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CHEMICAL EFFECTS

Developmental toxicity and cytotoxic/genotoxic potential of PM10 rural extracts using Xenopus laevis embryos and A549 lung epithelial cells

2026-01-29

Airborne particulate matter is increasingly recognized as a hazard for developmental health. While epidemiological studies associate PM_{10} prenatal exposure and adverse outcomes (including low birth weight and preterm birth), experimental evidence clarifying biological plausibility remains limited, especially for complex PM mixtures collected in non-urban settings. Air-quality-related developmental risks in rural areas interested by PM pollutions are underestimated. In this context, our study aimed to assess the developmental toxicity of PM_{10} extracts collected at a rural Po Valley site, using a sensitive vertebrate embryo model. We exposed Xenopus laevis embryos to extracts of daytime and nighttime PM_{10} collected over two weeks (March 2022) and evaluated lethality, teratogenicity and developmental progression with the Refined Frog Embryo Teratogenesis Assay-Xenopus (R-FETAX). In parallel, PM_{10} filters were chemically characterized (mass, major ions, carbon fractions, and multiple elements), allowing us to model links between developmental outcomes and specific PM components. To provide a conventional toxicological benchmark, extracts were also tested in A549 human lung epithelial cells for cytotoxicity and genotoxicity. Our results show that, despite the absence of lethality or gross malformations, some PM_{10} extracts induced statistically significant developmental delays. Modelling revealed correlations between delays and PM_{10} mass as well as several measured analytes, with Zn and Cu displaying the clearest dose-dependent associations. Embryonic development detected subtle effects of low-level PM_{10} exposure that were not captured by standard cytotoxicity/genotoxicity endpoints in A549 cells under the tested conditions. Collectively, these findings support the utility of a developmental model for mixture-based particulate toxicology evaluation.

Authors: Gloria Melzi, Maria Battistoni, Renato Bacchetta, Beatrice Biffi, Cristina Colombi, Emanuela Corsini, Francesca Di Renzo, Marina Marinovich, Francesca Metruccio, Elena Menegola, Sofia Pantaleoni, Sara Valentini, Gianluigi Valli, Roberta Vecchi

Full Source: Reproductive toxicology (Elmsford, N.Y.) 2026 Jan 29:140:109178. doi: 10.1016/j.reprotox.2026.109178.

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Seasonally different toxicity drivers in a river system revealed by insights from POCIS, bioassays, and suspect screening

2026-01-27

To determine whether hydrological extremes alter the toxicological modes of action of riverine contaminant mixtures, an integrated framework combining passive sampler, in-vivo and in-vitro bioassays, and high-resolution mass spectrometry-based suspect screening was applied. POCIS were deployed in the Nakdong River of South Korea under contrasting monsoon-driven summer runoff and winter low-flow conditions. Seasonal mixtures differed not only in composition but also in biological mechanisms: summer extracts induced acute toxicity and activation of receptor-mediated endpoints (AR, ER, PPARγ, PXR), whereas winter extracts showed minimal acute toxicity but strong oxidative stress response (Nrf2), consistent with effluent-dominated chronic exposure. Across polarity-based fractions, the polar fraction (F4) accounted for the majority of observed bioactivities. Suspect screening identified 111 chemicals with a clear seasonal differentiation, with pesticides and UV filters prevailing in summer and pharmaceuticals in winter. To address the identification gap in effect-directed analysis, a quantitative potency-balance approach integrating bioanalytical equivalents (BEQbio) and chemically predicted equivalents (BEQchem) identified telmisartan as a major contributor to PPARγ activity. These findings demonstrate that hydrological regime shifts can drive mechanistic changes in mixture toxicity and highlight the value of potency-based EDA for linking biological effects to causative chemicals.

Authors: Hyungjoon Im, Yegyun Choi, Kimberly Etombi Muambo, Yunho Lee, Jeong-Eun Oh

Full Source: Water research 2026 Jan 27:293:125453. doi: 10.1016/j.watres.2026.125453.

