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CHEMICAL EFFECTS

Exposure to a persistent organic pollutant mixture resulted in sex-specific steatotic liver disease: Role of the liver-endocrine axis

2025-11-12

Exposures to persistent organic pollutants (POPs) have been associated with steatotic liver disease (SLD), but how these chemicals impact women's liver health is underexplored. Our goal was to determine the sex-specific impact of POPs on SLD and identify underlying sex-specific mechanisms. Male and female C57BL/6 mice were fed either a low-fat control diet (CD) or western diet (WD) and exposed to the vehicle control or a POP mixture of chlordane (20 mg/kg) and PCB 126 (20 µg/kg) over 12 weeks. Another group of intact or ovariectomized (OVX) female mice were exposed to the same POP mixture/vehicle control for 2 weeks. Compared to their diet- and sex-matched controls, WD-fed females exposed to the POP mixture exhibited steatosis, confirmed by H&E staining and quantification of hepatic triglycerides/cholesterol, and decreased physical activity (assessed using metabolic chambers). These observations were absent in males. Mechanistically, POPs activated hepatic xenobiotic receptors, namely the arylhydrocarbon receptor and constitutive androstane receptor (CAR), measured by Cyp1a1/Cyp1a2 and Cyp2b10 induction respectively. However, more robust CAR activation was observed in CD-fed females. This group also showed decreased liver gene expression of estrogen sulfotransferase (Sult1e1), a key enzyme in estrogen metabolism. Further, POPs induced hepatomegaly and resistance to glucose clearance only in intact, but not OVX females, suggesting that altered estrogen signaling by POPs played a mechanistical role in driving hepatic POP-mediated toxicity in females. Female mice exposed to the POP mixture were more susceptible to toxicant-associated SLD. Our findings emphasized the significance of examining biological sex in assessing environmental liver disease risk.

Authors: Banrida Wahlang, Yuan Hua, Gavin J Phillips, Shikshita Singh, Oluwanifemi E Bolatimi, Bana Luulay, Tyler C Gripshover, Walter H Watson, Michael L Merchant, Maiying Kong, Jeffrey Kim, Carolyn M Klinge

Full Source: Environmental pollution (Barking, Essex : 1987) 2025 Nov 12:388:127364. doi: 10.1016/j.envpol.2025.127364.

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Exposure to a mixture of endocrine disrupting chemicals and thyroid function tests in pregnant women in the SELMA study

2025-11-14

Background: Based on experimental and human studies, endocrine disrupting chemicals (EDCs) can disrupt the thyroid hormone system. However, their association with thyroid function tests when considered as part of a chemical mixture is unknown.
Methods: We used data of 1970 pregnant women from the Swedish Environmental Longitudinal Mother and Child, Asthma and Allergy (SELMA) study to investigate the cross-sectional association between exposure to 26 chemical compounds with maternal thyroid function tests in early pregnancy, using Weighted Quantile Sum (WQS) regression.
Results: Higher exposure to EDCs mixtures was associated with a lower FT3 [WQS Estimate per an IQR increase (95 % CI): -0.09 (-0.16 to -0.01), mostly driven by PCBs] and a lower TT3 [WQS Estimate per an IQR increase (95 % CI): -0.05 (-0.09 to -0.01), mostly driven by PFOS]. In addition, higher exposure to a mixture of short lived urinary based compounds was associated with a lower TT4/TT3 ratio while higher exposure to a mixture of persistent serum based compounds was associated with a higher TT4/TT3 ratio.
Conclusions: In this proof-of-principle analysis, we show that there could be an added benefit of analyzing thyroid hormone system disrupting EDCs using a mixture-based analysis approach. Our findings pave the way and provide hypotheses for future experimental and human studies to investigate the effects of EDCs as a mixture on the thyroid hormone system, revealing information on potential biological mechanisms explaining the associations from observational data.

Authors: Arash Derakhshan, Eva Tanner, Marlene Stratmann, Huan Shu, Robin P Peeters, Barbara Demeneix, Chris Gennings, Tim I M Korevaar, Carl-Gustaf Bornehag

Full Source: International journal of hygiene and environmental health 2025 Nov 14:271:114711. doi: 10.1016/j.ijheh.2025.114711.

