

Bulletin de veille
Perturbateurs Endocriniens
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Objectif : cette veille bibliographique a pour objectif la surveillance de l'actualité et de la littérature scientifique sur les perturbateurs endocriniens. Cette veille est axée sur les aspects suivants : l'exposition, la toxicité, l'évaluation, la prévention, l'épidémiologie et l'actualité.

La validation des informations fournies (exactitude, fiabilité, pertinence par rapport aux principes de prévention, etc.) est du ressort des auteurs des articles signalés dans la veille. Les informations ne sont pas le reflet de la position de l'INRS.

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Exposition professionnelle

Service Year-Dependent Disruption of Reproductive Hormones and Altered DNA Methylation in Male Firefighters.
Leung YK, Ouyang B, Cheong A, Karyala SV, Chen J, Medvedovic M, et al. *J Occup Environ Med*. 2026 Jun 9.

OBJECTIVES: Firefighters are routinely exposed to combustion-derived toxicants. This exploratory study examined associations between occupational exposure, DNA methylation, and reproductive hormones. METHODS: Genome-wide methylome profiling using MIRA-seq was performed on pooled blood samples from six male firefighters and four matched controls. Candidate genes were validated by bisulfite sequencing. Jurkat and U937 cells were exposed to benzo[a]pyrene and a phthalate

mixture to assess methylation and gene expression. Plasma reproductive hormones were measured in 17 firefighters and 17 matched controls. RESULTS: Firefighters showed 960 differentially methylated genes enriched in reproductive pathways. KLHL17 promoter hypomethylation and increased expression were reproduced in vitro. Hormone analyses demonstrated elevated anti-Müllerian hormone, service year-dependent increases in follicle-stimulating hormone, and reduced testosterone and estradiol. CONCLUSIONS: Occupational exposure in firefighters is associated with epigenetic and endocrine alterations potentially affecting reproductive health in firefighters. https://doi.org/10.1097/JOM.0000000000003783

Bisphenol A in contemporary dentistry: from material chemistry and exposure pathways to potential clinical relevance-a comprehensive narrative review,
Aliberti, A., Borges, A. L. S., Piscopo, M., Garcia-Godoy, F., Orsini, G. and Ausiello, P., *Frontiers in Dental Medicine*, 2026 2026, Vol. 7, p. 1972627.

INTRODUCTION: Resin-based dental materials have substantially improved contemporary dental care while raising interest in their long-term biological safety. Attention has focused on bisphenol A (BPA), which may be associated with dental materials through BPA-derived monomers, residual impurities, or degradation processes. This narrative review critically synthesizes current evidence regarding BPA in dentistry, focusing on its origin and availability, biological implications, clinical relevance, and regulatory perspectives. METHODS: A comprehensive narrative review was conducted through a structured search of PubMed/MEDLINE, Scopus, and Web of Science from database inception to 15 July 2026. Experimental, clinical, human biomonitoring, review, and relevant regulatory evidence published in English was integrated across defined thematic domains. RESULTS: BPA availability from resin-based dental materials may reflect distinct processes, including elution of pre-existing impurities and BPA formation through chemical or biologically mediated degradation of susceptible BPA-derived monomers. Incomplete polymerization may increase the availability of residual resin constituents but does not itself generate free BPA, while ageing and wear may facilitate constituent release without necessarily producing BPA. Reported BPA concentrations vary according to material composition, experimental conditions, analytical methods, and sampling strategies. Human biomonitoring studies indicate that the largest post-treatment changes generally occur during early sampling periods, although their magnitude and temporal pattern vary with the procedure, treatment burden, biological matrix, sampling interval, and background environmental exposure. Available human evidence remains insufficient to establish a causal relationship between BPA exposure specifically attributable to dental materials and clinically relevant systemic adverse health outcomes. However, the absence of demonstrated long-term adverse outcomes should not be interpreted as definitive evidence of long-term safety, because longitudinal studies evaluating clinically relevant systemic outcomes remain limited. CONCLUSIONS: Current evidence supports a balanced and precautionary interpretation of BPA in dentistry. Clinical decision-making should consider the overall biological and clinical performance of dental materials while minimizing avoidable exposure whenever reasonably achievable. Analytical detection or experimental biological activity should not, in isolation, be interpreted as evidence of clinically meaningful harm; conversely, the absence of demonstrated adverse outcomes does not establish definitive long-term safety. Further longitudinal studies are required, particularly under repeated or cumulative exposure conditions and in potentially susceptible populations. https://doi.org/10.3389/fdmed.2026.1972627

Infertility Risk and Employment History Among US Women: Findings From National Health and Nutrition Examination Survey 2013–2014,
Benomar, C., Konkle, A. T. M. and Phillips, K. P., *American Journal of Industrial Medicine*, 2026/05/01 2026, Vol. 69, no. 5, p. 358–371.

ABSTRACT Introduction It is well established that exposure to chemical, radiological, and biological hazards in the workplace are infertility risk factors. Although workplace-specific infertility risks have been documented, the associations between employment history and infertility risk remain largely unexplored. The cross-sectional, nationally representative US National Health and Nutrition Examination Survey (NHANES) provided an opportunity to explore the relationship between employment history and infertility risk. Methods Employment history and reproductive measures are available in the NHANES 2013?2014 cycle. Infertility was assessed using self-reported, binary indicators: unsuccessful conception attempts and sought fertility consultation; combined to create a third, aggregate infertility measure. Associations between infertility risk and employment history, categorized by industry group and compared to respondents with no work history, were examined using three weighted binary logistic regression models while adjusting for sociodemographic, reproductive health, and relevant behavioral covariates. Results The sample consisted of 1126 women, aged 20 to 50 years; 1082 (96.1%) with a history of employment across 10 industry groups. Infertility was reported by 177 (17.2%), who reported unsuccessful conception attempts or fertility consultations. Across industry sectors, employment in the manufacturing of durable goods industry was significantly associated with unsuccessful conception attempts (adjusted odds ratio [AOR]: 4.15; 95% CI: 1.22, 14.08), fertility consultations (AOR: 6.94; 95% CI: 1.44, 25.25), and the aggregate infertility measure (AOR: 4.43; 95% CI: 1.32, 14.81). Conclusion Employment in durable goods manufacturing is associated with multiple self-reported infertility measures, compared to women with no work history. In the absence of individualized workplace risk assessments, industry-level analyses may better inform workplace health promotion, with emphasis on reproductive health protections. https://doi.org/https://doi.org/10.1002/ajim.70068

Per- and polyfluoroalkyl substances in occupational settings: a review,
Cambrai-Erb, A., Chalansonnet, M., Cosnier, F., Gaté, L., La Rocca, B., Mourot-Bousquenaud, M., Zerkef, R. and Grova, N., *Environmental Chemistry Letters*, 2026/09/29 2026.

Per- and polyfluoroalkyl substances (PFAS) are a large family of synthetic, persistent chemicals that are used extensively in various consumer products and industrial applications, yet there is currently no specific regulations in occupational settings. Here review the toxicity and risks associated with PFAS exposure in occupational settings, with focus on biomonitoring procedures and health effects. Biomonitoring procedures include the choice of the biological matrix, and targeted- and non-targeted approaches. Health effects comprise immunotoxicity, cardiovascular effects, carcinogenicity, hepatotoxicity, effects on the tyroid function and reproduction, and neurotoxicity. Liquid chromatography coupled with tandem mass spectrometry is widely used for biomonitoring, particularly for PFAS quantification in serum, however, such targeted approaches have so far focused only on a few congeners. Whereas some PFAS are linked to hepatotoxicity by altering liver enzymes and lipid metabolism, to immunotoxicity such as reduced vaccine antibody responses, and to carcinogenicity, for instance perfluorooctanoic acid is classified as carcinogenic to humans, toxicological data remains limited. In particular, reported results on cardiovascular, thyroid, reproductive, developmental and neurotoxic effects are less conclusive. https://doi.org/10.1007/s10311-026-01930-2

Emerging and legacy per- and polyfluoroalkyl substance (PFAS) in airborne particles in a fluorochemical industrial cluster: Occurrence, occupational exposure and health risk,
Chen, H., Xu, M., Hong, M., Kong, D., Shen, X., Chen, Z. and Zhang, Y., *Environmental Research*, 2027/01/01/ 2027, Vol. 312, p. 126185.

Per- and polyfluoroalkyl substances (PFAS) are extensively used in fluorochemical manufacturing, yet their occurrence in airborne particles and occupational health risk remain largely unknown. In this

study, 26 emerging and legacy PFAS were measured in airborne particles from 19 production units within a worldwide mega fluorochemical industrial cluster. Particle-bound PFAS concentrations ranged from <1.2 to 255,000 pg/m3, with a hotspot found associated with polytetrafluoroethylene reaction. Hexafluoropropylene oxide dimer acid (HFPO-DA, trade name "GenX") and perfluorohexanoic acid (PFHxA) were the predominant substances detected. The fingerprint of PFAS profile in particles was characterized by a one-substance dominance by HFPO-DA or perfluorobutanoic acid (PFBA) or PFHxA in most locations. Exposure through inhalation was estimated to be 0.1 to 19,400 pg/kg/day. Non-carcinogenic risk was screened for 9 PFAS with available reference dose and higher risk was noted for HFPO-DA and perfluorooctanoic acid (PFOA). The hazard index representing their sum risk was 4.7 × 10−3 to 8.3, with high risk at a location associated with polytetrafluoroethylene reaction. The carcinogenic risk for PFOA was estimated to be 1.3×10−8–1.5 × 10−3 among the production locations, of which six locations exceeded the risk screening level. The potential health concern warrants attention and reinforces the need for protective measures. https://doi.org/https://doi.org/10.1016/j.envres.2026.126185

Association of perfluoroalkyl and polyfluoroalkyl substances with polyendocrine metabolic ovarian syndrome and endocrine abnormalities: A case-control study,
Cheng, G., Li, F., Li, H., Li, Y., Cao, Y., Liu, Y., Huang, D., Liu, W., Xin, M., Miao, H., Zhai, Y. and Cao, Z., *Clinica Chimica Acta*, Mar 15 2027, Vol. 594.

Background Polyendocrine metabolic ovarian syndrome (PMOS) is a systemic endocrine and metabolic disorder that has been increasingly linked to exposure to environmental endocrine-disrupting chemicals. Although perfluoroalkyl and polyfluoroalkyl substances (PFASs) have been implicated as potential contributors, the combined health effects of PFASs mixtures and the potential pathways linking PFAS exposure to endocrine abnormalities remain incompletely understood. Methods In this hospital-based case-control study, 109 women with PMOS and 96 healthy controls were recruited. Serum concentrations of 19 PFASs were measured using ultra-high-performance liquid chromatography coupled with tandem mass spectrometry (UPLC-MS/MS), and 11 PFASs congeners with detection frequencies exceeding 80% were included in subsequent analyses. Bayesian logistic regression and dose response analyses were used to evaluate the associations of individual PFASs with PMOS risk and endocrine biomarkers, while generalized additive models were used to characterize potential nonlinear exposure response relationships. The combined effects of PFASs mixtures were evaluated using quantile g-computation (Qgcomp) and weighted quantile sum (WQS) regression. Propensity score overlap weighting was used in sensitivity analyses to assess the robustness of the findings with respect to baseline differences in age and BMI. Exploratory mediation analyses were conducted using circulating hormone ratios related to steroidogenesis as surrogate markers to evaluate potential statistical indirect effect signals. Results Eleven PFASs were included in the statistical analyses: PFBA, PFOA, PFBS, PFPeS, PFTrDA, PFHpS, PFOS, PFDS, PFHxS, PFNA, and 6:2 Cl-PFESA. PFDS, PFBA, PFHxS, and 6:2 Cl-PFESA were associated with higher PMOS risk and elevated total testosterone (TT) levels, whereas PFPeS, PFTrDA, and PFDS were associated with a lower FSH/LH ratio. Mixture analyses consistently showed that combined PFASs exposure was associated with higher PMOS risk, elevated TT levels, and a lower FSH/LH ratio. PFDS showed the largest relative contribution to the mixture associations with PMOS risk and TT levels, whereas PFTrDA showed the largest relative contribution to the association with a lower FSH/LH ratio. Sensitivity analyses using overlap weighting were broadly concordant with the primary analyses. The overall association between PFASs mixtures and PMOS remained statistically significant after overlap weighting (beta = 0.57, 95% CI: 0.44-0.69). In addition, the inverse associations of PFTrDA, PFPeS, and PFDS with the FSH/LH ratio and the positive associations of PFDS and 6:2 Cl-PFESA with TT remained statistically significant. Exploratory mediation analysis identified a statistically significant indirect effect involving the circulating DHT/TT ratio, which was used as an exploratory surrogate marker of androgen

conversion related to SRD5A. This indirect effect accounted for 25.9% of the association between PFDS and PMOS. Conclusions PFASs mixture exposure was associated with higher PMOS risk, elevated TT levels, and a lower FSH/LH ratio. PFDS and PFTrDA showed relatively large contributions to the observed mixture associations. Exploratory mediation analysis further identified an indirect effect involving the circulating DHT/TT ratio in the association between PFDS and PMOS; however, the biological relevance of this finding requires further mechanistic validation. https://doi.org/10.1016/j.cca.2026.121314

Assessment of per- and polyfluoroalkyl substances (PFAS) exposure in Korean firefighters by serum analysis,
Choi, S. and Oh, J.-E., *Environmental Geochemistry and Health*, 2026/10/20/ 2026, Vol. 48, no. 16, p. 647.

This study assessed serum concentrations of seven per- and polyfluoroalkyl substances (PFAS) in Korean firefighters and the general population to characterize exposure levels, compositional profiles, and associated demographic, occupational, and lifestyle factors. The median serum concentration of perfluorooctanoic acid (PFOA) was significantly higher in firefighters (6.60 ng/mL) than in the general population (3.84 ng/mL) (Mann-Whitney U test, p < 0.01). PFOA accounted for the largest proportion of total PFAS in firefighters, whereas perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS) were more prominent in the general population. Principal component analysis showed substantial overlap between the groups, with PFOA and selected long-chain perfluoroalkyl carboxylic acids contributing more strongly to variability among firefighters. In firefighters, length of service was positively correlated with several PFAS in univariate analyses, while primary multivariable analyses showed positive associations with perfluorononanoic acid (PFNA) and PFHxS, although these associations were attenuated in sensitivity analyses using alternative covariate specifications. In the general population, selected associations with age, height, and walking or strolling time also persisted after adjustment. These findings indicate differences in PFAS exposure patterns and associated factors between the two groups and underscore the importance of considering occupational characteristics in exposure assessment and management. https://doi.org/10.1007/s10653-026-03547-4

Associations between maternal occupational history and autism spectrum disorder diagnosis in offspring in Denmark,
Dickerson, A. S., Liu, Y., Ladd-Acosta, C., Wang, J., Schendel, D., Weisskopf, M. G., Fallin, M. D. and Hansen, J., *Occupational and Environmental Medicine*, 2026, Vol. 83, no. 3, p. 130–137.

Objectives We investigated associations between maternal occupations and a diagnosis of autism spectrum disorder (ASD) in offspring.Methods We obtained data for 1702 ASD cases born between 1973 and 2012 from the Danish National Patient Registry and matched each case to up to 100 population based controls based on sex and birth year (n=110 234). Mothers' employment histories were obtained from the Danish Pension Fund Registry. Conditional logistic regression models were used to test associations between occupations held ever, 1 year before conception, during pregnancy and during infancy, adjusting for the mother's age and history of neuropsychiatric disorders, parity and residential location.Results There were increased odds of having a child with ASD for mothers who were employed before conception up to infancy in ground transportation (adjusted OR (aOR) 1.24, 95% CI 1.08 to 1.42; q=0.036), public administration (aOR 1.20, 95% CI 1.07 to 1.35; q=0.018) and military/defence occupations (aOR 1.59, 95% CI 1.39 to 1.82; q<0.001). Associations for judicial occupations and military/defence service were also apparent 1 year before conception and during pregnancy. We observed sex differences, with significant associations in male children for employment in ground transportation and defence occupations.Conclusions Associations between

certain maternal employment categories with high toxicant or psychosocial stress exposure suggest future studies should focus on examining specific toxicant exposures common in those occupations and neurodevelopment in offspring. This is of particular concern for associations seen for occupations held several years before conception.Data may be obtained from a third party and are not publicly available. These data are not publicly available and cannot be shared by the authors. However, qualified researchers may apply for access to the data through the appropriate Danish authorities. Information on the application process can be found through Statistics Denmark (www.dst.dk) and the Danish Health Data Authority (www.sundhedsdatastyrelsen.dk). https://doi.org/10.1136/oemed-2026-110912

Assessing occupational exposure to imidacloprid among animal shelter workers using human biomonitoring,
Doherty, D. M., Wrobel, S. A., Lee, S., Koch, H. M., Käfferlein, H. U., Bury, D., Kelly, R., Slattery, C. and Connolly, A., *Environmental Toxicology and Pharmacology*, 2026/12/01/ 2026, Vol. 128, p. 105232.

Imidacloprid (IMI) is a neonicotinoid insecticide used as an ectoparasite treatment for pets in professional and home-use settings. Animal shelter workers apply these treatments to pets in their care and often use multiple ectoparasite treatments per day, resulting in a potential for occupational IMI exposure. To assess IMI exposures among animal shelter workers, human biomonitoring approaches were adopted, with multiple individual spot urine samples collected over 24- or 48-hour periods from eight full-time animal shelter workers. Samples were analysed for IMI and its metabolites, IMI-olefin and OH-IMI, to assess occupational exposure to IMI. Study results show that animal shelter workers had elevated urinary concentrations of IMI and metabolites compared to a previous general population study, with concentrations comparable to pet owners using the same products. However, all urinary concentrations were below 1.4% of the Acceptable Operator Exposure Level, indicating low-level exposures among the study cohort. https://doi.org/https://doi.org/10.1016/j.etap.2026.105232

Biomonitoring of organic compounds in Turin waste-to-energy plant workers, Italy,
Farina, E., Iamiceli, A. L., Bena, A., Ivaldi, C. and Gandini, M., *Occupational Medicine*, 2026.

Third-generation waste-to-energy (WTE) plants represent a technological advancement introduced in recent years for the treatment of municipal solid waste. Although Best Available Technologies (BAT) are employed, potential health effects on both residents and workers remain a public health concern and warrant continuous monitoring. The Turin WTE came into operation in 2013 and a human biomarker measurement (HBM) study was set up.To assess the potential occupational exposure to persistent organic pollutants of a cohort of workers at the WTE plant using a longitudinal approach.Serum concentrations of polychlorinated dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs) and polychlorinated biphenyls (PCBs) were measured at baseline (T0), before plant start-up and after 3 years of operation (T2) in 25 workers permanently employed at the facility. In addition, a cross-sectional sample of 13 subcontractor personnel potentially exposed to ash was included (Tx). Tests were performed for paired temporal comparisons and intergroup analyses (T2 versus Tx).Considering permanent workers, serum concentrations of PCDDs, PCDFs and PCBs after 3 years of activity (T2) were not significantly higher than baseline levels (T0), with median values always below occupational reference limits. The Tx group showed slightly elevated concentrations of Σ6NDL-PCBs and Σ30NDL-PCBs compared to the T2 group, although these differences were not statistically significant. The increase is likely attributable to specific maintenance tasks involving direct contact with ash or residual materials.A very low level of occupational exposure to organic compounds was found in this context. https://doi.org/10.1093/occmed/kqag081

Temporal Variability of Urinary Organophosphate Flame Retardant Metabolites Among E-Waste Workers in France: A Pilot Study to Inform Occupational Biomonitoring Sampling Design,
Habchi, B., Antoine, G., Martin Remy, A., Zimmermann, F., Lecler, M.-T., Esteve, W., Emond, C., Grova, N. and Ndaw, S., *Toxics*, 2026, Vol. 14, no. 9, p. 778.

Workers in the e-waste industry are exposed to chemical hazards, including organophosphate esters (OPEs) used as flame retardants (FRs). Assessing exposure through spot urine metabolite analysis is challenging due to limited knowledge of the toxicokinetics and urinary excretion patterns of OPEs. This pilot study investigates the temporal variability of seven organophosphate flame retardants (OPFRs) in urine samples from e-waste workers over five workdays to identify the most representative spot urine sample for accurately assessing occupational exposure. Six exposed workers provided urine samples from the first shift of the working week to the morning after the last workday. Seven metabolites, (bis(2-chloroethyl) phosphate (BCEP), diphenyl phosphate (DPHP), di-o-cresyl phosphate (DoCP), di-m-cresyl phosphate (DmCP), di-p-cresyl phosphate (DpCP), bis(1,3-dichloro-2-propyl) phosphate (BDCPP) and bis-(1-chloro-2-propyl) phosphate (BCPP)), were analyzed using liquid chromatography-mass spectrometry. DmCP + DpCP showed weekly increases and fair to good intraclass correlation coefficient (ICC), indicating moderate temporal variability across days. Conversely, DPHP and BCEP showed rapid decreases and lower ICC, suggesting higher intra-day variability. A grouping approach based on collection time and workday showed that the suitable spot urine is 2–5 h delayed post-shift for BCEP and DPHP, whereas the end of the workweek is the most appropriate time for DmCP + DpCP. This pilot study provides preliminary information on temporal variability to inform sampling design. This approach could be extended to a broader range of FRs, thereby enhancing the efficiency and accuracy of occupational biomonitoring.
https://www.mdpi.com/2305-6304/14/9/778

Association of combined exposure to polycyclic aromatic hydrocarbons, BTX and metals with metabolic syndrome risk,
Hao, X., Zhao, X., Gu, Z., Yang, B., Zhang, D., Zhao, R., Guo, X., Cheng, Z., Wang, G., Li, X., Zhao, J., Li, Z., Zhao, X., Wang, P. and Wang, W., *Environmental Pollution*, Nov 1 2026, Vol. 408.

Despite the increasing prevalence of metabolic syndrome (MetS) worldwide, its environmental determinants in complex occupational settings remain unclear. This study aimed to evaluate the associations between occupational mixed exposure to polycyclic aromatic hydrocarbons (PAHs), benzene, toluene, and xylene (BTX), and metals and MetS risk, and identify key pollutants for occupational health monitoring and risk management. We recruited 1205 coal chemical workers in central China and measured urinary levels of 14 PAH metabolites, 6 BTX metabolites, and 40 metals. Associations between mixed exposures and MetS and its components were analyzed using weighted quantile sum (WQS) regression and restricted cubic spline (RCS) models.Among the participants, 245 individuals (20.33%) were diagnosed with MetS. Exposure to PAH mixtures was significantly associated with an increased risk of MetS (OR = 1.28, 95% CI: 1.08, 1.52). Mixed exposure to BTX and PAHs further increased MetS risk (OR = 1.77, 95% CI: 1.35, 2.31). Notably, mixed exposure to PAHs, BTX, and metals was associated with a substantially increased risk of MetS (OR = 3.49, 95% CI: 2.38, 5.18), exceeding the effects observed for individual chemical groups.The study identified 9-hydroxyfluorene (9-OHFlu) and zinc (Zn) as key pollutants contributing to MetS risk among workers. Similar associations were observed for MetS components (high fasting glucose, triglycerides, low high-density lipoprotein cholesterol (HDL-C), high blood pressure). Mixed exposure to PAHs, BTX, and metals increased MetS risk more than single pollutants. 9-OHFlu and Zn were identified as key contributors, highlighting their importance for future occupational health monitoring and risk management. https://doi.org/10.1016/j.envpol.2026.128939

m6A RNA methylation at the nexus of nickel-cobalt-manganese cathode material hazards,
He, K. and Wang, Y., *Journal of Hazardous Materials Letters*, Nov 2026, Vol. 7.

The rapid expansion of lithium-ion battery technologies has markedly increased global demand for nickel (Ni), cobalt (Co), and manganese (Mn), critical components of layered LiNixCoyMnzO2 (NCM) cathode materials used in new energy vehicles and energy storage systems. Although these energy-transition metals are indispensable for decarbonization efforts, their intensified extraction, refining, manufacturing, recycling, and disposal raise growing concerns regarding occupational and environmental exposure. Increasing evidence indicates that Ni, Co, and Mn induce diverse adverse health effects, including neurotoxicity, reproductive dysfunction, pulmonary injury, and metabolic disorders, primarily through disruption of redox homeostasis. Beyond the well-established roles of oxidative stress, mitochondrial dysfunction, and DNA damage, emerging studies identify N6-methyladenosine (m6A) RNA modification as a critical post-transcriptional mechanism underlying metal-induced toxicity. As the most abundant internal modification in eukaryotic messenger RNA, m6A dynamically regulates RNA splicing, stability, translation, and degradation through coordinated actions of methyltransferases ("writers"), demethylases ("erasers"), and m6A-binding proteins ("readers"). Exposure to Ni, Co, and Mn alters the expression and activity of key m6A regulators, including METTL3, METTL14, METTL16, FTO, ALKBH5, YTHDF proteins, and YTHDC family members, leading to widespread epitranscriptomic reprogramming. Here, we synthesize current evidence demonstrating that these metals exploit m6A-dependent pathways to drive neuroinflammation, ferroptosis, autophagy impairment, mitochondrial dysfunction, aberrant iron metabolism, defective spermatogenesis, ribosome biogenesis disorders, and malignant transformation. We further highlight the bidirectional interplay between m6A signaling and redox-responsive pathways, including hypoxia-inducible factor signaling, oxidative stress responses, and mitochondrial quality control. Collectively, this review positions m6A modification as a redox-sensitive regulatory hub linking exposure to critical battery metals with adverse health outcomes. Elucidating m6A-mediated mechanisms may facilitate the identification of novel biomarkers for mitigating health risks associated with the accelerating global transition toward electrification. https://doi.org/10.1016/j.hazl.2026.100196

The Fate of Per- and Polyfluoroalkyl Substances (PFAS) in Municipal Solid Waste Incineration: Atmospheric Emissions from a Waste-to-Energy Plant,
Hofman, J., Peters, J., Jacobs, G., Carvalho, A. R. D., Bergh, G. V. D., Baeyens, B., Aerts, W., Van Laer, J., Moonen, N., Lefebvre, W., Berghmans, P., Voorspoels, S. and Otten, G., *Environmental Science & Technology*, 2026/11/03/ 2026, Vol. 60, no. 43, p. 30767–30779.

The atmospheric fate of per- and polyfluoroalkyl substances (PFAS) represents a very recent field of research. While ISO and CEN standards are yet under development, PFAS have been identified during the past years in atmospheric emissions, ambient air, and deposition. As high-quality field data are currently scarce, the objectives of this study were to (i) characterize atmospheric PFAS emissions of a state-of-the-art waste-to-energy (WtE) plant under representative operational conditions and (ii) evaluate the emission impact in ambient air in the vicinity of the plant. Results suggest a contribution from the WtE plant at the nearest ambient monitoring location, 450 m downwind of the plant, with a measurable contribution and distinct PFAS fingerprint closely matching the emission profiles independently characterized at two grate incinerator lines. Quantified PFAS emissions do not exceed the temporary assessment framework for ambient air in Flanders. Furthermore, optimization of the activated carbon (AC) dosage achieved a 95% reduction in emissions at line 1, with subsequent emission levels approaching those of field blanks. The waste treatment sector represents a critical frontier of environmental management. Building experimental evidence of potential PFAS releases will be key to ensure comprehensive strategies for responsible PFAS management in the years ahead. https://doi.org/10.1021/acs.est.6c05879

Advances in biomarkers of benzene exposure and toxicity: From mechanistic insights to occupational health applications (Review),
Huang, Y., Xi, Z., Mao, J. and Li, X., *Molecular Medicine Reports*, Nov 2026, Vol. 34, no. 5.

Benzene is a toxic aromatic hydrocarbon widely used in industrial production, posing a notable occupational health threat. Classified as a Group 1 carcinogen, chronic benzene exposure primarily targets the hematopoietic system, causing leukopenia, thrombocytopenia, aplastic anemia and acute myeloid leukemia. Furthermore, emerging evidence highlights its multi-systemic toxicity, inducing oxidative stress, DNA damage and cellular dysfunction, across the nervous, respiratory, dermatological, reproductive, immune and cardiovascular systems. The present review systematically summarizes recent advances in these occupational hazards and the evolving landscape of benzene biomonitoring. Traditional exposure biomarkers, such as urinary phenol and hydroquinone, are increasingly being supplemented by highly specific metabolites, notably S-phenylmercapturic acid, for low-dose exposure assessments. Effect biomarkers capture early biological damage through hematological indices and molecular alterations, while susceptibility biomarkers, such as cytochrome P450 2E1, glutathione S-transferase mu 1 and DNA repair gene polymorphisms, identify genetically vulnerable populations. Additionally, emerging non-invasive tools, particularly exhaled breath metabolomics, show promise in correlating specific metabolites with hematopoietic function. By integrating mechanistic insights into multi-organ toxicity with advanced multi-omics profiling, the present review highlights a critical paradigm shift from reactive traditional monitoring to artificial intelligence-driven, multi-biomarker integration frameworks. Ultimately, it provides a forward-looking roadmap for individualized risk stratification and precision occupational health surveillance in the low-dose exposure era. https://doi.org/10.3892/mmr.2026.14028

Investigation of Exposure to Plasticizers Among Electronic Waste Recycling Workers and Their Health: Protocol fora Cross-Sectional Study,
Ketema, R., Le, T., Nguyen, S., Ngo, H., Zeng, Y., Yasuda, A., Marsela, M., Minatoya, M., Le, T., Ta, B., Pham, V., Nguyen, H., Pham, T., Tran, H., Ha, P., Phan, C., Bamai, Y., Kishi, R. and Ikeda, A., *Jmir Research Protocols*, 2026 2026, Vol. 15.

Background: The global consumption of electronic and electrical products has increased the generation of electronic waste (e-waste), which poses environmental and public health concerns. In Vietnam, informal e-waste processing, characterized unregulated collection and dismantling, is widespread and exposes workers to hazardous substances. However, data on the health status of e-waste workers remain limited, and exposure to phthalates, which are endocrine-disrupting chemicals widely used electronics, has not yet been evaluated. Objective: This study aims to assess the health status of e-waste workers in Vietnam, measure their phthalate exposure levels, and examine associations with health outcomes. Methods: We conducted a cross-sectional study of adult e-waste workers in Bui village, Vietnam. Trained staff collected demographic, occupational, respiratory, and dietary habit information using a structured questionnaire in Vietnamese. Medical examinations were performed and body composition measurements, blood samples, and urine samples were obtained. Blood samples were analyzed for hematological parameters and several biochemical markers; urine samples were collected for routine urinalysis parameters and phthalate quantification. Results: Field survey data were collected in March 2025, and 253 e-waste workers were recruited. Preliminary descriptive analysis indicated that most participants were female, had low income, and relied on e-waste processing as their primary income. Personal protectiveequipment, particularly dust masks and gloves, was commonly used. Laboratory measurements of urinary phthalate metabolites were completed by November 2025. Conclusions:This protocol provides a framework for evaluating the health status, metabolic indicators, and phthalate exposure among e-waste workers in Vietnam and

supports occupational health evaluation. The preliminary findings highlight thefeasibility of this study, which supports the evaluation of occupational exposure and health outcomes. https://doi.org/10.2196/96702

Toxic and explosive risks in pharmacy: An underestimated reality,
Larioui, K., Khoukh, K., Zekri, S. and Bruno, F., *Presse Medicale*, Sep 2026, Vol. 55, no. 3.

