Bulletin de veille Perturbateurs Endocriniens N°34 - Janvier/Février 2026

Objectif : cette veille bibliographique à 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.

Les liens mentionnés dans le bulletin donnent accès aux documents sous réserve d'un abonnement à la ressource.

Les bulletins de veille sont disponibles sur le portail documentaire de l'INRS. L'abonnement permet de recevoir une alerte mail lors de la publication d'un nouveau bulletin (bouton « M'abonner » disponible après connection à son compte).

Exposition professionnelle

Occupational exposures among hairdressers and the occurrence of hormone-related conditions.

Ogunsina K, Richardson KA, White A, Chang CJ, Sandler DP, O'Brien KM. *Occup Environ Med*. 2026 Jan 19.

OBJECTIVE: To investigate the association between hairdresser exposures and hormone-related conditions. METHODS: Using data from 50 800 eligible Sister Study participants (enrolled 2003-2009, aged 35-74 years), we estimated ORs and 95% CIs for associations between ever working as a hairdresser (n=1803) and prevalent fibroids, endometriosis, hysterectomy and oophorectomy. We

estimated HRs and 95% CI for incident fibroids, endometriosis, breast, uterine and ovarian cancers among ever hairdressers versus never hairdressers. We also examined associations of hormone-related diseases and professional use of products such as bleach, perms, chemical straighteners, permanent hair colour, hairspray, barbicide, formaldehyde and alcohol, comparing data from 985 long-term hairdressers who worked ≥2 years to non-long-term hairdressers (never workers and those working <2 years). RESULTS: Ever-hairdressers were more likely than never-hairdressers to have had a prebaseline hysterectomy (OR=1.23: 95% CI 1.11 to 1.36). Hysterectomies were more common among long-term hairdressers with more frequent applications of perms, chemical straighteners and permanent hair colour compared with less frequent applicators or never hairdressers. Ever-hairdressers had higher rates of incident endometriosis (477 cases, HR=1.61: 95% CI 1.08 to 2.38) compared with never-hairdressers, but there were no notable associations between working as a hairdresser and fibroids (1805 cases, HR=1.04: 95% CI 0.80 to 1.34), breast cancer (4628 cases, HR=0.98: 95% CI 0.83 to 1.16), ovarian cancer (300 cases, HR=1.33: 95% CI 0.77 to 2.29) or uterine cancer (447 cases, HR=1.04: 95% CI 0.60 to 1.77). In race-stratified analyses, Black hairdressers were more likely to be diagnosed with fibroids than Black never-hairdressers (201 cases, HR=1.56: 95% CI 0.93 to 2.62). CONCLUSIONS: Hairdresser occupation was associated with increased odds of hysterectomy and increased rates of incident endometriosis and possibly fibroids among Black women. Lien vers l'article

Health conditions in aircrew - Association with neurotoxic substances and other occupational factors.

Hageman G, van Broekhuizen P, Nihom J. *J Occup Environ Hyg*. 2026 Jan 27:1-17.

Aircrew are exposed to in-cabin engine oil and hydraulic fumes during work. A wide spectrum of symptoms, referred to as Aerotoxic Syndrome (AS), has been described in case series and health surveys. In addition, epidemiological studies have consistently shown elevated risks for breast cancer in females and for melanoma in both male and female aircrew members. The concentrations of neurotoxic, endocrine-disrupting, and carcinogenic components of fumes have been too low to explain chronic health effects. Instead, ionizing radiation, elevated ozone levels, and disruption of circadian rhythms have been considered as occupational risk factors for certain cancers in aircrew. This review examines the significance of these factors in the context of AS and cancers. A literature search in MEDLINE was conducted (via PubMed and ScienceDirect) for studies published up to May 2025 on (1) neuro- or immunotoxicity of contaminated cabin air, (2) increased cancer rate of cabin crew, and (3) suspected contributing occupational risk factors. From 672 screened titles and abstracts, 162 relevant full-text papers were selected and grouped into these three categories. An association between organophosphate exposure and elevated levels of neuronal auto-antibodies has been demonstrated with presentation of neurological symptoms of autoimmunity. By-products of ozone degradation appear to be more toxic than ozone itself and are both carcinogenic and neurotoxic. Disruption of circadian rhythms (night shifts) has been shown to influence the immune status of aircrew, change the metabolic degradation of toxic compounds, disrupt hormones (melatonin, cortisol), and could contribute to the risk of breast cancer among female crew members. Exposure to cosmic radiation has a suspected link to breast cancer. Overall, chronic exposure of aircrew to a mixture of neurotoxic compounds in conjunction with auto-immune mechanisms and external factors appears etiologically relevant for increased breast cancer risks in aircrew as well as for symptoms associated with AS. Endocrine-disrupting chemicals, exposure to elevated ozone levels, ionizing radiation, and night-shift work with the disturbed circadian rhythms are contributing factors. Lien vers l'article

