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CHEMICAL EFFECTS

Hormonal Perturbations Induced by Multicategory Endocrine-disrupting Chemicals Increase the Risk of Polycystic Ovary Syndrome

2026-02-13

Polycystic ovary syndrome (PCOS) is intricately linked to both reproductive and metabolic health, and its pathogenesis remains unclear. Previous studies suggest that exposure to endocrine disrupting chemicals (EDCs) may contribute to PCOS. However, there is still a lack of systematic researches and analyses on this topic. In this study, we investigated the association between PCOS and EDC exposure and established a mechanistic link between the two by analyzing hormone levels. The meta-analysis pointed out that the levels of EDCs in patients with PCOS were significantly higher than those in the control group (standardized mean differences: bisphenol A, 1.92; phthalates (PAEs), 0.07; per- and perfluoroalkyl substances, 0.21; polychlorinated biphenyl (PCBs), 0.80; organochlorine pesticides (OCPs), 0.71). Subgroup analyses revealed that age and body mass index were potential sources of heterogeneity. EDC levels in urine in Asian populations (36.23 ng/mL) were higher than those observed in European and American cohorts (6.91 and 20.63 ng/mL, respectively). Structural equation modeling indicated that the alterations in fasting insulin caused by PCBs (β= 0.284) and HOMA-IR levels caused by OCPs and PAEs were exactly contribute to the formation of PCOS (β= 0.231, 0.257), thereby suggesting an underlying pathogenic mechanism. Low levels of PCBs pose a relatively high risk. Additionally, EDC-induced elevations in luteinizing hormone and testosterone promote ovarian cell overactivity and enhance insulin resistance. It is imperative to cultivate a more comprehensive understanding of overall impact of EDCs on human health in the future by multifaceted monitoring and assessment strategies.

Authors: Meichen Lu, Qingqing Zhu, Shuang Liu, Yitong Pan, Chunyang Liao, Guibin Jiang

Full Source: Environmental pollution (Barking, Essex : 1987) 2026 Feb 13:127825. doi: 10.1016/j.envpol.2026.127825.

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HEAVY METAL TOXICITY VERSUS TRACE ELEMENT PROTECTION IN WOMEN'S REPRODUCTIVE HEALTH - A SYSTEMATIC REVIEW

2025-12

Background: Environmental exposures are increasingly linked to reproductive dysfunctions such as endometriosis, ovarian insufficiency, and polycystic ovary syndrome (PCOS). Through endocrine disruption, oxidative stress, and epigenetic pathways, heavy metals (such as cadmium [Cd], lead [Pb], mercury [Hg], and arsenic [As]) and trace elements (such as zinc [Zn], copper [Cu], and selenium [Se]) may affect female fertility. Nevertheless, there are still few integrated assessments that address their combined consequences. The goal is to perform a critical evaluation and systematic analysis of epidemiological data about the link between reproductive health issues in women of reproductive age and exposure to heavy metals and trace elements.

Methods: A comprehensive literature search was carried out in PubMed, Scopus, Google Scholar, and Web of Science to locate articles published between 2010 and 2024. Included were observational human studies that looked at correlations between metal exposure and the reproductive results of females. The study's quality was assessed using the Newcastle-Ottawa Scale (NOS), and the review process adhered to PRISMA guidelines.

Findings: A total of twenty-three studies were included in the review: eleven case-control studies, eight cross-sectional studies, three cohort studies, and one analytical study. Cd, Pb, As, Hg, Cu, and Zn were the most frequently evaluated elements; these were usually detected in biological samples such blood, serum, or follicular fluid. While low Zn and Se levels were linked to endometrial diseases and a reduced ovarian reserve, elevated levels of Cd, Pb, and As were linked to an increased risk of PCOS and endometriosis. Inflammation and endocrine dysregulation were inversely correlated with protective trace elements, especially zinc and selenium. 17 studies had a high-quality rating (NOS score ≥7).

Conclusions: One important and controllable risk factor for the reproductive health of women is exposure to hazardous metals. It seems that preserving reproductive function depends on striking a balance between harmful and necessary components. To elucidate dose-response connections, synergistic effects, and possible therapeutic options, further prospective and mechanistic research is required.