Pharmacists, while central to medication safety, face underestimated risks due to their daily exposure to toxic and explosive substances. In compounding pharmacies, handling carcinogenic, mutagenic, and reprotoxic (CMR) substances such as chemotherapy drugs, anesthetic gases, antibiotics, and hormones poses significant health hazards. These substances can cause environmental and secondary contamination through fine powder dispersion or volatile vapors, leading to indirect exposure even with standard protective gear. Explosive and fire risks also abound, especially with volatile solvents like ethanol, acetone, and ethyl ether. These substances are flammable and require careful storage and handling. Accidental chemical reactions, such as the mixing of acids and bases or contact between unstable compounds like picric acid and friction, can result in toxic gas release or explosions. To mitigate these dangers, pharmacies must implement strict preventive measures. This includes the use of fume hoods, appropriate personal protective equipment (PPE), and standardized protocols for hazardous drug preparation. Flammable substances must be stored in ventilated, ATEX-compliant cabinets, and chemicals clearly labeled with updated safety data sheets (SDS). Safe waste management and continuous staff training are also essential. Current challenges, such as drug shortages, force pharmacies to work with unfamiliar raw materials, increasing the risk of accidents. A notable example is potassium clavulanate, a fine powder prone to dust explosions if not carefully managed. Ultimately, ensuring pharmacist safety requires a culture of vigilance, continuous education, and adherence to safety protocols to manage both toxicological and explosive risks effectively. https://doi.org/10.1016/j.lpm.2026.104364

The impact of short-term exposure to volatile hydrocarbons on fertility: Findings from the Gulf Long-term Follow-up Study,
Noga, R., Thistle, J., Kamai, E., Stewart, P., Stenzel, M., Jackson, W. I., Christenbury, K., Kwok, R., Lawrence, K., Sandler, D., Engel, L. and Engel, S., *International Journal of Hygiene and Environmental Health*, Sep 2026, Vol. 278.

Petrochemicals benzene, toluene, ethylbenzene, xylene, n-hexane (BTEX-H) and total hydrocarbons (THC) have been linked to adverse reproductive health outcomes, yet few studies have examined their impact on fertility, particularly among oil spill response and clean-up (OSRC) workers. Using data from the Gulf Long-Term Follow-Up (GuLF) Study, a prospective cohort of OSRC workers and non-workers associated with the 2010 Deepwater Horizon disaster clean-up, we evaluated associations between BTEX-H and THC inhalation exposures and post-spill subfertility among 2671 male and 618 female OSRC workers Subfertility was defined as a self-reported infertility diagnosis and/or failure to conceive after 12 months of attempts. Cumulative and maximum daily average exposures to each BTEX-H constituent (ppb-days) and THC (ppm-days) were estimated via job-exposure matrixes combining air monitoring data with detailed Deepwater Horizon disaster-related work histories. Modified Poisson regression models estimated multivariable adjusted risk ratios for subfertility in relation to BTEX-H components, total BTEX, non-BTEX THC, and THC. Among male workers, higher cumulative daily average BTEX-H (RR = 1.14, 95% CI 0.98, 1.32) and THC (RR = 1.18, 95% CI 1.06, 1.31) exposures were associated with monotonically increasing subfertility risk. Among females, associations were less evident; however, increased risk was present for maximum daily average exposures to toluene and total BTEX. Overall, BTEX-H and THC exposures were associated with increased risk of subfertility among male workers, with suggestive evidence of similar associations in female workers. These

findings highlight potential reproductive risks linked with OSRC work. https://doi.org/10.1016/j.ijheh.2026.114906

Tetrabromobisphenol A (TBBPA) in e-waste and e-waste recycling/dismantling sites: Endocrine disruption, ecotoxicological and human health risks, remediation strategies, and policy recommendations,
Okeke, E. S., Emmanuel, S. S., Ezeorba, T. P. C., Enochoghene, A. E., Okeke, V. C., Eze, C. T., Feng, W., Mao, G., Chen, Y. and Wu, X., *Journal of Environmental Chemical Engineering*, 2026/02/01/ 2026, Vol. 14, no. 1, p. 120797.

Tetrabromobisphenol A (TBBPA) is the most widely used brominated flame retardant in electronic products, and its persistence, endocrine-disrupting potential, and bioaccumulative behavior make it a growing environmental and public-health concern. Rapid expansion of the e-waste recycling sector—particularly in developing countries where informal dismantling practices dominate—has intensified TBBPA release into soil, water, air, and food chains. This review synthesizes current evidence on TBBPA levels in e-waste recycling/dismantling sites, its environmental fate, and its ecotoxicological and human-health impacts. In contrast to previous reviews, this work provides a comprehensive global assessment, integrates recent data on TBBPA derivatives and transformation products, and offers comparative insights between formal and informal recycling settings, revealing considerably higher exposure risks in developing regions. The review also highlights documented neurotoxicity, thyroid disruption, reproductive harm, and immunological effects in exposed workers and biota. Finally, we summarize emerging remediation strategies and present policy recommendations tailored to high-risk e-waste regions. These insights aim to guide improved risk management and support safer, more sustainable e-waste recycling practices. https://doi.org/https://doi.org/10.1016/j.jece.2025.120797

Trace element dynamics and male fertility: A narrative review on lead, iron, and zinc,
Parameswari, R., Kumar, P., Kasthuri, K., Ganesamoorthy, R., Babujanarthanam, R., Sridharan, T., Abilash, D. and Thirugnanasambandham, K., *Journal of Trace Elements and Minerals*, Dec 2026, Vol. 18.

Background: Male infertility is an increasing global health concern, with growing evidence highlighting the role of essential trace elements and toxic metals in male reproductive physiology. Zinc and iron are critical for spermatogenesis, redox homeostasis, and endocrine regulation, whereas lead is a persistent environmental contaminant with well-established reproductive toxicity. Escalating industrialization, environmental pollution, and occupational exposures have intensified human contact with these metals, underscoring the need for a transparent and integrative evaluation of their biological and clinical relevance to male fertility. Objective: This narrative review aims to synthesize and critically evaluate current evidence on the effects of lead (Pb), iron (Fe), and zinc (Zn) on male reproductive health, with emphasis on trace element homeostasis, exposure-related reproductive outcomes, and underlying molecular mechanisms. Materials and methods: A structured narrative literature review was conducted using PubMed, Scopus, and Web of Science to identify studies published between January 2000 and December 2025. Titles and abstracts were screened for relevance to trace elements, metal exposure, and male reproductive outcomes. Duplicate records and overlapping datasets were excluded. Full-text articles were assessed based on exposure characterization, methodological rigor, and relevance of fertility-related endpoints. Human clinical and epidemiological studies were prioritized, while animal and in vitro studies were included selectively to support mechanistic interpretation. Results: Human studies consistently associate lead exposure with impaired sperm motility, abnormal morphology, increased DNA fragmentation, and endocrine disruption. Iron demonstrates a concentrationdependent role, supporting mitochondrial

function and spermatogenesis at physiological levels, but promoting oxidative stress and hormonal imbalance when dysregulated or excessive. Zinc plays a central role in sperm chromatin stabilization, testosterone biosynthesis, and sperm maturation, with deficiency strongly linked to reduced semen quality and reproductive potential. Conclusion: This review highlights the importance of maintaining trace element balance for male reproductive health. Integration of clinically relevant evidence with mechanistic insights indicates that both toxic metal exposure and imbalance of essential trace elements contribute significantly to male infertility. Clinical and nutritional significance: Optimizing zinc and iron status while minimizing lead exposure may offer practical strategies for improving sperm quality, hormonal regulation, and overall male fertility potential. https://doi.org/10.1016/j.jtemin.2026.100338

Occupational Organophosphorus Pesticide Exposure and Metabolic Syndrome: Implications of PPARγ,
Sakr, S., Eldaly, M., Elshamy, R., Almadani, N., Nofal, H., Hammad, S., Eldesoqui, M. and Soliman, W., *Toxics*, Sep 6 2026, Vol. 14, no. 9.

Organophosphorus pesticides (OPPs) are widely used and have recently been linked to metabolic syndrome (MS). This study aimed to investigate the probable association between chronic OPP exposure and MS among farm workers in Sharkia Governorate, Egypt, and to assess the potential role of peroxisome proliferator-activated receptor gamma (PPAR gamma). This comparative cross-sectional study included 140 participants, equally divided into OPP-exposed farm workers and non-exposed subjects. OPP exposure was confirmed by detecting plasma residues and cholinesterase activity. MS was diagnosed by assessing body mass index (BMI), waist circumference (WC), blood pressure, plasma glucose, serum insulin, and lipid parameters. Oxidative and inflammatory markers, including malondialdehyde (MDA), gamma-glutamyl transferase (GGT), ferritin, superoxide dismutase (SOD), tumor necrosis factor-alpha (TNF-alpha), and high-sensitivity C-reactive protein (hs-CRP), were measured. The mRNA expression of the PPAR gamma and paraoxonase 1 (PON1) genes was also investigated. In total, 60% of farm workers demonstrated MS, compared with 10% of non-exposed participants. Workers exhibited elevated oxidative and inflammatory indices and reduced PPAR gamma and PON1 expression. PPAR gamma positively correlated with high-density lipoprotein (HDL), SOD, and PON1, while negatively correlating with glucose, insulin resistance (IR), low-density lipoprotein (LDL), triglycerides (TGs), MDA, GGT, ferritin, TNF-alpha, and hs-CRP. The study concluded that chronic OPP exposure was associated with increased oxidative stress and inflammation, reduced PPAR gamma and PON1 expression, disturbed glucose and lipid metabolism, and increased IR. The observed associations between PPAR gamma downregulation, metabolic disturbances, and oxidative and inflammatory markers suggest that PPAR gamma dysregulation may represent a potential mechanistic link between chronic OPP exposure and MS. However, this proposed mechanism requires further validation. https://doi.org/10.3390/toxics14090788

P23-03 Untargeted Metabolomics Reveals Endocrine Disruption and Inflammatory Lipid Signaling in E-Waste Workers,
Sanajou, S., Kaplan, O., Muhammetli, S., Koç, E., Demir, C., Celebier, M., Girgin, G. and Baydar, T., *Toxicology Letters*, 2026/09/01/ 2026, Vol. 423, p. 112599.

Workers involved in e-waste recycling are chronically exposed to mixtures of hazardous metals, including lead, cadmium, and antimony, yet the biological consequences of long-term mixed exposure remain poorly understood. To capture these early systemic effects, we applied an untargeted serum metabolomics approach to characterize exposure-related biochemical disturbances in recycling workers. In this pilot cross-sectional study, serum samples from 30 e-waste recycling workers and 30 non-exposed controls were analyzed by LC-QTOF-MS in negative ionization mode. Multivariate

modeling was used to assess group separation, and metabolites that contributed most strongly to discrimination were selected based on VIP scores >1.0. Hierarchical clustering and pathway enrichment analysis were then used to define the major metabolic pathways associated with occupational exposure. A distinct metabolic profile was observed in exposed workers compared with controls. Twenty discriminatory metabolites were identified, and the separation between groups was supported by both unsupervised and supervised analyses. The most prominent feature was a coordinated decrease in steroid-related metabolites, including pregnenolone, corticosterone, tetrahydrocortisol, and 17-hydroxyprogesterone, indicating impaired steroidogenic activity. In parallel, alterations in inflammatory and oxidative stress-related lipid mediators, including thromboxane B2, prostaglandins, and hydroxyeicosatetraenoic acids, pointed to activation of pro-inflammatory signaling. Pathway enrichment analysis identified steroid hormone biosynthesis ($p < 0.001$) and arachidonic acid metabolism ($p < 0.01$) as the leading
perturbed pathways. Additional disturbances were observed in bile acid metabolism, polyamine biosynthesis, mitochondrial energy metabolism, and redox-associated pathways. Occupational exposure in e-waste recycling appears to be associated with a coordinated endocrine-inflammatory-metabolic signature characterized by suppression of steroidogenesis and dysregulation of lipid-mediator pathways. These findings provide mechanistic insight into the systemic effects of heavy metal mixtures and support untargeted metabolomics as a promising strategy for early monitoring of biological effects and future biomarker development in exposed worker populations.
https://doi.org/10.1016/j.toxlet.2026.112599

Occupational cadmium exposure and endocrine biomarker alterations in male workers: a cross-sectional study,
Vardar, D., Tutkun, L., Iritas, S., Gözükara, M., Abusoglu, G., Deniz, S., Türksoy, V. and Tutkun, E., *Bmc Endocrine Disorders*, Sep 28 2026, Vol. 26, no. 1.

Background Occupational exposure to cadmium (Cd) remains an important environmental health concern, particularly in industrial settings where long-term exposure may affect multiple physiological systems. Although Cd has been linked to reproductive and cardiovascular toxicity, human studies that simultaneously evaluate biomarkers of endocrine and endothelial dysfunction remain limited. This cross-sectional study examined the association between occupational Cd exposure and hormonal and endothelial biomarkers in adult male workers. Methods This cross-sectional study included 170 men, comprising 85 cadmium-exposed workers and 85 unexposed controls. Urinary cadmium concentrations were measured by inductively coupled plasma mass spectrometry (ICP-MS). Serum levels of total testosterone, luteinizing hormone (LH), follicle-stimulating hormone (FSH), asymmetric dimethylarginine (ADMA), symmetric dimethylarginine (SDMA), arginine, and citrulline were measured using standard laboratory methods. Group comparisons and correlation analyses were conducted to assess associations between cadmium exposure and biomarker profiles. Results Cadmium-exposed workers had substantially higher urinary Cd concentrations than controls and higher ADMA and SDMA levels (both $p < 0.001$). In contrast, total testosterone, FSH, and the arginine/ADMA ratio were significantly lower in the exposed group, while LH showed a smaller but statistically significant reduction. Urinary Cd was inversely correlated with total testosterone and FSH, indicating that a higher internal cadmium burden was associated with less favorable endocrine biomarker profiles. Conclusions Occupational cadmium exposure was associated with concurrent changes in endocrine and endothelial biomarkers among male workers. These findings suggest that combined assessment of endocrine and endothelial biomarkers may be useful for occupational monitoring of workers with chronic cadmium exposure. https://doi.org/10.1186/s12902-026-02605-3

Industrial sector fingerprinting: Cross-media characterization and risk assessment of organophosphorus compounds,
Wang, H., Lin, M., Sun, F., Xiao, W. and Wang, S., *Environmental Research*, 2026/12/15/ 2026, Vol. 311, p. 126149.

Sector-specific contamination profiles of organophosphorus compounds (OPCs) from undocumented industrial sources remain largely unexplored. This study employed an integrated analytical strategy combining target, suspect, and nontarget screening to characterize and prioritize OPC contaminations across multimedium samples (wastewater, sludge, soil, and atmospheric particulates) collected from electronics, plastics, electroplating, and pharmaceutical sectors. Total concentration of organophosphate esters (Σ18OPEs) spanned four orders of magnitude: wastewater (56–35,799 ng/L), sludge (21–572 ng/g dw), soil (12–776 ng/g dw), and atmospheric particulates (198–148,928 ng/g). Compound distribution exhibited distinct sectoral fingerprints: triethyl phosphate (TEP) and diphenyl phosphate (DPHP) dominated plastics and electronics, whereas tris(1-chloro-2-propyl) phosphate (TCIPP) and bis(1-chloro-2-propyl) phosphate (BCIPP) prevailed in electroplating sectors. Tris(2-butoxyethyl) phosphate (TBOEP) and bis(2-ethylhexyl) phosphate (BEHP) emerged as pharmaceutical sector indicative compounds. Suspect/nontarget analysis identified 28 emerging OPCs, including 11 tri-esters, 3 di-esters, 2 organothiophosphates, 3 phosphonates, 3 phosphine oxides, and 1 organophosphate antioxidant, with 10 compounds firstly documenting in industrial wastewater. ToxPi-based prioritization coupled with hazard assessment revealed significant ecological risks from emerging OPCs. This work identified pharmaceutical and electroplating industries as potentially under-recognized sources of OPC emissions and established a scientific foundation for differentiated sectoral control strategies. https://doi.org/https://doi.org/10.1016/j.envres.2026.126149

Mixed Exposure to Underground Air Pollutants and Metabolic Syndrome in Coal Miners: A Cross-Sectional Study Integrating Multi-Pollutant Models and Urinary Metabolomics,
Wang, J., Chen, S., Wang, C., Li, W., Zou, Y., Zhu, F. and Mu, M., *Toxics*, Aug 24 2026, Vol. 14, no. 9.

To investigate the associations between single and mixed exposure to air pollutants in underground coal mine environments and the risk of metabolic syndrome (MetS) among workers, we conducted a cross-sectional study. Multivariable logistic regression, Bayesian kernel machine regression (BKMR), and quantile-based g-computation (Qgcomp) were used to evaluate the joint effects of mixed pollutant exposures and to identify the major contributing components. In addition, untargeted urinary metabolomics analysis was performed to explore the potential biological mechanisms. After adjusting for confounding factors, logistic regression analysis revealed that exposure to coal dust (CD), carbon monoxide (CO), carbon dioxide (CO2), and nitrogen dioxide (NO2) was associated with an increased risk of MetS. Furthermore, BKMR and Qgcomp models consistently indicated a significant positive association between mixed pollutant exposure and MetS risk, with CD and NO2 identified as the primary components with the strongest statistical contribution. CD exposure was mainly associated with central obesity and hypertension, whereas NO2 exposure was primarily linked to elevated blood glucose and triglyceride levels. MetS patients exhibited significant alterations in urinary metabolic profiles, with more than 113 differentially abundant metabolites identified. Notably, leukotrienes were positively correlated with NO2 exposure, while acylcarnitines were associated with CD exposure. Pathway enrichment analysis indicated significant disturbances in pyrimidine and arachidonic acid metabolism. These findings provide important evidence for developing comprehensive occupational health strategies in mining environments. https://doi.org/10.3390/toxics14090746

Associations of Serum Per- and Polyfluoroalkyl Substances (PFAS) With Epigenetic Age andDNAMethylation in US Airport Firefighters,
Ward, L., Goodrich, J., Calkins, M., Beitel, S., Calafat, A., Caban-Martinez, A., Louzado-Feliciano, P., Botelho, J., Furlong, M., Krause, R., Matthis, R., Hughes, J. and Burgess, J., *Environmental and Molecular Mutagenesis*, Oct 9 2026, Vol. 67, no. 8-9.

Per- and polyfluoroalkyl substances (PFAS) are synthetic chemicals used in a variety of consumer and industrial applications for their water- and oil-resistant properties. Firefighters can be exposed to PFAS as part of their job through gear, aqueous film-forming foams (AFFFs) used to extinguish aircraft and liquid fuel fires, along with exposure through other combustible materials during fire suppression activities. PFAS exposure has been linked to a variety of health conditions including cancer, obesity, reproductive issues, and immunosuppression. Epigenetic modifications may be one mechanism underlying PFAS toxicity. In this study, we used epigenetic indicators to assess association of PFAS serum concentrations with (1) epigenetic aging and (2) DNA methylation at loci within genes related to immune function. Blood leukocyte DNA methylation was quantified via the Infinium EPIC array from 184 participants in the Fire Fighter Cancer Cohort Study involved in aircraft rescue and firefighting, and serum PFAS was measured via on-line solid phase extraction liquid chromatography isotope dilution tandem mass spectrometry. We observed inverse associations between PFAS concentrations and epigenetic clocks including between serum linear perfluorooctanoic acid (n-PFOA) with four epigenetic clocks ($p < 0.05$); however, most did not remain significant in sensitivity analyses. Associations ($q < 0.1$) were observed between perfluorodecanoic acid, n-PFOA, sum of branched perfluorooctane sulfonic acid isomers and differential methylation of specific loci within 34 immune-related genes. Further research can help to better understand the functional impacts of the observed differential methylation on immune health. https://doi.org/10.1002/em.70085

The association between mixed exposure to multiple metals and the risk of abnormally elevated blood glucose among aluminum factory workers,
Zhang, Y., Xin, Y., Li, M., Xu, H., Guo, X., Wang, L., Zhang, H., Yin, J., Lu, X., Pan, B. and Song, J., *Environmental Geochemistry and Health*, Aug 31 2026, Vol. 48, no. 14.

This study aims to analyze the connection between mixed metal exposure and abnormal blood glucose (defined as fasting plasma glucose >= 6.1 mmol/L, according to the World Health Organization diagnostic criteria) among aluminum plant workers. A total of 384 male workers from a large aluminum plant in Shanxi Province were surveyed between July and August 2024. Fasting glucose and eight plasma metals were measured. Logistic regression, Restricted cubic spline (RCS) analyses, least absolute shrinkage and selection operator (LASSO) regression, Weighted quantile sum (WQS) regression, and Bayesian kernel machine regression (BKMR) were used to examine single-metal and mixture effects. Following adjustment for potential confounders, the highest quartile (Q4) of plasma aluminum, selenium, and copper was associated with higher odds of abnormal blood glucose, with adjusted ORs of 2.93 (95% CI: 1.16-7.40), 2.30 (95% CI: 1.05-5.05), and 2.71 (95% CI: 1.17-6.27), respectively, compared with the lowest quartile (Q1). RCS analyses further indicated positive, approximately linear dose-response relationships across the observed concentration ranges for these three metals. LASSO regression identified aluminum, selenium, and copper as key metals. WQS regression revealed an overall positive association between mixed metal exposure and abnormal blood glucose, with aluminum and selenium contributing the most, with weights of 0.434 and 0.375, respectively. BKMR analyses suggested positive exposure-response trends for individual metals, with no strong evidence of interactions. These findings suggest that higher plasma aluminum, selenium, and copper are associated with a higher likelihood of abnormal blood glucose among aluminum plant workers. Targeted strengthening of occupational health protection is necessary. https://doi.org/10.1007/s10653-026-03460-w

Epidémiologie

Is Exposure to Certain Endocrine-Disrupting Chemicals Associated with Increased Skin Cancer Risk?, Betsi, G., Koumaki, D., Kountouri, A. and Xekouki, P., *Cancers*, 2026/10/12/ 2026, Vol. 18, no. 20, p. 3283.

BACKGROUND/OBJECTIVES: This review investigated whether exposure to certain endocrine-disrupting chemicals (EDCs) increases skin cancer risk. METHODS: We performed a comprehensive narrative review of in vitro, animal, and human studies examining the association of EDCs with melanoma and non-melanoma skin cancer (NMSC). RESULTS: Chemicals are classified as (i) established EDCs with evidence of skin carcinogenicity; (ii) chemicals that are carcinogenic with endocrine-related effects; and (iii) chemicals with limited or uncertain evidence. Proposed carcinogenic mechanisms include oxidative stress, chronic inflammation, immunosuppression, DNA repair inhibition, and epigenetic alterations; AhR likely mediates the carcinogenicity of dioxin (TCDD), dioxin-like PCBs, and PAHs. Epidemiological evidence linking PCBs with melanoma is inconsistent. High cumulative occupational exposure to PAH-containing mineral oils or tar/pitch increases skin cancer risk. Evidence for PFAS and skin cancer is limited and inconsistent. Increased melanoma incidence has been reported after chronic occupational exposure to certain pesticides, including carbaryl, parathion, and maneb/mancozeb. There is substantial evidence of a dose-response association between chronic arsenic exposure and NMSC risk. CONCLUSIONS: High chronic exposure to specific EDCs (especially arsenic, certain PAHs, and certain pesticides) may increase skin cancer risk. For several chemicals, evidence supports carcinogenicity with endocrine-related effects, but direct mechanistic evidence that endocrine disruption specifically mediates skin carcinogenesis is lacking. https://doi.org/10.3390/cancers18203283

Joint associations between 10-year average residential proximity-based pesticide exposures and cardiometabolic markers among women from an agricultural region, Calderon, L. E., Gunier, R. B., Warner, M., Kogut, K., Perez-Rocha, Y., Maccuish, K., Rauch, S., Eskenazi, B. and Torres, J. M., *Journal of Exposure Science & Environmental Epidemiology*, 2026/10/24/ 2026.

BACKGROUND: Chronic exposure to multiple agricultural pesticides may influence cardiometabolic disease risk. OBJECTIVE: We examined joint associations between long-term, residential proximity-based exposure to seven pesticide classes and cardiometabolic risk factors among women from an agricultural region using complementary mixture methods. METHODS: Women participating in the Center for the Health Assessment of Mothers and Children of Salinas Maternal Cognition Study completed anthropometric measurements, blood collection, and interviews in 2022-2024. Using participant-reported addresses and California's Pesticide Use Reporting database, we estimated average agricultural use (kg/year) of seven pesticide classes within 1 km of homes in the 10 years preceding outcome assessment. We used quantile g-computation (QGCOMP) and Bayesian kernel machine regression (BKMR) to estimate joint associations with cardiometabolic risk factors and explore the relative contributions of pesticide classes to joint exposure effects. RESULTS: Participants (n = 459) were 48.4 ± 5.5 years old at outcome assessment. Using QGCOMP, a joint one-quartile increase in pesticide exposures was associated with higher systolic blood pressure (β = 1.82 mm Hg, 95% CI = 0.38, 3.25), higher pulse pressure (β = 1.59 mm Hg, 95% CI = 0.56, 2.63), and lower HDL cholesterol (β = -1.35 mg/dL, 95% CI = -2.61, -0.10; <50 mg/dL or self-report cholesterol medication: RR = 1.12, 95% CI = 1.02, 1.23). BKMR results were generally consistent, with modest nonlinearity for blood pressure (e.g., pulse pressure: p25 to p50: β = 0.32, 95% CrI = -1.65, 2.29; p50 to p75: β = 3.46, 95% CrI = 1.35, 5.57) and elevated risk of low HDL cholesterol (p25 to p50: RR = 1.09, 95% CrI = 1.01, 1.18; p50 to p75: RR = 1.03, 95% CrI = 0.93, 1.13). In exploratory analyses, we found the

most consistent agreement for glyphosate herbicide's contribution to the joint associations with low HDL cholesterol and, to a lesser extent, continuous pulse pressure. Joint associations with other outcomes, including body mass, blood sugar, and inflammatory markers, were null. IMPACT: This study evaluates the cardiometabolic impacts of long-term, residential proximity-based exposure to various agricultural pesticide classes among midlife women from an agricultural region. Using two complementary mixture modeling approaches, we demonstrate robust joint associations between chronic pesticide exposure and adverse cardiometabolic outcomes, specifically higher blood pressure and lower HDL cholesterol. Our findings highlight the relevance of ambient, non-occupational pesticide exposure to cardiometabolic disease risk and underscore the importance of considering correlated exposure mixtures when assessing environmental health risks. To our knowledge, this is the first study to examine long-term, joint exposure to current-use pesticides in association with a wide range of cardiometabolic outcomes. https://doi.org/10.1038/s41370-026-00994-0

Prenatal Exposure to Phthalates and Bisphenols in Association with Hypomineralization of Second Primary Molar,
Cots, E., Güil-Oumrait, N., Marquez, S., Urquiza, J. M., Sol, C. M., Guinot, F., Toran, P., Jaddoe, V. W. V., Trasande, L., Wolvius, E. B. and Kragt, L., *Journal of Dental Research*, 2026/10/24/ 2026, p. 220345261490933.

Hypomineralized second primary molars (HSPM) affect approximately 6.8% of children. Molars affected by HSPM mineralize between 20 wk of gestation and 15 to 17 mo of age. Experimental studies suggest that exposure to endocrine-disrupting chemicals, including di-2-ethylhexyl phthalate (DEHP) and bisphenol A (BPA), may disrupt enamel formation, but evidence in humans remains limited. This study investigates the association between prenatal exposure to individual phthalates, BPA, and their mixtures and the odds of HSPM in children. It was embedded in the Generation R study, a population-based prospective birth cohort in the Netherlands. Maternal urinary concentrations of BPA and 11 phthalate metabolites were measured each trimester. HSPM was diagnosed at age 6 y based on European Academy of Paediatric Dentistry criteria. Multivariate logistic regression models and Bayesian weighted quantile sum regression were used to assess individual and mixture associations, respectively. Among 1,160 mother-child pairs, 10.2% of children were diagnosed with HSPM. In single-exposure models, higher prenatal concentrations of monobenzyl phthalate (mBzBP) were associated with lower odds of HSPM (odds ratio [OR] = 0.76; 95% confidence interval [CI]: 0.59 to 0.97). Second-trimester exposure to DEHP metabolites showed a nonsignificant trend toward increased HSPM odds (eg, mEOHP OR = 1.15; 95% confidence interval [CI]: 0.91 to 1.45). Sex-specific associations were observed: higher BPA and phthalate concentrations were associated with lower likelihood of HSPM in girls (eg, BPA OR = 0.70; 95% CI: 0.50 to 0.98) and higher odds in boys (p-interaction < 0.10). Mixture analyses showed a nonsignificant inverse association for overall prenatal exposure (OR = 0.84; 95% CI: 0.63 to 1.15), with mBzBP contributing most to the mixture. No overall association was observed for DEHP mixture, although sex-specific trends were consistent with single-exposure results. Prenatal exposure to phthalates and BPA may influence HSPM development. These findings highlight the need to consider early-life endocrine-disrupting chemical mixture exposure in HSPM etiology. https://doi.org/10.1177/00220345261490933

Plasma chlorinated paraffin mixtures and breast cancer: Nonlinear patterns in an exploratory case-control study,
Deng, C., Li, W., Wang, L., Liu, Y., Liu, W., Ma, M., Hou, B., Wang, Y., Tian, Y., Zhao, Y., Gao, W. and Zheng, Y., *Environmental Pollution*, Dec 1 2026, Vol. 410.

Increasing evidence suggests that chlorinated paraffins (CPs) exhibit estrogen-disrupting effects, thus necessitating further investigation into their impact on breast cancer development. Building upon this

context, we analyzed plasma samples from 70 clinically diagnosed breast cancer patients and 101 healthy controls recruited from screening programs, aiming to quantitatively assess their internal CPs exposure levels. The results showed that short-chain chlorinated paraffins were detected in all plasma samples, with a detection rate of 100.0% and a concentration of 9.58 (4.09, 15.71) ng/mL. Medium-chain chlorinated paraffins had a detection rate of 90.1% and a concentration of 14.40 (7.83, 23.76) ng/mL. The median concentration of SCCPs were lower in the case group than in controls (6.75 vs. 11.42 ng/mL, P < 0.01), whereas MCCPs levels showed no significant difference (14.35 vs. 14.48 ng/mL, P = 0.485). Using the Bayesian kernel machine regression model, we observed an association between mixed CPs exposure and breast cancer risk-driven by C13H23Cl5-SCCPs and C16H27Cl7-MCCPs-which was evident only when all mixture components were jointly fixed at the upper exposure percentiles relative to their median levels. Further exploratory stratified analysis suggests potential associations between CPs exposure and the luminal A and luminal B subtypes of breast cancer, with C16H27Cl7-MCCPs may potentially contribute to the development of the Luminal A subtype. Molecular docking suggested the potential for interactions between selected CP congeners and estrogen receptors. As an exploratory case-control study, we found that exposure to higher concentrations of CP mixtures may be associated with breast cancer case status, providing evidence for understanding the potential health risks of CPs based on a small-sample population, and also laying the foundation for subsequent mechanistic studies and environmental health risk assessments. However, due to the limited sample size, these findings need to be confirmed in larger-scale prospective studies https://doi.org/10.1016/j.envpol.2026.129185

Perinatal phthalate, paraben, and phenol exposure is associated with the neonatal metabolome measured in umbilical cord plasma,
Ferris, A. J., Kalia, V., Mcneil, B., Udhani, H., Dubey, S., Nandakumar, R., Trasande, L., Wu, H., Singh, R. R., Herbstman, J. B. and Deyssenroth, M. A., *Ecotoxicology and Environmental Safety*, 2026/11/01/ 2026, Vol. 326, p. 121007.

BACKGROUND: Perinatal exposure to phthalates, parabens, and phenols-common endocrine disrupting chemicals (EDCs)-has been associated with adverse health outcomes, but the underlying biological mechanisms remain unclear. This study aims to explore the associations between perinatal EDC exposure--individually and as a mixture--and the neonatal metabolome, which provides a readout of metabolic processes and the factors that impact them. METHODS: EDCs and the metabolome were characterized in umbilical cord blood plasma from 175 pregnant participants recruited through the Columbia Center for Children's Environmental Health. Nontargeted screening revealed 15 EDCs using gas chromatography coupled to high resolution mass spectrometry (HRMS) and 5835 metabolic features using liquid chromatography HRMS. Correlated features were grouped into 21 modules using weighted gene co-expression network analysis and into integrative networks using xMWAS. Linear regression and quantile g-computation were used to assess associations between EDC exposures and individual metabolic feature abundance and the modules. RESULTS: We observed 2208 metabolome-wide associations between individual metabolic features and EDCs modeled individually and one association with the EDC mixture. Eight EDCs were individually associated with 7 modules, and the EDC mixture was associated with 1 module. Pathway enrichment analyses revealed phenol and phthalate exposures were associated with fatty acid and energy metabolism. xMWAS networks demonstrated similar EDC-module and EDC-metabolic feature relationships. CONCLUSION: Perinatal EDC exposure, individually and as a mixture, is associated with individual metabolic features and metabolic networks measured in cord plasma. These results could offer insight into the biological processes underpinning relationships between perinatal EDC exposure and adverse health outcomes. https://doi.org/10.1016/j.ecoenv.2026.121007

Investigation of individual and cohort-level temporal changes to legacy and emerging endocrine disrupting chemical exposures and their relationship with birth outcomes,
Ferris, A. J., Olivares, A., Riley, K. W., Calero, L., Tobon, C., Diaz, D., Badia, G., Perera, F., Hu, H., Kannan, K., Wang, S., Zota, A. R., Deyssenroth, M. A. and Herbstman, J. B., *Journal of Exposure Science & Environmental Epidemiology*, 2026/10/30/ 2026.