Les perturbateurs endocriniens en Odontologie : revue de la littérature,

UCA Faculté Odontologie - Université Côte d'Azur - Faculté de Chirurgie Dentaire (16 décembre 2025),
Les perturbateurs endocriniens (PE) sont des substances chimiques capables d'altérer le système hormonal, avec des conséquences sur la fertilité, le métabolisme, le développement et la santé bucco-dentaire. En Odontologie, plusieurs biomatériaux (résines composites, adhésifs, gouttières orthodontiques…) peuvent libérer du bisphénol A, des phtalates ou autres composés à risque, exposant patients et praticiens. Cette revue narrative de la littérature (1996-2025) analyse leur présence, leurs effets et les facteurs d'exposition. Des recommandations sont proposées pour limiter les risques : choix de matériaux alternatifs, protocoles optimisés, précautions pour les populations vulnérables et rôle des pouvoirs publics. Une dentisterie plus biocompatible et préventive est indispensable pour réduire l'impact des PE. https://dumas.ccsd.cnrs.fr/dumas-05418555

Prenatal occupational exposure to endocrine-disrupting chemicals during pregnancy and adult male reproductive hormones,
Blanc-Petitjean, P., Rahban, R., Dananche, B., Senn, A., Zufferey, F., Stettler, E., Multigner, L., Nef, S. and Garlante, R., *Reproductive Biomedicine Online*, Mar 2026, Vol. 52, no. 3.

Research question: Does maternal occupational exposure to endocrine-disrupting chemicals (EDC) during pregnancy affect reproductive hormone concentrations in adult sons? Design: Data from a cross-sectional study of 2326 Swiss conscripts collected between 2005 and 2017 were analysed. On inclusion, the conscripts' mothers completed a detailed questionnaire about their pregnancy. A job-exposure matrix was used to assess exposure to 10 categories of potential EDC. Reproductive hormones - FSH, LH, total and free testosterone, oestradiol and sex hormone-binding globulin (SHBG) - were determined in serum samples from all conscripts whose mothers were exposed to EDC during pregnancy (n =138) and a random sample of non-exposed conscripts (n = 276). Multiple linear regression analyses were adjusted for potential confounders. Results: Prenatal exposure to phthalates or alkyl phenolic compounds was significantly associated with higher FSH concentrations (a$ = 0.26, 95% CI 0.03-0.49, and a$ = 0.22, 95% CI 0.02-0.42, respectively) and prenatal exposure to pesticides was significantly associated with higher SHBG concentrations (a$ = 0.22, 95% CI 0.05-0.38). No statistically significant associations were found between other EDC categories and reproductive hormones. Conclusions: Maternal occupational exposure to certain types of EDC during pregnancy was associated with the concentrations of reproductive hormones in adult sons. These findings require replication in larger, prospective population studies.
https://doi.org/10.1016/j.rbmo.2025.105236

Increasing PFAS concentrations in human serum correlate with elevated blood lipid levels,
Falls, A. T., Boatman, A. K., Ryan, J. P., Solosky, A. M., Dodds, J. N., Chappel, J. R., Fry, A. N., Kirkwood-Donelson, K. I., Baker, E. S. and Stapleton, H. M., *Environmental Science-Advances*, Mar 9 2026, Vol. 5, no. 3, p. 885-899.

Per- and polyfluoroalkyl substances (PFAS) are a large group of synthetic chemicals which have been detected in the blood of >99% people worldwide. Currently, certain PFAS are linked to elevated cholesterol levels in humans, but few studies have assessed changes in specific lipid species to assess mechanistic changes. In this study, 78 serum samples were attained from 49 participants exposed to elevated PFAS through drinking water and 29 occupationally exposed firefighters. PFAS serum concentrations were initially assessed, and drinking water exposure participants illustrated higher PFAS serum levels than both the firefighters and national median values from the National Health and Examination Survey (NHANES). Participants were then regrouped for lipidomic analyses using their summed serum concentration for 7 PFAS (Sigma 7 PFAS). Thirty-four participants in our study had Sigma 7 PFAS concentrations >= 20 ng mL(-1), a level that has been associated with increased

risk of dyslipidemia, thyroid dysfunction and cancer according to the National Academies PFAS Exposure Guidance Report. Statistical analyses revealed that 24 lipids out of 387 detected in all participants were significantly higher in participants with Sigma 7 PFAS values >= 20 ng mL(-1). Triglycerides and phosphatidylethanolamines specifically represented 62.5% of these 24 lipids, suggesting alteration of cellular membrane structures and energy storage. A statistical assessment on the female-only samples from the drinking water cohort was also performed to reduce bias due to sex, age and occupational covariates and further validated these trends. This study therefore illustrates increased serum PFAS concentrations correlate with elevated lipid species and molecular pathway alterations in highly exposed individuals. https://doi.org/10.1039/d5va00483g

Characteristics of the Fatty Acid Composition in Elderly Patients with Occupational Pathology from Organophosphate Exposure,
Goncharov, N. V., Savelieva, E. I., Koneva, T. A., Gustyleva, L. K., Vasilieva, I. A., Belyakov, M. V., Voitenko, N. G., Belinskaia, D. A., Korf, E. A. and Jenkins, R. O., *Diagnostics*, Dec 18 2025, Vol. 15, no. 24.