Unraveling structure-Toxicity relationships of PFAS: Insights from quantum chemical descriptors and QSAR models

2026-01-29

Assessing the ecotoxicity of per- and polyfluoroalkyl substances (PFAS) is essential for understanding their environmental behavior and potential risks. However, systematic evaluations linking PFAS toxicity to molecular-level characteristics remain limited. Here, quantitative structure-activity relationship (QSAR) models were developed to elucidate the relationships between acute and chronic toxicity thresholds for fish, Daphnid, and green algae across 26 PFAS and their quantum chemical descriptors. The

ECOSAR-based results demonstrated that both acute and chronic toxicity toward the three aquatic species increased with the number of -CF2- moieties, indicating a structure-dependent toxicity trend. The developed QSAR models exhibited excellent stability, robustness, and predictive performance (R2 > 0.9, q2 > 0.9, and Qext2 > 0.9). Moreover, the number of -CF2- moieties and the Fukui index with respect to electrophilic attack [f(-)] were identified as intrinsic factors governing PFAS toxicity. Overall, this work provides molecular-level insight into the structural determinants of PFAS toxicity and establishes a reliable theoretical framework for predicting the toxicological behavior of emerging PFAS.
Authors: Zhiwen Cheng, Jie Zhou, Xin Peng, Dingming Xue, Zhemin Shen, Qincheng Chen, Xiaojun Hu
Full Source: Environmental research 2026 Jan 29:294:123911. doi: 10.1016/j.envres.2026.123911.

ENVIRONMENTAL RESEARCH

Size-resolved and seasonal assessment of the undersized fraction of municipal solid waste: Resource potential and environmental risks

2026-01-30
The undersized fraction of municipal solid waste (UFMSW), typically <100 mm and produced during mechanical-biological treatment (MBT), remains an underutilised stream despite its considerable volume and resource potential. This study presents a seasonally and granulometrically resolved characterisation of stabilised UFMSW from a Hungarian MBT facility. Coarse fractions (20-60 mm), representing the largest mass share (36-45 w/w%), were rich in plastics and paper and exhibited high heating values (up to 22.7 MJ/kg), indicating strong suitability for mechanical, construction-related and chemical valorisation. In contrast, fine fractions (<10 mm), constituting 21-38 w/w% of the bulk, showed substantial accumulation of toxic metals (e.g., Cd 6.01 mg/kg, Pb 423 mg/kg), frequently exceeding regulatory thresholds and posing environmental risks that limit their potential for biological utilisation or material recovery. Thermal analysis confirmed size-dependent decomposition behaviour, with finer particles igniting earlier and coarser fractions displaying diffusion-limited combustion. Hazardous materials (3-12 w/w%) were detected across all size classes, underscoring deficiencies in upstream selective collection. Overall, the findings highlight a clear size-dependent distinction between highly contaminated fines and resource-rich coarse fractions. Effective granulometric separation is therefore essential to enable safe and efficient UFMSW valorisation within circular economy strategies.
Authors: Róbert Kurdi, Eliza Molnár, Kinga M Berta, Csilla Őze, Csaba Leitol, Janka Bobek-Nagy
Full Source: Journal of environmental management 2026 Jan 30:400:128749. doi: 10.1016/j.jenvman.2026.128749.

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PHARMACEUTICAL/TOXICOLOGY

Spatial transcriptomic profiling uncovers the molecular effects of the neurotoxicant polychlorinated biphenyls (PCBs) in the brains of adult mice

2026-01-31
Polychlorinated biphenyls (PCBs) are highly stable synthetic organic compounds that are present in air, water, and soil. PCBs have been identified in post-mortem human brains, indicating a possible link between environmental factors and disease risk. Research has revealed an association between PCB exposure and cognitive decline. Therefore, it is crucial to evaluate how PCB mixtures relevant to humans affect brain function and cognition. To investigate the effects of PCBs on memory and transcriptomic profiles, we exposed male C57BL/6 J mice orally to a synthetic PCB mixture daily. After seven weeks of exposure, the adult mice were assessed in a spatial object recognition task (SOR) to evaluate long-term spatial memory. Our findings showed that mice exposed to PCBs exhibited deficits in long-term spatial memory. To examine the molecular effects of PCB on the brain, we used a spatial transcriptomics technique to analyze gene expression changes in five brain regions: the hippocampus, neocortex, thalamus, caudal putamen, and fiber tracts. Our analysis of spatial gene expression revealed the molecular signatures influenced by PCB in these susceptible brain regions of mice. Network analysis suggests that these changes are associated with higher chlorinated PCBs present in the brain. Additionally, we show that PCB exposure disrupts the expression of tight junction proteins, which are crucial for maintaining the integrity of the blood-brain barrier (BBB). Thus, our results offer mechanistic insights into how PCB exposure affects brain function and cognition.
Authors: Budhaditya Basu, Nicole M Breese, Sal Lombardi, Hui Wang, Xueshu Li, Destiny Tiburcio, Zachary Niemasz, Stacy E Beyer, Laura E