Ionic strength modulates size-controlled ecotoxicity of citrate-coated silver nanoparticles to Daphnia magna in complex environmental matrices

2025-11-15

Silver nanoparticles (AgNPs) pose significant exposure risks to aquatic organisms, yet how ionic strength (IS) governs their toxicity in complex

environments remains unclear. This study examines IS-dependent aggregation, dissolution, and ecotoxicity of citrate-coated AgNPs (Cit-AgNPs) toward Daphnia magna in landfill leachate and domestic sewage. The results show that 0.2 mg/L Cit-AgNPs in 10% domestic sewage, as well as 0.4 mg/L in 5% landfill leachate, inducing 13-100% inhibition rate, where the test concentrations were well below current regulatory limits defined in both Chinese (GB 8978-1996) and U.S. (40 CFR Part 413) standards. It indicates that current environmental regulations may underestimate the risks of AgNPs. Regardless of the matrix type, the increased IS (10-450 mM) significantly ($p < 0.01$) reduced the Cit-AgNPs' absolute ξ-potential, promoting aggregation (118.43 nm vs. 299.93 nm), reducing the bioavailability and subsequent ecotoxicity effect (100% vs. 13% inhibition). Notably, at ultra-high ionic strengths (450-700 mM), the aggregates underwent a reduction in size and a concomitant increase in toxicity, likely due to surface etching and subsequent disassembly. The ecotoxicity contribution from silver dissolution was found to be minimal, attributing to the dominant formation of less toxic AgClx(x-1)- complexes from the dissolved Ag ions.

Authors: Ping Luo, Zhenghao Xu, Jiageng Zhang, Xin Wang, Xiujun Gu, Lizhang Wang, Dejun Yang, Jiachao Jiang

Full Source: Environmental geochemistry and health 2025 Nov 15;47(12):573. doi: 10.1007/s10653-025-02892-0.

ENVIRONMENTAL RESEARCH

The fetal exposome and Preterm Birth: a systematic synthesis of environmental exposures and multi-omics evidence

2025-11-17

Objectives: Preterm birth (PTB), defined as delivery before 37 weeks of gestation, is a leading cause of neonatal mortality and long-term developmental impairment. Its complex etiology, spanning environmental, genetic, psychosocial, and socio-economic domains, limits effective prediction and prevention. We systematically synthesized evidence on how environmental exposures influence PTB risk through multi-omic disruptions within a fetal exposome framework.
Methods: A comprehensive literature search was conducted in major biomedical databases, following PRISMA guidelines. Ninety-five human studies published through May 2025 were included, encompassing exposures such as ambient air pollution, endocrine-disrupting chemicals, maternal stress, nutrition, occupational hazards, climate variability, and microbiome alterations. Two reviewers independently extracted data (exposure type, omics platform, biospecimen, PTB subtype) with inter-rater reliability assessment, and study quality was evaluated using the Newcastle-Ottawa Scale. Findings were narratively stratified by exposure category, study design, and spontaneous vs. indicated PTB.
Results: Environmental exposures were consistently associated with disruptions in oxidative stress, inflammation, immune regulation, hormonal signaling, placental aging, and microbial ecology, mediated by multi-omic signatures in maternal, placental, and fetal tissues. Candidate biomarkers show promise for early risk stratification but lack validation and population-level predictive performance due to heterogeneous exposure assessment and study design.
Conclusions: Integrating fetal exposome concepts with multi-omics enhances mechanistic insight into PTB risk and may support biomarker discovery and precision-guided prenatal interventions. Clinical translation requires standardized exposure measurement, biomarker validation, and equity-focused implementation.

Authors: Wiku Andonotopo, Muhammad Adrianes Bachnas, Julian Dewantiningrum, Mochammad Besari Adi Pramono, Nuswil Bernolian, Cut Meurah Yeni, Anak Agung Gede Putra Wiradnyana, I Nyoman Hariyasa Sanjaya, Muhammad Ilham Aldika Akbar, Ernawati Darmawan, Sri Sulistyowati, Milan Stanojevic, Asim Kurjak

Full Source: Journal of perinatal medicine 2025 Nov 17. doi: 10.1515/jpm-2025-0231.

