exposure. Dietary exposure was inherently expressed on a daily basis, ensuring consistency while preserving the event-based nature of non-dietary exposures. Protective equipment and application rates were key determinants of occupational exposure, while environmental exposures were primarily influenced by meteorological conditions, particularly wind speed. Dietary exposures showed lower variability in exposure values in comparison with other modules, reflecting differences in pesticide residues across food categories and age groups. These determinants are essential for accurate exposure assessments and highlight the need for integrated tools like PESS.

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CHEMICAL EFFECTS

Potential role of miR-128-1 modulating antioxidant NRF2 pathway in linking acrylamide exposure with type 2 diabetes risk: Insight from epidemiological and toxicological evidence

Ecotoxicology and environmental safety 2026 May 09:318:120234 · 9 May 2026

Role of miR-128-1, an emerging therapeutic target of type 2 diabetes (T2D) and a targeted posttranscriptional suppressor of the antioxidant master nuclear factor erythroid 2-related factor 2 (NRF2), in linking acrylamide (ACR), a worldwide-concerning and lifelong-exposed pollutant, with T2D is unclear and warrants urgent elucidation. Epidemiologically, 482 Chinese adults from Wuhan-Zhuhai cohort were incorporated to evaluate the relationships among urinary ACR exposure biomarkers (N-acetyl-S-[2-carbamoylethyl]-L-cysteine [AAMA], N-acetyl-S-[2-carbamoyl-2-hydroxyethyl]-L-cysteine [GAMA], AAMA+GAMA [ΣUAAM], and GAMA/AAMA), plasma miR-128-1, and prevalent T2D by generalized-linear-models and the mediation role of miR-128-1 in ACR-T2D relationships by mediation analyses. Toxicologically, INS-1 cells were treated with ACR and miR-128-1 mimic/inhibitor for 24 h to explore the mechanism of miR-128-1 modulating antioxidant NRF2 pathway in ACR-related oxidative damage of β-cell function characterized by glucose-stimulated insulin secretion (GSIS). We uncovered linear positive relationships of ACR exposure biomarkers with miR-128-1 (β-coefficients: 0.63-1.45; $P < 0.05$) and T2D (odds ratio: 1.42-4.60; $P < 0.05$) and miR-128-1 with T2D (odds ratio: 1.34; $P < 0.05$) with elevated miR-128-1 mediated 18.39-24.54% of the ACR-T2D relationships. INS-1 cells treated with ACR showed NRF2 pathway activation and dose-dependent reduction in GSIS while elevations in miR-128-1 and oxidative stress (reactive oxygen species and malondialdehyde) levels. Compared to INS-1 cells treated with ACR+negative control, those treated with ACR+miR-128-1 mimic/inhibitor exhibited reduced/elevated

mRNA and protein levels of NRF2 and downstream antioxidant factors, increased/decreased oxidative stress levels, and reduced/elevated GSIS. Overall, miR-128-1 might play a potential mechanism role in linking ACR exposure and T2D risk, possibly involving targeted suppression of antioxidant NRF2 pathway and oxidative impairment of β-cell function.

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Prenatal phthalate mixture exposure increases early childhood internalising problems via maternal oxidative stress