Authors: A Amanzholkyzy, Y Sagidanova, E Stankevicius, A Donayeva, U Sarsengali

Full Source: Georgian medical news 2025 Dec:(369):210-216.

Distinguishing the contributions of organic matter and iron (oxyhydr)oxides to zinc availability in paddy soils surrounding lead-zinc mines

2026-02-12

Zinc (Zn) contamination in paddy soils near mining areas poses significant ecological and health risks, yet the mechanisms governing its mobility under redox-fluctuating conditions remain unclear. Here, we combined soil microcosm incubation, sequential Zn fractionation, and process-based kinetic modeling to elucidate Zn transformation pathways in a mining-affected paddy soil subjected to alternating anoxic-oxic phases. Results showed that under anoxic conditions, the concentration of available Zn decreased, with immobilization mainly via organic matter (OM) (45.8%) and Fe (oxyhydr)oxides (42.8%), with sulfate reduction contributing 11.4%. In contrast, oxic conditions enhanced available Zn, dominated by OM (48.6%) and Fe (oxyhydr)oxides (39.3%), with sulfide oxidation accounting for 12.1%. Fulvic acid-bound Zn was stable across redox transitions, whereas humic acid-bound and Fe (oxyhydr)oxides-bound fractions were highly redox-sensitive. The process-based kinetic model quantitatively captured Zn speciation changes and their links to Fe, C, and S cycling, enabling prediction of Zn behavior under dynamic redox regimes. These findings identify OM and Fe (oxyhydr)oxides as the key factors controlling Zn mobility and provide a mechanistic basis for redox-based remediation strategies in Zn-contaminated paddy soils near mining regions.

Authors: Yecheng Li, Zebin Hong, Yan Ru, Guojun Chen, Xiaomin Li, Shiwen Hu, Yang Yang, Chao Guo, Shan Wang, Pengfei Cheng, Qi Wang, Tongxu Liu

Full Source: Environmental pollution (Barking, Essex : 1987) 2026 Feb 12:127815. doi: 10.1016/j.envpol.2026.127815.

ENVIRONMENTAL RESEARCH

Environmentally relevant doses of gadolinium (GdCl3; Gd2O3) trigger immune and antioxidant effects in non-target organisms: Cellular and tissue responses in the gills of mussel Mytilus galloprovincialis

2026-02-11

The current abundance of gadolinium (Gd) in aquatic ecosystems is attributable to its wide use in several fields (i.e. metallurgy, electronic devices production), above all medical imaging and treatment. Various harmful effects of Gd have been largely documented on human cells,

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likely due to its chemical affinity with Ca2+. However, these effects are still poorly evaluated in aquatic organisms, especially invertebrates. Therefore, this work aims to unveil the impact of two forms of Gd (gadolinium chloride, GdCl3; gadolinium oxide nanoparticles, Gd2O3) on the gills of mussels Mytilus galloprovincialis, following exposure for 28 days to two environmental doses (1 µg/L; 10 µg/L) of GdCl3 and Gd2O3, by investigating on tissue organization, antioxidant system, immune responses, energy metabolism, and neurotransmission system. Despite the lack of a relevant Gd bioaccumulation in mussel gills, after exposure to both Gd forms a marked haemocyte infiltration was observed in gill tissues at every exposure time-points (T7; T15; T28), suggesting a potential immune response involvement, further supported by an imbalance in mucopolysaccharide secretions and an enhancement in the alkaline phosphatase activity at T7. At T28, a disruption in the antioxidant system, evaluated by gene expression and enzymatic activity of the main antioxidant and detoxifying enzymes (GST, CAT, SOD), was reported, together with changes in lactate dehydrogenase (LDH) activity suggesting activation of anaerobic metabolism. Overall, this study highlights the ability of Gd to induce significant physiological disruptions even in the absence of substantial bioaccumulation, underscoring its potential ecological risk at environmentally relevant concentrations.

Authors: Mariachiara Galati, Giuseppe De Marco, Sara Falvo, Barbara Billè, Claudia La Corte, Mery Terranova, Francesco Crea, Giuseppe Zaffino, Maria Giovanna Parisi, Concetta De Stefano, Tiziana Cappello, Alessandra Santillo, Maria Maisano

Full Source: Environmental research 2026 Feb 11:296:124017. doi: 10.1016/j.envres.2026.124017.