Background/Objectives: The delayed effects of organophosphate poisoning may manifest years after exposure, often masked by age-related diseases. The aim of this retrospective cohort study was to identify the biochemical "trace" that could remain in patients decades after poisoning. We determined a wide range of biochemical parameters, along with the spectrum of esterified and non-esterified fatty acids (EFAs and NEFAs, respectively), in the blood plasma of a cohort of elderly patients diagnosed with occupational pathology (OP) due to (sub)chronic exposure to organophosphates in the 1980s. Methods: Elderly patients with and without a history of exposure to organophosphates were retrospectively divided into two groups: controls (n = 59, aged 73 +/- 4, men 29% and women 71%) and those with OP (n = 84, aged 74 +/- 4, men 29% and women 71%). The period of neurological examination and blood sampling for subsequent analysis was from mid-2022 to the end of 2023. Determination of the content of biomarkers of metabolic syndrome, NEFAs, and EFAs in blood plasma was performed by HPLC-MS/MS and GC-MS. Results: The medical histories of the examined elderly individuals with OP and the aged control group included common age-related diseases. However, patients with OP more often had hepatitis, gastrointestinal diseases, polyneuropathy, and an increased BMI. Analysis of metabolic biomarkers revealed, in the OP group, a decrease in the concentrations of 3-hydroxybutyrate ($p < 0.05$), 2-hydroxybutyrate ($p < 0.0001$), and acetyl-L-carnitine ($p < 0.001$) and the activity of butyrylcholinesterase (BChE) ($p < 0.05$), but an increase in the esterase activity of albumin ($p < 0.05$). Correlation analysis revealed significant relationships between albumin esterase activity and arachidonic acid concentrations in the OP group (0.64, $p < 0.0001$). A study of a wide range of fatty acids in patients with OP revealed reciprocal relationships between EFAs and NEFAs. A statistically significant decrease in concentration was shown for esters of margaric, stearic, eicosadienoic, eicosatrienoic, arachidonic, eicosapentaenoic, and docosahexaenoic fatty acids. A statistically significant increase in concentration was shown for non-esterified heptadecenoic, eicosapentaenoic, eicosatrienoic, docosahexaenoic, gamma-linolenic, myristic, eicosenoic, arachidonic, eicosadienoic, oleic, linoleic, palmitic, linoelaidic, stearic, palmitoleic, pentadecanoic, and margaric acids. Decreases in the ratios of omega-3 to other unsaturated fatty acids were observed only for the esterified forms. Conclusions: The data obtained allow us to consider an increased level of NEFAs as one of the main cytotoxic factors for the vascular endothelium. Modification of albumin properties and decreased bioavailability of docosahexaenoic acid could be molecular links that cause specific manifestations of organophosphate-induced pathology at late stages after exposure.
https://doi.org/10.3390/diagnostics15243246

Manganese Exposure in Occupational Settings: Disruptions in Endothelial Function and Thyroid Regulation,
Gözükara, M. G., Iritas, S. B., Tutkun, L., Büyüksekerci, M., Iritas, Ö., Türksoy, V. A., Vardar, D., Deniz, S. and Tutkun, E., *Metabolites*, Dec 19 2025, Vol. 16, no. 1.