BACKGROUND: Phthalates, parabens, and phenols co-occur in personal care and consumer products (PCPs). While policy and market-based campaigns have led to changes in product formulations, few studies have examined intra- and inter-individual changes in PCP chemical biomarkers in pregnant populations with birth outcomes. OBJECTIVE: Investigate changes in exposure to PCP-derived chemicals within and between pregnant women. Additionally, examine if exposures-individually and as a mixture-are associated with gestational age (GA) and birthweight z-scores (BWZ). METHODS: We collected maternal third-trimester urine samples from 299 Mothers and Newborns (MN, 2001-2006) and 246 Fair Start (FS, 2013-2021) New York City-based participants. A subset of MN (n = 62) provided urine at a subsequent pregnancy (Siblings cohort). We analyzed samples using high-performance liquid chromatography-tandem mass spectrometry for 16 phthalate, 4 paraben, and 5 environmental phenolic biomarkers. Paired t-tests and linear regression models compared intraindividual biomarker concentrations for participants that provided urine at two pregnancies. Linear regressions evaluated the interindividual differences in biomarker levels between cohorts. Linear regression and quantile g-computation were used to estimate the single- and multi-chemical relationships, respectively, with GA and BWZ for each cohort. RESULTS: Biomarkers of emerging contaminants di-(2-propylheptyl) phthalate and bisphenol S were higher in the FS cohort compared to the MN cohort in the interindividual analyses, and in subsequent pregnancies in the intraindividual analyses. Conversely, biomarkers of legacy chemicals (e.g., di-n-hexyl phthalate, di-(2-ethylhexyl phthalate)) were lower in the FS cohort and subsequent pregnancies compared to the MN cohort. Mono-hexyl phthalate was associated with earlier GA (β [95%CI]: -0.14 [-0.23, -0.05]) in the MN cohort. No significant mixture associations with GA and BWZ were observed. SIGNIFICANCE: Exposure to emerging contaminants has increased and exposure to legacy contaminants has decreased when assessing inter- and intra-individual urinary biomarker levels. Continued research is critical to better understand the health implications of emerging contaminants. IMPACT STATEMENT: Higher levels of emerging chemicals (e.g., di-(2-propylheptyl) phthalate, bisphenol S) were found in a New York City-based cohort of women who provided urine samples between 2013 and 2021 compared to women who provided urine samples between 2001 and 2006. This demonstrates the need to include these contaminants in environmental epidemiologic studies to better understand their impacts on health. When exploring associations with birth outcomes, we identified a metabolite of di-n-hexyl phthalate, a legacy compound, to be associated with earlier gestational age only in the cohort from 2001 to 2006. This may indicate that temporal changes in exposure are important to health outcomes. https://doi.org/10.1038/s41370-026-01000-3

Prenatal and childhood exposure to mixtures of endocrine-disrupting chemicals in association with measures of adiposity in childhood and adolescence,
Güil-Oumrait, N., Midya, V., India-Aldana, S., Anguita-Ruiz, A., Maitre, L., Bustamante, M., Montazeri, P., Urquiza, J., Haug, L., Brantsæter, A., Heude, B., Wright, J., Yang, T., Mceachan, R., Stephanou, E., Grazuleviciene, R., Slama, R., Chatzi, L., Vrijheid, M. and Valvi, D., *Environment International*, Sep 2026, Vol. 215.

Background Childhood obesity is a global public health crisis. Endocrine-disrupting chemicals (EDCs) - widespread pollutants that interfere with hormonal and metabolic systems - may contribute to excessive adiposity. The combined, long-term, and mechanistic effects of multi-class EDC mixtures remain unexplored. Methods We analyzed 1301 mother-child pairs from the Human Early Life

Exposome (HELIX) project, spanning six European cohorts. Prenatal and childhood exposures to 45 EDCs across nine chemical classes were measured in maternal and child biospecimens. Thirty-six plasma proteins were quantified in childhood using targeted proteomic panels. Adiposity outcomes in childhood (6-11 years) and adolescence (12-18 years) included BMI z-scores, waist circumference, and body fat percentage. We applied penalized Lasso-type Bayesian Weighted Quantile Sum Regression to assess mixtures, a signed iterative random forest for interactions, and mediation analyses for biological pathways. Results Prenatal metal and organochlorine pesticide mixtures were associated with higher BMI z-scores in childhood and adolescence and 47-48 % higher odds of overweight. Prenatal PFAS exposure was associated with higher body-fat percentage in both periods. Childhood phenol and high-molecular-weight phthalate exposures were associated with higher adolescent zBMI, whereas parabens and persistent compounds showed inverse associations. Childhood metal exposures were associated with higher body-fat percentage and overweight odds. An inflammatory-metabolic protein pattern mediated similar to 30 % of the prenatal metal-adolescent zBMI association. Conclusions Early-life exposure to EDC mixtures may reprogram metabolic and inflammatory pathways, predisposing children to obesity that persists into adolescence. These findings provide mechanistic evidence linking chemical exposures to the global obesity epidemic and underscore the urgent need for policies preventing EDC exposure during critical developmental periods. https://doi.org/10.1016/j.envint.2026.110495

Prenatal and childhood exposure to mixtures of endocrine-disrupting chemicals in association with measures of adiposity in childhood and adolescence,
Güil-Oumrait, N., Midya, V., India-Aldana, S., Anguita-Ruiz, A., Maitre, L., Bustamante, M., Montazeri, P., Urquiza, J., Haug, L. S., Brantsæter, A. L., Heude, B., Wright, J., Yang, T. C., Mceachan, R. R. C., Stephanou, E. G., Grazuleviciene, R., Slama, R., Chatzi, L., Vrijheid, M. and Valvi, D., *Environment International*, 2026/09/01/ 2026, Vol. 215, p. 110495.

Background Childhood obesity is a global public health crisis. Endocrine-disrupting chemicals (EDCs) − widespread pollutants that interfere with hormonal and metabolic systems − may contribute to excessive adiposity. The combined, long-term, and mechanistic effects of multi-class EDC mixtures remain unexplored. Methods We analyzed 1301 mother–child pairs from the Human Early Life Exposome (HELIX) project, spanning six European cohorts. Prenatal and childhood exposures to 45 EDCs across nine chemical classes were measured in maternal and child biospecimens. Thirty-six plasma proteins were quantified in childhood using targeted proteomic panels. Adiposity outcomes in childhood (6–11 years) and adolescence (12–18 years) included BMI z-scores, waist circumference, and body fat percentage. We applied penalized Lasso-type Bayesian Weighted Quantile Sum Regression to assess mixtures, a signed iterative random forest for interactions, and mediation analyses for biological pathways. Results Prenatal metal and organochlorine pesticide mixtures were associated with higher BMI z-scores in childhood and adolescence and 47–48 % higher odds of overweight. Prenatal PFAS exposure was associated with higher body-fat percentage in both periods. Childhood phenol and high-molecular-weight phthalate exposures were associated with higher adolescent zBMI, whereas parabens and persistent compounds showed inverse associations. Childhood metal exposures were associated with higher body-fat percentage and overweight odds. An inflammatory-metabolic protein pattern mediated ∼30 % of the prenatal metal-adolescent zBMI association. Conclusions Early-life exposure to EDC mixtures may reprogram metabolic and inflammatory pathways, predisposing children to obesity that persists into adolescence. These findings provide mechanistic evidence linking chemical exposures to the global obesity epidemic and underscore the urgent need for policies preventing EDC exposure during critical developmental periods. https://doi.org/https://doi.org/10.1016/j.envint.2026.110495

Phthalate Exposure and Breast Cancer: A Systematic Review and Meta-Analysis of Epidemiological Evidence,
Hernández-Mariano, J. Á., Domínguez-Aliphat, A., Mercado-Martínez, M. N., López-Jardón, J. E., Ángel-López, J., Salinas-Cruz, J. and Terán-Godínez, C., *Women*, 2026/12// 2026, Vol. 6, no. 4, p. 71.

Phthalates are widely used chemicals with endocrine-disrupting properties; however, epidemiological evidence regarding their association with breast cancer remains inconsistent. Therefore, we aimed to synthesize the available epidemiological evidence on the association between phthalate exposure and breast cancer and to quantify these associations through metabolite-specific meta-analyses. We conducted a systematic review and meta-analysis of epidemiological studies identified in PubMed, Web of Science, EBSCO, and LILACS up to 1 June 2026. We performed metabolite-specific meta-analyses using random-effects models, comparing the highest and lowest exposure categories, alongside complementary analyses harmonized to a common one-standard-deviation exposure scale. We included 12 studies in the systematic review. In the primary analyses, monobutyl phthalate (MBP)/mono-n-butyl phthalate (MnBP) (pooled odds ratio [OR] = 0.81; 95% confidence interval [CI]: 0.68–0.97) and monobenzyl phthalate (MBzP) (pooled OR = 0.76; 95% CI: 0.62–0.93) showed inverse associations with breast cancer, whereas the other metabolites included in the primary meta-analyses showed no statistically significant associations. After harmonization, the inverse association persisted for MBP/MnBP (pooled OR = 0.92; 95% CI: 0.85–0.99), and monoethyl phthalate (MEP) showed an inverse association (pooled OR = 0.87; 95% CI: 0.77–0.99), whereas MBzP was no longer statistically significant. These inverse associations should not be interpreted as protective biological effects, as they may reflect bias, residual confounding, or exposure misclassification. Overall, evidence shows no consistent association between phthalate exposure and breast cancer. https://doi.org/10.3390/women6040071

Potential Adverse Effects of Urinary Bisphenol A Concentrations on Renal Function, Gestation, and Newborn Characteristics in Healthy Pregnant Women,
Imamović Kumalić, S., Kavšek, G., Sladič, M., Premru-Sršen, T. and Virant-Klun, I., *Journal of Xenobiotics*, 2026/09/24/ 2026, Vol. 16, no. 6, p. 180.

The impact of bisphenols on the metabolism and kidney function of pregnant women, and consequently on the health of the child, is not yet well known. This study investigated urinary concentrations of bisphenols (BPA, BPF, and BPS) and their associations with biochemical parameters for kidney and liver function, serum anti-Müllerian hormone (AMH), vitamin D3, and pregnancy outcomes in pregnant women. Fasting morning urine and blood samples were collected from 80 healthy women with singleton, third-trimester pregnancy to quantify urinary BPA, BPF, and BPS concentrations and analyze routine biochemical parameters for kidney and liver function. BPA was detected in 78% of urine samples, compared with 10% for BPF and 5% for BPS, making it the predominant bisphenol. BPA concentrations positively correlated with serum creatinine, and this relationship remained significant after adjustment for maternal age, body mass index, gestational age, and urine specific gravity in multivariable linear regression analysis. Its concentrations were also positively correlated with AMH and negatively with gestational duration and newborn weight and head circumference, although these associations were not confirmed by linear regression analyses. These findings suggest that BPA exposure during late pregnancy may influence maternal kidney function and potentially ovarian reserve, as well as neonatal outcomes, warranting further investigation. https://doi.org/10.3390/jox16060180

Phthalates and Bisphenols as Endocrine-Disrupting Chemicals: Possible Determinants of Mood Disorders,

Lastretti, M., Faa, A., Piras, M., Dessì, A., Paribello, P., Piludu, M., Orrù, G., Manchia, M., Faa, G. and Fanos, V., *Environments*, Jul 28 2026, Vol. 13, no. 8.

Major depressive disorder (MDD) accounts for a substantial share of global disability-adjusted life years and remains inadequately treated despite pharmacological advances. Growing evidence implicates endocrine-disrupting chemicals (EDCs)-particularly phthalates and bisphenols-as environmental contributors to the onset of these conditions. This narrative review examines evidence from PubMed, Scopus, and Web of Science (January 2000-March 2025) on the relationship between early-life exposure to these compounds and the development of mood disorders, with emphasis on molecular and neurobiological mechanisms. Phthalates such as di(2-ethylhexyl) phthalate (DEHP), and bisphenols such as bisphenol A (BPA), are detected ubiquitously in human urine, blood, placenta, and umbilical cord blood. Key mechanisms identified include Nrf2/HO-1-driven oxidative stress and neuronal apoptosis, disruption of calcium signalling and synaptic plasticity via CREB phosphorylation deficits, epigenetic suppression of brain-derived neurotrophic factor (BDNF) via promoter hypermethylation, NF-kappa B/NLRP3/IL-1 beta neuroinflammatory cascades, interference with thyroid hormone bioavailability through transthyretin competition, and PPAR-mediated disruption of brain lipid metabolism. Prenatal and early-life exposure has been associated with ADHD, cognitive impairment, autism spectrum disorder, and elevated risk of depressive and anxiety phenotypes in epidemiological cohorts. Psychological vulnerability factors-perceived stress, deficient emotion regulation, and adverse childhood experiences-likely amplify this biological susceptibility through HPA axis sensitisation. Methodological limitations of current evidence, including reliance on single-spot urine samples and residual confounding, are critically appraised. Future research priorities include longitudinal biomonitoring cohorts, brain organoid mechanistic models, and integration of validated psychiatric assessments into environmental health study designs. https://doi.org/10.3390/environments13080425

A Systematic Review of Flame Retardants (Brominated and Organophosphate) and Human Cancer, Lin, X., Muthanna, A., Hamid, H., Ibrahim, Y., Alfutin, F., Akim, A. and Jin, Z., *Biomedical Research and Therapy*, 2026 2026, Vol. 13, no. 7, p. 8794–8808.

Background: Brominated flame retardants (BFRs) are persistent and ubiquitous environmental contaminants with recognized endocrine-disrupting potential, raising concern regarding their possible contribution to human carcinogenesis. This systematic review, conducted in accordance with the PRISMA guidelines, evaluated the association between BFR exposure and human cancer risk, examined the underlying mechanistic pathways, and identified existing research gaps. Methods: A comprehensive literature search of PubMed, Scopus, and EBSCO Discovery Service was performed for studies published between January 2015 and May 2025. Results: Of 752 records identified, 21 studies satisfied the eligibility criteria, comprising eight human epidemiological investigations and thirteen experimental studies. Among the malignancies examined, thyroid cancer exhibited the most consistent positive association with BFR exposure, with decabromodiphenyl ether (BDE-209) identified as the principal contributor (odds ratio [OR] = 1.03-2.29 for BDE-209), whereas the evidence for breast and other cancers remained inconsistent. Experimental investigations elucidated several biologically plausible mechanisms, including oxidative stress, endocrine disruption, pro-inflammatory nuclear factor kappa B (NF-kappa B) signaling, and immune modulation. Conclusion: Collectively, the available evidence indicates that BFR exposure may elevate cancer risk, particularly for thyroid malignancy; nevertheless, the substantial heterogeneity across studies underscores the need for standardized exposure assessment, prospective cohort designs, and further mechanistic validation before definitive causal inferences can be established. https://doi.org/10.15419/bmrat.v13i7.1086

Intrauterine exposures to legacy and emerging PFAS in the first trimester and their associations with early pregnancy loss,
Liu, A., Ran, M., Tian, Y., Li, X., Wang, M., Wang, J., Wu, Y., Liu, D. and Zhang, Y., *Ecotoxicology and Environmental Safety*, 2026/11/01/ 2026, Vol. 326, p. 120977.

Exposure to per- and polyfluoroalkyl substances (PFAS), including emerging substitutes, is associated with several adverse pregnancy outcomes. However, the evidence on intrauterine exposure to PFAS during human early pregnancy was limited. This study measured the concentrations of 31 (18 legacy and 13 emerging) PFAS chemicals in 402 maternal serum and 221 placental villi tissues collected during the first trimester. The associations of individual and combined PFAS exposures with early pregnancy loss (EPL) were estimated using multivariable generalized additive models, logistic regression models, quantile g-computation, subgroup stratified, and interaction analyses. Six PFAS chemicals detected simultaneously in the serum and villi with detection rates exceeding 80% showed strong correlations between the two matrices, with correlation coefficients ranging from 0.78 to 0.93, and with 9-chlorohexadecafluoro-3-oxanonane-1-sulfonate (9Cl-PF3ONS) exhibiting the highest correlation. Odds ratios (95% confidence intervals) of EPL were 1.72 (1.04, 2.83), 2.18 (1.02, 4.69), 1.99 (1.04, 3.79), 2.66 (1.35, 5.22), and 5.17 (2.30, 11.63) associated with per ten-fold increase in the concentrations of serum 9Cl-PF3ONS, serum perfluorohexane sulfonate (PFHxS), serum perfluorooctane sulfonate (PFOS), villi 9Cl-PF3ONS, and villi perfluorooctanoic acid (PFOA), respectively. However, the associations of serum 9Cl-PF3ONS, PFHxS, and PFOS with EPL were no longer statistically significant after false discovery rate correction. The joint association between PFAS mixture in villi and EPL was positive, with 9Cl-PF3ONS having the largest positive weights. Subgroups with age ≤ 30 years, body mass index ≥ 24 kg/m2, or tobacco exposure showed higher odds ratios of EPL associated with specific PFAS chemicals. In conclusion, emerging substitute 9Cl-PF3ONS could arrive at early placenta. Maternal and placental exposure to PFAS including 9Cl-PF3ONS showed positive associations with EPL; however, the findings in serum should be interpreted cautiously. https://doi.org/10.1016/j.ecoenv.2026.120977

The ACCEPT birth cohort: Real-life serum mixtures of Persistent Organic Pollutants in pregnant women disrupt estrogen and androgen receptor transactivity and affect fetal growth,
Long, M., Pedersen, J. S., Wielsøe, M. and Bonefeld-Jørgensen, E. C., *Environmental Toxicology and Pharmacology*, 2026/10/29/ 2026, Vol. 128, p. 105219.

Lipophilic persistent organic pollutants (lipPOPs) including polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) persist in human body and possess endocrine-disrupting potentials. To investigate the combined effects of real-life serum mixture of lipPOPs from 482 Greenlandic pregnant women on estrogen receptor (ER) and androgen receptor (AR) transactivity and their associations with neonatal birth size, lipPOPs mixture was extracted and xenohormone transactivities (XER and XAR) were measured using reporter gene bioassays. Around 29.7% of the serum lipPOP extracts exhibited agonistic XER and 10.8% antagonized the estradiol-induced ER transactivity. About 54.9% of extract elicited agonistic XAR, and 39.9% antagonized dihydrotestosterone -induced AR transactivity. XAR inversely associated with the serum estrogenic PCBs concentration and the principal component containing PCBs and OCPs. XAR inversely associated with birth weight, particular among female neonates. These findings indicate that serum lipPOPs mixtures can disrupt ER and AR function and may adversely affect fetal growth in a sex-specific manner. https://doi.org/10.1016/j.etap.2026.105219

Association between exposure to brominated flame retardants and thyroid function in NHANES 2007-2012,
Meng, L., Xu, F., Wang, D. and Cui, W., *Journal of Hazardous Materials Advances*, Nov 2026, Vol. 24.

Background: As persistent organic pollutants, brominated flame retardants (BFRs) may influence the endocrine system. Epidemiological results regarding the relation between BFRs and thyroid hormones are controversial. Methods: Data from the 2007-2012 National Health and Nutrition Examination Survey (NHANES) were analyzed. Thereafter, six BFRs alongside thyroid hormones were examined for their contents in serum. The separate and combined associations of BFRs with thyroid hormones were assessed by using weighted quantile sum (WQS) regression, generalized linear models (GLM), quantile-based g-computation (QGC) as well as principal component analysis (PCA). Results: In generalized linear models, PBB-153 was inversely associated with FT3 (beta = -0.048; 95% CI:0.070 to -0.025; q = 0.0095) and TT3 (beta = -1.940; 95% CI:3.056 to -0.823; q = 0.0349) after FDR correction. PCA revealed that PC2 (PBB-153-dominated) was significantly inversely associated with FT3 (beta = -0.062; 95% CI:0.085, -0.040; q < 0.001), TT3 (beta = -3.185; 95% CI:4.323, -2.047; q < 0.001), and TT4 (beta = -0.098; 95% CI:0.161, -0.035; q = 0.010). PC3 (PBDE-153-dominated) showed positive associations with FT3 and TT3, but inverse association with TT4 (all q < 0.05). WQS regression identified significant inverse associations of the BFR mixture with FT3 (beta = -0.042; 95% CI:0.070, -0.014; q = 0.008), FT4 (beta = -0.015; 95% CI:0.022, -0.008; q = 0.001), and TT3 (beta = -1.615; 95% CI:2.743, -0.487; q = 0.008). QGC confirmed a significant inverse association with FT4 (psi = -0.005; 95% CI:0.009, -0.002; q = 0.010). No significant associations were observed for TSH or TT4 after FDR correction in either method. Conclusion: Separate or combined BFRs exposures are associated with alterations in thyroid hormone concentrations. https://doi.org/10.1016/j.hazadv.2026.101570

Associations of individual and combined PFAS exposure with bone health outcomes in a Spanish adult population,
Moratalla-Aranda, E., García-Fontana, B., Espin-Moreno, L., Mustieles, V., García-Fontana, C., González-Salvatierra, S., Olivas-Martínez, A., Muñoz-Torres, M. and Fernández, M. F., *Journal of Hazardous Materials Advances*, 2026/11/01/ 2026, Vol. 24, p. 101718.

Background Per- and polyfluoroalkyl substances (PFAS) are ubiquitous environmental pollutants that may affect bone health. Previous studies have examined associations between PFAS and bone mineral density (BMD), while evidence on bone quality, fracture risk, and PFAS mixtures remains limited. Aim To investigate associations of individual and combined PFAS exposure with bone health outcomes in a Spanish adult population. Methods A cross-sectional study included 134 adults. Areal BMD at the lumbar spine, total hip, and femoral neck, together with cortical surface and integral volumetric BMD at the proximal femur, were assessed using X-ray absorptiometry and 3D-Shaper. Trabecular bone score (TBS) and 10-year fracture probability were estimated using TBS iNsight and the FRAX® tool, respectively. Serum concentrations of 12 PFAS were quantified by UHPLC-MS/MS in 99 participants. Adjusted linear regression and Bayesian weighted quantile sum (BWQS) models were applied. Results Each natural-log increase in PFHxS, PFHxA, and PFOA concentrations was associated with lower TBS [PC: −1.29% (95%CI: −2.18, −0.40), −2.37% (−4.59, −0.20) and −0.90% (−1.78, −0.10), respectively]. PFOA was associated with a 12.4% higher FRAX-predicted risk of major osteoporotic fracture, whereas PFPeA was associated with an 11.6% lower hip fracture risk. The PFAS mixture showed a suggestive association with lower TBS (PC: -2.19%, 95%CrI: −5.02, 0.61 per tertile mixture increase), mainly driven by PFHxS, PFPeA and PFOA. No significant associations were found with areal BMD. Conclusions PFAS exposure may impair bone microarchitecture without affecting BMD, suggesting that TBS is a more sensitive marker of PFAS-related skeletal effects. Prospective studies are warranted to confirm these findings. https://doi.org/https://doi.org/10.1016/j.hazadv.2026.101718

Mixture of Plasticizer Chemicals and Child Intelligence: A Weight-of-Evidence and Meta-Analysis-Informed Bayesian Approach in a Cohort with Improved Exposure Assessment,

Mustieles, V., Rolland, M., Pérez-Cantero, A., Bayat, S., Valmary-Degano, S., Thomsen, C., Sakhi, A. K., Slama, R., Guichardet, K. and Philippat, C., *Environmental Health Perspectives*, 2026/11/03/ 2026, Vol. 134, no. 7, p. 850–864.

Early-life exposure to plasticizer chemicals can affect child neurodevelopment. However, accurately characterizing exposure to these short-lived chemicals remains challenging. To address knowledge gaps, we examined the association between prenatal and infant exposure to a plasticizer mixture and child intelligence quotient (IQ) in a cohort with improved exposure assessment, informing the statistical analysis using the existing toxicological and epidemiological evidence. This work included 380 mother-infant pairs from the SEPAGES study, a French new-generation population-based birth cohort recruited between 2014 and 2018. Sixteen phenols and phthalate metabolites were quantified in pools of multiple urine samples collected at four time points during pregnancy and infancy (up to 21/week). Children's IQ was assessed using the Wechsler Preschool and Primary Scale of Intelligence at age 3. A structured review of the toxicological and epidemiological evidence was conducted to prioritize the chemicals with the highest weight of evidence (WoE) to be analyzed as a mixture. Meta-analyses of the retrieved epidemiological studies were performed and used as priors in single-chemical Bayesian regression models. Of 1189 references screened, we retrieved data from 30 toxicological and 57 epidemiological studies supporting the prioritization of bisphenol A and S, diethylhexyl phthalate metabolites, monoethyl phthalate (MEP), mono-n-butyl phthalate (MnBP), and mono-isobutyl phthalate (MiBP). Each quartile increase in maternal third-trimester concentrations of the high-WoE plasticizer mixture was associated with decreased full-scale (β: -2.86; 95% Credibility Interval, CrI: -5.05, -0.91), visual-spatial (-2.79; 95% CrI: -5.39, -0.82) and verbal (-1.95; 95% CrI: -3.84, 0.00) child IQ scores. Bayesian single-chemical models informed by meta-analysis-based priors also found that third-trimester concentrations of four of the six prioritized chemicals (bisphenol A, MEP, MnBP, and MiBP) were associated with reduced IQ scores. This novel evidence-based framework increased the biological plausibility and external validity of results, supporting that pregnancy exposure to a mixture of common plasticizers affects child IQ and represents a public health concern. The findings underscore the need to protect fetuses and children from plastic-associated chemicals and regulate them by class. https://doi.org/10.1021/EHP.6c00297

Prenatal exposure to nonpersistent endocrine disruptors and early childhood BMI: single pollutant and mixture analyses from the ECHO Program,
Nakiwala, D., Perng, W., Barrett, E., Niu, Z., Alshawabkeh, A., Meeker, J., Dabelea, D., Starling, A. and Smith, L., *Pediatric Research*, 2026.

Background Exposure to non-persistent endocrine-disrupting chemicals (EDCs), including phenols and phthalates, has been linked to obesity risk. While many studies focus on single-chemical exposures, mixture effects on child adiposity remain unclear.Objectives To assess associations of prenatal phenol and phthalate exposures, singly and as mixtures, with early childhood BMI in the U.S. Environmental influences on Child Health Outcomes (ECHO) Program.Methods We included 586 mother-child pairs from three ECHO sites with 23 phenols and phthalate metabolites measured in maternal urine during pregnancy, and child BMI z-scores (BMIZ) at 2-5 years. Associations were estimated using covariate-adjusted single-pollutant linear regression and two mixture methods: Bayesian Weighted Quantile Sum (BWQS) and Bayesian Kernel Machine Regression (BKMR). Sex-specific effects were examined in stratified models.Results No associations were observed between the overall prenatal EDC mixture and BMIZ. In single-pollutant models, MBzP (highest tertile) was inversely associated with BMIZ (beta = -0.36, 95% CI: -0.63, -0.08), while MEP (second tertile) was positively associated (beta = 0.27, 95% CI: 0.01, 0.53). Among boys, MBP (second tertile) was positively associated (beta = 0.45, 95% CI: 0.11, 0.79).Conclusions We found no strong evidence for mixture effects, though some individual

compounds showed non-linear and sex-specific associations. https://doi.org/10.1038/s41390-026-05466-7

Impact of prenatal pyrethroid pesticide exposure on neonatal lymphocyte subsets and apoptosis: a birth cohort study,
Qi, Z., Zhang, L., Xiao, X., Wu, K., Chen, S., Song, X. and Li, Y., *Journal of Global Health*, 2026/10/19/ 2026, Vol. 16, p. 04318.

BACKGROUND: Prenatal pyrethroid pesticides (PYRs) exposure may elevate infection diseases susceptibility of children. However, it is unclear the relationship of PYRs exposure and neonatal immune function. We explored the association of PYRs exposure during three trimesters with neonatal immunity and the roles of lymphocyte apoptosis. METHODS: Maternal urinary PYRs metabolites (3PBA, 4F3PBA, cis-DBCA) were measured in each trimester. Cord blood lymphocyte subsets and lymphocyte apoptosis rates were assessed by flow cytometry. Multivariate linear regression models were used to examine the associations of trimester-specific and repeated PYRs exposure during pregnancy with neonatal immune function. RESULTS: High-level cis-DBCA exposure (>75th percentile, 0.78 μg/g) in the third trimester was negatively associated with cord blood CD3+ T cell counts (β = -0.06; 95% CI = -0.12, -0.01) and CD8+ T cell counts (β = -0.09; 95% CI = -0.16, -0.01). Repeated high-level cis-DBCA exposure across two or more trimesters was associated with reduced CD3+ T cell counts (β = -0.09; 95% CI = -0.16, -0.02), CD4+ T cell counts (β = -0.13; 95% CI = -0.22, -0.04), CD8+ T cell counts (β = -0.13; 95% CI = -0.22, -0.04), B cell counts (β = -0.10; 95% CI = -0.20, -0.01), and NK cell counts (β = -0.14; 95% CI = -0.25, -0.03). High-level 3PBA exposure in the first trimester (β = 0.11; 95% CI = 0.01, 0.22) and high-level cis-DBCA exposure in the second trimester (β = 0.16; 95% CI = 0.04, 0.28) were positively associated with cord blood lymphocyte apoptosis rates. Repeated high-level cis-DBCA exposure in two or more trimesters was associated with increased cord blood lymphocyte apoptosis rates (β = 0.19; 95% CI = 0.03, 0.35). CONCLUSIONS: High-level maternal PYRs exposure during pregnancy may reduce neonatal lymphocyte counts and increase lymphocyte apoptosis. These effects persist throughout gestation, with the third trimester may represent a sensitive window for adverse effects on immune development. https://doi.org/10.7189/jogh.16.04318

Translational Gaps in Assessing the Obesogenic Effects of Herbicides: A Scoping Review,
Ramírez-Vargas, M., Bravo-Nava, C., Moreno-Godínez, M., Huerta-Beristain, G., Flores-Alfaro, E., Vences-Velázquez, G. and Cahua-Pablo, J., *Journal of Xenobiotics*, Sep 13 2026, Vol. 16, no. 5.

Obesity is a disease characterized by excessive accumulation of adipose tissue. It is a multifactorial condition arising from complex interactions among genetic background, lifestyle-related factors (such as physical inactivity, socioeconomic and cultural determinants), and environmental factors, including dietary patterns and exposure to environmental pollutants. In this context, exposure to environmental pollutants has been considered an independent risk factor for the development of obesity. However, the evidence linking herbicide exposure and obesity is limited. Therefore, the present scoping review aimed to map the available evidence regarding the obesogenic effects of herbicides across in vitro, in vivo, and epidemiological models, evaluate their translational concordance, and identify methodological gaps in the available literature. A systematic literature search was conducted in PubMed, Web of Science, and Scopus to identify studies reporting the effect of herbicide exposure and obesity-related endpoints. The search was limited to March 2026. A total of 24 studies fully met our eligibility criteria and were classified into in vitro, in vivo, and epidemiological evidence categories. The findings revealed a substantial disconnect across the different levels of evidence. In both in vitro and in vivo studies, the concentrations and doses tested often did not reflect realistic exposure scenarios, thereby limiting the applicability of these findings to human health risk assessment. In contrast, epidemiological studies frequently relied on obesity indicators with limited sensitivity and

specificity, such as body mass index (BMI). Overall, the evidence suggests limited external validity in population-based studies and the arbitrary selection of concentrations and doses in experimental models. https://doi.org/10.3390/jox16050173

Prenatal exposure to PFAS and multimodal structural brain development across childhood,
Rocha, S., Uy, J. P., Antonacci, C., Buthmann, J. L., Tan, A. P., Chong, Y. S., Fortier, M. V., Eriksson, J. and Gotlib, I. H., *Environment International*, 2026/10/18/ 2026, Vol. 217, p. 110565.