Dean, Rachel F Marek, Michal Toborek, Hans-Joachim Lehmler, Snehajyoti Chatterjee
Full Source: Molecular psychiatry 2026 Jan 31. doi: 10.1038/s41380-026-03466-x.

A novel metabolic gene signature induced by Di-(2-ethylhexyl) phthalate and Mono-(2-ethylhexyl) phthalate exposure predicts prognosis in breast cancer: An integrative bioinformatics and experimental study

2026-01-29
Di-(2-ethylhexyl) phthalate (DEHP) and its metabolite mono-(2-ethylhexyl) phthalate (MEHP) are endocrine-disrupting chemicals linked to breast cancer progression, yet the underlying prognostic mechanisms are poorly elucidated. This study employed a bioinformatics approach, integrating computational target prediction, protein-protein interaction (PPI) network analysis, and transcriptomic data from The Cancer Genome Atlas (TCGA), to identify prognostic genes modulated by DEHP/MEHP. Through Cox and LASSO regression, we identified a novel gene signature primarily involved in lipid metabolism (PPARD, CPT1A, LPCAT1, AGPAT1,PLIN5) and mitochondrial complex I (NDUFAB1, NDUFV1, NDUFAF4, MT-ND1), which was associated with patient survival. Molecular docking and dynamics simulations were performed to assess the binding affinity between DEHP/MEHP and core targets, confirming stable, high-affinity interactions. In vitro experiments further showed that DEHP and MEHP promote the proliferation and migration of breast cancer cells (MCF-7 and MDA-MB-231), enhance lipid accumulation and mitochondrial function, and validate the altered expression of these prognostic genes at the transcriptional level, with MEHP exerting more pronounced effects. In conclusion, this study suggests that DEHP and MEHP may activate metabolic reprogramming in breast cancer, thereby contributing to disease progression and poorer prognosis, highlighting these genes as potential prognostic biomarkers and therapeutic targets.
Authors: Yuxing Liao, Huiqiong Liang, Hongmei Huang, Shuangyan Su, Zilin Li, Lijin Huang, Ziyan Yang, Cuixiang Zhang, Han Wang, Guihua Wang, Guiyuan Chen, Xueying Li
Full Source: Ecotoxicology and environmental safety 2026 Jan 29:310:119814. doi: 10.1016/j.ecoenv.2026.119814.

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OCCUPATIONAL

The Impact of Military Occupational Combustion Smoke Inhalation on Neuroinflammation and Brain Health