Background: Manganese (Mn) exposure is common in welding and metal-processing occupations and has been implicated in both thyroid disruption and endothelial dysfunction through oxidative and nitric-oxide-related pathways. However, endocrine and vascular biomarkers have rarely been examined together in occupational settings. Methods: In this cross-sectional study, 95 Mn-exposed workers and 95 non-exposed controls were evaluated. Whole-blood Mn, triiodothyronine (T3), thyroxine (T4), thyroid-stimulating hormone (TSH), asymmetric dimethylarginine (ADMA), symmetric dimethylarginine (SDMA), arginine and citrulline were measured using validated Inductively Coupled Plasma-Mass Spectrometer and chemiluminescent immunoassays. Group differences were assessed using independent samples t-tests, and exposure-biomarker associations were evaluated using Pearson correlations (p < 0.05). Results: Mn-exposed workers had significantly higher blood Mn levels than controls (19.82 +/- 4.54 vs. 10.22 +/- 3.07 <mu>g/L; p < 0.001). Thyroid hormones (T3, T4, and TSH) were significantly lower among Mn workers, representing a non-classical hormonal pattern, including T3 (2.47 +/- 0.31 vs. 3.14 +/- 0.42 ng/L; p < 0.001), T4 (1.02 +/- 0.13 vs. 1.21 +/- 0.18 ng/L; p < 0.001), and TSH (1.75 +/- 0.53 vs. 2.88 +/- 0.37 mIU/L; p < 0.001). Endothelial biomarkers also differed: ADMA (0.26 +/- 0.14 vs. 0.19 +/- 0.08 mu mol/L; p < 0.001) and SDMA (0.24 +/- 0.06 vs. 0.20 +/- 0.03 <mu>mol/L; p < 0.001) were higher, while citrulline was lower (18.77 +/- 10.23 vs. 22.82 +/- 6.70 <mu>mol/L; p = 0.002). In Mn workers, blood Mn showed negative correlations with T3 (r = -0.535, p < 0.01), T4 (r = -0.331, p < 0.01), and TSH (r = -0.652, p < 0.01), and positive correlations with ADMA (r = 0.205, p < 0.05) and SDMA (r = 0.193, p < 0.05). Conclusions: These findings indicate measurable differences in thyroid hormones and dimethylarginine-related endothelial markers among Mn-exposed workers. While the cross-sectional design precludes causal inference, the combined pattern suggests a possible unusual biological response involving both endocrine regulation and nitric-oxide-related pathways. Further longitudinal studies incorporating oxidative stress markers, co-exposure assessment, and functional endothelial testing are needed to clarify the biological relevance of these associations.
https://doi.org/10.3390/metabo16010001

Impact of Cadmium on Prostate-Specific Antigen and Endothelial Markers: A Risk for Prostatic Damage,
Iritas, S. B., Gözükara, M. G., Tutkun, L., Vardar, D., Büyüksekerci, M., Abusoglu, G., Deniz, S., Türksoy, V. A. and Tutkun, E., *Toxics*, Dec 4 2025, Vol. 13, no. 12.

Cadmium (Cd) is a persistent toxic metal that bioaccumulates in human tissues and may disrupt redox and endocrine pathways, yet the metabolic mechanisms linking Cd exposure to both endothelial and prostate dysfunctions remain insufficiently defined. This study investigated whether chronic occupational Cd exposure alters methylated arginine metabolism and prostate-specific antigen (PSA) levels, indicating a shared toxicometabolic axis. A total of 150 male workers were enrolled, including 75 metallurgical employees with documented Cd exposure and 75 matched controls. All participants were non-smokers, eliminating confounding from tobacco-related oxidative or endocrine effects. Urinary Cd concentrations were quantified using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), and serum asymmetric dimethylarginine (ADMA), symmetric dimethylarginine (SDMA), L-arginine, citrulline, and PSA were measured by Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS) and electrochemiluminescence. The use of Inductively Coupled Plasma-Mass Spectrometry for cadmium quantification and LC-MS/MS for methylated arginine profiling provided high analytical specificity and sensitivity, strengthening the validity of

biomarker measurements. Correlation and multivariable analyses adjusted for age and body mass index. Cd-exposed workers demonstrated significantly elevated urinary Cd, PSA, ADMA, and SDMA levels, alongside reduced arginine/ADMA ratios, consistent with impaired nitric oxide bioavailability. Urinary Cd strongly correlated with PSA and ADMA levels. These findings indicate that Cd may disrupt the nitric oxide pathway and elevates PSA, supporting a mechanistic link between vascular and prostate stress. Combined ADMA, SDMA, and PSA profiling may serve as an early biomarker panel for Cd-related metabolic injury in occupational settings.
https://doi.org/10.3390/toxics13121049

The impact of pesticide exposure on thyroid function and neoplasia,
Lin, J. and Goldner, W., *Current Opinion in Endocrine and Metabolic Research*, Mar 2026, Vol. 42.

Environmental exposure to endocrine disrupting chemicals is a significant public health concern. Pesticides represent a subset of the potential environmental exposures impacting human health, including the thyroid. Some pesticides are considered persistent organic pollutants, and so are present in the soil, water, and food chain long after they have been used, creating the potential for exposure for decades, even after they have been removed from the market. Exposures can occur through occupational exposure, but there is increasing evidence for residential exposure in non-agricultural workers. Some pesticides are considered endocrine disruptors, and there are epidemiologic associations reported between specific pesticides and thyroid hormone alterations and thyroid carcinogenesis. In this review, we will discuss the relationship between pesticides and the thyroid. https://doi.org/10.1016/j.coemr.2025.100593

Effect of pesticides on breast cancer tumor,
Marcoccia, D., Palomba, S., Brajon, G., Baldi, A., Galli, F. S., Servadei, F., Palumbo, V., Bonfiglio, R., Treglia, M., Marsella, L. T., Botti, F., Shi, Y. F., Candi, E., Melino, G., Mauriello, A. and Scimeca, M., *Biology Direct*, Dec 8 2025, Vol. 21, no. 1.