BACKGROUND: Per- and polyfluoroalkyl substances (PFAS) are ubiquitous environmental pollutants that are posited to be neurotoxic to the developing brain; however, the impact of prenatal exposure to PFAS - particularly to newer, short-chain PFAS - on brain development across childhood is unclear. METHODS: Concentrations of 9 PFAS were quantified in cord blood plasma of 452 infants (440 for the diffusion sample) who later participated in structural and diffusion magnetic resonance imaging (MRI) at ages 4.5, 6, 7.5, and 10.5 years, providing estimates of regional cortical thickness and surface area, subcortical volumes, and fractional anisotropy (FA) of key white matter tracts. Longitudinal mixed-effect models estimated associations of PFAS with age 4.5 brain metrics and their developmental trajectories across childhood after correcting for the false discovery rate within PFAS and outcome domains. RESULTS: Higher concentrations of PFNA and PFDA in cord blood were associated with lower model-estimated age 4.5 surface area of the right paracentral lobule. PFHpA was associated with faster surface area growth in the left rostral anterior cingulate and slower growth in the right caudal middle frontal gyrus from 4.5 to 10.5 years. The short-chain compound PFBS was linked with greater model-estimated age 4.5 FA in 12 white matter tracts, while PFOA and PFNA were linked with lower FA in the middle cerebellar peduncle and the left corticospinal tract, respectively. Associations of PFBS with FA attenuated with age in several tracts. CONCLUSIONS: Prenatal exposure to PFAS was associated with altered development of frontal and paracentral regions and of white matter microstructure. These findings highlight the need for further research examining the long-term associations of prenatal exposure to PFAS with children's neurodevelopment. https://doi.org/10.1016/j.envint.2026.110565

The association between exposure to per- and polyfluoroalkyl substances and the risk of metabolic syndrome in adults: A systematic review and meta-analysis,
Su, Y., Lin, W., Wu, K., Hsiue, Y., Chen, M., Hung, K. and Chen, P., *Ecotoxicology and Environmental Safety*, Oct 1 2026, Vol. 324.

Background: Evidence regarding the association between per- and polyfluoroalkyl substances (PFAS) and metabolic syndrome (MetS) across adult subgroups remains limited. This study aimed to examine PFAS exposure and MetS risk in adults, focusing on potential susceptibility factors. Methods: We searched PubMed, CINAHL, Embase, MEDLINE and Web of Science from inception to December 2025 for studies reporting associations between four legacy PFAS-perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorohexanesulfonic acid (PFHxS)-and the risk of MetS. Pooled effect sizes were synthesized using random-effects models. To explore potential sources of heterogeneity, subgroup analyses were conducted according to geographic region, participant mean age, MetS prevalence, and study sample size. Results: A total of 10 studies comprising 32,597 participants, including 5437 cases of MetS, were included. No significant associations between legacy PFAS exposure and MetS risk were observed in the general adult population. Age-stratified analyses demonstrated that elevated PFOS and PFNA levels were associated with an increased risk of MetS in study populations with a mean age >= 50 years (Odds ratio [OR]: 1.67, 95% confidence interval [CI]: 1.26-2.22; P-interaction <0.01; OR: 1.88, 95% CI: 1.40-2.53, P-interaction <0.01, respectively). Geographical stratification further delineated regional heterogeneity, with the metabolic impacts of PFNA being localized to the Asian region (OR: 1.86, 95%

CI: 1.37-2.52, Pinteraction = 0.02). Conclusion: PFOS and PFNA may contribute to MetS risk among older adults, while PFNA-related risk may be more pronounced in Asian populations, suggesting potential age- and region-related effect modification of PFASassociated metabolic risk. https://doi.org/10.1016/j.ecoenv.2026.120786

Pesticide Exposure and Breast Cancer: Molecular Mechanisms, Epidemiological Evidence, and Current Challenges,
Tasan, E., Augimeri, G., Bonofiglio, D., Peluso, G., Marsico, S., Vivacqua, A., Rizza, P. and Aquila, S., *Journal of Xenobiotics*, 2026/10/09/ 2026, Vol. 16, no. 6, p. 192.

Breast cancer is a heterogeneous disease driven by complex interactions between genetic, hormonal, metabolic, lifestyle, and environmental factors. Among environmental exposures, agricultural pesticides represent potential contributors to breast carcinogenesis through endocrine-disrupting, oxidative, genotoxic, and epigenetic mechanisms. Utilizing a structured search strategy across PubMed, Scopus, and Web of Science, this review provides a critical synthesis of current evidence linking major pesticide classes with breast cancer dynamics, strictly distinguishing preclinical mechanistic findings from human epidemiological data. Special attention is given to endocrine-disrupting pathways involving estrogen receptors and aromatase hyper-induction, alongside oxidative stress, matrix metalloproteinase activation, epithelial-mesenchymal transition, cancer stemness expansion, and therapeutic resistance. We further evaluate the cytoprotective potential and severe bioavailability bottlenecks of dietary phytochemicals in mitigating pesticide-induced damage. Finally, we address critical methodological limitations, such as exposure misclassification, confounding factors, and the gap between micromolar in vitro doses and realistic nanomolar human exposures, stressing that preclinical mechanisms cannot prove direct clinical causality Therefore, integrating prospective multi-omics biomonitoring with cumulative cocktail risk assessments is essential for evidence-based primary prevention. https://doi.org/10.3390/jox16060192

Combined Effects of Metals and PFAS Exposure on Prevalent Diabetes,
Tasnia, R. and Obeng-Gyasi, E., *Journal of Xenobiotics*, Jul 10 2026, Vol. 16, no. 4.

Human per- and polyfluoroalkyl substances (PFAS) and metal exposures occur as mixtures, but most studies evaluate them independently. Using data from adults in the 2017-2018 National Health and Nutrition Examination Survey (NHANES) with directly measured PFAS and blood metals (N = 1648), we assessed joint associations of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), lead, cadmium, and mercury with prevalent diabetes via survey-weighted logistic regression, Weighted Quantile Sum (WQS) regression, quantile g-computation, and design-aware and na ïve Bayesian Kernel Machine Regression (BKMR). Survey-weighted diabetes prevalence was 11.4%. Lead and PFOS emerged as the dominant contributors to the exposure mixture in the BKMR model, with posterior inclusion probabilities of 1.00 and 0.997, respectively. In the WQS model, PFOS and PFOA were the primary drivers of the positive mixture index, consistent with their proposed roles in endocrine disruption and insulin resistance. BKMR exposure-response functions were non-monotonic, indicating that lead and cadmium associations with diabetes are nonlinear rather than uniformly directional across the exposure range, a structure that conventional logistic regression cannot capture. Overall, restricting to directly measured exposures, incorporating the full NHANES design in the primary regression, and triangulating across complementary mixture frameworks provide a more rigorous platform than prior single-pollutant or design-naive approaches. https://doi.org/10.3390/jox16040128

Prenatal exposure to di(isononyl) cyclohexane-1,2-dicarboxylate and adverse birth outcomes in the USA: a prospective analysis of births in a large American birth cohort,

Trasande, L., Nelson, M. E., Alshawabkeh, A., Barrett, E. S., Buckley, J. P., Dabelea, D., Dunlop, A. L., Herbstman, J. B., Meeker, J. D., Naidu, M., Newschaffer, C., Padula, A. M., Romano, M. E., Ruden, D. M., Sathyanarayana, S., Schantz, S. L., Starling, A. P., Etzel, T. M. and Consortium, E. C., *Environment International*, 2026/10/04/ 2026, Vol. 217, p. 110548.

BACKGROUND: A large body of evidence has documented the effects of ortho-phthalates, additives to soft plastic used in food packaging, on premature birth. Ortho-phthalates are increasingly replaced with alternatives including tere-phthalates and di(isononyl) cyclohexane-1,2-dicarboxylate (DINCH). A limited toxicological literature suggests that DINCH metabolites disrupt sex hormones and promote oxidant stress known to contribute to adverse birth outcomes, and epidemiologic studies have also been limited in sample size, inclusivity of different populations and measurements at different time points in pregnancy. METHODS: We leveraged a large American cohort comprised of mother-child dyads from twenty-two cohorts to assess associations of trimester-specific and pregnancy-wide DINCH metabolites with birth weight (BW) and gestational age (GA). FINDINGS: Average prenatal urinary DINCH was inversely associated with birth length, birthweight, and birthweight for gestational age z-scores, but not GA. A tenfold increase in the pregnancy-averaged DINCH metabolite cyclohexane-1,2-dicarboxylic acid-monocarboxy isooctyl ester (MCOCH) was associated with a decrease of 27.43 g (95%CI: -54.81, -0.04) in birthweight. Trimester-specific analyses revealed stronger associations for third trimester DINCH exposure with birth outcomes. INTERPRETATION: In a large American cohort representing a broad range of backgrounds, we identified an inverse association of DINCH with standardized measures of birth size, but not gestational age. Further studies should examine joint exposures to DINCH, tere- and orthophthalates, and repeated measures across pregnancy. https://doi.org/10.1016/j.envint.2026.110548

Gestational Exposure to Endocrine-Disrupting Chemicals and Small Vulnerable Newborns: A Systematic Review and Meta-Analysis,
Yu, G., Meng, X., Tan, Y. Q., Guivarch, C., Li, S., Yin, X., Pang, W. W., Yang, J., Wang, X., Bauchner, H. and Zhang, C., *Environmental Science & Technology*, 2026/09/15/ 2026, Vol. 60, no. 36, p. 25068–25087.

Endocrine-disrupting chemicals (EDCs) have been implicated in adverse birth outcomes, yet epidemiological findings remain inconsistent. We conducted a systematic review and meta-analysis to evaluate associations between gestational EDC exposure and small vulnerable newborns (SVNs), including preterm birth (PTB), low birth weight (LBW), and small for gestational age (SGA). PubMed, Web of Science, and Embase were searched from inception to January 5, 2026. A total of 106 observational studies involving 98,133 births from 31 countries were included. Higher prenatal exposure to several per- and polyfluoroalkyl substances (PFAS), including perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), and perfluorodecanoic acid (PFDA), was associated with an increased risk of PTB, while PFOS was also associated with LBW. Perfluorooctanoic acid (PFOA), PFNA, PFDA, and perfluorohexanesulfonic acid (PFHxS) were positively associated with SGA. Among other EDCs, higher exposure to ∑DEHP, mono-2-cyclohexyl phthalate (MCPP), mono(2-ethylhexyl) phthalate (MECPP), monoisobutyl phthalate (MiBP), and bisphenol A (BPA) was associated with increased PTB risk. Stratified analyses suggested stronger associations in Asian populations, pregnancies with female fetuses, and countries without or with partial folic acid fortification. These findings indicate that prenatal exposure to PFAS and phthalates may increase the risk of SVNs, particularly PTB, and that population characteristics may modify these associations. https://doi.org/10.1021/acs.est.6c06784

Prenatal PFAS exposure and early childhood sleep quality in the ECHO Cohort,

Zhang, C., Etzel, T., Schantz, S., Martenies, S., Khan, N., Qian, Z., Geiger, S. and Consortium, E. C., *Environmental Research*, Oct 1 2026, Vol. 307.

Per-and polyfluoroalkyl substances (PFAS) are persistent endocrine-disrupting chemicals that readily cross the placenta and may interfere with hormonal systems essential for neurodevelopment and circadian regulation. We examined associations between prenatal exposure to individual PFAS and early childhood sleep quality. The analytic sample included 2836 mother-child pairs from 14 study sites in the Environmental influences on Child Health Outcomes (ECHO) Cohort. We assessed Child Behavior Checklist (CBCL) Sleep Problems T-scores from ages 1-5 years. Maternal serum concentrations of perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA), and perfluorohexane sulfonic acid (PFHxS) were measured during pregnancy. Linear mixed-effects models with random intercepts estimated associations between log(2)-transformed PFAS concentrations and CBCL scores, with covariate adjustment. The mean maternal age was 29.6 years, and the sample was racially and socioeconomically diverse (43% non-Hispanic White, 24% Black, and 23% Hispanic; 27% holding advanced degrees; and 36% reporting annual incomes <$30,000). In adjusted analyses, higher prenatal PFOA concentrations were associated with higher CBCL sleep problem scores in early childhood (beta = 0.13; 95% CI: 0.05, 0.21). Associations for PFOS, PFNA, and PFHxS were small and not statistically significant. Although the magnitude of the observed PFOA association was modest, the findings add to a limited evidence base on prenatal PFAS exposure and parent-reported sleep-related behaviors in early childhood and warrant confirmation in future studies that incorporate harmonized trimester-specific exposure assessment, objective sleep measures, and mixture-based analytic approaches. https://doi.org/10.1016/j.envres.2026.125429

Associations between prenatal phthalate exposure and maternal immune cell profiles across trimesters,
Zhang, Y. and Tao, L., *Frontiers in Public Health*, Sep 1 2026, Vol. 14.

Introduction Phthalates (PAEs) are endocrine-disrupting chemicals, yet the association between prenatal PAE exposure and maternal blood immune cells remains unclear. Here, we enrolled 2,581 pregnant women, including 287 in the first trimester (gestational weeks 1-12), 807 in the second trimester (gestational weeks 13-27), and 1,487 in the third trimester (gestational weeks 28 to delivery). This study aimed to elucidate the association between urinary phthalates (PAEs) metabolites during pregnancy and characteristics of the maternal immune cell profile.Methods First, we analyzed differences in maternal PAE metabolites and immune cell counts (leukocytes, lymphocytes, neutrophils, eosinophils, basophils, monocytes, and platelets) in the three gestational stages using non-parametric alternatives (Kruskal-Wallis test). Subsequently, linear regression models quantified correlations between PAE metabolites and immune cell counts, while restricted cubic spline (RCS) analysis explored dose-response relationships between the two. Finally, Bayesian kernel machine regression (BKMR) was used to assess the non-linear associated between PAE metabolites and immune cells.Results Findings revealed pregnancy-stage differences in both maternal PAE metabolites and maternal immune cell counts within each trimester. Linear regression identified significant associations between specific PAE metabolites and immune cell subsets, while RCS models further confirmed dose-response relationships for multiple metabolites. BKMR analysis highlighted a nonlinear association between combined exposure to PAE metabolites and basophils, monocytes, and lymphocytes.Discussion In summary, this study has preliminarily established an association between prenatal maternal exposure to PAE metabolites and immune cells in maternal blood, highlighting the potential immunomodulatory effects of PAE exposure during pregnancy. However, as this study is primarily based on epidemiological research, all findings should be interpreted with caution. https://doi.org/10.3389/fpubh.2026.1912015

Toxicité sur l'homme

Common Chemicals Trigger Alarming Changes in Human Breast Tissue Models,
SCiTechDaily, 2026/10/23/.

Chemicals that disrupt hormones may leave a molecular "scar" that could someday help identify people at higher risk of breast cancer, research in human breast tissue models suggests. https://doi.org/, https://scitechdaily.com/common-chemicals-trigger-alarming-changes-in-human-breast-tissue-models/

Replacement bisphenols, phthalates, and micro-/nanoplastic exposures in human reproductive endocrinology,
Aygün, E., Kahraman, E., Celina, S. and Oral, E., *Frontiers in Endocrinology*, Sep 18 2026, Vol. 17.

Restrictions on bisphenol A (BPA), continued exposure to phthalates, and the emergence of micro- and nanoplastics (MNPs) have altered the plastic-associated exposure landscape relevant to human reproduction. Existing reviews commonly address these exposures separately or summarize broad reproductive outcomes. This review instead develops a comparative mechanistic framework centered on two connected mechanisms: disruption of gonadotropin-responsive steroidogenesis and oxidative stress, inflammation, and barrier dysfunction. Human biomonitoring, reproductive-tissue, fertility-clinic, and epidemiological evidence are prioritized, while experimental studies are used to resolve mechanisms that cannot be tested directly in humans. Replacement bisphenols can reproduce BPA-like estrogenic, anti-androgenic, and steroidogenic effects, but their actions are analogue-, tissue-, dose-, and time-dependent. Selected phthalates and metabolites have been shown in experimental and ex vivo studies to impair androgen synthesis through altered gonadotropin signaling, cholesterol transport, mitochondrial function, and steroidogenic enzymes. MNPs are heterogeneous particulate exposures whose biological effects depend on polymer composition, size, shape, surface properties, weathering, corona formation, additives, and co-contaminants. Experimental studies using specific MNP models suggest mainly indirect effects on steroidogenesis through particle uptake, altered gonadotropin-responsive signaling, organelle stress, inflammation, and barrier injury. Despite different initiating mechanisms, evidence across the three exposure classes implicates steroidogenesis, redox regulation, inflammatory signaling, and reproductive tissue barriers, although the strength and directness of evidence differ. Human evidence is strongest for phthalates, emerging and analogue-specific for replacement bisphenols, and still methodologically limited for MNP-related clinical outcomes. The framework separates direct catalytic inhibition from altered expression, tissue detection from toxicity, and mechanistic plausibility from demonstrated human effect, supporting targeted research, cautious clinical communication, safer chemical substitution, and MNP exposure mitigation. https://doi.org/10.3389/fendo.2026.1901581

Gout and Environment,
Bardin, T., Letavernier, E., Resche-Rigon, M. and Richette, P., *Bulletin De L Academie Nationale De Medecine*, Oct 2026, Vol. 210, no. 8, p. 954–962.

The role of the environment in the pathogenesis of gout is the subject of growing interest, motivated by the lack of a complete explanation for the disease based on genetic and dietary factors, which has led to a search for other etiological factors. Peaks in air pollution are characterized by increased concentrations of toxic microparticles capable of activating the NLRP3 inflammasome and have been identified by several studies as triggers for gout attacks. Many pollutants are associated with hyperuricemia, as shown by a number of accidental or occupational intoxications and multiple studies

in the general population. This is the case for persistent organic pollutants, which include dioxins and related products (which share the common feature of binding to the AHR cell receptor), PFASs, organochlorine pesticides, and brominated flame retardants. Our experimental work showed that the AHR receptor increased renal tubular reabsorption of urate, which may explain the hyperuricemia induced by dioxins. Other pollutants are associated with hyperuricemia: polycyclic aromatic hydrocarbons (which bind to AHR), phthalates, and bisphenols. Lead and cadmium are also associated with hyperuricemia. Many of these toxins are also carcinogens, endocrine disruptors, or are associated with metabolic syndrome, which is very common in gout patients. Climate change, which increases the spread of these pollutants, and the persistence of pollution despite the measures taken, are therefore a major challenge for health in general, but also for gout, and could explain the increased frequency of gout observed in recent decades. https://doi.org/10.1016/j.banm.2026.05.034

Endocrine disrupting chemicals remodel inflammatory microenvironment of endometriosis via a GSTP1-NR3C1-SELE regulatory network: an integrative bioinformatics analysis,
Dan, Q., Jin, Y., Li, X., Bai, J., Wei, W., Chen, Y. and Zheng, T., *Open Chemistry*, Jan 23 2026, Vol. 24, no. 1.

Endocrine-disrupting chemicals (EDCs) are recognized environmental contributors to endometriosis, yet the mechanisms by which they remodel inflammatory signaling within the lesion microenvironment remain unclear. In this study, integrated bioinformatics and systems-toxicology approaches were applied to elucidate EDC-driven inflammatory regulatory networks in endometriosis. Targets of seven representative EDCs (BPA, BPAF, BPF, DEHP, TCDD, PCB-126, and DDT) were predicted and intersected with differentially expressed and inflammation-related genes in endometriosis. Protein-protein interaction network analysis combined with LASSO regression and the Boruta algorithm identified three core signature genes: GSTP1, NR3C1, and SELE. GSTP1 was significantly downregulated, whereas NR3C1 and SELE were upregulated in endometriosis. Correlation analysis revealed negative associations between GSTP1 and both NR3C1 and SELE, while NR3C1 and SELE showed a positive correlation. Moreover, this gene network was closely associated with immune cell infiltration, including activated CD4+ T cells, effector memory CD8+ T cells, and natural killer cells. These findings identify a GSTP1-NR3C1-SELE regulatory network linking EDC exposure to inflammatory microenvironment dysregulation in endometriosis, providing potential biomarkers and therapeutic targets. https://doi.org/10.1515/chem-2025-0268

Differential impact of bisphenol S on human arterial endothelial cells from healthy and type-2 diabetic donors: a high-content imaging study,
Di Credico, A., Gaggi, G., Bibbò, S., Marchisio, M., Di Baldassarre, A. and Ghinassi, B., *Histochemistry and Cell Biology*, 2026/09/09 2026, Vol. 164, no. 1, p. 84.

Endothelial dysfunction is a central mechanism linking type 2 diabetes (T2D) to cardiovascular complications, and environmental endocrine-disrupting chemicals may further perturb vascular homeostasis. Bisphenol S (BPS), widely used as a bisphenol A substitute, is increasingly detected in human and environmental samples, but its impact on endothelial morphology in the context of pre-existing metabolic disease remains poorly defined. Here, we used high-content imaging and Cell Painting to determine whether exposure to 0.1 µM BPS for 96 h induces distinct morphology-based responses in primary human arterial endothelial cells from healthy and T2D donors. Multiplex staining of DNA, RNA-rich regions, RER, Golgi/membrane structures, and mitochondria was combined with automated segmentation, multidimensional feature extraction, sparse partial least-squares discriminant analysis, and inferential statistics. Metabolic status was the main determinant of the endothelial morphology-based profile, clearly separating healthy and T2D-derived cells. In addition,

BPS induced a pronounced multidimensional phenotypic shift in healthy endothelial cells, involving nuclear, mitochondrial, RNA-associated, and membrane/perinuclear descriptors. In contrast, T2D-derived cells retained a dominant disease-associated profile, with a less evident whole-cell response to BPS. However, selected RER-associated descriptors remained BPS-responsive, indicating that BPS can still modulate stress-related subcellular organization under diabetic conditions. These findings show that BPS perturbs endothelial morphology under exposure-relevant low-dose conditions but that baseline metabolic status strongly shapes the magnitude and compartmental distribution of this response. The study identifies the diabetic endothelial phenotype as a key modifier of BPS-induced cellular remodeling and supports Cell Painting as a sensitive strategy to resolve context-dependent endothelial responses to environmental pollutants. https://doi.org/10.1007/s00418-026-02535-0

Environmental endocrine-disrupting chemicals as ototoxicants: a systematic review of epidemiological evidence,
Floriano Da Silva, C. F., Garcia, É. C., Nunes De Sousa, A., Máximo, V. G., Soares Beserra, B. T., Quaglio Bellozi, P. M., Fabro De Bem, A. and Amato, A. A., *Environmental Research*, 2026/12/15/ 2026, Vol. 311, p. 126081.

Hearing loss affects over 1.5 billion people globally and is projected to rise substantially by 2050. While several environmental pollutants are established ototoxicants, those that act as endocrine-disrupting chemicals (EDCs) have received far less attention as auditory hazards, despite mechanistic evidence for effects on thyroid hormone signaling, oxidative stress, and direct cochlear toxicity. No systematic review has comprehensively synthesized the human evidence linking EDC exposure to auditory outcomes. We conducted a systematic review in accordance with PRISMA 2020 guidelines (PROSPERO CRD420261383642). PubMed, Scopus, and Web of Science were searched from inception to June 10, 2026. Observational studies assessing EDC exposure through biological samples and hearing function by pure-tone audiometry or otoacoustic emissions (OAE) were eligible, and risk of bias was assessed using the Office of Health Assessment and Translation (OHAT) tool. Twenty-three studies were included (16 cross-sectional, 6 cohort, 1 case-control), encompassing ten EDC classes: polychlorinated biphenyls (PCBs), per- and polyfluoroalkyl substances (PFAS), organochlorine pesticides, organophosphates, parabens, phenols, pyrethroids, volatile organic compounds, phthalates, and polychlorinated dibenzofurans. Evidence was most consistent for PCBs, for which postnatal exposure was associated with reduced OAE amplitudes across repeated analyses of a single birth cohort, and for PFAS, with perfluorononanoic acid showing the most robust audiometric associations. Parabens and bisphenol A were associated with cochlear dysfunction in pediatric populations, though on the basis of a single research group. Within-class heterogeneity for phenols and PCBs cautioned against class-level generalizations. Overall, the evidence suggests that exposure to several EDC classes may be associated with impaired hearing in humans, supporting the inclusion of cochlear outcomes in EDC risk assessment and environmental health surveillance while underscoring the need for independent replication. https://doi.org/10.1016/j.envres.2026.126081

Endocrine and cardiovascular consequences of plasticiser exposure: a narrative review from the thyroid- cardiac axis perspective,
Halder, D., Varshini, P., Mitra, T., Karthikeyan, D., Kumar, A., Sundari, S., Mishra, S. and Janardhanan, R., *Frontiers in Pharmacology*, Aug 28 2026, Vol. 17.

Endocrine-disrupting chemicals particularly plasticisers such as phthalates, bisphenols and their emerging substitutes, are increasingly recognised as the main environmental toxicants with significant implications for thyroid and cardiovascular health. Due to their widespread use in consumer products, food packaging, medical devices, cosmetics and industrial materials, chronic human exposure occurs via ingestion, inhalation, dermal absorption and parenteral administration.

Increasing evidence indicates that these compounds disrupt the hypothalamic-pituitary-thyroid axis by interfering with thyroid hormone synthesis, transport, receptor signalling, iodine homeostasis and endocrine feedback regulation. These disruptions contribute to thyroid autoimmunity, hypothyroidism, and broader endocrine imbalance. Because tfundihyroid hormones are vital for cardiovascular health, plasticiser-related thyroid problems can indirectly lead to cardiovascular issues, including hypertension, endothelial dysfunction, dyslipidaemia, arrhythmias, atherosclerosis and heart failure. Mechanistically, these effects are mediated by oxidative stress, mitochondrial dysfunction, inflammatory signalling, ion-channel disruption, metabolic dysregulation and epigenetic modifications. Integrated thyroid-cardiac crosstalk is increasingly recognised as a critical mechanistic axis linking environmental EDC exposure to the progression of cardiometabolic disease. The review highlights the emerging biomarkers and advanced microfluidic and organ-on-chip technologies as promising tools for early detection and mechanistic evaluation of plasticiser-induced thyroid-cardiac dysfunction. Collectively, this review also highlights the critical need for long-term human studies, combined exposure assessments and translational diagnostic approaches to enhance our understanding and alleviate the escalating public health burden of environmental plasticiser exposure. https://doi.org/10.3389/fphar.2026.1876287

Benzophenone-3 as a UV filter: A comprehensive analysis of human exposure risks,
Hou, K., Zhang, L., Zhang, X., Fan, X., Yang, L., Li, L., Jiang, L. and Yuan, G., *Process Safety and Environmental Protection*, Sep 15 2026, Vol. 218.

The UV filter benzophenone-3 (BP-3 or oxybenzone) has been widely used as a broad-spectrum UV absorber and is now commonly found in humans and the surrounding environment. While its ecological and toxicological effects have been studied, a systematic assessment of the extent of human exposure, influencing factors, and associated health risks remains lacking. To better understand the risks posed by BP-3, we conducted a comprehensive review of studies focusing on its physicochemical properties, exposure pathways, biotransformation, internal concentrations, and associated potential toxic effects in humans. Our findings show that BP-3 is readily absorbed through the skin and gains entry into the human body and is consistently detected in serum, urine, breast milk, and other biological matrices across global populations. Body burdens vary significantly by geography and demographic factors, including lifestyle and socioeconomic status. Importantly, BP-3 has been found in maternal urine, placenta, and amniotic fluid, with correlated levels in maternal and cord serum, confirming transplacental transfer and potential fetal exposure. The accumulated biomonitoring data, coupled with evidence of endocrine-disrupting potential, underscore significant public health concerns. This review underscores the urgent need for the potential health effects associated with BP-3 exposure and highlights the urgent need for further epidemiological studies to clarify dose-response relationships and long-term health outcomes. Collectively, our findings provide critical evidence to inform regulatory actions aimed at mitigating human exposure to BP-3. https://doi.org/10.1016/j.psep.2026.109438

Multi-omics, machine learning, and molecular simulation identify CD44 as a candidate target in endocrine-disrupting chemical-associated thyroid cancer progression,
Hu, Y., Liu, K., Chen, T., He, Z., Li, S., Hu, W., Fu, Q. and Chen, X., *Molecular Diversity*, Dec 2026, Vol. 30, no. 6, p. 8905–8925.

Endocrine-disrupting chemicals (EDCs) are widely present in the environment and consumer products and may disturb thyroid hormone homeostasis. However, the molecular mechanisms linking EDC exposure to thyroid cancer progression remain unclear. This study integrated toxicity prediction, toxicogenomics, transcriptomic analysis, machine learning, molecular simulation, and experimental validation to identify EDC-related key targets in thyroid cancer. ADMETlab 3.0 was used to evaluate

the potential toxicity of BPA, PFOA, DDT, BDE-209, TCDD, and DEHP, and compound-related genes were obtained from the CTD database. By integrating thyroid cancer-related genes from multiple disease databases, 1113 shared EDC-thyroid cancer targets were identified and were mainly enriched in PI3K-Akt, FoxO, and AGE-RAGE signaling pathways. Combined with differential expression analysis, machine learning identified a six-gene diagnostic model consisting of FN1, BCL2, CD44, CDKN1A, CTNNB1, and JUN. The Lasso + LDA model achieved an average AUC of 0.976 across the training cohort and three external validation cohorts. CD44 showed robust diagnostic performance, with AUC values of 0.950, 0.801, 0.878, and 0.938 in the training set, GSE27155, GSE29265, and GSE153659, respectively, and had the highest contribution in SHAP analysis. Immune infiltration, TCGA survival, and single-cell analyses indicated that CD44 was associated with the tumor immune microenvironment, cellular state changes, and prognosis. Molecular docking and 200 ns molecular dynamics simulations generated plausible docking poses of BPA, DEHP, and PFOA on CD44, with PFOA showing the most favorable predicted docking score. Experimental validation showed higher CD44 expression in thyroid cancer tissues and cells and increased CD44 expression following EDC exposure. CD44 knockdown attenuated EDC-associated increases in proliferation, colony formation, and migration. These findings identify CD44 as a candidate molecule associated with EDC-responsive malignant phenotypes in thyroid cancer. https://doi.org/10.1007/s11030-026-11721-0

Multi-omics analysis reveals ITGA2 mediates DEHP-induced decidual endothelial dysfunction in recurrent pregnancy loss,
Jiang, Z., Wu, X., Luo, Y. and Zhou, Y., *Ecotoxicology and Environmental Safety*, 2026/10/15/ 2026, Vol. 325, p. 120960.

Di(2-ethylhexyl) phthalate (DEHP), a ubiquitous environmental endocrine disruptor, has been detected in over 97% of pregnant women. Epidemiological studies have linked DEHP exposure to increased risk of recurrent pregnancy loss (RPL); however, the underlying mechanistic pathways remain poorly characterized. This study employed an integrated multi-omics approach combining network toxicology, machine learning, Mendelian randomization (MR), single-cell RNA sequencing (scRNA-seq), and molecular dynamics (MD) simulation to elucidate the molecular mechanism by which DEHP exposure induces RPL. Network toxicology analysis identified 143 shared targets between DEHP-associated genes and RPL-related genes, which were significantly enriched in focal adhesion and PI3K-Akt signaling pathways. Integration of machine learning analysis on RPL transcriptomic data with MR identified ITGA2 as a genetically supported protective factor causally associated with RPL. scRNA-seq precisely localized ITGA2 expression to decidual endothelial cells, where it was significantly downregulated in RPL patients. In silico gene knockout predicted that ITGA2 deficiency leads to dysregulation of angiogenesis- and immune regulation-associated genes, impairing decidual endothelial cell function and the immunological microenvironment. MD simulation predicted that DEHP forms a direct, stable complex with the extracellular domain of ITGA2. In HUVECs, DEHP dose-dependently reduced ITGA2 mRNA and protein levels and impaired migration. Silencing ITGA2 reproduced this migration defect, indicating that ITGA2 downregulation contributes to DEHP-induced endothelial dysfunction. Collectively, these findings identify ITGA2 as a biologically and genetically supported candidate linking DEHP exposure to impaired decidual endothelial function in RPL and provide a basis for future biomarker and mechanistic studies. https://doi.org/10.1016/j.ecoenv.2026.120960

Investigation of the Potential of Bisphenol A Substitutes to Induce Allergic Contact Sensitization OECD Defined,
Johnson, V., Gulledge, T., Luster, M., Burleson, G., Burleson, F. and Germolec, D., *Altex-Alternatives to Animal Experimentation*, 2026 2026, Vol. 43, no. 3, p. 453–463.