Environment international 2026 Apr 06:212:110237 · 6 Apr 2026

Prenatal phthalate exposure has been linked to internalising problems in children. Maternal oxidative stress is a plausible biological mechanism underlying this association as it is induced by phthalates and is associated with early internalising problems, but this pathway has not yet been empirically tested. In the Barwon Infant Study, a population-based birth cohort of 1,074 Australian children, we investigated the potential mixture effect of prenatal phthalate exposure on maternal oxidative stress and assessed whether oxidative stress mediates the relationship between the prenatal phthalate mixture and early internalising problems. Concentrations of phthalate metabolites and nucleic acid oxidation biomarkers (8-hydroxy-2'-deoxyguanosine and 8-hydroxyguanosine) were measured in third-trimester maternal urine, and phthalate daily intakes estimated. Internalising problems were assessed at ages 2 and 4 years using the parent-report Child Behavior Checklist and Strengths and Difficulties Questionnaire, respectively. Applying weighted quantile sum regression with repeated holdout validation, we found that higher phthalate mixture exposure was associated with increased maternal oxidative stress (0.22 standard deviations per interquartile range increase in mixture, 95% CI: 0.13, 0.31), with dimethyl phthalate and diethyl phthalate as the top contributors. Bayesian kernel machine regression yielded comparable results. For all child outcomes, counterfactual mediation analyses across holdout datasets revealed evidence of mediating effects, suggesting that oxidative stress is a pathway through which prenatal phthalate mixture exposure increases early-childhood internalising problems. These findings highlight the heightened risk associated with co-exposure to multiple phthalates during pregnancy and the potential to mitigate this harm not only through improved chemical regulation but also by monitoring and reducing maternal oxidative stress.

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Prenatal paraben exposure and pregnancy complications: The moderating role of psychological anxiety

Ecotoxicology and environmental safety 2026 May 09:318:120223 · 9 May 2026

METHODS: We conducted a prospective cohort study including 934 mother-infant pairs recruited from a tertiary hospital in Ningxia, China. Maternal serum concentrations of five PBs, such as methylparaben (MeP), ethylparaben (EtP), propylparaben (PrP), butylparaben (BuP), and hexylparaben (HeP), were quantified using high-performance liquid chromatography-tandem mass spectrometry. Pregnancy-related anxiety was assessed with the Pregnancy-related Anxiety Questionnaire. Pregnancy complications were defined as gestational anemia, hypertensive disorders of pregnancy (HDP), and gestational diabetes mellitus (GDM). Binary logistic regression and quantile g-computation were applied to estimate the individual and mixture effects of PBs exposure.

Stratified analyses and interaction terms were used to evaluate effect modification by pregnancy-related anxiety.

RESULTS: Higher maternal serum concentrations of EtP (OR = 1.14, 95% CI: 1.05-1.25), PrP (OR = 1.12, 95% CI: 1.01-1.24), and BuP (OR = 1.22, 95% CI: 1.03-1.44) were significantly associated with an increased risk of overall pregnancy complications. EtP (OR = 1.13, 95% CI: 1.01-1.28) and BuP (OR = 1.28, 95% CI: 1.01-1.62) were positively associated with HDP. In addition, MeP (OR = 1.32, 95% CI: 1.08-1.60), EtP (OR = 1.24, 95% CI: 1.08-1.42), and PrP (OR = 1.39, 95% CI: 1.16-1.66) were significantly associated with GDM. Quantile g-computation further indicated that mixed PBs exposure was positively associated with GDM, with varying contributions across individual congeners. A significant interaction was observed between pregnancy-related anxiety and EtP exposure. Among women reporting pregnancy-related anxiety, BuP remained significantly associated with pregnancy complications. Moreover, mixture exposure was associated with an elevated risk of gestational anemia (95% CI: 1.06-6.87), and both EtP (95% CI: 1.12-2.22) and BuP (95% CI: 1.08-3.43) showed significant positive associations with gestational anemia. Sensitivity analyses supported the robustness of these findings.

CONCLUSION: Prenatal exposure to EtP and BuP was positively associated with gestational anemia, particularly among pregnant women experiencing pregnancy-related anxiety. These findings highlight the importance of considering psychological factors when evaluating the health impacts of endocrine-disrupting chemical mixtures during pregnancy.

OBJECTIVE: This study aimed to investigate the individual and combined effects of prenatal parabens (PBs) exposure on pregnancy complications and to determine whether pregnancy-related anxiety modifies these associations.