Breast cancer is the most common malignancy among women worldwide. Increasing evidence suggests that chronic exposure to pesticides, many of which act as endocrine-disrupting chemicals, represents a significant and underappreciated determinant for both cancer origin and progression. In this review, we reported the most recent epidemiological data, exposure pathways, and mechanistic insights linking major pesticide classes, including persistent organochlorines, organophosphates, triazines, carbamates, pyrethroids, neonicotinoids, and glyphosate-based herbicides, to breast carcinogenesis. These compounds are ubiquitous, detectable in food, water, household dust, and occupational environments, and display high lipophilicity that enables long-term bioaccumulation in adipose-rich breast tissue. Therefore, recognition of pesticides as modifiable environmental determinants of breast cancer should prompt strengthened regulation, improved biomonitoring, and public-health strategies aimed at reducing chronic exposure.
https://doi.org/10.1186/s13062-025-00709-9

Thèse - Développement durable et écoresponsabilité au cabinet dentaire : état des lieux et des connaissances des chirurgiens-dentistes en région PACA,
Michotey Agnès, *UCA Faculté Odontologie - Université Côte d'Azur - Faculté de Chirurgie Dentaire* (14 mars 2025),
La transition écologique des cabinets dentaires repose sur plusieurs axes essentiels. La conception bioclimatique des bâtiments, l'utilisation d'énergies renouvelables et une gestion optimisée des ressources, comme l'eau et les équipements, permettent de limiter leur impact environnemental. Des achats écoresponsables, la réduction du plastique et du papier, ainsi que l'adoption de l'informatique verte, contribuent également à cette démarche. L'hygiène, la stérilisation et la

gestion des déchets, notamment des substances toxiques, jouent un rôle clé dans la réduction de leur nocivité. Le transport, principal poste de pollution, constitue un enjeu prioritaire, avec des solutions comme les alternatives durables ou le recours à des laboratoires locaux. Enfin, la prévention, grâce à l'éducation à l'hygiène bucco-dentaire, une alimentation équilibrée et des visites régulières, réduit les interventions invasives et leur empreinte écologique. Introduction : dans un contexte de transition écologique, il apparait important d'évaluer les connaissances actuelles des chirurgiens-dentistes sur cette thématique, afin de mesurer leur niveau de sensibilisation et d'identifier des leviers qui permettraient de faciliter l'accès à une information ciblée et de stimuler leur intérêt en matière d'écoresponsabilité sur le plan professionnel. Méthode : une étude descriptive transversale a été menée auprès des chirurgiens-dentistes de la région Provence-Alpes-Côte d'Azur, à l'aide d'un questionnaire anonyme informatisé ouvert entre juillet et novembre 2024. Résultats : cette étude a révélé un intérêt croissant pour les enjeux environnementaux, avec plus de la moitié des répondants ayant déjà mis en place des actions écoresponsables. Cependant, des obstacles subsistent, notamment le manque d'information, d'aides organisationnelles et la méconnaissance de certains produits dangereux, des perturbateurs endocriniens, et des problématiques liées à la pollution de l'air intérieur. Les praticiens plébiscitent des supports concrets, tels que des fiches outils et des webinaires. Conclusion : l'intégration d'un enseignement spécifique sur les pratiques écoresponsables dès la formation initiale apparaît indispensable. En s'appuyant sur des outils concrets, des aides ciblées et une sensibilisation renforcée, les cabinets dentaires peuvent devenir des acteurs exemplaires dans la lutte contre le changement climatique, en conciliant performance professionnelle, respect des normes et respect de l'environnement.
https://dumas.ccsd.cnrs.fr/dumas-04991444v1

Hormonal changes in professional printers exposed to phthalates suggesting potential disturbances of the hypothalamic-pituitary-gonadal axis,
Nita, T. M., Wrobel, S. A., Vernez, D., Koch, H. M., Wild, P., Zufferey, F., Rudaz, S., Stenz, L., Odermatt, A. and Hopf, N. B., *Environmental Research*, Feb 15 2026, Vol. 291.