Bisphenol A is a high production volume chemical used extensively in the manufacture of poly-carbonate plastics, epoxy resins, and thermal printer paper with a high potential for occupational and post-production dermal exposure. Bisphenol A-containing plastics were commonly used in food packaging, resulting in significant public exposure through leaching into foodstuff. The public is also at risk of dermal exposure due to environmental contamination. Due to public health concerns regarding the potential for endocrine disrupting effects, efforts have been applied to replace bisphenol A with safer alternatives. Bisphenol A has been shown to cause skin sensitization in humans; however, there is a paucity of information available on the sensitizing potential of the structural analogues which are increasingly being employed as substitutes. We utilized new approach methodologies (NAMs) addressing key events 1-3 of the adverse outcome pathway for skin sensitization to assess the potential of bisphenol A substitutes to induce dermal sensitization. Defined approaches (DA) were applied to further classify and categorize potency according to OECD TG 497. The NAMs and DAs confirmed that bisphenol A was a skin sensitizer in potency category UN GHS 1B. Bisphenol B, AP, and E were also classified as UN GHS 1B sensitizers, and bisphenol AF as UN GHS 1A/1B depending on the DA, while 2,4-bisphenol Sand F were borderline sensitizers, and bisphenol S was classified as a non-sensitizer. These data provide evidence of skin sensitization hazard for the bisphenol structural analogues tested, except for bisphenol S, suggesting that they present risks for dermal allergy. https://doi.org/10.14573/altex.2512011

Risk assessment of benzophenone-3, a UV filter in cosmetics,
Kang, K.-T., Kim, M., Sung, C. R., Lee, J. D., Yoon, T., Kim, K.-B., Kwack, S. J. and Lee, J. Y., *Toxicological Research*, 2026/11// 2026, Vol. 42, no. 6, p. 705–724.

Benzophenone-3 (also known as oxybenzone) is an ultraviolet filter commonly used in sunscreen formulations and personal care products. Given its systemic exposure through dermal and oral absorption, the toxicity of benzophenone-3 has been widely studied. In rodents, dietary exposure to high experimental doses of benzophenone-3 was associated with mild systemic toxicity, including reduction in body weight gain, increase in liver and kidney weights, and signs of nephropathy. While benzophenone-3 was shown to be non-irritating and non-skin sensitizing following ocular instillation and dermal application in animal studies, it has been recognized as a cause of photoallergic contact dermatitis in clinical studies. Mild reproductive and developmental effects have also been reported, including reduced offspring body weight, slightly reduced litter size, and altered sperm parameters. Benzophenone-3 was non-mutagenic in genotoxicity assays, and a lifetime dietary exposure study in rodents suggested equivocal evidence of carcinogenic activity. The endocrine-disrupting potential of benzophenone-3 is of concern because it binds to estrogen receptors. Although in vitro and in vivo assays have shown inconsistent results, the potential risk to humans remains a concern. For the safety assessment, a no-observed-adverse-effect level of 1,000 ppm (67.9 mg/kg/day) was selected from a reproductive and developmental toxicity study in which a reduced number of spermatocytes per seminiferous tubule was observed in male F1 offspring. The systemic exposure dose, calculated based on the daily usage amount for the Korean population, was 0.6732 mg/kg/day when used at 2.4% in sunscreen products, resulting in a margin of safety for benzophenone-3 that was approximately equal to or greater than 100. Therefore, the use of benzophenone-3 in cosmetics under current regulations is considered safe. https://doi.org/10.1007/s43188-026-00364-w

Endocrine-Disrupting Chemicals and Hypertension: Mechanisms and Clinical Implications,
Keskin, M., Baykal, G., Koca, A., Yetkin, I. and Cesur, M., *Journal of Cardiovascular Development and Disease*, Sep 14 2026, Vol. 13, no. 9.

Hypertension remains one of the leading causes of global morbidity and mortality and is the leading modifiable risk factor for cardiovascular disease worldwide. The inability of conventional risk factors

alone to fully explain the global prevalence of hypertension, together with accumulating evidence implicating endocrine-disrupting chemicals (EDCs) in the pathogenesis of hypertension, has led to growing scientific interest in this field over recent years. EDCs are exogenous environmental chemicals capable of disrupting hormone synthesis, transport, metabolism, and signaling pathways, thereby adversely affecting vascular and metabolic homeostasis. In particular, per- and polyfluoroalkyl substances (PFASs), bisphenol A, phthalates, PCBs, heavy metals, and pesticides have been associated with hypertension and may influence blood pressure regulation through multiple interconnected mechanisms, including oxidative stress, endothelial dysfunction, inflammation, epigenetic modifications, and activation of the renin-angiotensin-aldosterone system. Moreover, prenatal exposure to EDCs has been associated with hypertensive disorders of pregnancy, including gestational hypertension and preeclampsia, with potential implications for long-term maternal cardiovascular health. This review provides a comprehensive overview of the experimental and epidemiological evidence linking endocrine-disrupting chemicals to hypertension, with particular emphasis on the underlying molecular mechanisms, emerging clinical evidence, and future research directions. https://doi.org/10.3390/jcdd13090462

PFAS and microbiota dysbiosis: An emerging link to respiratory toxicity,
Khan, S., Chen, M., Chen, Z., Liang, Z., Abbas, M., Ahmad, S., Hassan, M. U., Xie, S. and Chen, D., *Comparative biochemistry and physiology. Toxicology & pharmacology: CBP*, 2027/01// 2027, Vol. 311, p. 110732.

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants of increasing concern because of their widespread use, environmental mobility, bioaccumulation, and multisystem toxicity, including immunotoxicity, hepatotoxicity, neurotoxicity, reproductive toxicity, and endocrine disruption. Regulatory restrictions on legacy PFAS have accelerated the use of short-chain, ether-containing, and other replacement compounds, including GenX/HFPO derivatives, 6:2 Cl-PFESA, OBS, and ultrashort-chain PFAS; however, their respiratory and toxicological profiles remain incompletely characterized. Although ingestion through food and drinking water is the major exposure route for the general population, inhalation through indoor dust, aerosols, occupational emissions, and firefighting-related sources may be relevant in high-exposure settings, while the actual dose reaching human lung tissue remains poorly defined. Emerging evidence indicates that PFAS-induced toxicity may also involve disruption of host-microbiota interactions. The lung microbiome, despite its low biomass, contributes to mucosal immunity, epithelial homeostasis, and respiratory defense, while the gut-lung axis enables intestinal microbial signals to influence pulmonary inflammation. PFAS-associated gut dysbiosis can alter short-chain fatty acids, bile-acid metabolism, tryptophan-derived metabolites, and microbial products such as lipopolysaccharide, thereby providing plausible mechanistic links between intestinal disturbance and pulmonary immune responses. However, direct evidence that PFAS causally remodel the lung microbiota or that microbiota-derived signals mediate PFAS-induced lung injury remains limited. This review integrates current evidence from epidemiological, in vitro, and in vivo studies to evaluate PFAS-associated respiratory toxicity, with particular emphasis on emerging PFAS, exposure relevance, pulmonary inflammation and injury, and microbiota-mediated mechanisms along the gut-lung axis. By distinguishing established pulmonary effects from emerging microbiota-related hypotheses, this review identifies critical knowledge gaps and highlights priorities for future exposure assessment, mechanistic research, and risk evaluation. https://doi.org/10.1016/j.cbpc.2026.110732

Hazardous Chemicals Associated with Plastics and Plastic Waste: Environmental Occurrence and Toxicity of TCDD, DEHP, BPA, and Acrylonitrile,
Kozłowski, M., Zawadzka, M., Kalinowska, M. and Matejczyk, M., *Materials*, 2026/10/17/ 2026, Vol. 19, no. 20, p. 4368.

Hazardous compounds including 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), bis(2-ethylhexyl) phthalate (DEHP), bisphenol A (BPA), and acrylonitrile (ACN) are ubiquitous in environmental matrices such as soil and water. This review synthesizes their environmental occurrence and multi-organ toxicity. Its objective was to integrate occurrence and toxicity data for TCDD, DEHP, BPA, and ACN into a single account and to identify early-hazard biomarkers and regulatory gaps. A structured documentary search covering mainly 2000 to 2024 was performed in Google Scholar, ScienceDirect, Scopus, Web of Science, and PubMed, prioritizing in vivo and in vitro experimental studies and complemented by governmental and institutional reports. The analysis shows that all four compounds act through convergent mechanisms centered on oxidative stress and mitochondrial dysfunction, via compound-specific signalling pathways, and that adverse effects arise across cytotoxic, neurotoxic, cardiotoxic, reproductive, and immune endpoints at environmentally relevant concentrations, with some reproductive effects extending across generations. HSP47 and HSP70 emerge as early biomarkers of cellular stress. Although regulation has measurably reduced some exposures, chronic low-dose risk remains underestimated, supporting harmonized limits, premarket screening of substitutes, and source control. https://doi.org/10.3390/ma19204368

Impact of microplastics on reproductive health: genetic and epigenetic insights into idiopathic recurrent pregnancy loss and infertility-a narrative review,
Kumar, K., Bhat, D. and Prashant, A., *F&S Reviews*, Dec 2026, Vol. 7, no. 3.

Microplastics (MPs) have emerged as pervasive environmental pollutants with growing evidence of bioaccumulation in human tissues, including the reproductive system. Although their ecological and metabolic toxicity is well recognized, their role in human reproductive dysfunction, particularly recurrent pregnancy loss and infertility, remains insufficiently explored. This review summarizes current evidence on the genetic, epigenetic, endocrine, and immunological mechanisms underlying the associations between MPs exposure and adverse reproductive outcomes reported in human observational studies; however, causal relationships remain unestablished. This review synthesizes current evidence on the genetic, epigenetic, endocrine, immunological, and molecular mechanisms through which MPs may impair reproductive health. The MPs enter the body through ingestion, inhalation, and dermal exposure, subsequently accumulating in reproductive organs and placental tissues, where they may act as carriers of endocrine-disrupting chemicals. Experimental studies indicate that MPs exposure promotes oxidative stress, mitochondrial dysfunction, inflammation, DNA damage, endocrine dysregulation, and altered gene expression, leading to chromosomal instability and epigenetic alterations, including DNA methylation, histone modifications, and microRNA dysregulation. Current human evidence, including placental, biomonitoring, and assisted reproductive technology-related studies, supports the biological plausibility of MP-associated reproductive toxicity, although direct clinical evidence linking MPs exposure to recurrent pregnancy loss remains limited. Unlike previous reviews, this article integrates mechanistic evidence with emerging human clinical findings to provide a comprehensive framework connecting environmental exposure, genetic and epigenetic regulation, and reproductive dysfunction. Furthermore, it identifies key translational knowledge gaps and outlines future research priorities aimed at improving risk assessment, biomarker discovery, and preventive strategies for MP-associated reproductive disorders. (F S Rev (R) 2026;7:100119. (C) 2026 by American Society for Reproductive Medicine.) https://doi.org/10.1016/j.xfnr.2026.100119

Neuroendocrine Disruption of Reproduction by Bisphenols and Phthalates: From Molecular Mechanisms to Reproductive Outcomes,
Lencu, C., Gerdanovics, C., Orasan, O., Iancu, D., Gerdanovics, A., Perne, M., Milaciu, M., Negrean, V., Dobrota, I. and Alexescu, T., *International Journal of Molecular Sciences*, Aug 16 2026, Vol. 27, no. 16.

Bisphenols and phthalates are ubiquitous endocrine-disrupting chemicals with potential effects on reproductive neuroendocrine regulation, particularly during sensitive developmental windows. This review summarizes current evidence on their exposure profile, mechanisms of reproductive disruption, and female- and male-specific reproductive adversities. A structured narrative review was conducted using PubMed/MEDLINE, Scopus, and Web of Science, including experimental, epidemiological, biomonitoring, systematic review, and meta-analytic studies addressing bisphenols, phthalates, fertility, hormonal regulation, gametogenesis, pregnancy outcomes, and reproductive toxicity mechanisms. Bisphenols and phthalates interfere with estrogenic and androgenic signaling, hypothalamic-pituitary-gonadal axis regulation, steroidogenesis, oxidative stress, inflammation, apoptosis, mitochondrial function, and epigenetic regulation. Reported outcomes include impaired ovarian function, altered oocyte development, hormonal imbalance, reduced semen quality, defective spermatogenesis, sperm DNA damage, infertility, and adverse developmental or pregnancy-related effects. However, human evidence remains heterogeneous and limited by observational designs, exposure misclassification, residual confounding, and insufficient mixture assessment. Current evidence supports biological plausibility for bisphenol- and phthalate-related reproductive toxicity, but causal inference remains limited. Prospective studies with repeated biomonitoring, standardized reproductive endpoints, sex- and age-specific analyses, and improved mixture modeling are needed. A precautionary reduction in avoidable exposure appears reasonable, particularly during sensitive reproductive and developmental periods. https://doi.org/10.3390/ijms27167311

Integrated computational and in vitro analysis reveals the toxic mechanisms of PFAS in female diminished ovarian reserve,
Li, H., Hu, X., Guo, Z. and Sun, Z., *Scientific Reports*, Aug 1 2026, Vol. 16, no. 1.

Per- and polyfluoroalkyl substances (PFAS) are a class of anthropogenic organic compounds ubiquitous in the environment. Growing evidence has underscored these associated health risks. Diminished ovarian reserve (DOR), which is characterized by a decline in oocyte quantity and quality, is a significant cause of female infertility. However, the role of PFAS in the pathogenesis of DOR remains unclear. This study integrated network toxicology, machine learning, molecular docking, and molecular dynamics (MD) simulations to investigate the mechanisms of PFAS on DOR, with subsequent validation using KGN cells. Multi-database screening identified 35 candidate targets. Gene Ontology and KEGG enrichment analyses revealed that PFAS perturb pathways governing cell proliferation and differentiation, immune-inflammatory responses, and hormone signaling. Furthermore, we identified three core targets by integrating the GEO database analysis, and machine learning. Single-gene GSEA elucidated multi-pathway regulatory mechanisms. Molecular docking demonstrated strong binding affinities between PFAS and these targets, while MD simulations confirmed the structural stability of the resulting complexes. PFAS exposure induces dose- and time-dependent cytotoxicity and oxidative stress in KGN cells in vitro. It activates apoptotic signaling via BAX upregulation and Bcl-2 downregulation and accelerates oxidative stress by suppressing glutathione S-transferase P1 (GSTP1) and peroxiredoxin 5 (PRDX5) expression. Additionally, PFAS impair ovarian reserve function by inhibiting the synthesis and secretion of anti-M & uuml;llerian hormone (AMH) and inhibin B (INHB). Notably, TGFBR1 upregulation suggests the activation of pro-fibrotic signaling markers, further compromising ovarian function. Our findings propose a potential mechanistic framework wherein PFAS may contribute to DOR progression by correlating with apoptosis, inducing oxidative stress, suppressing reserve markers, and activating fibrotic pathways. This study provides novel insights into the pathogenesis of PFAS-associated DOR. https://doi.org/10.1038/s41598-026-56614-2

Mechanistic insights into di(2-ethylhexyl) phthalate exposure in obstructive sleep apnea: network toxicology and in vitro validation,
Li, Y., Yin, D., Deng, S., Zhai, L., Wang, L., Zhang, L., Zhao, B., Niu, H. and Gao, X., *Bioorganic Chemistry*, Oct 15 2026, Vol. 182.

Background: Di(2-ethylhexyl) phthalate (DEHP), a widely used plasticizer and endocrine-disrupting chemical, has been associated with multiple adverse health outcomes. However, whether DEHP exposure contributes to poor outcomes in individuals with obstructive sleep apnea (OSA), particularly through interaction with chronic intermittent hypoxia (CIH), remains unclear. Methods: We used NHANES data to assess the relationship between DEHP exposure and all-cause mortality in OSA patients. Environmental health-related targets of DEHP were identified through ChEMBL, SEA, and SwissTargetPrediction databases. OSA-related genes were compiled from GeneCards, OMIM, and CTD. Proteinprotein interaction analysis and molecular docking were performed to explore potential molecular interactions. In vitro experiments were conducted in human bronchial epithelial cells using CCK-8 assays, LDH release assays, and RT-qPCR analysis. Concentration-dependent responses to DEHP exposure were evaluated, and the modifying effects of CIH, a hallmark feature of OSA, were further investigated. Results: Increased DEHP exposure was significantly associated with a higher risk of all-cause mortality in OSA patients, with a non-linear dose-response relationship. Network toxicology analysis revealed key DEHP-related targets involved in inflammation, tissue remodeling, and apoptosis, such as AR, BCL2, CASP3, PRKCA, CTSS, and MMP9. Molecular docking provided structural evidence supporting potential interactions between DEHP and these proteins. In vitro experiments demonstrated concentration-dependent alterations in hub gene expression following DEHP exposure, characterized by increased expression of AR, CASP3, PRKCA, CTSS, and MMP9 and decreased expression of BCL2. These molecular responses were further enhanced under combined DEHP exposure and CIH conditions. Conclusion: DEHP exposure was associated with increased mortality risk among individuals with OSA. DEHP induced concentration-dependent changes in OSA-related hub gene expression, which were further enhanced by intermittent hypoxia, providing potential insights into the biological effects of DEHP exposure in OSA. https://doi.org/10.1016/j.bioorg.2026.110498

A Universal Plasticizer Alkylsulfonic Phenyl Ester Activates Pregnane X Receptor to Increase Intestinal Cholesterol Uptake,
Okore, N., Kariuki, W., Brown, C., Moxley, M., Ramirez, N. and Sui, Y., *International Journal of Molecular Sciences*, Sep 15 2026, Vol. 27, no. 18.

Alkylsulfonic phenyl ester (ASE) is an alternate non-phthalate plasticizer used in PVC and polyurethane manufacture, such as for medical tubing and toys. Plastic-associated endocrine disrupting chemicals have been associated with increased cardiovascular disease risks and have been established as the agonists of a xenobiotic sensor, pregnane X receptor (PXR), which has atherogenic and dyslipidemic effects. However, it is unknown whether ASE activates PXR to adversely affect cardiovascular system. Our objective is to investigate how ASE impacts lipid profiles and cholesterol uptake via PXR signaling. Human hepatic and intestinal cells were used to test activation of PXR by ASE. The computational docking study and site-directed mutagenesis were used to identify key amino acid residues in PXR that interacted with ASE. The natural PXR inhibitor resveratrol was used to prohibit PXR activities. The male C57BL/6 wildtype mice were fed with ASE to evaluate if ASE could alter plasma lipid levels. Our data suggested that ASE was a specific PXR agonist and increased atherogenic cholesterol levels in mice mediated by PXR. Furthermore, ASE treatment increased cholesterol uptake by human intestinal cells through PXR signaling. Our study elucidates the role of PXR as a mediator of xenobiotic-elicited dyslipidemia and provides evidence for the future risk assessment of ASE on cardiovascular diseases. https://doi.org/10.3390/ijms27188189

Environmental chemical mixtures reprogram mammary epithelial development to epigenetic states associated with breast cancer,
Parrish, M., Seraj, M., Nikoueian, H., Traugh, N., Chen, A., Gupta, P. B., Monti, S. and Kuperwasser, C., *Proceedings of the National Academy of Sciences*, 2026/10/20/ 2026, Vol. 123, no. 42, p. e2613054123.

Environmental exposures occur as complex mixtures, yet the mechanisms by which they alter human tissue development and generate cancer-relevant tissue states remain poorly defined. Here, we establish a physiologically relevant 3D human breast organoid high-content screening platform that relates exposure-induced developmental disruption to cancer-relevant cell states. Screening of structurally diverse environmental chemicals as single agents and mixtures reveals heterogeneous but reproducible developmental responses, indicating that distinct environmental chemicals perturb different aspects of mammary morphogenesis. Focusing on bisphenols, we show that a low-dose mixture (BPA, BPS, and BPF; 3BPX) disrupts organoid development and induces transcriptional programs characterized by extracellular matrix remodeling, epithelial plasticity, and partial epithelial–mesenchymal transition, accompanied by widespread DNA methylation remodeling. A 3BPX exposure signature maps to ER+ luminal breast cancers and is preferentially enriched in invasive lobular carcinoma (ILC), a subtype characterized by epithelial plasticity. The 3BPX-associated methylation signature is detectable in primary tumors and adjacent normal tissue and is enriched in ILC. Together, these findings show that environmentally relevant chemical mixtures induce heterogeneous developmental perturbations that converge on conserved transcriptional and epigenetic programs associated with epithelial plasticity and tissue remodeling. These exposure-associated signatures are represented in defined epithelial and stromal compartments in human breast cancers, supporting a model in which developmental exposures may establish field-like, cancer-relevant tissue states. https://doi.org/10.1073/pnas.2613054123

An integrative review of Bisphenol A (BPA): mechanistic insights into exposure dynamics, multiorgan toxicity, and biomolecular pathways,
Rabby, T., Rafi, M., Sultana, N., Saha, S., Naziha, I., Islam, S., Chen, U., Sumi, S., Hussain, M., Danishuddin and Haque, M., *Environmental Reviews*, 2026 2026, Vol. 34.

Bisphenol A (BPA) is a highly consumed synthetic compound used in the production of polycarbonate plastics and epoxy resins, with global production exceeding six billion pounds yearly. Alarmingly, BPA leaching into food, beverages, and the environment results in hazardous exposure to humans and wildlife. The current review provides a holistic assessment of BPA, focusing on the convergence of environmental exposure dynamics, molecular toxicity pathways, and their consequences for human health and regulatory policy. By synthesizing evidence from experimental, epidemiological, and environmental studies, the current approach examines how BPA interacts with major organ systems through receptor-mediated signaling, oxidative stress, and epigenetic modulation and how these processes may contribute to multisystem outcomes, such as endocrine, metabolic, neurological, and immune alterations. Particular focus is given to emerging studies on immunological effects and the pervasiveness of BPA in environmental matrices, supported by biomonitoring data. The increasing use of BPA analogues also critically examined in the current review, which raises concerns regarding the structural similarities and the possibility of "regrettable substitution". Although a considerable number of investigations indicate ties between exposure to BPA and negative health outcomes, inconsistent study designs and exposure contexts highlight the need for careful interpretation. integrating mechanistic insights with real exposure patterns and changing regulatory stances that call for increased policy enforcement, the development of alternative materials, and ongoing biomonitoring, the current review aims to provide more coherent framework for understanding BPA-

related risks and to direct future research priorities and risk management strategies. https://doi.org/10.1139/er-2025-0245

Endocrine gland specific mechanistic paradigms of toxicity induced by metallic nanoparticles,
Rana, S. V. S., *Discover Toxicology*, 2026/09/09 2026, Vol. 3, no. 1, p. 20.

Nanoparticles (NPs), due to their small size and unique physico-chemical properties are now being increasingly utilized in agriculture, commerce, industry and medicine, raising concerns about their systemic health effects on human health. Amongst vulnerable systems, the endocrine glands have been identified as critical target(s) of NP toxicity. Present review highlights current understanding of mechanisms viz. oxidative stress, inflammation, apoptosis disruption of hormone synthesis and metabolism, involved in endocrine toxicity of metallic nanoparticles. Experimental evidence suggests that NPs can enter endocrine glands, mimic hormones, interact with hormone receptors and disrupt downstream signaling pathways. Specific effects of NPs thus induced in endocrine glands viz. thyroid, parathyroid, thymus, pineal, pancreas, adrenals, placenta and hypothalamo-pituitary axis have been documented. Since, a few nanoparticles do exhibit antioxidant properties or therapeutic potential, their dual role as endocrine disruptors and therapeutic agents contributes to diverse and complex biological manifestations. The review emphasizes the need for advanced experimental models, including organ chip systems and multi-omic approaches to better evaluate NP-induced endocrine disruption. The review concludes that endocrine toxicity remains crucial for risk assessment and safe integration of nanotechnology into health care, theranostics, industrial, commercial and environmental applications. https://doi.org/10.1007/s44339-026-00064-y

Impact of flame retardants on the reproductive system,
Robaire, B., *Biology of Reproduction*, 2026.

Flame retardants are a diverse class of environmental contaminants widely used to reduce flammability in consumer products, leading to pervasive human exposure. Among these, polybrominated flame retardants (PBFRs), including polybrominated diphenyl ethers (PBDEs), and organophosphate ester flame retardants (OPEs) have raised significant concern due to their potential to disrupt reproductive health. Increasing experimental, epidemiological, and mechanistic evidence demonstrates that both PBDEs and OPEs adversely affect both the male and female reproductive systems. In males, exposure to these compounds is associated with impaired spermatogenesis, altered sperm quality, disrupted steroidogenesis, and structural and functional damage to the testis. Mechanistic studies reveal direct toxicity to Leydig, Sertoli, and germ cells, driven by mitochondrial dysfunction, oxidative stress, endocrine disruption, and cytoskeletal disorganization that may compromise both fertility and offspring health. In females, PBDEs and OPEs disrupt ovarian folliculogenesis, steroid hormone synthesis, and oocyte quality, while also altering uterine receptivity. These effects are mediated through perturbations of the hypothalamic-pituitary-gonadal axis, interference with nuclear and membrane hormone receptors, mitochondrial injury, oxidative stress, and dysregulation of signaling pathways essential for follicle maturation and ovulation. Both classes of flame retardants can bioaccumulate and cross critical biological barriers, including the placenta, raising concerns about developmental and transgenerational effects. Collectively, the evidence underscores that PBFRs and OPEs pose significant risks to reproductive function in both sexes, acting through molecular mechanisms that disrupt gonadal development, endocrine signaling, and cellular homeostasis. Understanding these shared and sex-specific pathways is essential for improving human health risk assessment and guiding regulatory strategies.Both brominated flame retardants and organophosphate esters that are now mostly replacing them, affect cellular phenotypic endpoints, steroidogenesis, lipid accumulation, and fertility whether used alone or in mixtures. https://doi.org/10.1093/biolre/ioag170

The hidden threat: Integrated molecular mechanisms of lead-induced reproductive toxicity from endocrine disruption to epigenetic reprogramming,
Samaga, R., Ranade, S. D., Rajora, A. D. and Naresh, P., *Journal of Trace Elements in Medicine and Biology: Organ of the Society for Minerals and Trace Elements*, 2026/10/30/ 2026, Vol. 98, p. 127982.

Lead (Pb^{2+}) is a persistent environmental toxicant that adversely affects male and female reproductive health through endocrine disruption, oxidative stress, inflammation, mitochondrial dysfunction, DNA damage, apoptosis, and epigenetic alterations. Pb^{2+} disrupts the hypothalamic-pituitary-gonadal and hypothalamic-pituitary-ovarian axes while directly damaging reproductive cells. Excessive ROS generation, impaired antioxidant defense, and dysregulation of Nrf2 and NF-κB signaling promote oxidative and inflammatory injury, while mitochondrial dysfunction and impaired autophagy further accelerate cellular damage. In males, Pb^{2+} impairs Leydig and Sertoli cell function, steroidogenesis, blood-testis barrier integrity, spermatogenesis, sperm maturation, and fertilization, resulting in reduced sperm quality, motility, and DNA integrity. In females, Pb^{2+} disrupts ovarian steroidogenesis, follicular development, oocyte quality, and ovarian reserve, contributing to menstrual irregularities, impaired ovulation, subfertility, and adverse pregnancy outcomes. Epigenetic alterations may further contribute to persistent reproductive dysfunction and potentially affect offspring's health. Current management primarily involves exposure reduction and clinically indicated chelation, while antioxidant and micronutrient interventions may provide supportive protection. However, limitations in human evidence and incomplete understanding of molecular interactions remain important challenges. Integrating multi-omics approaches with reproductive phenotyping in the future may facilitate biomarker discovery and targeted therapy. Overall, Pb^{2+}-induced reproductive toxicity is a multifactorial molecular disorder, emphasizing the need for early detection, preventive strategies, and targeted interventions to protect reproductive health. https://doi.org/10.1016/j.jtemb.2026.127982

The hidden impacts of endocrine-disrupting chemicals on endometrial and pregnancy health,
Savin, S., Loveland, K. and Gurung, S., *Reproduction Fertility and Development*, Sep 29 2026, Vol. 38, no. 14.

Endocrine-disrupting chemicals (EDCs) are ubiquitous environmental contaminants that interfere with hormone signalling and are increasingly linked to adverse reproductive outcomes. This viewpoint highlights emerging evidence that EDC exposure disrupts both endometrial and placental function, contributing to disorders including endometriosis, endometrial cancer, pre-eclampsia, fetal growth restriction and preterm birth. We discuss the biological mechanisms underpinning these associations and the growing epidemiological evidence implicating EDCs in reproductive disease. Greater awareness, improved exposure assessment and continued translational research are needed to better understand the consequences of EDC exposure on the endometrium and reproductive health in order to inform strategies that reduce disease burden. https://doi.org/10.1071/rd26173

Impact of exposure to environmental chemicals on the occurrence of molar incisor hypomineralisation and developmental enamel defects in children: a systematic review,
Shanmugam, I., Sayee Srinivasan, S., Mahalingam, A., Jayakumar, P. and Vignesh, K. C., *European Archives of Paediatric Dentistry: Official Journal of the European Academy of Paediatric Dentistry*, 2026/10/22/ 2026.

PURPOSE: Children are particularly susceptible to environmental toxins because of their immature metabolic and detoxification systems. Disturbances during enamel formation may result in molar incisor hypomineralisation (MIH) and developmental defects of enamel (DDE). This systematic review

evaluated the association between exposure to environmental pollutants and the occurrence of MIH and DDE in children. METHODS: The review followed PRISMA 2020 guidelines and was registered with PROSPERO (CRD420251149569). A comprehensive search of PubMed, Scopus, Embase, Ovid, EBSCO Host, and Web of Science identified observational studies published up to 2025. RESULTS: Of 384 records identified, 9 studies met the eligibility criteria, including three cohort, one case-control, and five cross-sectional studies. Methodological quality was assessed using the Newcastle-Ottawa scale. Pollutants evaluated included polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs), per- and polyfluoroalkyl substances (PFAS), particulate matter ($PM_{2.5}$ and PM_{10}), and phenols and phthalates. Studies investigating PCBs and PCDD/Fs generally reported positive associations between prenatal or early postnatal exposure and increased occurrence or severity of MIH and DDE. Higher dioxin concentrations in maternal milk were also associated with more frequent and severe enamel hypomineralisation, with dose-response relationships reported in some studies. Evidence regarding PFAS was congener- and sex-specific, whereas findings for ambient air pollution, phenols, and phthalates were limited and inconsistent. CONCLUSION: Available evidence suggests an association between exposure to environmental pollutants and developmental enamel defects, particularly following exposure to persistent organic pollutants. However, heterogeneity in exposure assessment, diagnostic criteria, study design, and confounder adjustment limits the certainty of the evidence. Well-designed longitudinal studies using standardised diagnostic criteria and biomarker-based exposure assessment are needed to clarify these associations and determine potential causal relationships. https://doi.org/10.1007/s40368-026-01299-4

From Prenatal Exposure to Adult Sexual Dysfunction: The Impact of Plastic-Derived Endocrine Disruptors on Testosterone Homeostasis and Erectile Function,
Stavros, S., Christopoulos, P., Kokkosi, E., Moustakli, E., Zikopoulos, A., Potiris, A., Daskalaki, M., Arkoulis, I., Anagnostaki, I., Vassilaki, I., Kathopoulis, N., Daskalakis, G. and Drakakis, P., *Toxics*, Jul 29 2026, Vol. 14, no. 8.