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ENVIRONMENTAL RESEARCH

Lead and cadmium contamination in soils: impacts and phytoremediation strategies using ornamental plants, nanoparticles, and organic growth regulators

Environmental monitoring and assessment 2026 May 09;198(6) · 9 May 2026

The contamination of agricultural land with toxic chemicals, such as lead (Pb) and cadmium (Cd), has become a major global concern, negatively affecting the ecosystem, public health, and food safety. This review highlights the sources of Pb and Cd into the environment, current knowledge of the severity of Pb and Cd contamination in soil and vegetables, documents their phytotoxicity and human toxicity, and then assesses effective remediation strategies that include phytoremediation, foliar application of nanoparticles, and organic growth hormones. The current study found that the toxicity of Pb and Cd in soils and vegetables from different countries exceeded the WHO permissible limit. For the phytoremediation process, ornamental plants are selected due to their genetic and phenotypic characteristics, as well as their widespread use. Since the sisal plant (Agave sisalana) is a rapidly growing plant that produces a high quantity of biomass, its products never compete with the food chain. Hence, these characteristics make it a suitable choice for phytoremediation of Pb- and Cd-contaminated soil. Furthermore, the fiber derived from sisal's leaves has the capacity to sequester these toxic metals straight from the contaminated soil. Nanoremediation involves the foliar application of zinc oxide nanoparticles, and moringa leaf extract has been proposed to reduce the uptake of Pb and Cd in plants. However, more research is needed to understand better how the

individual and combined effects of these remediation techniques effectively treat Pb- and Cd-contaminated and co-contaminated soil.

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Prenatal exposure to metal mixtures and mitochondrial DNA content and telomere length in newborns: potential modulation by TERT gene variants

Environmental pollution (Barking, Essex : 1987) 2026 May 06:400:128283 · 6 May 2026

Prenatal exposure to environmental contaminants, including potentially toxic metals (PTMs), is a constant public health concern. The telomere length (TL) and mitochondrial DNA (mtDNA) content are sensitive biomarkers of biological aging and mitochondrial function that could be altered by exposure to pollutants. The Mexico City Metropolitan Area (MCMA) is characterized by being a densely populated and polluted urban region. This study aimed to evaluate the association between prenatal exposure to mixtures of PTMs and essential elements with mtDNA content and TL in newborns from the MCMA, and to explore the influence of genetic variants rs2736100 and rs2736098 on TL. For quantifying prenatal exposure to 24 elements in 160 umbilical cord blood samples, we used ICP-MS, TL and mtDNA content were determined by qPCR, and variant genotyping was performed using TaqMan probes. Associations were estimated using linear regression and two-index Weighted Quantile Sum (WQS) regression, a method that estimates the effects of chemical mixtures on a health outcome in the same model through the inclusion of two indices (evaluating both positive and negative directions simultaneously). Concentrations of several essential and toxic elements were associated with both TL and mtDNA content. The direction and magnitude of these effects varied according to the predominant metals in each WQS-identified mixture. The most influential metals were arsenic, antimony, titanium, manganese, and zinc. Finally, under an allelic model, the TERT variants showed a suggestive modulatory effect on TL lengthening. In summary, our findings suggest that prenatal exposure to metal mixtures may influence molecular aging markers at birth, potentially increasing disease susceptibility later in life.

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Chemical pollution alters detoxification capacity and behavior in the native freshwater fish Galaxias maculatus under in situ exposure

Environmental pollution (Barking, Essex : 1987) 2026 May 07:401:128300 · 7 May 2026