Background: Phthalate exposures might alter male reproductive health, but human evidence remains limited and inconsistent. Occupational settings often involve consistently high exposures from known sources, providing a basis for developing risk reduction strategies and interventions. Objectives: Evaluate dose-response relationships between phthalate exposures in professional printers (urinary metabolites) and male reproductive hormones, which were examined twice in one working week for workweek values (mean) and within-week changes, (ratio) responses. Methods: Occupational biomonitoring of 59 male printers was used to assess exposures to 18 phthalates by measuring 35 urinary phthalate metabolites. Blood samples collected on the first and last day of the workweek were analyzed for total testosterone, calculated free testosterone (cFT), bioavailable testosterone (BioT), measured free testosterone, sex hormone-binding globulin (SHBG), luteinizing hormone, follicle-stimulating hormone, prolactin, estradiol (E2), and inhibin B (INHB). Multiple covariate-adjusted linear regressions were used to evaluate the dose-response relationship. Results: cFT hormonal workweek response was negatively associated with di-n-butyl phthalate (DnBP) metabolites while SHBG was positively associated with diethyl-hexyl phthalate (DEHP) metabolites. BioT and E2 within-week responses were negatively associated with the DiBP metabolite mono-2-hydroxy-isobutyl phthalate (2OH-MiBP). Overall, ten low-molecular-weight phthalate metabolite concentrations were positively associated with INHB, while eight high-molecular-weight phthalate metabolite concentrations were negatively associated with FSH. Occupational exposure to these phthalates was elevated, as median concentrations of their metabolites were between 2-to 7-fold higher than general population levels. Conclusions: Occupational exposures to certain phthalates in professional printers were associated with hormonal patterns, indicative of anti-androgenic

reproductive disturbance and potential alteration of the HPG axis. https://doi.org/10.1016/j.envres.2025.123477

Occupational and environmental iron exposure: a hidden risk factor in breast cancer etiology, Obeagu, E. I., *Annals of Medicine and Surgery*, Jan 2026, Vol. 88, no. 1, p. 451-458.

Breast cancer remains a major public health challenge globally, with its etiology influenced by a complex interplay of genetic, hormonal, and environmental factors. While traditional risk factors such as age, reproductive history, and family predisposition are well-recognized, emerging evidence points to heavy metal exposure - particularly iron - as a potential contributor to carcinogenesis. Iron is a vital micronutrient required for cellular metabolism; however, excess iron has been shown to catalyze oxidative stress and deoxyribonucleic acid damage, both of which are implicated in tumor initiation and progression. Occupational and environmental iron exposure is increasingly prevalent due to industrial expansion, especially in metal-processing industries such as welding, mining, and steel manufacturing. Workers in these sectors, as well as individuals living near industrial zones, may experience chronic low-level exposure to iron through inhalation, ingestion, or dermal absorption. When iron accumulates beyond the body's regulatory capacity, it may foster a pro-oxidative and pro-inflammatory milieu conducive to breast tumorigenesis. Furthermore, iron's interaction with estrogen metabolism may have unique implications for hormonally sensitive tissues like the breast. https://doi.org/10.1097/ms9.0000000000004305

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. W., Mao, G. H., Chen, Y. and Wu, X. Y., *Journal of Environmental Chemical Engineering*, Feb 2026, Vol. 14, no. 1.

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/10.1016/j.jece.2025.120797

Pesticides associated with incident diabetes among licensed private pesticide applicators in the Agricultural Health Study cohort (1993-2021),
Parks, C. G., Xiao, Q., Wilkerson, J., Hofmann, J. N., Freeman, L. E. B. and Sandler, D. P., *Environment International*, Feb 2026, Vol. 208.

Background: Growing evidence suggests pesticides may increase risk of type 2 diabetes, but data are limited on many specific chemicals. Methods: In 29,527 private pesticide applicators in the Agricultural Health Study cohort (enrolled 1993-1997 in Iowa and North Carolina), 3,847 incident diabetes cases were identified by self-report during follow-up surveys in 1999-2003, 2005-2010, 2013-2015, and 2019-2021. We examined 50 pesticides reported at enrollment, updated in 1999-2003 or 2005-2010, prior to diabetes diagnosis or end of follow-up, using log-binomial regression to calculate relative risks (RR) and 95% confidence intervals (CI) for ever-use and intensity-weighted lifetime days (IWLD) use (tertiles, T1-3), adjusting for covariates and correlated pesticides. Findings: Greater diabetes risk was associated with 7 organochlorine insecticides: ever-use of DDT, aldrin, dieldrin, chlordane, heptachlor, and toxaphene (RRs 1.08-1.31), without monotonic exposure-response trends, and lower IWLD of lindane use (T1RR=1.32; 95%CI 1.12-1.57). Risk was associated with 5 organophosphate or carbamate insecticides: ever-use of diazinon and carbofuran, and exposure-response trends for malathion (T3RR=1.13;95%CI 1.02-1.25, p-trend=0.025), phorate (T3RR=1.22;95%CI 1.08-1.39, p-trend=0.001), and carbaryl (T3RR=1.26;95%CI 1.11-1.43, p-trend=0.005). Risk was associated with 2 phenoxy herbicides, 2,4,5-T (ever-use RR=1.25;95%CI 1.14-1.37) and 2,4,5-TP (T1RR=1.35;95%CI 1.04-1.76), and 3 other herbicides [butylate (T3RR=1.26;95%CI 1.10-1.44, p-trend<0.001), metribuzin (T3RR=1.16;95%CI 1.16-1.32, p-trend=0.022), chlorimuron ethyl (T3RR=1.16;95%CI 1.02-1.31, p-trend=0.033)], and the fumigant carbon tetrachloride/disulfide (RR=1.16;95%CI 1.02-1.33). Associations were not confounded by BMI and weight gain. Conclusions: These results show greater diabetes risk associated with use of persistent organochlorine insecticides and banned phenoxy herbicides. Novel findings for widely used insecticides and other pesticides warrant further investigation. https://doi.org/10.1016/j.envint.2026.110082