Bisphenols, phthalates, and other plastic-associated compounds are endocrine-disrupting chemicals (EDCs), common environmental contaminants that can disrupt hormonal homeostasis. Human exposure to such chemicals occurs mainly through food packaging, consumer goods, medical devices, and the environment, starting right from early development stages up to adulthood. These chemicals might cause damage to male reproductive systems as a result of being anti-androgens and estrogenic chemicals. However, the proper development of the male reproductive system requires well-regulated hormonal signaling pathways; hence, exposure to such compounds during the developmental stages poses a great risk. Environmental exposure to plastics during fetal development may influence the development of the testes, reduce the function of the Leydig cells, disrupt steroidogenesis, and produce epigenetic modifications, as documented through studies. This has been shown to increase the risk of developing reproductive disorders and reduce the production of testosterone. Therefore, one of the pathophysiological links between endocrine disruptor exposure and ED might be testosterone deficiency. Apart from disrupting testosterone production, the plastic-sourced EDCs could influence various physiological processes associated with erectile performance, such as those related to vasculature, inflammation, metabolism, and endocrinology. In this review, a comprehensive overview of the scientific data on the effect of plastic-based EDCs on testosterone regulation and male reproductive health has been provided. The role of developmental programming, endocrine disruption, oxidative stress, epigenetics, and vascular dysfunction has been explored in detail. Moreover, the possible involvement of micro- and nanoplastics has also been reviewed. From the data that is currently available, there seems to be a physiologically plausible association between plastic-based contaminants, testosterone dysregulation, and adverse reproductive outcomes. https://doi.org/10.3390/toxics14080673

Plastic-Associated Pollutants and the Paternal Germline: From Reproductive Toxicity and Sperm Molecular Alterations to Potential Offspring Effects,
Stavros, S., Kathopoulis, N., Zikopoulos, A., Moustakli, E., Machairiotis, N., Sioutis, D., Anagnostaki, I., Arkouli, N., Potiris, A. and Drakakis, P., *Journal of Xenobiotics*, 2026/11// 2026, Vol. 16, no. 7, p. 210.

Paternal preconception health is increasingly recognized as an important determinant of reproductive success and offspring development. Plastic-associated contaminants, including endocrine-disrupting chemicals, microplastics, and nanoplastics, have been increasingly associated with adverse effects on male reproductive function. The effects of these exposures may extend beyond conventional sperm quality, potentially inducing molecular changes in paternal germ cells with consequences for embryonic development and offspring health. This review examines how preconception exposure to plastic-associated pollutants may alter the male germline through oxidative stress, mitochondrial dysfunction, endocrine disruption, inflammation, and epigenetic alterations. Particular attention is given to DNA methylation, histone modifications, non-coding RNAs, and other epigenetic mechanisms that may contribute environmentally induced molecular information to the embryo. We will provide information about experimental and epidemiological research related to environmental exposure in males and the resulting impacts on fertility, development of embryos, placenta function, adverse pregnancy outcomes, and vulnerability of the offspring to reproduction, metabolic, neurodevelopmental, and cardiovascular diseases. By integrating evidence from reproductive biology, toxicology, developmental epigenetics, and environmental health, this review provides a framework for understanding how environmental exposures may alter the paternal germline and potentially influence health across generations. Finally, we identify key research gaps and methodological challenges, outline priorities for future research, and emphasize the need for comprehensive exposure assessment, mechanistic studies in humans, and strategies to reduce environmental exposures during the preconception period. https://doi.org/10.3390/jox16070210

Microplastics and human health: exposure pathways, toxicological evidence and mitigation strategies,
Venkatramanan, V., Nath, S. and Naha, A., *Environmental Science and Pollution Research International*, 2026/10/30/ 2026.

Microplastics, typically defined as plastic particles smaller than 5 mm, have emerged as a pervasive class of environmental contaminants with increasing relevance to human health. Their widespread distribution in air, water, food and consumer products has raised concerns regarding chronic human exposure and potential biological effects. This review critically examines current evidence on exposure pathways, biological uptake, toxicological mechanisms, organ-specific health effects and mitigation strategies, with particular emphasis on human biomonitoring findings and challenges in health risk assessment. Microplastics have been detected in human biological matrices, including blood, placental tissue, lung tissue, breast milk and faecal samples, confirming internal exposure. Experimental studies have reported oxidative stress, inflammation, mitochondrial dysfunction, endocrine disruption, immune modulation, and adverse effects on the gastrointestinal, hepatic, pulmonary, cardiovascular, reproductive, renal, and nervous systems. However, most evidence is derived from in vitro and animal studies, while human epidemiological data remain limited. This review further discusses the influence of particle size, morphology, polymer composition, surface chemistry, weathering and contaminant adsorption on bioavailability and toxicity. The role of microplastics as carriers of chemical pollutants, plastic additives and microbial communities is also evaluated. Additionally, limitations in analytical methodologies, biomonitoring interpretation, exposure assessment and dose-response characterization are critically examined. A microplastic-specific risk assessment framework is proposed to support future regulatory and public health decision-making. Future research should prioritize standardized analytical methodologies,

environmentally realistic exposure models, longitudinal human studies and integrated biomonitoring approaches to strengthen the evidence base for quantitative risk assessment and effective mitigation strategies. https://doi.org/10.1007/s11356-026-38343-1

Tebuconazole-induced ferroptosis impairs human trophoblast function via GPX4: A multi-omics study on unexplained recurrent pregnancy loss,
Wang, S., Che, H., Ren, X., Lin, Z., Chen, Z., Zhu, Y., Chen, J., Tang, Y., Ge, R.-S. and Ying, Y., *Ecotoxicology and Environmental Safety*, 2026/10/15/ 2026, Vol. 325, p. 120943.

Tebuconazole (TEB) is a widely used triazole fungicide with suspected endocrine-disrupting and reproductive toxicity. However, its effects on human placental trophoblasts and its association with unexplained recurrent pregnancy loss (RPL) remain poorly defined. Chorionic villi from 27 women with unexplained RPL and 25 women with normal pregnancies were analyzed by HPLC-MS/MS, and TEB effects were examined in BeWo and HTR-8/SVneo trophoblasts. Villus TEB residues were 1.82-fold higher in the RPL group (mean 0.0356 versus 0.0196 ng/g; P < 0.001), whereas TEB-OH did not differ significantly. In HTR-8/SVneo cells, 48-h TEB exposure reduced estradiol secretion at 20-80 μM and impaired migration at 40-80 μM without a significant loss of CCK-8 viability, and increased intracellular labile Fe2 +. Transcriptome profiling at 80 μM identified 1680 differentially expressed genes (797 up-regulated, 883 down-regulated), and the downregulation of GPX4, TFRC, and SLC40A1 was confirmed by RT-qPCR and Western blotting. Network toxicology identified 72 core targets shared with RPL and fetal growth restriction, and docking predicted GPX4 as a candidate binding target of TEB (Ki= 44.74 μM). Consistent with a ferroptotic mechanism, ferrostatin-1 (2 μM) attenuated TEB-induced lipid peroxidation and Fe2+accumulation and partially restored GPX4, SLC40A1, and TFRC abundance, trophoblast migration, and estradiol secretion. These findings suggest that ferroptosis-related lipid peroxidation contributes to TEB-induced trophoblast dysfunction and links chorionic villus TEB residues to unexplained RPL. Because the effective in vitro concentrations exceed typical human exposure levels, the results provide mechanistic evidence of hazard and warrant further risk assessment. https://doi.org/10.1016/j.ecoenv.2026.120943

Impairment of placental function and maternal-fetal immunity cross-talk by per- and polyfluoroalkyl substances during early pregnancy,
Xia, Y., Ayuk, H., Myhre, O., Zenclussen, A. and Stojanovska, V., *Ecotoxicology and Environmental Safety*, Sep 15 2026, Vol. 323.

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental pollutants that have been associated with adverse pregnancy outcomes and immune dysfunction. However, the impact of PFAS on trophoblastmediated immune interactions at the maternal-fetal interface remains unclear. In this study, we evaluated the effects of human-relevant PFAS on trophoblast function and immune crosstalk using a three-dimensional (3D) trophoblast spheroid model and a co-culture system with CD4+ T cells. JEG-3 spheroids were exposed to multiple PFAS, including perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), and perfluoroundecanoic acid (PFUnDA), individually and as a mixture at real-life concentrations to assess viability, invasion and trophoblastderived (3-hCG secretion. Using a placental-immune cell co-culture model, we examined bidirectional interactions and their respective effects on functional endpoints in both cellular compartments and further investigated how exposure to PFAS may interfere in the bidirectional communication. We reported a significant decrease in trophoblast viability, after exposure to individual PFOS, PFOA and the PFAS mixture. PFAS mixture, PFOS, PFHxS, PFNA and PFDA exposure significantly increased invasiveness in JEG-3 spheroids, while PFOA decreased JEG-3 invasion significantly. Additionally, (3-hCG production declined after 48 h of PFOS and PFAS mixture exposure in JEG-3 spheroids. Moreover, following PFAS

mixture exposure, we observed a downregulation of CD69 and IFN gamma production in CD4+ T cells, particularly within Th2 cells, while CD154 expression was also reduced. Overall, these findings suggest that PFAS exposure may influence trophoblast-mediated immune signaling, with potential implications for pregnancy-related processes. https://doi.org/10.1016/j.ecoenv.2026.120664

Impairment of placental function and maternal-fetal immunity cross-talk by per- and polyfluoroalkyl substances during early pregnancy,
Xia, Y., Ayuk, H. S., Myhre, O., Zenclussen, A. C. and Stojanovska, V., *Ecotoxicology and Environmental Safety*, 2026/09/15/ 2026, Vol. 323, p. 120664.

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental pollutants that have been associated with adverse pregnancy outcomes and immune dysfunction. However, the impact of PFAS on trophoblast-mediated immune interactions at the maternal-fetal interface remains unclear. In this study, we evaluated the effects of human-relevant PFAS on trophoblast function and immune crosstalk using a three-dimensional (3D) trophoblast spheroid model and a co-culture system with CD4+ T cells. JEG-3 spheroids were exposed to multiple PFAS, including perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), and perfluoroundecanoic acid (PFUnDA), individually and as a mixture at real-life concentrations to assess viability, invasion and trophoblast-derived β-hCG secretion. Using a placental–immune cell co-culture model, we examined bidirectional interactions and their respective effects on functional endpoints in both cellular compartments and further investigated how exposure to PFAS may interfere in the bidirectional communication. We reported a significant decrease in trophoblast viability, after exposure to individual PFOS, PFOA and the PFAS mixture. PFAS mixture, PFOS, PFHxS, PFNA and PFDA exposure significantly increased invasiveness in JEG-3 spheroids, while PFOA decreased JEG-3 invasion significantly. Additionally, β-hCG production declined after 48 h of PFOS and PFAS mixture exposure in JEG-3 spheroids. Moreover, following PFAS mixture exposure, we observed a downregulation of CD69 and IFNγ production in CD4+ T cells, particularly within Th2 cells, while CD154 expression was also reduced. Overall, these findings suggest that PFAS exposure may influence trophoblast-mediated immune signaling, with potential implications for pregnancy-related processes. https://doi.org/https://doi.org/10.1016/j.ecoenv.2026.120664

Novel brominated flame retardant TBPH upregulates thyroid synthesis markers via S1PR3 and involves IL-10 with atypical JAK-STAT activation,
Yang, J., Zhang, Q., Zhang, H., Zhou, T., Chen, L., Xiao, Q., Meng, Q., Jiang, J., Hao, W. and Wei, X., no. 1096-0953 (Electronic).

Bis(2-ethylhexyl) tetrabromophthalate (TBPH), an emerging brominated flame retardant, has raised environmental concern due to its endocrine-disrupting potential. While epidemiological evidence and our previous animal studies have linked TBPH to thyroid disruption, the molecular mechanisms remain unclear. This study aimed to identify potential molecular targets and downstream pathways involved in TBPH-induced effects on thyroid. We found that TBPH (100 nM) significantly upregulated the expression of key thyroid hormone synthesis markers PAX-8, TPO, and TG in human thyroid follicular cells (Nthy-ori 3-1). In silico docking identified S1PR3 as a potential interactor with moderate predicted affinity, and cellular thermal shift assay (CETSA) provided initial evidence of target engagement. S1pr3 knockdown partially attenuated TBPH-induced marker upregulation. Mechanistically, TBPH increased interleukin-10 (IL-10) in an S1PR3-dependent manner, coupled with activation of a non-canonical JAK-STAT pathway (JAK3, TYK2, STAT2, and STAT5). Further, overexpression of Il-10 enhanced downstream effector expression, whereas overexpression of Jak3 similarly promoted PAX-8 and TPO levels; conversely, Tyk2 knockdown reduced these markers, supporting a functional role

for this alternative signaling cascade. Importantly, key elements of this pathway were recapitulated in thyroid tissues of TBPH-treated rats, providing in vivo corroboration for the cellular observations. Collectively, our results suggest a S1PR3/IL-10/non-canonical JAK-STAT axis as a candidate mechanism for TBPH-induced thyroid marker upregulation, providing a hypothesis-generating framework for future toxicological investigations of TBPH and related emerging brominated flame retardants. https://pubmed.ncbi.nlm.nih.gov/42722097/

Bisphenol A and ovarian cancer: emerging evidence and potential biological mechanisms,
Zhang, L., Yu, T., Bian, Z., Mao, T. and Xu, C., *Frontiers in Cell and Developmental Biology*, Aug 17 2026, Vol. 14.

This review summarizes current evidence concerning the relationship between bisphenol A (BPA) exposure and ovarian cancer (OC). Human epidemiological studies have mainly examined possible associations between BPA concentrations and OC occurrence, but their cross-sectional or case-control designs do not establish that BPA exposure increases OC risk. Experimental studies in OC cell lines and tumor-bearing animals suggest that BPA may alter tumor-related phenotypes, including proliferation, migration, invasion, angiogenesis, and stemness. These findings concern potential tumor progression rather than patient prognosis. Separate studies in normal ovarian tissue and granulosa cells indicate possible ovarian toxicity, including oxidative stress, apoptosis, and steroidogenic disturbances, but these findings should not be interpreted as direct evidence of OC risk. Mechanistically, BPA exposure has been reported to be associated with changes in endocrine signaling, oxidative processes, metabolism, and epigenetic regulation in selected experimental models. Overall, evidence linking BPA exposure to ovarian-cancer-related outcomes remains limited, and current findings do not establish that BPA causes OC or worsens patient prognosis in humans. https://doi.org/10.3389/fcell.2026.1899695

The associations between bisphenol compounds and cardiovascular health: A narrative review of the available epidemiological evidence,
Zhou, K., Dong, J., Wang, B., Zhao, M., Qiu, Z., Chen, Y., Qu, H., Zhou, Y., Wang, Y., Pang, M. and Diao, H., *Emerging Contaminants*, Sep 2026, Vol. 12, no. 3.

Cardiovascular diseases (CVDs) remain the leading cause of global mortality, with growing evidence suggesting that exposure to environmental contaminants, such as bisphenol compounds, may serve as a potential risk factor. While the relationship between bisphenol A (BPA) and cardiovascular health has been investigated, a comprehensive epidemiological synthesis encompassing its numerous substitutes is lacking. This review provides a narrative synthesis of current epidemiological evidence on the associations of exposure to BPA and its analogues with clinical CVD events and major cardiometabolic risk factors. Available evidence generally supports associations between bisphenol exposure and clinical cardiovascular disease, particularly coronary artery disease, although evidence for other cardiovascular events remains limited. Bisphenol exposure has also been associated with cardiometabolic outcomes, including hypertension, type 2 diabetes mellitus, dyslipidemia, obesity, and hyperuricemia. Overall, the available evidence suggests potential cardiovascular concerns associated with bisphenol exposure, while substantial uncertainties remain regarding temporality and causality. Epidemiological evidence for emerging bisphenol substitutes remains scarce, underscoring the need for broader research on exposure to bisphenol compounds and their cardiovascular effects, particularly through prospective and experimental studies. (c) 2026 The Authors. Publishing services by Elsevier B.V. on behalf of KeAi Communications Co. Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-ncnd/4.0/). https://doi.org/10.1016/j.emcon.2026.100721

Méthodes

Testing strategy for the identification of thyroid hormone system disrupting chemicals,
Axelstad, M., Holmer, M. L., Ramhøj, L., Wedebye, E. B., Scholze, M., Köhrle, J., Fini, J.-B., Meima, M., Svingen, T. and Hamers, T., *Archives of Toxicology*, 2026/10/31/ 2026.

Disruption of the thyroid hormone (TH) system during fetal and neonatal life poses a significant risk to human neurodevelopment, yet current regulatory assessments lack sufficiently sensitive and specific endpoints to identify chemicals causing TH system disruption (THSD). The ATHENA project aimed to develop an integrated framework combining in silico, in vitro, and in vivo approaches to improve the identification of substances causing THSD and support their assessment within a regulatory context. This testing strategy emphasizes increased use of the adverse outcome pathways (AOP) framework and read-across approaches to better predict and address adversity. It further provides recommendations for in silico and in vitro test batteries and targeted in vivo investigations to improve identification of chemicals causing THSD. In addition, we propose enhancements to current regulatory practice, including further standardization of test methods, improved integration of human epidemiological and cross-species evidence, and recognition of altered TH concentration in serum and brain in animal studies as predictors of adverse neurodevelopmental outcomes in humans. Collectively, these measures are intended to strengthen chemical hazard assessment and improve protection of human and environmental health through more robust and efficient identification of THSD. https://doi.org/10.1007/s00204-026-04599-2

A new high-accuracy QSAR model based on ultra-curated data for predicting thyroid receptor-related endocrine activity,
Ay-Albrecht, E., Todorov, Z., Bauer, F., Darracq-Ghitalla-Ciock, M., Charmeau-Genevois, C., Sarang, S. and Thomas, P., *Frontiers in Toxicology*, Aug 20 2026, Vol. 8.

Introduction Endocrine active substances interfere with hormone signalling and represent a major regulatory concern. The thyroid system is particularly vulnerable, with disruption linked to neurodevelopmental, metabolic, and cardiovascular effects. Current in vitro assays may improve mechanistic understanding but are resource-intensive while screening databases (e.g., Tox21 assays) is insufficient for large-scale chemical coverage or for assessing new materials. In silico tools such as QSAR models offer scalable alternatives, yet existing thyroid receptor (TR) models suffer from poor data curation, class imbalance, and limited regulatory acceptance. Methods This study aimed to develop a high-accuracy QSAR model, aligned with the OECD QSAR Assessment Framework, to accurately predict TR-related endocrine activity, thereby supporting the reduction of animal testing and regulatory decision-making. In this work, data from Tox21 TR luciferase agonist and antagonist assays were combined with curated BindingDB data, followed by expert review of activity-cytotoxicity relationships and strict filtering of low-affinity interactions (termed here as "ultra-curation"). Agonists and antagonists were grouped together as "actives". The final dataset comprised 291 active and 6,049 inactive compounds. Each substance was associated with a standardised SMILES, to locate duplicates (subsequently removed), and the dataset split into training, internal validation, and external validation sets with chemical diversity balancing. A Support Vector Machine (SVM) classifier using circular fingerprints (FCFP6) was optimised via grid search. Model performance was evaluated with cross-validation and external validation, complemented by an applicability domain (AD) framework based on analogues. Results The SVM achieved strong performance in training (balanced accuracy = 96.03%; AUC-ROC = 99.91%; AUC-PR = 99.21%) and robust performance on the external validation set (balanced accuracy = 92.46%; sensitivity = 87.65%; specificity = 99.42%). Incorporation

of the AD framework improved minority class (active) detection, raising balanced accuracy to 96.15%, sensitivity to 92.30%, and specificity to 100%, while excluding similar to 14% of compounds with uncertain predictions. Discussion The QSAR model developed here demonstrates good predictive accuracy for thyroid receptor-related endocrine activity and addresses key regulatory concerns through rigorous data ultra-curation and applicability domain assessment. This high-accuracy QSAR provides a promising in silico tool to support integrated approaches to testing and assessment (IATA) and regulatory evaluation of endocrine disruption potential. https://doi.org/10.3389/ftox.2026.1852502

Non-targeted identification of PPARγ-active contaminants in human breast milk by affinity selection-mass spectrometry,
Cao, W., Guo, Q., Li, M., Jia, J., Du, Z., Chang, R., Chen, Y., Liang, C., Wu, X., Zhang, J., Niu, Y., Li, Q., Li, H. and Shao, B., *Ecotoxicology and Environmental Safety*, Sep 15 2026, Vol. 323.

Human breast milk surveillance is essential for assessing infants and early-childhood exposure to endocrinedisrupting chemicals. However, current biomonitoring is challenged by the growing number and chemical complexity of emerging contaminants, leaving substantial gaps in data on their occurrence and contamination profiles in breast milk. To address this, we developed a peroxisome proliferator-activated receptor gamma (PPAR gamma) affinity selection-mass spectrometry (PPAR gamma-ASMS) assay for the non-targeted identification of bioactive ligands in this matrix. We successfully identified 18 potential PPAR gamma-binding contaminants in ten human breast milk samples. Among these, seven were confirmed with high confidence (Schymanski level 1). Their semi-quantitative concentrations ranged from 0.67 to 303.37 ng/mL and highlighted the potential for co-exposure to multiple PPAR gamma-active contaminants for both mothers and infants. Notably, octyl hydrogen phthalate (OHP) was validated as a direct PPAR gamma ligand via docking (-7.3 kcal/mol) and surface plasmon resonance (SPR) binding assays (KD = 0.149 µM). A dual-luciferase reporter gene (DLR) assay further demonstrated OHP acted as PPAR gamma agonist, exhibiting dose-dependent activity with an EC50 of 7.5 µM. Overall, this study established a reliable, effectdirected affinity screening approach for emerging contaminants in human breast milk biomonitoring and delineated the risk profile associated with chemical mixture exposure. https://doi.org/10.1016/j.ecoenv.2026.120774

Biomonitoring: a demonstration of the importance of direct analytical methods for the assessment of chemical exposures,
Gerona, R., Sovereign, A. and Hunt, P., *Frontiers in Chemistry*, Sep 3 2026, Vol. 14.

Introduction Biomonitoring of commercial endocrine-disrupting chemicals (EDCs) increasingly underpins exposure assessment and risk evaluation, yet most large-scale studies still rely on indirect, enzymatic hydrolysis-based methods whose quantitative performance has not been systematically verified. Here, we describe the development and rigorous validation of a direct liquid chromatography-tandem mass spectrometry (LC-MS/MS) assay using validated standards to simultaneously quantify bisphenol S (BPS), propylparaben (PrP), monobutyl phthalate (MBP), and their major urinary glucuronide and sulfate conjugates in human urine.Methods A direct LC-MS/MS assay was developed for the simultaneous quantification of BPS, PrP, MBP and their major urinary metabolites. The method was validated in accordance with U.S. Food and Drug Administration bioanalytical guidelines, including assessments of linearity, accuracy, precision, selectivity, specificity, matrix effects, recovery, and carryover. The validated assay was then used to evaluate the accuracy of a conventional beta-glucuronidase-based hydrolysis workflow across a wide concentration range in spiked synthetic urine by comparing indirect measurements with direct totals for each analyte. Method utility in human biomonitoring was demonstrated by analysis of urine samples from 30

pregnant women in their second trimester.Results Using isotope-dilution calibration, solid-phase extraction, and negative-ion electrospray multiple reaction monitoring, the method achieved sub-ng/mL limits of detection for all analytes, linear response over 3-4 orders of magnitude, and intra- and inter-day precision and accuracy within contemporary bioanalytical criteria, confirming fitness for trace-level biomonitoring. Indirect, hydrolysis-based measurements closely tracked direct totals for BPS and PrP, but systematically underestimated MBP, with a concentration-dependent negative bias that increased at higher levels, demonstrating that hydrolysis efficiency is analyte-specific and cannot be inferred from surrogate substrates alone. Application of the direct method to archived urine samples from 30 pregnant individuals enabled the first simultaneous resolution of the free and conjugated forms of these three EDCs in a maternal cohort and revealed that glucuronides accounted for the majority of the total urinary burden, with total concentrations exceeding contemporary NHANES estimates.Discussion Collectively, these findings show that indirect methods can introduce substantial, analyte-dependent underestimation of internal dose, with implications for exposure misclassification, attenuation of epidemiologic effect estimates, and underestimation of population risk. The data support the position that direct LC-MS/MS quantification of parent and conjugated species, coupled with analyte-resolved assessment of hydrolysis efficiency, should become standard practice in method validation and national biomonitoring programs to ensure accurate exposure assessment for non-persistent EDCs. https://doi.org/10.3389/fchem.2026.1894102

Monitoring of BTEX levels in saliva and urine using optimized MWCNTs/ATSB nanocomposite fibers: a comparative study on benzene-steroid hormones interaction,
Tahmasebi, R., Farhadi, K. and Rafipour, A., *Journal of the Iranian Chemical Society*, Aug 21 2026, Vol. 23, no. 9.

BTEX (benzene, toluene, ethylbenzene, xylene) and/or their metabolites compounds have been used as biomarkers. Monitoring BTEXlevels in biological samples like blood, saliva, or urine helps evaluate individual exposure and potentialhealth risks, making them useful biomarker candidates in environmental and occupational health studies. Solid-phase microextraction (SPME) fibers containing multi-walled carbon nanotubes (MWCNTs) and aluminum tri-sec-butylate (ATSB) sol-gel were prepared and applied to survey BTEX compounds levels, followed by analysis using gas chromatography coupled with flame ionization detector (GC-FID) via headspace SPME. Important parameters including extraction temperature and time, as well as desorption temperature and time-were optimized using response surface methodology (RSM) and analysis of variance (ANOVA) to maximize extraction eficiency. The method was validated for linearity, precision and limit of detection (LOD). The optimized conditions were used to analyze BTEX levels in saliva and urine samples. The fibers demonstrated high thermal stability up to 250 degrees C, indicating excellent thermal resilience and allowing effective desorption without fiber degradation, which is critical for reproducibility and long-term use. Additionally, binding interaction of benzene with steroid hormones was studied using Scatchard method. https://doi.org/10.1007/s13738-026-03580-1

Validation of a Rapid Screening Method for Textile Additives with Applications to Firefighter Station Wear,
Wicks, A., Miller, A. M., Takaku-Pugh, S., Xiao, R., Boettger, J. D., Mccord, J. M., Park, J.-S. and Peaslee, G. F., *Environmental Science & Technology*, 2026/10/06/ 2026, Vol. 60, no. 39, p. 27629–27639.

Firefighters have previously received attention for their occupational exposure to numerous chemicals of concern through their turnout gear, aqueous film-forming foam, and fire events. However, their station wear, uniforms worn daily in the station, has not yet been investigated for textile additives of concern. In this study, 57 firefighter station wear uniforms were screened using the paired method of particle-induced gamma-ray emission (PIGE) and particle-induced X-ray emission (PIXE)

spectroscopies to estimate concentrations of 21 elements between F and Pb. As this is the first instance of quantifying elements in textiles using PIXE, validation of PIXE results was conducted using inductively coupled plasma-optical emission spectroscopy (ICP-OES), ultrahigh-performance liquid chromatography coupled to high-resolution tandem mass spectrometry (UHPLC-HRMS/MS), and gas chromatography-tandem mass spectrometry (GC-MS/MS). These analyses detected elevated concentrations of Cl, Zn, Cr, and/or Sb in numerous station-wear samples. Additionally, targeted liquid chromatography-tandem mass spectrometry (LC-MS/MS) for 31 per- and polyfluoroalkyl substances (PFAS) was performed on a subset of samples. Together, these results demonstrate the effectiveness of PIGE/PIXE for screening textiles and highlight the concerning presence of PFAS, flame retardants, and halogenated azobenzene disperse dyes in some station-wear uniforms. https://doi.org/10.1021/acs.est.6c06909

Endocrine-Disrupting Pesticides as Drivers of Human Disease: Mechanistic Toxicology and Life-Course Health Effects,
Zidan, N. E., Alshaal, T., Elhawat, N., Elhamalawy, O., Malhat, F. and Eissa, F., *International Journal of Molecular Sciences*, Aug 1 2026, Vol. 27, no. 15.