PHARMACEUTICAL/TOXICOLOGY

Occupational Exposure to Welding Fumes and the Risk of Bladder Cancer: A Systematic Review and Meta-Analysis

2026-02-15

Background: Occupational exposure to welding fumes has been suggested as a potential risk factor for bladder cancer, but evidence remains inconclusive. This review aimed to systematically evaluate the association between welding fume exposure and risk of bladder cancer through a meta-analysis of observational studies.

Methods: A comprehensive literature search was conducted in PubMed, Embase, and the Cochrane Library. Eligible studies were identified based on predefined criteria. The pooled odds ratio (OR) and 95% confidence

interval (CI) were calculated using a random-effects model. Subgroup analyses were performed based on study design, publication year, geographic region, sex, and exposure assessment methods.
Results: A total of 34 epidemiological studies were included. The pooled analysis revealed a 20% increased risk of bladder cancer among welders (OR = 1.20, 95% CI: 1.11-1.30). This association remained statistically significant in analyses restricted to studies that adjusted for both age and smoking. Subgroup analyses indicated variation by publication period, geographic region, and exposure assessment method. Sensitivity analyses restricted to high-quality studies confirmed the robustness of the findings.
Conclusions: Welding fume exposure is associated with an elevated risk of bladder cancer. These findings suggest the need for improved occupational safety measures, exposure monitoring, and further research to clarify underlying biological mechanisms and dose-response relationships.
Authors: Seung-Woo Ryoo, Baek-Yong Choi, Seok-Yoon Son, Ji-Hyeon Lee, Mo-Yeol Kang
Full Source: American journal of industrial medicine 2026 Feb 15. doi: 10.1002/ajim.70062.

Diet and Everyday Product Use and Serum Per- and Polyfluoroalkyl Substances Levels in the Korean Population: Findings from the Korean National Environmental Health Survey

2026-02-11
Per- and polyfluoroalkyl substances (PFASs) are persistent synthetic chemicals widely used in consumer and industrial products and lead to ubiquitous human exposure and adverse health effects. However, how various exposure sources contribute relatively to the human PFAS burden remains unclear. The primary exposure sources contributing to serum PFAS concentrations, specifically dietary intake and everyday product use, were examined in a nationally representative sample using Korean National Environmental Health Survey Cycle 4 (2018-2020) data, including 2,990 adults and 778 secondary school students. Information on exposure sources was collected through questionnaires, and serum concentrations of perfluorohexanesulfonic (PFHxS), perfluorooctanesulfonic, perfluorooctanoic, perfluorononanoic, and perfluorodecanoic acids were measured. Exposure patterns were identified using sparse reduced-rank regression. In the first pattern, diet, particularly seafood consumption, and food contact material (FCM) use were identified as significant contributors to overall PFAS levels in adults. In the second, PFHxS showed distinct

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exposure characterized by a greater contribution from processed food and non-dietary sources, such as fast food, disposable paper cups, plastic containers for storing hot food, body wash, and household cleaners, compared to other PFAS compounds. Exposure patterns varied by age. The dominant exposure sources for older and younger adults were seafood and FCMs, respectively. Sex-stratified analyses revealed that bodywash was a primary exposure source in men, whereas cosmetic use was a major source in women, particularly for PFHxS. Students showed patterns similar to those of adults over 40, likely reflecting household lifestyles. These findings highlight exposure-related patterns that may inform future research aimed at reducing PFAS exposure.
Authors: Hyun-Wook Park, Donghwan Lee, Byung-Sun Choi, Weon-Young Lee, Wanhyung Lee, Bomi Park
Full Source: Environmental research 2026 Feb 11:124013. doi: 10.1016/j.envres.2026.124013.