Thèse - L'impact des perturbateurs endocriniens en dentisterie,
Rose Lou, *UNIVERSITÉ DE LILLE - UFR3S – DEPARTEMENT ODONTOLOGIE* (12 janvier 2026),
Cette thèse vise à sensibiliser l'ensemble de la profession dentaire à la nécessité de réduire l'exposition à ces substances et à encourager l'évolution vers des pratiques plus systémique et soutenable. https://pepite.univ-lille.fr/ori-oai-search/notice/view/univ-lille-48605

Sex, hormones, and lung health,
Silveyra, P., Babayev, M. and Ekpruke, C. D., *Physiological Reviews*, Jan 6 2026, Vol. 106, no. 1.

Sex plays an essential role as a biological variable in lung health, leading to observed differences in lung disease susceptibility. Some respiratory conditions are more common in women than men, especially after puberty, indicating the influence of ovarian hormones on disease mechanisms. Other conditions display sex disparities that begin in utero and progress throughout the life span. Preclinical and clinical studies have indicated that both sex chromosomes and hormones can influence lung disease outcomes, immune responses, susceptibility to viral and bacterial infection, and responses to environmental challenges. This review summarizes the latest research on how sex affects lung physiology and health, drawing on a wide range of studies in respiratory physiology and anatomy, genetics, molecular and cellular biology, environmental health, and immunity. We emphasize how biological sex, gonadal hormones, and occupational and environmental exposures can impact disease mechanisms and outcomes. As clinical outcomes among women have not improved at the same rate as men over the past few decades, it is crucial to understand the role played by the sex variable in designing strategies to prevent and mitigate disease. The collective research indicates that sex-induced differences in the respiratory system are essential determinants of physiological responses and clinical outcomes. https://doi.org/10.1152/physrev.00026.2024

Occupational polycyclic aromatic hydrocarbons (PAHs) exposure is associated with accelerated aging trajectories in Chinese coke oven workers,
Wang, Y. D., Geng, S. X., Wang, W. Y., Yuan, L. J., Nie, J. S., Zhang, H. F., Pan, B. L. and Niu, Q., *Scientific Reports*, Jan 31 2026, Vol. 16, no. 1.

Long-term effects of occupational polycyclic aromatic hydrocarbons (PAHs) on biological aging are unclear. A prospective cohort study was conducted from 2019 to 2023, involving 610 coke oven workers and 454 control workers from a water treatment plant. Biological age was calculated using the Klemera and Doubal method (KDM-BA) based on 12 clinical biomarkers, and aging acceleration (KDM-Accel) was derived. Group-based trajectory modeling (GBTM) was employed to identify distinct aging trajectories over five time points. The associations between eleven urinary mono-hydroxylated PAH metabolites (measured via HPLC-MS) and both KDM-Accel and aging trajectories were assessed using multiple linear regression and multivariable logistic regression, respectively. GBTM identified three distinct aging trajectories: slow aging (14.86%), moderately accelerated aging (59.14%), and rapidly accelerated aging (26%). Higher concentrations of urinary Sigma-OHPAHs (sum of all metabolites), 1-hydroxypyrene (1-OHPyr), and 2-hydroxyphenanthrene (2-OHPhe) were significantly associated with increased KDM-Accel. A natural log-unit increase in Sigma-OHPAHs and 1-OHPyr was associated with a 0.029-year and 0.028-year increase in KDM-Accel, respectively. Workers in the highest tertile (T3) of Sigma-OHPAHs exposure had a 61.2% increased odds (OR = 1.612, 95% CI 1.093-2.376) of being in the rapidly accelerated aging trajectory compared to those in the lowest tertile (T1). Similar positive dose-response relationships were observed. Occupational exposure to PAHs, as specifically indicated by elevated levels of urinary Sigma-OHPAHs,1-OHPyr, and 2-OHPhe, is correlated with accelerated biological aging and a heightened probability of a rapid aging trajectory. Therefore, enhanced protection measures and early intervention strategies are necessary. https://doi.org/10.1038/s41598-026-36579-y

Relationship between lead exposure and different types of hypertension: systematic review and dose-response meta-analysis,
Yang, P. L., Ji, T. Y., Yang, Z. D., Song, J. Y., Liu, H. W. and Fan, H. X., *Frontiers in Public Health*, Dec 10 2025, Vol. 13.