Integrated Toxicological Assessment of Environmental Microplastics and Diuron on Mytilus galloprovincialis Larvae: Toward Improved Marine Risk Management

2025-11-12

Coastal marine ecosystems are increasingly threatened by complex mixtures of emerging and persistent pollutants, including environmental microplastics (EMPs) and the herbicide diuron. These contaminants, frequently detected in coastal waters, can exert harmful effects even at low, environmentally relevant concentrations, particularly during sensitive early life stages of marine invertebrates. Here, we conducted the first investigation of the combined toxicity of EMPs and diuron at realistic exposure levels (100 µg/L EMPs, 50 ng/L diuron, and their mixture), reflecting concentrations commonly found in marine environments. We assessed their toxicological impact on Mytilus galloprovincialis larvae after 48 hours of exposure. An integrated approach combining

chemical, morphological, biochemical, and molecular markers was used to characterize induced cellular and physiological responses. Specifically, we analyzed larval abnormalities, micronucleus formation, antioxidant enzyme activity (catalase and GST), and the expression of genes involved in oxidative stress, apoptosis, and stress protein responses (cat, gst, caspase3, p53, dna ligase, bax, bcl2, hsp27, hsp70, calreticulin). The Integrated Biomarker Response (IBR), supported by correlation matrix analysis and hierarchical clustering, allowed us to identify functionally related groups of biomarkers exhibiting similar response patterns. Our findings reveal a synergistic toxicological interaction between EMPs and diuron, leading to enhanced oxidative stress, genotoxicity, and transcriptional disturbances. These results highlight the need to incorporate microplastic-chemical pollutant interactions into marine risk assessment frameworks to improve environmental monitoring and mitigation strategies, especially in vulnerable coastal ecosystems affected by agricultural and urban runoff. This study provides valuable insights and tools for evaluating the combined effects of pollutants on marine biodiversity.

Authors: Khouloud Boukadida, Ahlem Sahnoun, Mohamed Rida Abelouah, Sonia Gaaied, Rania Mlouka, Yosra Missaoui, Aicha Ait Alla, Maria Giovanna Parisi, Mohamed Banni

Full Source: Environmental pollution (Barking, Essex: 1987) 2025 Nov 12:127378. doi: 10.1016/j.envpol.2025.127378.

Characterizing pollution and identifying heavy metal sources in surface sediments: a PMF-based assessment of environmental risks from produced water discharges during hydraulic fracturing

2025-11-16

This study highlights the critical environmental and human health risks posed by heavy metal contamination in oil and gas drilling regions. Heavy metal contamination in surface sediments resulting from oil and gas drilling activities presents a significant environmental and human health concern. This research critically examines the impacts of hydraulic fracturing wastewater on surface sediment quality, focusing on environmental consequences. For the first time in the region, sediment samples were analysed to identify heavy metals associated with oil and gas operations. A combination of pollution indices, positive matrix factorization (PMF), and health risk assessment (HRA) was applied to comprehensively assess sediment quality, contamination sources, and health risks. To evaluate contamination levels, various pollution indices were employed, including Geoaccumulation Index (Igeo), enrichment factor (EF), contamination factor (CF), pollution load index (PLI), potential ecological risk index (PERI), toxic risk index (TRI), and modified hazard quotient (mHQ). Source apportionment was conducted using PMF and multivariate statistical techniques to identify the potential origins of heavy metals in surface sediments. The results of the pollution indices indicate moderate to severe contamination, with As, Cr, and Pb showing elevated levels beyond sediment quality guidelines. The PERI and TRI values confirmed high ecological risk, with arsenic and chromium contributing the most to environmental toxicity. PMF analysis identified five major contamination sources, including geogenic weathering, petroleum drilling waste, industrial effluents, aquaculture inputs, and agricultural runoff. The HRA results demonstrated that children are at greater non-carcinogenic risk (HI > 1), particularly due to As, Cr, and Pb exposure via ingestion. The carcinogenic risks for As and Cr exceeded the USEPA threshold (1 × 10-4), suggesting long-term health concerns for populations residing near contaminated sites. The integration of pollution indices, PMF source apportionment, and HRA provides a scientific framework for assessing contamination severity and health risks. These findings underscore the urgency of implementing proactive environmental monitoring, stricter regulatory controls, and effective remediation strategies to safeguard ecosystem and human health in hydrocarbon-extraction areas.

Authors: Babu Mallesh Dasari, Keshav Krishna Aradhi

Full Source: Environmental geochemistry and health 2025 Nov 16;47(12):574. doi: 10.1007/s10653-025-02872-4.