2026-01-28
Airborne combustion emissions from military burn pits, wildfires, and urban/industrial sources are increasingly recognized as a component of the neurotoxic exposome, with potential consequences extending beyond cardiopulmonary disease to brain health. These aerosols comprise heterogeneous mixtures of fine and ultrafine particulate matter ($PM_{2.5}$/$PM_{0.1}$), polycyclic aromatic hydrocarbons, volatile organic compounds, metals, and reactive gases whose composition varies with fuel type, combustion efficiency, and atmospheric aging. Evidence from experimental models, epidemiology, and exposed human cohorts supports two principal routes by which inhaled pollutants may influence the central nervous system: (i) the lung-brain axis, where pulmonary oxidative injury and systemic immune activation promote endothelial dysfunction and compromise blood-brain barrier integrity; and (ii) the olfactory (nose-to-brain) pathway, in which ultrafine and lipophilic constituents interact with the olfactory neuroepithelium and are associated with early neuroimmune changes in olfactory-connected brain regions. At the cellular level, these exposures converge on microglial and astrocytic activation, TLR-NF-κB and inflammasome signaling, mitochondrial dysfunction, and lipid peroxidation, processes that can sustain chronic neuroinflammation and plausibly interact with 'second hits' such as traumatic brain injury, psychological stress, heat stress, sleep disruption, and cardiometabolic comorbidity. Veterans and wildland firefighters represent sentinel occupational groups for defining exposure-biomarker-outcome relationships. This review brings together current evidence linking combustion-derived aerosols to neuroinflammatory and neurodegeneration-relevant mechanisms, highlighting source-specific considerations for military operational exposure, and outlines translational strategies for exposure monitoring, multi-omic biomarker discovery (blood and nasal/olfactory sampling), and early risk stratification to enable targeted prevention in vulnerable populations.
Authors: Anthony R White
Full Source: Neurotoxicology 2026 Jan 28:103394. doi: 10.1016/j.neuro.2026.103394.

Exposure to hexavalent chromium and 1800 MHz electromagnetic radiation can synergistically induce intracellular DNA damage in mouse embryonic fibroblasts

2026-01-28

Radiofrequency electromagnetic fields (RF-EMF) are widely present in the modern environment and have been classified by the International Agency for Research on Cancer as possibly carcinogenic to humans (Group 2B). However, their potential role as co-carcinogens remains unclear. The present study aimed to evaluate whether 1800 MHz RF-EMF exposure can modulate chemically induced DNA damage. Mouse embryonic fibroblasts (MEF) were exposed to RF-EMF alone or in combination with hydrogen peroxide (H2O2), 4-nitroquinoline-1-oxide (4NQO), cadmium (Cd2+), or hexavalent chromium [Cr(VI)]. RF-EMF exposure was performed using a waveguide system under standardized, non-thermal conditions, and DNA damage was assessed using the alkaline comet assay. RF-EMF exposure alone did not induce detectable DNA damage, nor did it significantly enhance DNA damage caused by H2O2, 4NQO, or Cd2+. In contrast, co-exposure to RF-EMF and Cr(VI) resulted in a significant synergistic increase in DNA damage in MEF cells. These findings suggest that RF-EMF may selectively exacerbate Cr(VI)-induced genotoxicity, highlighting the need for further investigation into the underlying co-toxic mechanisms.

Authors: Ying Zhu, Longtao Zhu, Yue Lan, Chuan Sun, Guangdi Chen

Full Source: Biochemical and biophysical research communications 2026 Jan 28:804:153360. doi: 10.1016/j.bbrc.2026.153360.

Associations of prenatal exposure to organophosphate, pyrethroid, and neonicotinoid insecticides with maternal and infant urinary reproductive hormones

2026-01-26

Organophosphate (OPPs), pyrethroids (PYR), and neonicotinoid (NNIs) insecticides are widely used chemicals that may disrupt endocrine function. However, the effects of prenatal co-exposure on maternal and infant reproductive hormones remain unclear. In a prospective cohort of 846 mother-infant pairs, we measured five OPPs metabolites (mOPPs), three PYRs metabolites (mPYRs), and ten NNIs and their metabolites (mNNIs) in maternal urine; eight steroid reproductive hormones in maternal and infant urine; and two gonadotropins in infant urine. Individual insecticides were associated with increased maternal hormones, with the greatest increase in 17α-OH-progesterone (67.29 %; 95 % CI: 56.03 %, 79.36 %). Quantile-based g-computation analysis showed that