Endocrine-disrupting pesticides (EDPs) are environmental toxicants capable of perturbing hormonal homeostasis through multiple molecular and cellular mechanisms. Growing evidence indicates that these compounds contribute to a broad spectrum of adverse health outcomes extending beyond classical endocrine dysfunction. This review critically synthesizes current knowledge on the toxicological mechanisms of EDPs and evaluates epidemiological evidence linking exposure to human disease. Mechanistically, EDPs act through modulation of nuclear hormone receptors, disruption of membrane-associated signaling pathways, interference with hormone synthesis, metabolism, and transport, induction of oxidative stress and mitochondrial dysfunction, and epigenetic reprogramming. These molecular events converge on shared biological pathways that affect multiple organ systems and life stages. Human and experimental evidence associates EDP exposure with reproductive dysfunction, endocrine-related cancers, metabolic disorders, thyroid abnormalities, and neurodevelopmental impairments. Particular concern surrounds exposure during critical windows of susceptibility, especially prenatal development and early childhood, when endocrine systems are highly vulnerable to disruption and developmental programming. Across disease endpoints, recurring mechanisms, including endocrine receptor perturbation, oxidative stress, inflammation, and epigenetic alterations, support a unifying toxicological framework linking diverse adverse outcomes. Despite substantial progress, important uncertainties remain regarding chronic low-dose exposure, non-monotonic dose-response relationships, cumulative effects of pesticide mixtures, and the translation of mechanistic findings into human risk assessment. Future research should integrate repeated biomonitoring, advanced mixture modeling, mechanistic biomarkers, and multi-omics approaches within longitudinal life-course studies. Improved integration of toxicological and epidemiological evidence will strengthen causal inference, refine hazard characterization, and support more protective regulatory strategies for reducing the human health burden associated with endocrine-disrupting pesticides worldwide. https://doi.org/10.3390/ijms27156928

Agenda, actualité, politique

EDList - Endocrine Disruptor Lists - List Updates,
(novembre 2026),
List II

3,5,5-trimethylcyclohex-2-enone added: ED HH CLH intention submitted
p-(1-phenylethyl)phenol added: ED ENV 1 CLH intention submitted
Reaction products of ammonium bromide and sodium hypochlorite, generated in-situ added: Concluded ED in BPC opinion. Not yet legally adopted
Zineb added: Concluded ED in BPC opinion. Not yet legally adopted
Iodine and PVP-iodine added: Concluded ED in BPC opinion. Not yet legally adopted
Proquinazid added: Concluded ED in EFSA opinion. Not yet legally adopted
Updated information on: Oxybenzone, methylparaben, ammonium perchlorate, sodium perchlorate, and dicyclohexyl phthalate (DCHP)
Butanone removed: SEv concluded that ED HH hazard is unlikely https://edlists.org/list-updates

New EU rules on packaging enter into application - Environment.
The measures will protect consumers and help strengthen the Single Market for packaging. https://environment.ec.europa.eu/news/new-eu-rules-packaging-enter-application-2026-08-11_en

Bisphénol A (BPA) dans les produits du quotidien : quelle est l'absorption des consommateurs et qu'est-ce que cela signifie ? (En allemand : Bisphenol A (BPA) in Alltagsprodukten: Wieviel nehmen Verbraucherinnen und Verbraucher auf und was bedeutet das?),
German Federal Institute for Risk Assessment (BfR) (07 septembre 2026),
FAQ : questions fréquemment posées sur le bisphénol A. https://www.bfr.bund.de/veroeffentlichung/bisphenol-a-in-alltagsprodukten-antworten-auf-haeufig-gestellte-fragen/

Budget de la Sécu: l'Assemblée vote pour l'interdiction de l'hexane dans les produits alimentaires | LCP - Assemblée nationale, 2026/10.
Alors que l'examen du projet de budget de la Sécurité sociale se poursuit à l'Assemblée nationale, les députés ont adopté, ce mercredi 21 octobre au soir, un amendement de Benoît Biteau (Écologiste et Social) visant à interdire l'hexane dans l'industrie agro-alimentaire à compter du 1er janvier 2027. Présent dans les huiles issues de graines oléganineuses, ce solvant est un neurotoxique avéré, en plus d'être suspecté d'être un perturbateur endocrinien. https://lcp.fr/actualites/budget-de-la-secu-l-assemblee-vote-pour-l-interdiction-de-l-hexane-dans-les-produits

Chemicals classification & labelling – endocrine disruptors & persistent pollutants. European Commission - Have your say,
(2026/11/17),
This initiative adds the substances that were already identified as endocrine disruptors or persistent pollutants under the Chemicals Regulation (REACH), the Biocidal Products Regulation, and the Plant Protection Products Regulation into Annex VI to the Regulation on Classification, Labelling and Packing of Chemicals (CLP Regulation). This is in line with the Commission's 'one substance, one assessment' chemicals assessment reform and is required under Article 37(7) of the CLP Regulation.This initiative runs in parallel with Endocrine disruptors & persistent & bioaccumulative substances – transfer from related EU legislation to CLP Regulation., https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/15632-Chemicals-classification-labelling-endocrine-disruptors-persistent-pollutants_en

Endocrine disruptors & persistent & bioaccumulative substances – transfer from related EU legislation to CLP Regulation. European Commission - Have your say,
(2026/10/28),
Substances already identified under REACH, the Plant Protection Products Regulation or the Biocidal Products Regulation as (i) endocrine disruptors, (ii) persistent, bioaccumulative and toxic substances,

or (iii) very persistent and very bioaccumulative substances will be added to the CLP Regulation on the classification, labelling and packaging of substances and mixtures.This initiative provides further instructions on how to classify and label these substances or mixtures containing them.This initiative runs in parallel with Chemicals classification & labelling – endocrine disruptors & persistent pollutants., https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/17632-Endocrine-disruptors-persistent-bioaccumulative-substances-transfer-from-related-EU-legislation-to-CLP-Regulation_en

Endocrine Society Submits Letter to EU Heads of Delegation on EDCs,
ENDOCRINE SOCIETY (24 septembre 2026),
L'Endocrine Society intervient dans le processus du traité mondial sur les plastiques en demandant que la réglementation prenne explicitement en compte les substances utilisées dans les plastiques susceptibles d'agir comme PE. https://www.endocrine.org/advocacy/society-letters/2026/letter-on-edcs-to-heads-of-delegation

The EU wants to make it easier to use pesticides. Here's why,
Deutsche Welle, 2026/10.
The European Union wants to relax rules for pesticides, saying it will be easier for farmers to adopt more environmentally friendly options. But health and environmental experts say the risks are far too great. https://www.dw.com/en/eu-moves-to-loosen-rules-on-pesticide-use-as-experts-sound-the-alarm/a-79646422

Les députés approuvent l'interdiction de l'hexane dans l'alimentation à partir de 2027,
Le Figaro, 2026/10/21.
Contre l'avis du gouvernement, les députés ont voté de justesse en faveur de l'interdiction de ce solvant, suspecté d'être un perturbateur endocrinien. https://www.lefigaro.fr/conjoncture/les-deputes-approuvent-l-interdiction-de-l-hexane-dans-l-alimentation-a-partir-de-2027-20261021

Pesticides, perturbateurs endocriniens, PFAS : Atmo Occitanie confirme que notre air est pollué,
actu.fr, 2026/10/19.
A couper le souffle : une étude d'Atmo Occitanie, l'observatoire régional de la qualité de l'air, confirme que l'atmosphère est pollué en Occitanie. https://actu.fr/occitanie/montpellier_34172/pesticides-perturbateurs-endocriniens-pfas-atmo-occitanie-confirme-que-notre-air-est-pollue_64928182.html

Publication du plan d'actions 2026-2030 sur les perturbateurs endocriniens,
(2026/10/22),
Le Gouvernement publie ses priorités et un plan d'actions sur les perturbateurs endocriniens poursuivant ainsi les engagements de l'Etat pour lutter, avec l'ensemble des parties prenantes, contre les PE et protéger ainsi la santé et l'environnement. Plan d 'actions : https://sante.gouv.fr/IMG/pdf/plan_actions_pe_octobre_2026_vf.pdf Priorités d'actions : https://sante.gouv.fr/IMG/pdf/priorites_actions_pe_octobre_2026_vf.pdf ,
https://sante.gouv.fr/actualites-presse/presse/communiques-de-presse/article/publication-du-plan-d-actions-2026-2030-sur-les-perturbateurs-endocriniens
https://sante.gouv.fr/sante-et-environnement/substances-chimiques/article/perturbateurs-endocriniens

Replay Webinaire. Reducing EDC Exposures: From informed consumers to policy solutions,
(2026/11),

Endocrine-disrupting chemical (EDC) exposures vary widely across individuals and populations, highlighting important opportunities for intervention. Effective exposure-reduction strategies should prioritize chemicals with high toxicity and well-characterized, modifiable exposure sources. LIste des derniers webinaires disponibles en replay : https://www.healthandenvironment.org/latest-research/che-webinars/call-archive/?year=2026#tabmenu , https://www.healthandenvironment.org/che-webinars/97203

Risk Evaluation for 4,4'-(1-Methylethylidene)bis[2, 6-dibromophenol] (TBBPA),
EPA (juin 2026),
In June 2026, EPA released the draft risk evaluation and associated technical support documents for 4,4'-(1-methylethylidene)bis[2, 6-dibromophenol] (TBBPA) under the Toxic Substances Control Act (TSCA) for public comment and for peer review by the Science Advisory Committee on Chemicals (SACC).
EPA's draft risk evaluation for TBBPA identifies unreasonable risk to workers driven by inhalation exposure (three conditions of use) and unreasonable risk to the environment driven by to releases to surface water during certain processing and disposal activities (two conditions of uses). The draft risk evaluation did not find unreasonable risk to consumers or the general population. **https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-evaluation-44-1-methylethylidenebis2-6**

Scientific discussions and seminars. Stakeholders event on the new CLP hazard classes for endocrine disruption for human health and environment,
(2026/06),
Workshop with stakeholders on the new CLP hazard classes for endocrine disruption for human health (ED HH) and for the environment (ED ENV). Two first presentations are given by consultants of WCA and Regulatory Science Associates (RSA), contracted by ECHA. Recordings available., https://echa.europa.eu/fr/science/discussions-and-seminars

Substitution des substances chimiques - Bulletins d'information | Substitution,
(2026/10),
Au sommaire : Substitution des PFAS : lancement d'un nouveau revêtement pour débitmètres électromagnétiques résistant aux effluents chimiquement agressifs - Un nouveau revêtement exempt de PFAS pour l'industrie du papier et du carton - xNDRYVE™ : une solution sans PFAS incorporée dans la masse pour la protection des fibres textiles - Un projet européen innove pour la substitution des PFAS dans les revêtements, https://substitution.ineris.fr/sites/substitution-portail/files/newsletter/bulletin_ssc_ndeg27_fr_07_10_2026.pdf
https://substitution.ineris.fr/fr/newsletters/archive

"Une douleur très intense" : un collectif alerte sur les effets des gaz lacrymogènes sur les règles,
Bécherel, S., (2026/10/31),
Les gaz lacrymogène perturbent le cycle menstruel des femmes qui participent aux manifestations. Le collectif "Lacrymos de sang" a recueilli 8 000 témoignages et appelle les autorités sanitaires à se saisir de la question pour financer des recherches., https://www.radiofrance.fr/franceinter/podcasts/l-info-de-france-inter/regles-et-gaz-lacrymo-9747573

Grossesse : des perturbateurs endocriniens associés à une diminution du QI chez l'enfant,
Benoist, Q., *Le Figaro Santé*, 2026/10/21.

DÉCRYPTAGE - L'exposition pendant la grossesse à des phtalates et des phénols influe sur les scores de quotient intellectuel chez les enfants à 3 ans, selon une nouvelle étude de l'Inserm.

https://sante.lefigaro.fr/social/sante-publique/grossesse-des-perturbateurs-endocriniens-associes-a-une-diminution-du-qi-chez-l-enfant-20261021

L'exposition pendant la grossesse à certains phtalates et phénols pourrait être associée à une diminution du QI des enfants à 3 ans,
Cara, G., *Salle de presse de l'Inserm*, 2026/10/20.
Phtalates et phénols sont des produits chimiques présents dans l'environnement et l'organisme des femmes enceintes. Plusieurs d'entre eux sont des perturbateurs endocriniens avérés ou suspectés et sont à ce titre, à même d'altérer le fonctionnement du système hormonal. Une équipe de l'Inserm de l'université de Grenoble-Alpes, en collaboration avec le CNRS, le CHU de Grenoble et l'université de Grenade (Espagne), s'est intéressée à l'impact de l'exposition périnatale à ces substances sur le quotient intellectuel (QI) des enfants, évalué à l'âge de trois ans. https://presse.inserm.fr/lexposition-pendant-la-grossesse-a-certains-phtalates-et-phenols-pourrait-etre-associee-a-une-diminution-du-qi-des-enfants-a-3-ans/73531/

Strategy for mixture risk assessment using European human biomonitoring data: lessons learned from applications to pesticides, per- and polyfluoroalkyl substances and metal(loid)s,
Crépet, A., Mckeon, H., Angeli, K., Bil, W., Cox, B., Govarts, E., Mcvey, E., Palmont, P., Vrijenhoek, N., Kruisselbrink, J., Bonefeld-Jørgensen, E. C., Čupr, P., Deepika, D., Esteban-López, M., Fillol, C., Fragnière Rime, C., Gabriel, C., González-Ruiz, S., Husøy, T., Janoš, T., Karakitsios, S., Klánová, J., Knutsen, H. K., Komprdová, K., Kumar, V., Long, M., Moeller, R., Pálešová, N., Papaioannou, N., Remškar, A., Santonen, T., Sarigiannis, D., Schmidt, P., Haug, L. S., Snoj Tratnik, J., Torres Toda, M., Vogel, N., Vogs, C., Von Goetz, N., Wielsøe, M., Morreto, A., Hernández-Jerez, A. F., Machera, K., Mengelers, M., Engel, J., Carsique, M. and Van Klaveren, J., *Environment International*, 2026/10/21/ 2026, Vol. 217, p. 110560.

Humans are exposed daily to mixtures of chemicals from multiple sources and routes, including diet and the environment. These combined exposures may cause adverse health effects that are not adequately captured by conventional substance-by-substance risk assessment, due to the inherent complexity of assessing combined risks. To address this gap, the Partnership for the Assessment of Risks from Chemicals (PARC) Real-life Mixtures project aims to consolidate scientific knowledge regarding mixture risk assessment (MRA). In synergy with ongoing activities of European agencies and other initiatives, this project developed a strategy to perform MRA using human biomonitoring (HBM) data. The approach consists of five steps: (1) prioritisation of chemical mixtures of interest for human health to guide case-study selection; (2) collection and organisation of the data required for MRA, including exposure, hazard, and toxicokinetic information; (3) development of methods for conducting MRA using HBM data; (4) implementation of these methods within the Monte Carlo Risk Assessment (MCRA) toolbox; and (5) application of the strategy to prioritised case studies. Three chemical families and four associated adverse health outcomes were selected based on the results of PARC priority process: pesticides affecting the nervous system, per- and polyfluoroalkyl substances (PFAS) affecting the immune system, and metal(loid)s affecting kidney function and neurodevelopment. HBM data from studies conducted across Europe and Greenland were harmonised using the HBM data toolkit. Hazard and toxicokinetic data were compiled to derive internal toxicological values suitable for MRA. The MRA was then performed in a harmonised way for each case study using the MCRA toolbox. The strategy developed within the PARC Real-life Mixtures project provides a proof-of-concept for conducting HBM-based MRA and for informing policymakers. Future research will focus on reducing uncertainties and expanding the approach to additional chemicals with common health endpoints and co-exposure. https://doi.org/10.1016/j.envint.2026.110560

The New Frontiers in Endocrine Disruption Research and Policy,
Filipowicz, A. and Allard, P., *Environmental Science & Technology*, 2026/11/03/ 2026, Vol. 60, no. 43, p. 30335–30344.

Since the 1991 Wingspread Consensus Statement, the field of endocrine disruption has emerged as a distinct and complex area that continues to challenge conventional approaches to toxicology and risk assessment. Nonetheless, despite substantial scientific advances, including the identification of over 1,000 Endocrine Disrupting Chemicals (EDCs), the description of nonmonotonic dose–response relationships, and the elucidation of multiple mechanisms of action, regulatory progress continues to lag. Recent stagnation in research investment into EDCs reflects a persistent tension between robust scientific evidence and policy implementation for environmental chemicals, which is especially salient for those bearing the unique properties and concerns of endocrine disruptors. In this article, we delineate the lull in EDC research that began in the mid-to-late 2010s and discuss how per- and polyfluoroalkyl substances (PFAS) have refocused public, scientific, and regulatory attention away from EDCs. While PFAS qualify as EDCs, their structural similarity and environmental persistence enable regulatory pathways that circumvent traditional research bottlenecks confronting other endocrine disruptors. This divergence presents both opportunities and potential drawbacks: while PFAS regulation may revitalize the broader EDC field, overemphasis on PFAS could perpetuate longstanding challenges in chemical prioritization, mixture assessment, and cumulative risk evaluation. We highlight state-level initiatives in Maine, Minnesota, and Washington as promising models for adaptive regulation. Moving forward, coordinated action among states, industry, academia, and civil society will be essential to advancing protective EDC policy while maintaining scientific rigor and feasibility. https://doi.org/10.1021/acs.est.6c00841

ExpoLib: a framework for an MS/MS exposome library of anthropogenic and natural toxicants and their biotransformation products,
Hernandes, V., Ramos, M., Breinbauer, R., Fruhmann, P., Mikula, H., Ehling-Schulz, M., Zechner, E., Balskus, E. and Warth, B., *Metabolomics*, Aug 26 2026, Vol. 22, no. 5.

Introduction: Despite technological advancements over the last three decades in small-molecule omics, compound annotation remains a major bottleneck in untargeted metabolomics and non-targeted environmental analysis. This is especially true for exposomics applications, which remain significantly affected by the limited chemical space coverage. Objectives: This work aims at describing the development of an MS/MS spectral library containing > 170 relevant xenobiotics from different classes of food, environmental, and microbial toxicants. Methods: LC-MS/MS data was acquired using collision-induced dissociation in data dependent acquisition mode under 13 different single collision energies with four additional collision energy spread experiments. A diverse set of compounds including natural toxins produced by bacteria, fungi (mycotoxins), and plants (phytotoxins), as well as anthropogenic chemicals such as bisphenols, phthalates, PFAS chemicals, drugs, consumer care products ingredients, and pesticides, and additional toxicologically relevant chemical classes were screened. Metabolic products for which commercially available reference standards and/or MS/MS spectra are not available in any public or commercial database have been included (e.g. colibactin-DNA-adduct, cereulide, deoxynivalenol-3-glucuronide). Library generation was performed in mzmine. Results: Open-format data based on representative spectra are provided.This new resource, available at https://zenodo.org/records/20715576, is aimed at providing a ready-to-use tool for the annotation of key exogenous compounds which are frequently overlooked in clinical metabolomics but may exert potent biological effects. A detailed discussion from a user perspective is provided regarding the library generation workflow in mzmine, aiming at facilitating the work of fellow researchers in the creation of their own in-house libraries. Conclusion: We intend to provide the metabolomics community with better tools for exposomics research and to reduce perceived barriers in developing

specialized MS/MS libraries for widening chemical space coverage and increasing quality and confidence. https://doi.org/10.1007/s11306-026-02481-x

Human health impact of endocrine disruptors: time to regain our stolen future!,
Kimura-Kuroda, J., *Endocrine Journal*, 2026.

In the latter half of the 20th century, humans have produced various synthetic chemicals, several of which had serious adverse effects on ecosystems and human health. Colborn et al. noticed that some chemicals disrupt the hormonal system of living organisms. They named these chemicals endocrine-disrupting chemicals (EDCs) and published the book Our Stolen Future. In classical toxicology, toxins directly act on cellular components, such as proteins, DNA, and cell membranes; cause damage and exhibit toxicity; and demonstrate a linear dose-response relationship, thus allowing safe thresholds. EDCs transmit abnormal signals through receptors, thus causing errors in the timing, type, and quantity of gene expression, which lead to adverse effects. Through the hormonal signaling system, EDCs can exhibit hormone-disrupting effects even at low doses, thus making it difficult to establish clear thresholds. EDCs have been reported to cause adverse effects by disrupting the estrogenic, androgenic, thyroid, and other signaling systems. Therefore, EDCs affect not only the endocrine system but also the reproductive, nervous, and immune systems. Owing to the wide-ranging effects of EDCs, there is no standardized definition of EDCs, and further research is needed to scientifically clarify EDCs. However, there are accumulating reports on the health hazards to humans caused by EDCs. Considering the precautionary approach, regulations regarding EDCs need to be reevaluated at both the national and international levels. This review introduces and discusses recent research and public initiatives related to EDCs. Can "our stolen future" be regained? https://doi.org/10.1507/endocrj.EJ25-0373

Endocrine Society of India's National White Paper on Endocrine Disrupting Chemicals - A Call for Action,
Priya, G., Kotwal, N., Madhu, S., Patra, S., Pandit, K., Anne, B., Shenoy, M., Swain, J., Das, S., Kopalle, L., Nagendra, L., Bhattacharya, S., Shaikh, S., Mondal, S., Bhat, G., Joshi, A., Kalra, S., Biswas, K., Kumar, H., Mishra, S., Dutta, D., Kapoor, N. and Mittal, S., *Indian Journal of Endocrinology and Metabolism*, Jan–Feb 2026, Vol. 30, no. 1, p. 4–19.

Endocrine disrupting chemicals (EDCs) are exogenous substances that interfere with hormonal pathways, leading to a broad spectrum of adverse health outcomes across the life course. This white paper by the Endocrine Society of India consolidates global and Indian evidence on EDC exposure, health effects, and regulatory challenges. Major classes of EDCs, including pesticides, industrial pollutants, plastic additives, and heavy metals, affect neurodevelopmental, reproductive, metabolic, musculoskeletal, thyroid and other outcomes, with implications extending to future generations through epigenetic and transgenerational effects. Indian data reveal widespread exposure through food, water, packaging material, and industrial waste, with studies linking EDCs to infertility, polycystic ovary syndrome, obesity and diabetes. Despite growing awareness, India lacks a comprehensive regulatory and surveillance framework for EDCs. This white paper outlines key gaps and provides actionable recommendations: strengthening systematic monitoring, harmonizing regulations, promoting research on emerging chemicals, fostering cross-sector and international collaboration, and empowering healthcare professionals and the public. Adoption of structured regulatory mechanisms modeled on global frameworks, combined with public education and institutional accountability, is essential to mitigate risk. Coordinated national efforts that bridge science, policy and community action are urgently needed to safeguard health and environment for future generations. https://doi.org/10.4103/ijem.ijem_976_25

Effectiveness of a Web-Based Educational eHealth Platform on Women's Health Literacy About Phthalate Exposure: Randomized Controlled Trial,
Shih, Y., Wu, S., Li, P., Hsieh, C. and Liu, C., *Journal of Medical Internet Research*, Sep 1 2026, Vol. 28.

*Background: Phthalates are environmental endocrine-disrupting chemicals widely used in plastics, cosmetics, food packaging, and personal care products. Women may experience frequent exposure through everyday consumer and household products. Improving phthalate-related health literacy may support informed exposure-reduction decisions; however, conventional health education provides limited opportunities for repeated, interactive, and individually tailored learning.
 Objective: This randomized controlled trial evaluated the effectiveness of an eHealth educational intervention (Phthalates Free) in improving women's overall and domain-specific phthalate-related health literacy and examined the association between platform engagement and health literacy outcomes. Methods: A double-blind randomized controlled trial was conducted in the outpatient department of a regional teaching hospital in Taipei, Taiwan. A total of 114 women were randomly assigned to an intervention group (n=58) receiving a 6-month eHealth platform-based education program and a control group (n=56) receiving conventional paper-based education. Assessments were conducted at baseline (T0), 3 months (T1), and 6 months (T2). The Phthalate Health Literacy Scale (10 items; alpha=.90, content validity index=0.93) measured overall and domain-specific literacy (health care, disease prevention, and health promotion). Longitudinal outcomes were analyzed using generalized estimating equations based on all available observations according to participants' original randomized assignments, with adjustment for waist circumference and pregnancy history. Analysis of covariance (ANCOVA) was used to compare 6-month outcomes after adjustment for baseline scores. Platform engagement and perceived usability were assessed using back-end analytics and the System Usability Scale (SUS).
 Results: At 6 months, the intervention group showed a significantly greater increase in total health literacy than the control group (+9.93 points, Wald chi 21=17.74; P<.001). Domain analyses revealed significant improvements in health care (+1.52; P=.001), disease prevention (+1.32; P=.001), and health promotion (+1.12; P=.001) domains. ANCOVA confirmed the between-group difference at T2 after adjusting for baseline scores (F1,109=11.43; P=.001; adjusted mean difference=7.15, 95% CI 2.96-11.34). Engagement analysis showed that high-engagement users (n=10) scored significantly higher in overall health literacy (t55=-3.00; P=.004) and all domains than general users. The SUS results (mean 84.7, SD 5.2; n=46, 79.3%) indicated high perceived usability. Conclusions: The Phthalates Free eHealth educational intervention significantly improved women's overall and domain-specific health literacy over 6 months. Higher platform engagement was associated with better health literacy outcomes. The intervention may serve as a practical adjunct to nurse-led education in outpatient and community settings by providing accessible, continuous, and evidence-based guidance on reducing phthalate exposure.* https://doi.org/10.2196/87063

Le système endocrinien et les substances chimiques dans les produits cosmétiques,
Zavtoni, M. and Zavtoni, A. M., *Les actes du Symposium de la recherche scientifique francophone en Europe centrale et orientale (ECO). Tome III*, 2025/10. https://aos.ro/symposium-de-la-recherche-scientifique-francophone/tome-3

Evaluation de l'exposition

Exposomic Assessment of Endocrine-Disrupting Chemicals Using Hair: A Cross-Matrix Comparison with Serum and Urine by LC-HRMS and Metabolite Profiling,
González-Ruiz, A., Sunyer-Caldú, A., Carneiro, R. B., Restrepo-Montes, E., Ballester-Miró, O., Lobato-Berezo, A., Pujol, R. M., Marquès, M., Gil-Solsona, R. and Gago-Ferrero, P., *Environmental Science & Technology*, 2026/09/22/ 2026, Vol. 60, no. 37, p. 26100–26115.

Endocrine-disrupting chemicals (EDCs) are increasingly implicated in chronic diseases, yet their biomonitoring in human studies still relies mainly on urine and serum, which capture only short-term exposure to these fast-elimination compounds. Here, we evaluated hair as a complementary and long-term biomonitoring matrix for EDC mixtures by integrating it into an LC-HRMS exposomics workflow together with paired serum and urine samples. We developed and validated a method targeting 44 endocrine disruptors from five chemical families (benzophenones, phthalates, parabens, bisphenols, and organophosphate esters), combining quantitative analysis with suspect screening and semi-quantification of phase II metabolites. Applied to samples from 20 postmenopausal women, the hair-based approach provided the broadest coverage and highest concentrations (31/44 compounds), up to about three orders of magnitude higher than in urine or serum, consistent with distinct accumulation mechanisms and temporal integration windows. In hair, EDCs were present in unconjugated form (>99%), whereas urine was dominated by conjugated metabolites and serum showed limited detection. Overall, these findings demonstrate that integrating hair into multimatrix exposomics designs substantially expands both the chemical and temporal resolution of human exposure assessment. https://doi.org/10.1021/acs.est.6c05029

Simultaneous Quantification of 22 Phenolic Compounds in Human Serum Using 96-Well HybridSPE-PPT and Dansyl Derivatization-Based LC-MS/MS,
Huang, K., Li, P., Wu, R., Liuguo, Z., Guo, Y., Ma, Z., Yu, Y., Hua, R. and Ma, S., *Analytica*, 2026/12// 2026, Vol. 7, no. 4, p. 79.

Environmental phenolic endocrine-disrupting chemicals (EDCs) are ubiquitous in the environment and human matrices, raising growing concerns regarding maternal and child health. Here, we present a sensitive analytical method for the simultaneous quantification of 22 phenolic compounds—including 7 bisphenols, 2 alkylphenols, 11 pharmaceutical and personal care product-related phenols, and 2 endogenous estrogens—in human serum. The method combines enzymatic deconjugation, 96-well plate-based protein precipitation and phospholipid removal using HybridSPE technology with dansyl chloride derivatization and liquid chromatography–tandem mass spectrometry, requiring only 100 µL of serum per sample. Validation using fetal bovine serum as a surrogate matrix yielded limits of detection of 0.023–0.227 ng/mL, recoveries of 86–114%, relative standard deviations below 20%, and matrix effects ranging from −35% to −2%. The method was applied to 30 serum samples from pregnant women in southern China, with nine analytes—including bisphenol A, triclosan, and endogenous estrogens—detected in at least 70% of samples. The median concentrations of the target compounds following enzymatic deconjugation ranged from below limits of detection to 28.4 ng/mL (for estrone). This method enables the simultaneous analysis of environmental phenols and endogenous estrogens in limited-volume human serum, supporting biomonitoring studies. https://doi.org/10.3390/analytica7040079

Tissue-specific microplastic burdens in humans: An intra-individual mapping of 18 tissue types,
Liu, Z., Wu, R., Zhang, C., Li, R., Liu, J., Zhu, J., Wu, E., Xie, J., Liu, C., Liu, X. and Sun, H., *Journal of Hazardous Materials*, 2026/10/23/ 2026, Vol. 518, p. 144001.

Microplastics (MPs) are ubiquitous environmental contaminants, yet their tissue-specific distribution within individuals remains poorly characterized. We analyzed 165 samples from 18 tissue types collected from ten donors, including two newborns, using pyrolysis-gas chromatography/mass spectrometry (Py-GC/MS) and Laser Direct Infrared (LDIR) imaging for chemical quantification and morphological characterization, respectively. MPs were detected in all donors and tissues, with substantial inter-individual and tissue-specific variation. MP burdens in the two neonatal donors fell within the range observed across the adult donors. MP accumulation was tissue-specific, with lipid-

rich tissues (adipose and brain) and highly perfused endocrine/metabolic organs (adrenal, liver, thyroid) harboring the highest burdens, whereas blood contained the lowest MP levels. Polyethylene (PE), polyamide 66 (PA66), and polyvinyl chloride (PVC) accounted for > 90% of the 11 MP types quantified by Py-GC/MS. LDIR analysis showed that MPs were predominantly small (66.06% within 20-40 µm) and moderately rounded, although particles > 150 µm were also detected across tissues. These findings provide a systematic map of human MP distribution, demonstrating heterogeneous tissue accumulation and providing a understanding for the absorption, distribution, metabolism, and excretion (ADME) of MPs and associated their health risks. https://doi.org/10.1016/j.jhazmat.2026.144001

Matrix-Resolved Profiling of the Prenatal Chemical Exposome Reveals Selective Placental Retention and Fetal Transfer,
Marquès, M., Gil-Solsona, R., González-Ruiz, A., Restrepo-Montes, E., Megía, A., Ballesteros, M., Domingo, J. L., Navas-Acien, A., Miller, G. W., Covaci, A. and Gago-Ferrero, P., *Environmental Science & Technology*, 2026/10/06/ 2026, Vol. 60, no. 39, p. 27562–27578.

Chemical exposure during human development, especially in utero, can disrupt many biological processes and increase disease vulnerability. Assessing the chemical landscape across the maternal-fetal interface is challenging. Here we address this challenge by conducting an exposome-based analysis across a suite of integrated maternal-fetal biological compartments: maternal urine, maternal serum, placental tissue, and umbilical cord serum. Using wide-scope liquid chromatography-high-resolution mass spectrometry (LC-HRMS) in 23 mother-infant dyads from the INSULIN cohort (Spain), we profiled 659 chemicals and transformation products, enabling a comprehensive characterization of prenatal chemical exposure and its compartment-specific distribution. We identified 76 unique compounds, including food additives, personal care products, pharmaceuticals, plasticizers, pesticides, flame retardants, industrial chemicals, and tobacco-related biomarkers. Matrix-resolved profiling revealed distinct compartmentalization patterns, with lipophilicity (logP) emerging as the primary physicochemical determinant of placental retention and transplacental transfer, while active transport mechanisms governed the fetal transfer of selected compounds despite properties inconsistent with passive diffusion. We report, for the first time, the transplacental passage of multiple emerging contaminants, including organophosphate esters, food-related compounds and personal care product ingredients. In contrast, several other contaminants–such as selected biomarkers of plastics, smoke, and personal care products–showed no evidence of transplacental transfer. These findings highlight the value of comprehensive, multi-matrix exposome profiling for assessing prenatal chemical exposures and provide a scalable framework for exposome-wide association studies in pregnancy cohorts and beyond. https://doi.org/10.1021/acs.est.6c02272

Occurrence of Bisphenols A and S in Paired Human Skin and Adipose Tissue in Neonatal Males,
Minsky, H. B., Li, Z., Andrews, W. T., Van Ee, A., Kane, M., Sumner, S. J., Garza, L. A. and Kannan, K., *Environmental Chemistry and Ecotoxicology*, 2026 2026, Vol. 8, p. 2476–2483.

Human exposure to bisphenols (BPs) is often assessed through biomonitoring of urinary concentrations of these chemicals. Nevertheless, a few earlier studies have reported elevated concentrations of BPs in solid tissue matrices in adults. Little is known about the occurrence of BPs in adipose or skin of neonates. In this study, we measured BPA, BPS, BPF and chlorinated BPA in 25 paired skin and adipose samples collected from healthy newborn males (< 28 days of age) from the United States. BPA and BPS were widely detected, with respective geometric mean concentrations of 22.4 (range: 8.65-220) and 0.55 (range: 0.24-2.27) ng/g in skin, and 38.6 (range: 13.7-283) and 1.01 (range: 0.40-6.51) ng/g in adipose. BPA and BPS concentrations were significantly correlated in

adipose (Spearman r = 0.581, p = 0.002) and skin (Spearman r = 0.401, p = 0.0470). Further, the BPA and BPS concentrations in adipose were significantly higher than those in paired skin (BPA: p = 0.0038, BPS: p = 0.0074), which suggests accumulation of these chemicals in lipid-rich tissues. Our findings highlight neonatal exposure to notable levels of BPs and suggest that skin might be a depot for systemic rather than simply transcutaneous BP exposure. https://doi.org/10.1016/j.enceco.2026.06.006

Aggregate risk assessment of bisphenols A, S, and F among the general Korean population,
Park, S., Bak, S., Kwon, Y., Kim, D., Yong, D., Lee, R., Kim, J., Shin, Y. and Lee, H., *Food Additives and Contaminants Part a-Chemistry Analysis Control Exposure & Risk Assessment*, Nov 2 2026, Vol. 43, no. 11, p. 1720–1733.

Bisphenol A (BPA) and its substitutes Bisphenol S (BPS) and Bisphenol F (BPF) have been identified as endocrine-disrupting chemicals that affects reproductive functions. In Korea, BPA use has been restricted, resulting in increased utilisation of BPS and BPF as alternatives. However, risk assessment and exposure management of these alternatives remain limited. Therefore, we conducted a risk assessment of BPA, BPS, and BPF prioritising human-use products while considering additional environmental exposure pathways. Product concentration data, usage amounts, and frequency factors were studied for products considered in the National Institute of Food and Drug Safety Evaluation between 2023 and 2024. Based on the data, the estimated daily exposure levels of the general Korean population indicated that food is the primary source of bisphenol exposure. The age-specific exposure levels corresponded to 0.02-0.12% of the health-based guidance value. Risk characterisation based on the hazard index for BPA and the margin of exposure approach for BPS and BPF revealed that current regulatory measures have managed BPA, BPS, and BPF exposures effectively. Reassessment should be considered if new evidence of unrecognised toxicities becomes available. These findings highlight the need for continuous monitoring of alternative bisphenols to ensure public health protection. https://doi.org/10.1080/19440049.2026.2701456

Risk assessment of bisphenol A and its analogues via breast milk within a select population of lactating women in South Korea: A multi-method approach for reducing exposure assessment uncertainty,
Park, S., Lee, H.-Y., Ji, K., Im, H. and Kim, J. H., *Environmental Science and Pollution Research International*, 2026/10// 2026, Vol. 33, no. 38, p. 17656–17671.