PHARMACEUTICAL/TOXICOLOGY

Hematological effects of chronic heavy metal exposure in children from marginalized occupational communities in Mexico

2025-11-14

Children engaged in precarious labor activities may experience exposure to environmental contaminants, including heavy metals, particularly in marginalized communities. Limited evidence exists regarding the potential hematological implications of such exposures in pediatric populations. A cross-sectional study was conducted among 50 children (<18 years) from three communities in San Luis Potosí, Mexico, engaged in informal recycling (Zone B), artisanal brickmaking (Zone C), or artisanal stone-carving (Zone A). Urinary concentrations of 15 metals were

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determined by ICP-MS, and hematological parameters were assessed using an automated analyzer. Associations were examined using nonparametric statistics, age-adjusted correlations, Bayesian Kendall's Tau analysis, and post hoc power evaluation. Distinct urinary metal profiles and hematological parameters were observed across the study zones. Zone B showed higher concentrations of Cr, Co, Ni, Al, and Sn, whereas As was elevated in Zone C. Hematological differences included higher WBC, lymphocyte, granulocyte counts, and MPV in Zone C. Age-adjusted correlations identified associations of As with WBC, lymphocyte, and granulocyte counts; Co with platelet indices; and negative correlations of Ni, Al, and Sn with several hematological variables. Bayesian analysis confirmed robust associations for Co with WBC, Al with granulocytes, and Sn with MPV. This study provides exploratory evidence of associations between urinary metal concentrations and hematological parameters in children engaged in precarious labor activities. While preliminary, the findings underscore the importance of child-focused public health strategies and support the need for larger, longitudinal studies to validate these associations and clarify their implications.

Authors: B Méndez-Rodríguez Karen, J Pérez-Vázquez Francisco, Van Brussel Evelyn, K González-Palomo Ana, Reyes-Zavala Axel, Saldaña-Villanueva Kelvin

Full Source: Toxicology letters 2025 Nov 14:111776. doi: 10.1016/j.toxlet.2025.111776.

Occupational exposures and skin cancer incidence in six Swiss cantons

2025-11-14

Objectives: Most studies on occupational risk factors for melanoma have focused on ultra-violet radiation (UVR) exposure from outdoor work. This study investigates a broader range of occupational exposures including UVR, ionizing and non-ionizing radiation, benzene, poly- and monocyclic aromatic hydrocarbons, hexavalent chromium, nickel, coal tar, black carbon, ozone, soot and nitrous oxides with skin cancer in a working-age population-based prospective cohort.

Methods: Adult residents (20 to 65 years) in the cantons of Fribourg, Ticino, Vaud, Valais, Neuchâtel, and Genève at the 2000 census were included (n = 1,077,487). Incident cases of primary melanoma and squamous cell carcinoma (SCC) of the skin were retrieved from cantonal cancer registries until 2012. Job-exposure matrices were used to assign exposures, using two assessment methods to explore exposure misclassification (i.e. conservative approach for main analyses vs. inclusive approach

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for sensitivity analyses). Cox proportional hazard models, with age as timescale and adjusted for demographic and environmental factors (residential radon, ambient UVR, and PM2.5 concentrations) were used to estimate hazard ratios (HR) in relation to each occupational exposure.

Results: 2757 incident melanoma cases were observed during an average of 8.4 years follow-up. Occupational exposure to UVR and black carbon were associated with melanoma incidence (HR = 1.23; 95 % CI: 1.02-1.50 and HR = 1.59; 95 % CI: 1.18-2.13, respectively). Occupational exposure to ionizing radiation and ozone were only associated with melanoma when using the inclusive exposure assessment method. No associations were found for SCC incidence.

Conclusion: UVR and air pollution in occupational settings were associated with melanoma incidence. Melanoma related to these risk factors is only recognized as an occupational disease in a few countries, while other occupational risk factors are largely neglected.

Authors: Seçkin Boz, Marek Kwiatkowski, Murielle Bochud, Jean-Luc Bulliard, Marcel Zwahlen, Isabelle Konzelmann, Yvan Bergeron, Bernadette W A van der Linden, Elisabetta Rapiti, Manuela Maspoli Conconi, Andrea Bordoni, Martin Röösli, Danielle Vienneau

Full Source: The Science of the total environment 2025 Nov 14:1007:180938. doi: 10.1016/j.scitotenv.2025.180938.