OCCUPATIONAL

Exposure to personal care products and thyroid function in adults: Unveiling the association and potential mechanism

2026-02-13
Background: Personal care products (PCPs) are a ubiquitous source of endocrine-disrupting chemicals, yet their combined impact on thyroid function and the underlying mechanisms remain poorly understood.
Methods: A total of 2714 adults from the NHANES 2007-2012 were included. Survey-weighted linear regression assessed individual associations and mixture effects were evaluated via quantile g-computation (QGC) and Bayesian kernel machine regression (BKMR). Causal mediation analysis was performed to examine the potential mediating role of systemic inflammation in the observed associations.
Results: Most urinary PCPs metabolites were significantly correlated with reduced thyroid function in a dose-dependent manner, particularly for TT4. One-unit increase in concentrations of bisphenol A, benzophenone-3, butyl paraben, ethyl paraben, methyl paraben, and propyl paraben were associated with percent changes in TT4 of -3.11, -1.28, -1.41, -2.44, -1.46, and -1.55, respectively. QGC and BKMR models consistently identified the PCPs mixture was significantly associated with decreased FT4 and TT4. Bisphenol A, triclosan, and ethyl- and propyl-parabens were the dominant contributors, with a joint effect of -0.014 in FT4 and -0.027 in TT4 per quartile increase in the mixture. Mediation analysis showed that associations of urinary PCPs metabolites, especially triclosan, butyl

paraben, ethyl paraben, and methyl paraben, with thyroid function were significantly mediated by neutrophil to platelet ratio (NPR), with mediation proportions ranging from 4.91% to 25.3%.
Conclusion: Both individual and mixed exposure to PCPs were associated with reduced thyroid function, with effects partially mediated by systemic inflammation. These findings highlight the importance of regulating priority chemicals and assessing combined exposure risks.
Authors: Hui Zou, Jinyan Zhong, Xing Wei, Yuquan Wen, Jjayi Liu, Xueping Hu, Jiangnan Yu, Yang Yu, Yunbo Wan, Lili Xiao
Full Source: Ecotoxicology and environmental safety 2026 Feb 13:311:119855. doi: 10.1016/j.ecoenv.2026.119855.

Exposure to benzene, toluene and xylenes (BTX) and biological aging: epidemiological evidence from Chinese industrial workers and mechanistic insights

2026-02-05
Benzene, toluene and xylenes (BTX) are common workplace volatile organic compounds, but evidence linking BTX exposure to biological aging is limited. We examined associations between urinary BTX metabolites and biological age acceleration, and explored biological plausibility using computational analyses (network toxicology and molecular docking). We enrolled 301 BTX-exposed workers and 741 unexposed controls (Henan, China, 2022-2023), and selected 301 matched controls using 1:1 propensity score matching. Biological age was estimated with the Klemera-Doubal method (KDM) from clinical biomarkers, and biological age acceleration (KDM-BA.Accel) was defined as biological age minus chronological age. Creatinine-adjusted urinary metabolites of benzene (S-phenylmercapturic acid [SPMA] and trans, trans-muconic acid [TTMA]), toluene (S-benzylmercapturic acid [SBMA]) and xylenes (2-methylhippuric acid [2MHA] and 3-/4-methylhippuric acids [3&4MHA]) were analyzed using generalized linear models, and mixture associations were assessed with Bayesian kernel machine regression (BKMR). In fully adjusted models, higher SPMA (β = 0.15, 95% CI: 0.07 to 0.24) and TTMA (β = 0.08, 95% CI: 0.01 to 0.14) were associated with higher KDM-BA.Accel, and xylene metabolites also showed positive associations. BKMR suggested a positive overall association of the BTX mixture with KDM-BA.Accel, with SPMA and TTMA contributing most prominently. Network toxicology prioritized eight hub genes (TP53, TNF, NFKB1, TGFB1, MAPK3, CTNNB1, FOS and JUN), and enrichment analyses were consistent with oxidative stress response, inflammatory signaling, and cell-cycle regulation pathways. Overall, higher urinary BTX metabolites,

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particularly benzene biomarkers SPMA and TTMA, was associated with higher biological age acceleration. Future work should include prospective cohorts with repeated biomonitoring and experimental studies to validate the associations and test the implicated mechanisms.
Authors: Bin Yang, Xiangkai Zhao, Mengqing Yan, Yangyang Jia, Zhiguang Gu, Xiaoyu Hao, Sihua Wang, Zhiheng Li, Xiangwei Zhao, Yongli Yang, Pengpeng Wang, Wei Wang
Full Source: Environment international 2026 Feb 5:208:110124. doi: 10.1016/j.envint.2026.110124.