Bisphenol A (BPA) and its structural analogues-bisphenol F (BPF) and bisphenol S (BPS)-are ubiquitous environmental contaminants of concern for breastfed infants due to their high intake per body weight and vulnerable developmental windows. This study evaluated bisphenol exposure via breast milk in Korean infants using three complementary methodological approaches-deterministic, probabilistic, and individualized assessment-to reduce assessment uncertainty. Breast milk samples from 203 Korean lactating mothers were analyzed for BPA, BPF, and BPS using validated LC-MS/MS methods. EDIs were calculated using deterministic assessment, probabilistic Monte Carlo simulation with 10,000 iterations, and individualized pair-level assessment. Detection frequencies were 39% for BPA, 26% for BPF, and 28% for BPS, with geometric mean concentrations of 0.101, 0.127, and 0.070 µg/L, respectively. Median EDIs ranged from 5.37 to 11.61 ng/kg bw/day across the three bisphenols. Risk characterization varied substantially depending on selected international HbGV. Sensitivity analysis revealed that bisphenol concentration contributed 65-82% of exposure variability, followed by milk intake (15-30%). Individualized assessment identified high-risk subgroups with BPS exposures exceeding 1000 ng/kg bw/day. The multi-method assessment framework effectively reduces exposure assessment uncertainty and reveals how methodological choices influence risk characterization. Because BPF and BPS were detected almost as frequently as BPA, yet neither

compound has a compound-specific health-based guidance value in any jurisdiction, an expedited regulatory review of the BPA substitutes-rather than a continued exclusive focus on BPA-is required if the current market substitution is not to reproduce, in the most vulnerable population, the very risk that restricting BPA was intended to remove. https://doi.org/10.1007/s11356-026-38324-4

Trends of Nonylphenol Exposure in an Australian Population Based on Urinary Metabolite Analysis, Que, D., Ebert, K., Zammit, I., Ringbeck, B., Nilsson, S., Wang, X., Eaglesham, G., Toms, L., Hobson, P., Glover, H., Mueller, J. and Koch, H., *Environmental Science & Technology*, Sep 22 2026, Vol. 60, no. 37, p. 26293–26305.

Nonylphenol (NP) is an alkylphenol primarily used to synthesize nonylphenol ethoxylates (NPEO) and tris(4-nonylphenyl) phosphite (TNPP) which are extensively used in industrial and consumer products. NP and its derivatives are well-known endocrine disruptors and are associated with other toxic effects, raising concerns regarding exposure. This study assessed NP exposure in an Australian population by quantifying two specific urinary NP metabolites (OH-NP and oxo-NP) in age-and sex-stratified pooled urine samples collected in 2014-2015 and 2022-2023 (48 pools representing 4,800 individuals). OH-NP (major metabolite) was detected in all pools, with urinary levels and calculated daily intakes (DIs) approximately four times lower in 2022/23 than in 2014/15. OH-NP urinary levels and DIs decreased with age in females, while no age-related trend was observed in males. Male children and female children had similar exposure levels, while sex-related differences were more pronounced in adults (males>females). When combining all ages, males exhibited higher intakes than females. On average, DIs calculated from the pooled samples suggest no appreciable risk from NP exposure in the studied Australian population. However, potential high individual exposures within a pool and uncertainties due to limited knowledge of isomer-specific toxicokinetics and human isomer profiles should be acknowledged. https://doi.org/10.1021/acs.est.6c10598

Trends of Nonylphenol Exposure in an Australian Population Based on Urinary Metabolite Analysis, Que, D. E., Ebert, K. E., Zammit, I., Ringbeck, B., Nilsson, S., Wang, X., Eaglesham, G., Toms, L.-M. L., Hobson, P., Glover, H., Mueller, J. F. and Koch, H. M., *Environmental Science & Technology*, 2026/09/22/ 2026, Vol. 60, no. 37, p. 26293–26305.

Nonylphenol (NP) is an alkylphenol primarily used to synthesize nonylphenol ethoxylates (NPEO) and tris(4-nonylphenyl) phosphite (TNPP) which are extensively used in industrial and consumer products. NP and its derivatives are well-known endocrine disruptors and are associated with other toxic effects, raising concerns regarding exposure. This study assessed NP exposure in an Australian population by quantifying two specific urinary NP metabolites (OH-NP and oxo-NP) in age- and sex-stratified pooled urine samples collected in 2014-2015 and 2022-2023 (48 pools representing 4,800 individuals). OH-NP (major metabolite) was detected in all pools, with urinary levels and calculated daily intakes (DIs) approximately four times lower in 2022/23 than in 2014/15. OH-NP urinary levels and DIs decreased with age in females, while no age-related trend was observed in males. Male children and female children had similar exposure levels, while sex-related differences were more pronounced in adults (males>females). When combining all ages, males exhibited higher intakes than females. On average, DIs calculated from the pooled samples suggest no appreciable risk from NP exposure in the studied Australian population. However, potential high individual exposures within a pool and uncertainties due to limited knowledge of isomer-specific toxicokinetics and human isomer profiles should be acknowledged. https://doi.org/10.1021/acs.est.6c10598

Multimatrix Biomonitoring and Transplacental Transfer of Legacy and Emerging PFAS in Korean Pregnant Women,

Shin, H., Park, N.-Y., Lee, Y. A., Jun, J. K., Choi, K., Cho, S. W. and Kho, Y., *Environmental Science & Technology*, 2026/10/13/ 2026, Vol. 60, no. 40, p. 28471–28483.

Maternal-fetal exposure to per- and polyfluoroalkyl substances (PFAS) cannot be adequately characterized using single biological matrices because compound-specific distribution patterns vary according to physicochemical properties and elimination pathways. We measured 33 legacy, precursor, and emerging PFAS in maternal serum, plasma, urine, and cord serum from Korean singleton pregnancies (n = 151) to characterize matrix-specific exposure profiles, transplacental transfer, and associations with maternal and neonatal factors. Matrix-specific detection patterns distinguished predominantly protein-bound PFAS detected in blood matrices from short-chain, renally excreted PFAS prevalent in urine at the population level. Notably, the precursor 6:2 diPAP showed a relatively high estimated maternal-cord concentration ratio, whereas the alternative PFAS 9Cl-PF3ONS was consistently detected in maternal blood and cord serum, suggesting compound-specific distribution patterns compared with regulated legacy PFAS. Associations with fetal growth indicators were modest, matrix- and sex-specific, and interpreted as exploratory. Overall, these findings suggest that multimatrix biomonitoring can reveal matrix-specific PFAS detection and distribution patterns that may not be captured by single-matrix approaches. However, maternal-cord comparisons should be interpreted cautiously because maternal samples were collected during pregnancy rather than at delivery. https://doi.org/10.1021/acs.est.6c08434

Toxicité sur les animaux

Disruption of the thyroid hormone system and patterns of altered thyroid hormone serum concentrations after chemical exposures in adult rodents - a systematic review,
Baig, A., Forner-Piquer, I., Ermler, S. and Kortenkamp, A., *Frontiers in Endocrinology*, Sep 28 2026, Vol. 17.

Introduction Identification of thyroid hormone system-disrupting chemicals (THSDC) requires a solid understanding of the mechanisms by which exposure leads to adverse outcomes in the thyroid hormone system (THS). Methods In this systematic review, we present the results from our extensive evidence mapping of thyroid hormone (TH) and thyroid stimulating hormone (TSH) patterns in serum or plasma, after exposure to various THSDCs in adult rodents. Following PRISMA guidelines, we systematically searched PubMed, Web of Sciences and Scopus for relevant studies. Eligible studies were selected according to predefined inclusion and exclusion criteria. Results Our review of 234 peer-reviewed studies revealed that only a small group of compounds induced changes in T4 and TSH consistent with the canonical view of the hypothalamic-pituitary-thyroid (HPT) negative feedback loop, whilst the most frequent pattern was a decrease in T4 without TSH changes. The lack of a TSH response may have been due to T4 decreases not being sufficient to change HPT feedback. However, risk of bias analysis also identified deficits in TH/TSH analytical methodology, including the timepoints of TH measurements, possibly explaining discrepancies between studies. We further compared T4/TSH patterns to mechanism-of-action information and other THS-related outcomes and found that THSDCs frequently affected TH synthesis, induced hepatic enzymes involved in TH metabolism, and exhibited other differences in pharmacokinetic properties. Given the diverse chemical nature of the various THSDCs and variety of molecular targets in the THS, there is likely no single explanation for the different patterns observed. Conclusion Our compilation of T4/TSH patterns observed after different chemical exposures demonstrated that it is important to not solely rely on the canonical serum hormonal patterns to determine adversity of chemical exposures. Chemicals with different responses should be carefully considered, as current regulatory criteria may fail to identify them as being harmful to human health. https://doi.org/10.3389/fendo.2026.1911254

Paternal zearalenone exposure impairs transgenerational male spermatogenesis via the METTL14-m6A-Thap1-glutathione axis,
Chen, C., Ren, Y.-T., Lin, S., Hu, X.-Y., Wei, Y.-N., Liu, J.-R., Wang, R. and Chen, Y.-H., *Environmental Research*, 2026/11/06/ 2026, Vol. 311, no. Pt 2, p. 126119.

Zearalenone (ZEA), a widespread mycotoxin with endocrine-disrupting activity, poses a potential risk to male reproduction. However, the transgenerational effects of paternal ZEA exposure on offspring spermatogenesis and the underlying epitranscriptomic mechanisms remain poorly understood. Here, we investigated whether paternal ZEA exposure causes transgenerational male reproductive toxicity and elucidated the associated epitranscriptomic mechanism. In mice, chronic paternal ZEA exposure (5 mg/kg/day for 10 weeks) significantly reduced sperm count and motility, increased the sperm malformation rate, and disrupted testicular histomorphology in F1 and F2 male offspring. Mechanistically, multi-omics analysis revealed a marked reduction in testicular GSH levels. This reduction was attributable to decreased expression of GSS, the terminal enzyme catalyzing the final step of de novo GSH synthesis, and of GGT7, a GSH hydrolase involved in GSH degradation/recycling; both enzymes are transcriptionally activated by THAP1. Notably, paternal ZEA exposure is associated with increased METTL14-mediated m6A enrichment at candidate sites of Thap1 mRNA, which may promote YTHDF2-dependent decay and reduce THAP1 protein. Knockdown of Mettl14 in paternal testes or targeted overexpression of Thap1 in offspring testes rescued GSH levels, restored spermatogenesis, and alleviated reproductive impairment. Collectively, our findings identify a previously unrecognized epitranscriptional mechanism by which paternal ZEA exposure transmits reproductive toxicity across generations via the METTL14-m6A-Thap1-GSH axis, providing a potential target for intervention against mycotoxin-induced male infertility. https://doi.org/10.1016/j.envres.2026.126119

Prenatal and Lactation Exposure to Bisphenol A (BPA) at the Global Mean Daily Intake Level Leads to Sex-Dependent Changes in Microglial State, Gene Expression, and Behavioral Patterns in Newborn and Juvenile Wistar Rat Offspring,
Gerasimov, A., Sentyabreva, A., Gantsova, E., Melnikova, E. and Kosyreva, A., *Life-Basel*, Sep 14 2026, Vol. 16, no. 9.

Bisphenol A (BPA) is a widespread plasticizer widely used in the food industry worldwide. However, a consensus on the safe level of its daily intake does not currently exist, while there are numerous data pointing to a link between prenatal exposure to BPA and early neuropsychiatric disorders, such as autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD). The global average human-equivalent dose of BPA is estimated at 30 ng/kg body weight/day. Thus, the research herein was conducted on newborn and juvenile rat offspring of both sexes delivered from rats treated with 30 ng/kg body weight/day orally from day 6 to 21 of pregnancy and for a further 21 days during lactation. Our data indicate that prenatal exposure to 30 ng/kg/day from gestation day 6 to delivery induced sexually dimorphic, region-specific alterations in the neonatal (PD1) rat brains, impacting inflammatory reactions, estrogen receptor signaling, and neural progenitor dynamics. Prenatally BPA-treated males exhibited a pro-inflammatory state characterized by an increased total number of ramified Iba1+ microglia cells in the hippocampus alongside upregulation of Aif1, Nfkb, Tnf, Il1b, and Hif1a. Conversely, prenatally BPA-treated females showed only an increased total number of hippocampal Iba1+ cells and displayed inflammatory resilience, lacking upregulation of these markers. Both sexes exhibited a pro-inflammatory state in the prefrontal cortex via upregulation of Nfkb, Tnf, Il1b, and Hif1a. While both sexes showed decreased Tgfb in the prefrontal cortex, they deployed distinct compensatory responses: males upregulated the neuroprotector Igf1 only in the hippocampus, whereas in females, it was upregulated in both the hippocampus and the prefrontal cortex. Estrogen receptor expression was also highly dimorphic. In the hippocampus, males displayed

an imbalance via Esr1 upregulation and Esr2 downregulation, while females showed Esr2 downregulation alone. In the prefrontal cortex, these transcriptional profiles were the opposite. Finally, neural progenitor markers were altered. In the prefrontal cortex, BPA drove the upregulation of Sox2 and Pax6 in males but Sox9 in females; in the hippocampus, only Pax6 was upregulated, and only in males. The PAX6 protein level in the hippocampus was significantly increased in males but decreased in females. In juvenile offspring (PD21), behavioral patterns characterized by hyper-exploration, increased environmental investigation, and heightened emotional reactivity during social exposure were more pronounced in female offspring. These baseline neonatal disparities followed by behavioral changes underscore the necessity of sex-specific approaches when evaluating early-life neurodevelopment and subsequent adult behavioral and biological vulnerabilities. https://doi.org/10.3390/life16091526

Co-exposure to high temperature and mono(2-ethylhexyl) phthalate inhibits mouse antral follicle growth and estradiol synthesis: Phthalate-heat interactions in the ovary,
Ghuneim, S., Wilson, M., Harper, C., Sherlock, S., Ruschman, G. and Hannon, P., *Toxicological Sciences*, 2026.

Humans are ubiquitously exposed to di(2-ethylhexyl) phthalate (DEHP), which is a phthalate plasticizer used in consumer goods that has been identified as a reproductive toxicant. DEHP toxicity is mediated by mono(2-ethylhexyl) phthalate (MEHP), its bioactive metabolite that has been shown to target ovarian processes, including folliculogenesis and steroidogenesis. Simultaneously, humans are ubiquitously exposed to non-chemical stressors like high temperatures, which have also been shown to impair ovarian function. Given the unavoidable exposure to both increasing heat and DEHP, this study tested the hypothesis that exposure to high temperature will exacerbate the negative effects of MEHP exposure on antral follicle function. Antral follicles from CD-1 mice were cultured for 24-96hr with vehicle control (DMSO) or MEHP (0.2-20µg/ml) at a control temperature (CT; 37 °C) or high temperature (HT; 42 °C, 8hr per 24hr) to assess effects on follicle growth and steroidogenesis. Compared to control (CT+DMSO), HT+DMSO and HT+MEHP inhibited the cell cycle and steroidogenic pathway and upregulated follicle-stimulating hormone receptor expression. CT+MEHP, HT+DMSO, and HT+MEHP decreased estradiol levels over time, and HT+DMSO and HT+MEHP also inhibited antral follicle growth compared to CT+DMSO. Therefore, MEHP exposure decreased estradiol levels, while HT exposure and HT+MEHP co-exposure decreased estradiol levels and follicle growth by inhibiting the steroidogenic pathway and cell cycle. Further, several significant interactions were identified, providing the first evidence of a phthalate-heat interaction in a mammalian model. Thus, exposure to ubiquitous chemical and non-chemical stressors, like MEHP and HT, disrupt critical ovarian processes and may potentiate ovarian dysfunction when combined. https://doi.org/10.1093/toxsci/kfag127

The EDC mixture "NeuroMix" alters neuroendocrine physiology, fatty food preference, and the central reward transcriptome,
Hilz, E., Gonzalez, N., Morales-Grahl, E., Deka, J., Sheinhaus, D., Thompson, L., Kassotis, C. and Gore, A., *Endocrinology*, Sep 2026, Vol. 167, no. 9.

Obesity prevalence has risen dramatically in recent decades, coincident with increasing human exposures to endocrine-disrupting chemicals (EDCs). Many EDCs act as "obesogens" by promoting adipogenesis and disrupting metabolism; however, little is known about their effects on neural circuits that regulate food reward and motivation. EDCs cause neurobiological and behavioral changes, implicating them in central energy balance regulation. In this experiment, we tested whether developmental exposure to the environmentally relevant EDC mixture NeuroMix (NMX) may have obesogenic-like effects in rats through central mechanisms. Using a dose-response approach, male

and female rats were exposed perinatally to NMX (0, 0.1 & times;, 1 & times;, 10 & times; doses) and assessed for adult high-fat food and sucrose preference, thyroid hormones, and transcriptomics in reward and hypothalamic nuclei. Females exposed to the 1 & times; dose exhibited an increase in fatty food preference and consumption accompanied by appreciable weight gain. Males showed reduced thyroid hormone levels at the highest 10 & times; dose. NMX antagonized thyroid hormone receptor beta in vitro, suggesting a potential molecular mechanism underlying the observed neuroendocrine effects. Transcriptomic analyses in 1 & times; rats identified the nucleus accumbens (NAc) as a key neural substrate in both sexes, with spliceosomal complex eigengenes in the NAc acting as correlates of high-fat food behaviors, and individual splicing factors emerging as possible neuromolecular mechanisms linking endocrine disruption to obesogenic eating. Together, this research demonstrates that environmentally relevant EDC mixtures exert sex- and dose-specific effects on food choice, thyroid hormones, and gene expression, highlighting neuromolecular reward mechanisms as potential contributors to environmentally mediated obesity risk. https://doi.org/10.1210/endocr/bqag084

Perinatal Bisphenol S Exposure Induces Hepatotoxicity in Female Rat Offspring: Insights into Disrupted Hepatic Cholesterol Homeostasis,
Huang, H., Zhang, J., Jin, J., Xie, Y., Pan, R., Zhao, M., Zhu, B. and Hua, J., *Toxics*, 2026/09/30/ 2026, Vol. 14, no. 10, p. 878.

Recent research has highlighted concerns regarding the hepatotoxicity of Bisphenol S (BPS), particularly its potential transgenerational effects. In this study, we investigated the effects of perinatal BPS exposure on female offspring (F1) by exposing pregnant Sprague-Dawley (SD) rats (F0) to 0.05 and 20 mg/kg BPS from gestational day 6 to postnatal day 21. Results showed that perinatal BPS exposure resulted in increased body weight, higher liver coefficient, and impaired liver function in female rat offspring (F1). Untargeted metabolomics analysis revealed suppression of the primary bile acid biosynthesis pathway, and network toxicology predicted cholesterol metabolism and bile secretion as key pathways, suggesting altered cholesterol and bile acid homeostasis in the liver of female offspring. Validation studies demonstrated activation of cholesterol synthesis, as shown by upregulation of sterol regulatory element-binding protein 2 (SREBP2), squalene epoxidase (SQLE), and 3-hydroxy-3-methylglutaryl-CoA reductase (HMGCR). Furthermore, the down-regulated expression levels of acetyl-CoA acetyltransferase 1 (ACAT1), ATP-binding cassette sub-family G member 8 (ABCG8), and ATP-binding cassette sub-family G member 5 (ABCG5) indicated that pathways associated with cholesterol conversion, including cholesterol esterification, transport, and secretion as very low-density lipoprotein cholesterol (VLDL-C), were suppressed. Specifically, reduced transcription of ACAT1, ABCG8, and ABCG5, which are involved in cholesterol esterification and cholesterol efflux, was observed. This imbalance was associated with hepatic cholesterol accumulation and hepatotoxicity, although whether cholesterol accumulation was a cause or a consequence of liver injury remained unclear. In summary, our findings demonstrate that perinatal BPS exposure disrupted hepatic cholesterol homeostasis, which was associated with cholesterol accumulation and hepatotoxicity in F1 female rats. https://doi.org/10.3390/toxics14100878

Gestational benzyl butyl phthalate exposure impairs sperm capacitation in F1 offspring by altering PKA-associated signaling and tyrosine phosphorylation,
Lee, W.-J., Jo, J.-H., Uwamahoro, C., Jang, S.-I., Jung, E.-J., Bae, J.-W. and Kwon, W.-S., *Archives of Toxicology*, 2026/10/23/ 2026.

Benzyl butyl phthalate (BBP) is a phthalate plasticizer recognized as an endocrine-disrupting chemical. However, the effects of gestational BBP exposure on sperm function during capacitation in adult offspring remain unclear. This study investigated the effects of gestational BBP exposure on sperm

function in adult male offspring, focusing on PKA-associated signaling and protein tyrosine phosphorylation. Pregnant ICR mice were orally administered BBP at 100, 250, or 500 mg/kg/day from gestational day 7 to 20. Adult male F1 offspring were evaluated on postnatal day 78, and sperm function was assessed by measuring motility, kinematic parameters, capacitation status, cell viability, intracellular ATP and reactive oxygen species (ROS) levels, PKA-associated signaling, and protein tyrosine phosphorylation. Gestational BBP exposure significantly reduced body weight, anogenital distance, and testicular size. While cell viability and intracellular ROS levels were unchanged, sperm motility and intracellular ATP levels were significantly reduced, capacitation status was altered, and the acrosome reaction was increased. Furthermore, PKA substrate phosphorylation and protein tyrosine phosphorylation were significantly decreased in spermatozoa. Collectively, these findings demonstrate that gestational BBP exposure impairs sperm function in adult male offspring, potentially through ATP depletion and disruption of capacitation-associated signaling pathways. https://doi.org/10.1007/s00204-026-04588-5

Bisphenol M Impairs Ovarian Function through Disrupting Estrogen Synthesis in Female Mice: A Comparative Study with Bisphenol A,
Luo, S., Wu, F., Sun, Y., Li, Z., Wang, J., Cao, M., Pang, S., Wang, L., Cao, H., Li, J. and Liang, Y., *Environment & Health*, 2026/10/16/ 2026, Vol. 4, no. 10, p. 2289–2300.

Bisphenol M (BPM) has been increasingly used as a substitute for bisphenol A (BPA), yet its reproductive toxicity remains poorly characterized. Unlike BPA, which is well characterized as a weak estrogen receptor (ER) agonist, BPM has been identified as an ER antagonist. In this study, we systematically compared the effects of BPM and BPA on the reproductive neuroendocrine system of female mice during puberty. Five-week-old female ICR mice were exposed to BPM and BPA at doses of 1 μg/kg bw/day, 50 μg/kg bw/day, and 1 mg/kg bw/day for 14 days. Both chemicals induced comparable adverse reproductive outcomes at 50 μg/kg bw/day and 1 mg/kg bw/day, including reduced uterine weight, disrupted estrous cyclicity, depletion of primordial follicles, and increased follicle atresia. However, BPM and BPA had divergent effects on molecular and hormonal end points. BPM exposure significantly elevated ovarian Cyp19a1 expression, as well as serum estradiol (E2), follicle-stimulating hormone (FSH), and luteinizing hormone (LH) levels, whereas BPA did not significantly alter any of these parameters. Mechanistically, BPM acts as an ER antagonist, reducing functional E2-ER complexes and creating a perceived "E2 signaling deficiency". This triggers compensatory upregulation of ovarian ERs and steroidogenic genes (Star, Cyp19a1, and Hsd17b1), leading to enhanced E2 synthesis. The resulting hyperestrogenism exerts positive feedback on hypothalamic GnRH neurons, driving sustained gonadotropin secretion and creating a self-sustaining high-E2 loop that disrupts estrous cyclicity and follicle dynamics. In contrast, BPA, as a weak ER agonist, partially substitutes for endogenous E2 at ERs, preventing the perception of E2 deficiency. Consequently, no compensatory steroidogenic activation occurs, and hormone levels remain unchanged. Despite these distinct mechanisms, both compounds impair female reproductive function. Importantly, BPM exerted more pronounced endocrine disturbances than BPA, raising concerns regarding its use as a safer alternative. These findings highlight the necessity of comprehensive toxicological evaluation of BPA analogues and emphasize that ER antagonism does not necessarily imply reduced reproductive risk. https://doi.org/10.1021/envhealth.6c00098

Preconception paternal PFAS exposure in mice reprograms the placental epigenome,
Maxwell, D. L., Maxwell, A., Nowak, K., Gurdziel, K., Ding, J., Mor, G., Petriello, M. C. and Pilsner, J. R., *Molecular Human Reproduction*, 2026/10/06/ 2026, Vol. 32, no. 4, p. gaag056.

The placenta plays a vital role in supporting fetal growth and development by facilitating nutrient exchange, hormone signaling, and immune regulation. Environmental toxicants such as

perfluoroalkyl and polyfluoroalkyl substances (PFAS) can disrupt placental homeostasis, leading to increased risk of disease later in life. Paternal environmental exposures may influence offspring health by inducing epigenetic changes in sperm, which may affect sex-dependent placental programming. Here, male mice were exposed to a PFAS mixture (PFOS, PFOA, PFNA, PFHxS, GenX; 20 µg/l each) for 10 weeks and mated with unexposed females. We identified 6656 and 3242 differentially methylated regions (DMRs) in E12.5 placentas of female and male offspring, respectively. Female placentas showed predominantly hypermethylation (78.5%), whereas male placentas were mostly hypomethylated (62%). Gene ontology analyses linked female placental DMRs to cell and embryonic morphogenesis, and male DMRs to anatomical size regulation and hemostasis. Bulk RNA sequencing revealed 168 and 148 differentially expressed genes (DEGs) in female and male placentas, respectively. Female DEGs were related to immune regulation, while male DEGs were involved in muscle and mesenchyme development. Sex-by-PFAS interaction models identified distinct methylation and transcription biological pathways. Overlap analysis between F0 sperm and F1 placentas identified 265 shared genes, including 289 female-specific and 124 male-specific genes. Paternal exposure to the PFAS mixture increased glycogen concentrations in male, but not female, placentas. No effects were observed at imprinted loci. These findings demonstrate that paternal preconception exposure to a PFAS mixture alter placental epigenomic and transcriptomic landscapes, which may contribute to sex-dependent trajectories of fetal health and development and offspring phenotypes. https://doi.org/10.1093/molehr/gaag056

Sex-specific accumulation and oxidative stress of tris(1,3-dichloro-2-propyl) phosphate and its metabolite bis(1,3-dichloro-2-propyl) phosphate in rats after 90-day exposure,
Sha, Y., Lin, K., Liu, C., Bian, J., Chen, Z., Wei, H., Yao, Y., Chen, Y. and Lu, S., *Ecotoxicology and Environmental Safety*, 2026/10/15/ 2026, Vol. 325, p. 120949.

Tris(1,3-dichloro-2-propyl) phosphate (TDCIPP) is a widely used organophosphate ester (OPE), but sex-dependent differences in tissue distribution and toxicity in mammals remain unclear. In this study, male and female SD rats were orally dosed with TDCIPP (0-360 mg/kg bw/day) for 90 days. We quantified TDCIPP and its metabolite bis(1,3-dichloro-2-propyl) phosphate (BDCIPP) in serum, urine, liver, and kidney, assessed glutathione (GSH) homeostasis and lipid peroxidation, and employed network toxicology with molecular docking for target prediction. Male rats exhibited significantly higher BDCIPP accumulation and elevated BDCIPP/TDCIPP ratios in most matrices ($P < 0.05$), suggesting possible differences in parent/metabolite disposition. Hepatic malondialdehyde (MDA) increased dose-dependently in both sexes (dose main effect, $P < 0.001$), with an overall higher level in females (sex main effect, $P < 0.001$) but no significant sex × dose interaction. In kidney, males exhibited significant MDA elevation at 360 mg/kg bw/day despite preserved GSH reserves, suggesting that lipid peroxidation may occur independently of GSH depletion. Human-based network toxicology predicted that pathways associated with liver and kidney injury may be affected by TDCIPP/BDCIPP and involve multiple common signaling pathways, including endocrine disruption, suggesting that sex-specific oxidative responses may involve CYP450 and hormone-receptor crosstalk. In addition, pathway enrichment suggested that oxidative stress pathways were more prominently enriched in the predicted liver injury network, whereas receptor-inflammation pathways were more prominently enriched in the predicted kidney injury network. PIK3R1 and PTK2 emerged as common core nodes shared between organs, while liver-specific targets (EGFR, ERBB2, SRC) and kidney-specific targets (PIK3CB, PIK3CD, JAK2, FYN, PTPN11) revealed distinct organ-specific signaling networks. Collectively, these findings suggest sex-dependent toxicokinetics are associated with organ-specific oxidative responses and may potentially contribute to injury via CYP450 and hormone crosstalk, emphasizing the necessity of incorporating sex- and metabolite-specific oxidative stress and predicted toxicity into OPE risk assessment. https://doi.org/10.1016/j.ecoenv.2026.120949

Developmental exposure to PBDE-47 induces sex- and organ-specific glucose uptake alterations linked to thyroid hormone disruption in rats: phenotypic parallels to early cardiorenal-metabolic crosstalk,
Wei, H., Wen, S., Tan, B., Qiu, X., Li, P., Li, J., Xia, T., Wang, A., Gao, H. and Zhang, S., *Environmental Pollution*, 2026/12/15/ 2026, Vol. 411, no. Pt B, p. 129440.

2, 2', 4, 4'-Tetrabromodiphenyl ether (PBDE-47) is a ubiquitous persistent organic pollutant with developmental toxicity and thyroid-disrupting activity. Increasing evidence links PBDE-47 exposure to metabolic disorders, yet it remains unclear whether developmental PBDE-47 exposure disturbs glucose metabolism in multiple organs of offspring and how thyroid hormone (TH) changes relate to such effects. Using a rat model of perinatal PBDE-47 exposure, organ-specific glucose metabolism were assessed via positron emission tomography with the 18F-fluorodeoxyglucose (18F-FDG) tracer. Adult male offspring exhibited increased FDG uptake in the heart but decreased uptake in the brain and kidneys, whereas female offspring showed elevated uptake in the brain and kidneys and reduced cardiac FDG uptake. These changes were accompanied by sex-specific TH alterations, with increased T3 in males and decreased T3 and T4 in females. Correlation analyses revealed significant associations between TH levels and organ-specific FDG uptake. Intriguingly, these coordinated metabolic and endocrine disruptions exhibited early phenotypic parallels to features of the cardiovascular-kidney-metabolic (CKM) framework. Network toxicology identified 89 core targets, with PIK3CB, PIK3R1, PIK3R2, PLCG1, and PLCG2 as hub molecules enriched in apoptosis, endocrine signaling, insulin resistance, and central carbon metabolism pathways. Molecular docking suggested high-affinity binding of PBDE-47 to these targets, and gene set analysis further implicated PI3K/AKT, insulin receptor signaling, and the AGE-RAGE pathway. Collectively, this study suggests that perinatal PBDE-47 exposure elicits sex-specific multi-organ alterations in FDG uptake that correlate with TH disruption, providing a hypothesis-generating basis for developmental metabolic toxicity and highlighting phenotypic parallels to early cardiorenal-metabolic crosstalk. https://doi.org/10.1016/j.envpol.2026.129440

Tetrachlorobisphenol A inhibits steroidogenesis in pubertal rat Leydig cells through disruption of copper homeostasis,
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Tetrachlorobisphenol A (TCBPA) is a widely used flame retardant with potential endocrine-disrupting properties. This study investigated the effects of TCBPA on steroidogenesis in pubertal rat Leydig cells, focusing on copper homeostasis and on whether the cuproptosis pathway is engaged. Male Sprague-Dawley rats (35 days old) were administered TCBPA (0, 10, 100, and 200 mg/kg/day) for 21 days. TCBPA exposure (100 and 200 mg/kg) significantly reduced serum and testicular testosterone levels without affecting testis weight or Leydig cell numbers. TCBPA downregulated steroidogenic genes (Lhcgr, Scarb1, Star, Cyp11a1, Insl3, and Hsd11b1) and their corresponding proteins, while increasing Leydig cell proliferation. TCBPA elevated testicular copper levels and altered expression of cuproptosis-related proteins, upregulating FDX1 and LIAS while downregulating ATP7B. In vitro studies confirmed that TCBPA induced reactive oxygen species generation, reduced mitochondrial membrane potential, and triggered copper accumulation in primary Leydig cells. Co-treatment with the copper chelator tetrathiomolybdate attenuated these changes, with a significant TCBPA by tetrathiomolybdate interaction for six of eight endpoints, indicating dependence on copper availability. At concentrations that did not affect cell viability, two molecular features of cuproptosis were tested directly: the iron-sulfur cluster protein SDHB was not significantly reduced, and DLAT oligomerisation was not detected, although it was readily produced by the positive control elesclomol-

CuCl(2). These findings indicate that TCBPA impairs steroidogenesis in rat Leydig cells through suppression of steroidogenic enzymes and copper-dependent mitochondrial dysfunction, without engaging cuproptosis, providing a basis for evaluating the reproductive risk of halogenated bisphenols. https://www.sciencedirect.com/science/article/pii/S0147651326011310