OCCUPATIONAL

Prenatal organophosphate ester exposure and epigenetic changes at birth: a characterization of the methylome in the ECHO cohort

2025-11-07

Background: Prenatal exposure to organophosphate esters (OPEs) affects multiple child health domains. Alterations to the DNA methylome are a plausible mechanism through which these changes occur. This study characterized DNA methylation signatures at birth associated with prenatal OPE biomarkers.

Methods: We included 736 mother-infant pairs from 7 sites in the Environmental influences on Child Health Outcomes (ECHO) Cohort. Five OPE biomarkers were quantified in maternal urine samples collected during the second and third trimesters and modeled as log2-transformed continuous variables. Using covariate-adjusted linear regression, we tested associations between OPE biomarkers and locus-specific, regional, and global cord blood DNA methylation changes measured by Illumina 450 K

and EPIC arrays, and gestational epigenetic age measured by the Knight gestational age epigenetic clock generated with measures from the 27 K, 450 K, and EPIC arrays. When feasible, we examined relationships by sex. Findings: Global hypomethylation at multiple regions was associated with BDCPP concentrations (p = 0.003 to 0.02, coef = -0.002). Differentially methylated regions annotated to PCDHGB1 and SLC43A2 were associated with BDCPP and DPHP concentrations, respectively (FDR q < 0.05). In sex-specific analyses, global hypomethylation was associated with prenatal BDCPP (p = 0.006 to 0.03, coef = -0.0003 to -0.0002) and DBUP_DIBP (p = 0.01, coef = -0.0007 to -0.0006) concentrations in females; and global hypermethylation was associated with DBUP_DIBP concentrations in males (p < 0.05, coef = 0.0004). BCETP concentrations were significantly associated with decelerated epigenetic aging at birth in females (p < 0.05, coef = -0.05).
Interpretation: Prenatal exposure to OPEs impacts child methylation at birth, suggesting a potential mechanism for the association between prenatal OPE exposure and child health outcomes.
Authors: Rose Schrott, Jennifer L Ames, Emily S Barrett, Deborah H Bennet, Lisa A Croen, Sarah D Geiger, Kurunthachalam Kannan, Zorimar Rivera-Nunez, Jiwon Oh, Alicia K Peterson, J Richard Pilsner, Rebecca J Schmidt, Anne P Starling, Yeyi Zhu, Christine Ladd-Acosta, ECHO Cohort Consortium
Full Source: Environment international 2025 Nov 7:205:109908. doi: 10.1016/j.envint.2025.109908.

Co-exposure to dimethoate and tetracycline induces synergistic ecological risks to Brachionus calyciflorus

2025-11-14
Dimethoate, a widely used organophosphorus pesticide in agriculture and animal farming, poses significant risks to aquatic ecosystems and human health upon environmental release. Tetracycline, one of the most widely used antibiotics, is frequently detected in surface water and groundwater. In agricultural or urban watersheds, where pesticide runoff and antibiotic-laden wastewater frequently co-occur. The coexistence of tetracycline and dimethoate in nature is common, and this coexistence might impose environmental stress, affecting other organisms. This study investigated the interactive effects of tetracycline (0, 0.085, and 0.85 mg/L) and dimethoate (0, 1.6, and 16 mg/L) on the freshwater rotifer Brachionus calyciflorus, focusing on life cycle parameters, oxidative stress responses, and microbial-mediated dimethoate degradation. Key findings revealed that the co-exposure to tetracycline and dimethoate exerted a synergistic effect, significantly reducing rotifer population

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density and growth rate compared to exposure to either contaminant alone. Additionally, tetracycline inhibited bacterial growth, which in turn prolonged the environmental persistence of dimethoate in aquatic systems by impeding its natural biodegradation. Collectively, these results highlight the non-additive interactive risks associated with the coexistence of tetracycline and dimethoate, emphasizing the necessity of considering such contaminant interactions in environmental risk assessment to more accurately evaluate the ecological hazards of combined pollution in aquatic systems.
Authors: Huahua Gao, Yao Xiao, Juan Hu, Gen Zhang, Peiyuan Qian, Lingli Liu
Full Source: Ecotoxicology and environmental safety 2025 Nov 14:307:119416. doi: 10.1016/j.ecoenv.2025.119416.