Cadmium exposure induces renal fibrosis by inhibiting hsa_circ_0075684/miR-363-3p/KLF4 signaling pathway

2026-02-13
To date, no effective chelation therapy exists to remove cadmium (Cd) from the kidneys, a condition that increases the risk of cadmium-induced chronic kidney disease among humans. consequently, it is vital to prevent kidney damage due to cadmium exposure. However, it has been challenging to identify an early diagnostic marker of cadmium-induced kidney damage through mechanism studies. Interestingly, our previous study revealed that the expression of the microRNA miR-363-3p was upregulated in workers who had been diagnosed with chronic occupational cadmium toxicity. Thus, we aimed to investigate the role of miR-363-3p and its potential signaling pathway in cadmium-induced kidney damage. In this study, we identified a novel signaling pathway, hsa_circ_0075684/miR-363-3p/Krüppel-Like Factor 4 (KLF4), through a comprehensive bioinformatics analysis involving six databases. Next, we validated the role of the hsa_circ_0075684/miR-363-3p/KLF4 pathway in human renal tubular epithelial cell line (HK-2) treated with 0, 5, 10 and 15 μM cadmium chloride (CdCl2). Reverse transcription quantitative PCR (RT-qPCR) and western blot analyses showed that cadmium exposure induced renal fibrosis by regulating the expression of classic renal fibrosis biomarkers, including Fibronectin (Fn), E-cadherin (E-cad) and α-smooth muscle actin (α-SMA) through hsa_circ_0075684/miR-363-3p/KLF4 pathway inhibition. In a mice subchronic model (treated with 0, 5, 10 and 20 mg/kg CdCl2), Masson's staining revealed obvious renal fibrosis in mice treated with 5, 10 and 20 mg/kg CdCl2 compared to the control group. The altered expression of hsa_circ_0075684/miR-363-3p/KLF4 pathway components and classic renal fibrosis biomarkers in model mice exposed to cadmium was consistent with that observed in HK-2 cells. In summary, we first report hsa_circ_0075684/miR-363-3p/KLF4 axis in cadmium

nephrotoxicity, positioning it as a potential early diagnostic marker for cadmium-induced renal fibrosis.
Authors: Jiazhen Zhou, Yiqi Huang, Guoliang Li, Zhiqiang Zhao, Yaotang Deng, Siming Xian, Yue Hu, Mushi Yi, Lili Liu
Full Source: Scientific reports 2026 Feb 13. doi: 10.1038/s41598-026-39715-w.

Distinct profiles and elevated exposure to liquid crystal monomers in urban areas: Insights from indoor dust across China

2026-02-11
Liquid crystal monomers (LCMs) added in liquid crystal displays (LCDs) are emerging contaminants. While indoor LCD emissions are a potential exposure source, the correlation between LCM concentrations and device numbers, along with urban-rural differences, remains uncharacterized. In this study, indoor dust samples from 10 provinces in China were collected and 60 LCMs were determined. Significant positive correlation ($P < 0.05$) was observed between LCM concentrations and the numbers of electronic devices. The concentrations of LCMs in the dust from urban areas (78.7-2730 ng/g, average: 565 ng/g) were statistically higher than those from rural areas (57.8-2050 ng/g, average: 386 ng/g). The compositions of LCMs in dust samples from urban and rural areas were considerably different. Trans-1-ethoxy-4-(4-pentylcyclohexyl)benzene was the dominant LCM in urban dust, while 4-[difluoro(3,4,5-trifluorophenoxy)methyl]-3,5-difloro-4'-propyl-biphenyl was the dominant LCM in rural dust. Median daily intakes of LCMs through dust ingestion were 0.984 and 0.093 ng/kg BW/day for children and adults, while those through dermal absorption were 0.818 and 0.184 ng/kg BW/day. This study highlights the urban-rural disparities, thus providing crucial insights for targeted pollution control strategies and public health interventions.
Authors: Ye-Yang Hou, Da-Jian Li, Shi-Yang Liu, Peng-Ran Guo, Liang-Ying Liu
Full Source: Environmental research 2026 Feb 11:296:124004. doi: 10.1016/j.envres.2026.124004