Understanding how chemical pollution translates into biological effects under environmentally realistic conditions remains a central challenge for freshwater ecotoxicology. The aim of this study was to evaluate whether an integrated in situ approach combining exposure and behavioral biomarkers, with chemical indicators can detect sublethal impairment associated with chemical pollution in river ecosystems. We performed a 72-h in situ caging experiment using the native fish Galaxias maculatus in Cruces River (Chile), comparing a reference site with a site impacted by urban, agricultural, and industrial discharges. Neurotoxicity and detoxification responses were assessed though brain acetylcholinesterase (AChE) activity and hepatic ethoxyresorufin-O-deethylase (EROD) activity, respectively, while behavior (activity, social proximity, immobility) was quantified through video tracking. To characterize chemical exposure, the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) was quantified in sediments and fish tissues. Fish from the impacted site exhibited marked AChE inhibition (≥60%) and a five-fold induction of EROD activity

relative to reference fish. Tissue analyses revealed a two-fold higher accumulation of 2,4-D at the impacted site, despite comparable sediment concentrations, indicating increased internal exposure. These biochemical responses were accompanied by reduced activity, decreased social proximity, and increased immobility. Cluster analysis revealed a shift toward hypoactive and isolated behavioral phenotypes at the impacted site. By integrating targeted chemical analyses with multi-level biological endpoints in a native sentinel species, this study highlights the value of in situ approaches for supporting the interpretation that pollutant exposure is associated with functional impairment and supports their application in freshwater pollution monitoring and risk assessment frameworks.

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PHARMACEUTICAL/TOXICOLOGY

BaP and 17Î²-estradiol affect retromer-VPS35, restricting pro-survival transcription and exacerbating neurotoxicity in a reclaimed water environment

Aquatic toxicology (Amsterdam, Netherlands) 2026 May 05:296:107847 · 5 May 2026

Under the reclaimed water system, Endocrine-disrupting chemicals and persistent organic pollutants often co-occur in realistic mixed-pollution environments and may jointly enhance neurotoxicity. In this study, we investigated the combined effects of 17β-estradiol (E2) and benzo[a]pyrene (BaP) by integrating seasonal monitoring of secondary wastewater effluent with mechanistic assays in NGF-differentiated PC12 cells. Pollutant levels in the effluent were highest during the dry season, supporting the construction of a co-exposure scenario relevant to industrially impacted reclaimed-water systems. Compared with single exposure, combined exposure to BaP and E2 resulted in markedly greater oxidative stress and reduced cell viability, with ROS levels increasing to approximately 2.9-fold of the control level and cell viability declining to about 61 %. These data indicate a synergistic neurotoxic effect and suggest that, although upstream survival-related signaling pathways were activated in response to stress, this activation was insufficient to elicit effective downstream neuroprotective transcription. Molecular docking further indicated that both pollutants could stably interact with VPS35, a core component of the retromer complex, suggesting impaired endosome-to-Golgi retrieval and enhanced cargo misdirection toward lysosomal degradation. Collectively, these findings identify retromer-VPS35 dysfunction as a potential mechanistic link between BaP/E2 co-exposure and synergistic neurotoxicity, and emphasized the importance of considering intracellular transport interference in the mixed risk assessment of pollutants derived from reclaimed water.

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Heavy metals in horses: A review of the toxicity, clinical consequences and expected safe tissue concentrations

Environmental toxicology and pharmacology 2026 May 07:124:105038 · 7 May 2026

Trace elements arsenic, cadmium, lead, chromium, mercury, nickel, and zinc are high-density, naturally occurring metals notable for their toxicity and environmental persistence. Cadmium and mercury are particularly concerning due to their capacity for bioaccumulation and biomagnification within the food chain. Dispersed through both anthropogenic and natural sources, these elements pose significant threats to ecosystems and animal health. In equines, they induce oxidative stress by

disrupting mitochondrial function, generating reactive oxygen species, and inhibiting antioxidant enzymes, leading to cellular damage and organ dysfunction. Clinical presentations including gastrointestinal, neurological, renal, and musculoskeletal disorders vary by element, dose, and exposure duration. This review compiles information on the origins, pathogenesis, clinical signs, and therapeutics for poisoning by these seven elements in horses. Additionally, literature-derived baseline levels in blood, serum, hair, liver, and kidneys are synthesized to propose preliminary species-specific reference values, supporting environmental monitoring, clinical diagnosis, and equine product safety.

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