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overall and class-specific mixtures were associated with elevated maternal hormones, especially dihydrotestosterone (an androgen) (β: 0.54; 95 % CI: 0.45, 0.64). Conversely, several mOPPs and mNNIs were associated with lower infant hormone levels, most notably a reduction in progesterone (-10.85 %; 95 % CI: -20.43 %, -0.10 %). The total mixture was linked to decreased infant progesterone (β: -0.13; 95 % CI: -0.25, -0.01), while the mOPPs mixture was associated with reduced androstenedione (an androgen) (β: -0.07; 95 % CI: -0.13, -0.00). Compared to the low insecticides cluster, the high insecticides cluster and the high mNNIs cluster were associated with higher maternal progestogens (progesterone (β: 0.32; 95 % CI: 0.03, 0.61); 17α-OH-progesterone (β: 0.25; 95 % CI: 0.03, 0.47)). Elevated maternal progesterone had a suppressive mediation effect on the negative association between specific mNNIs (desmethyl-acetamiprid and clothianidin) and progesterone in male infants (proportion >15 %). These findings demonstrated that prenatal insecticide exposure, whether analyzed individually, as mixtures, or by co-exposure clusters, was associated with increased maternal reproductive hormone levels and reduced levels of specific infant hormones, highlighting the need for further research into the long-term health implications.

Authors: Ying Li, Ying Jiang, Ruizhen Li, Sha Huang, Ruijia Li, Qing Guo, Pei Leng, Rui Ma, Dingye Zheng, Yuanyuan Li, Shunqing Xu, Wei Xia

Full Source: Journal of hazardous materials 2026 Jan 26:504:141260. doi: 10.1016/j.jhazmat.2026.141260.

Military Exposures Research: A State-of-the-Art Review

2026-01-31

Introduction: Military personnel encounter a wide range of environmental and occupational exposures during their service such as burn pit smoke, chemical warfare agents, depleted uranium, jet fuel, radiation, and pesticides. The field of military exposures research seeks to better understand the nature of these exposures and their effects on Veteran and service member health. This state-of-the-art review assesses the breadth and depth of published military exposures research so that stakeholders can identify trends and gaps in this growing field.

Materials and methods: An evidence mapping approach was used to perform a literature review of military exposures research published from 1962 to 2024. The search strategy was developed around exposed cohorts: groups of military personnel with a shared potential for exposure to toxic agents. Publications were included if they directly addressed exposures or related health outcomes in military cohorts. Publications were then further

categorized by the type of research, and the results were analyzed to build a map of the current military exposures research landscape.
Results: Thirty-six exposed cohorts were identified in the literature which were then grouped based on the nature of the exposure event: Wars and Operations (4 cohorts), Occupational Exposures (5), Combat and Combat Training (2), Across Military (2), Ship Exposures (2), Defense Testing (2), Base/Garrison Exposures (9), Toxic Substance Clean-Up and Disposal (5), and Isolated Exposure Events (5). The search identified 2,321 publications that fit the review inclusion criteria. The exposed cohort with the highest number of publications was Gulf War (940, 40.5% of all publications) followed by Vietnam War (277, 11.9%), Post-9/11 Operations in Iraq and Afghanistan (191, 8.2%), Aircraft Mechanics and Ground Support (176, 7.6%), and Munition Emissions and Embedded Fragments (164, 7.1%). Each remaining cohort individually represented < 4% of the literature. Six cohorts appeared only in non-peer-reviewed reports. The type of research best represented was Epidemiology (34.0%) followed by Animal and In Vitro Models (18.8%), Sequelae and Management (17.1%), Reviews and Meta-Analyses (11.7%), Exposure Assessment (9.5%), Toxic Agent Sampling and Analysis (4.3%), and publications from the National Academy of Sciences, Engineering, and Medicine (4.6%). The volume of military exposures research has increased steadily since the early public reports of Gulf War Illness in 1994, with 50% of articles being published after 2008.
Conclusion: Military exposures research published since 1962 has focused on cohorts from large, high-profile deployments, particularly the Gulf War. Underrepresented cohorts with potential exposures on bases or from military occupations present opportunities for future research. The lack of meaningful exposure assessment data that has been published also points to further research opportunities to specifically improve collection and accessibility of exposure data. This work should be done with a focus on cohorts where research can directly impact Veterans access to benefits and exposure-informed care.

Authors: Rachel T Wright, Jacob B Lindheimer, Israel C Christie, Jaraad Ramkissoon, Shaili Bhavsar, Rosalinda Desrochers, Walter W Frauman V, Drew A Helmer

Full Source: Military medicine 2026 Jan 31:usaf647. doi: 10.1093/milmed/usaf647.