Background: This systematic review and meta-analysis aimed to quantify the association between environmental and occupational lead exposure and the risk of various hypertension subtypes. We further evaluated this relationship through a dose-response analysis to provide a scientific basis for targeted public health interventions. Methods: Observational studies on lead exposure and hypertension were searched from Chinese/English databases (inception to June 9, 2025). Two researchers independently screened studies, extracted data, and assessed bias risk. Random-effects meta-analysis calculated pooled ORs (95% CIs); meta-regression/subgroup analyses explored heterogeneity. Egger's test evaluated publication bias, sensitivity analyses verified result robustness, and dose-response analysis was applied to multi-level exposure data. Result: 24 studies (181,500 participants) were included. Lead exposure correlated significantly with hypertension (pooled OR = 1.27, 95% CI: 1.20-1.34) with high heterogeneity (I-2 = 91.4%, p < 0.001). Stronger associations were found for blood lead (OR = 1.32), essential hypertension (OR = 1.31), and resistant hypertension (OR = 1.36); no significant associations for bone lead or gestational hypertension. Hypertension risk rose sharply at blood lead >= 0.107 mu g/dl, reaching OR = 4.85 at 8.435 mu g/dl. Potential publication bias existed, but sensitivity analyses confirmed robustness. Conclusion: Lead exposure is a hypertension risk factor with a clear dose-response relationship. It is recommended to include blood lead in hypertension risk assessment and set a blood lead action level of < 0.107 mu g/dl for high-risk groups to reduce hypertension burden from lead pollution.
https://doi.org/10.3389/fpubh.2025.1706805

Epidémiologie

Association between endocrine disruptors and surgical congenital malformations: Systematic review and meta-analysis,
Bernardo, N. G. and Natalia, A. G., *Journal of Pediatric Surgery*, Mar 2026, Vol. 61, no. 3.

Background: Prenatal exposure to endocrine disruptors (EDs) represents a growing public health concern due to its potential association with congenital malformations requiring pediatric surgical intervention. The ubiquity of these chemicals in modern environments and their ability to interfere with normal hormonal development during critical fetal windows raises significant concerns for pediatric surgeons. This systematic review was registered prospectively in PROSPERO (CRD420251158778). Methods: We conducted a systematic review and meta-analysis following PRISMA 2020 guidelines. We searched PubMed, Embase, Web of Science, and gray literature from 2010-2025 for observational studies evaluating prenatal exposure to phthalates, bisphenols, perfluorinated compounds (PFAS), and organochlorines, with outcomes of surgical congenital malformations. Quality was assessed using the Newcastle-Ottawa Scale and GRADE methodology. Random-effects meta-analysis was performed using R software. Results: Of 4,121 studies identified, 66 met inclusion criteria (total population: 35,732). According to the Newcastle-Ottawa Scale, 42 studies (64%) had high quality (>= 7 points), 18 (27%) moderate quality (5-6 points), and 6 (9%) low quality (<5 points). Significant associations were found between ED exposure and hypospadias (pooled OR: 2.21, 95% CI: 1.15-3.27; I-2=65.4%, p=0.003), cryptorchidism (OR: 1.85, 95% CI: 1.02-3.36; I-2=58.2%, p=0.041), and congenital heart disease (OR: 1.39, 95% CI: 1.09-1.76; I-2=42.1%, p=0.008). DEHP and DBP phthalates showed the highest risks for urogenital malformations (OR: 3.12, 95% CI: 1.45-6.72). First trimester exposure demonstrated the strongest associations across malformation types. GRADE evidence was rated as moderate to high for urogenital and cardiac anomalies but low for gastrointestinal and neural defects. Conclusions: Prenatal ED exposure is significantly associated with increased risk of surgical congenital malformations, particularly male urogenital and cardiac anomalies. These findings support implementing preventive strategies during pregnancy and justify stricter regulatory policies to protect fetal health and reduce the surgical burden in pediatric populations. https://doi.org/10.1016/j.jpedsurg.2025.162829

Exposure to bisphenol analogues and risk of anemia in young adults,
Chang, T. J., Chiu, C. Y., Huang, P. C., Chen, P. C., Guo, Y. L., Cheng, T. J., Hwang, J. S. and Su, T. C., *Environment International*, Feb 2026, Vol. 208.

Background: Bisphenol A (BPA) and its analogues are widely used endocrine disruptors. Their potential role in anemia remains unclear. Methods: We conducted a cross-sectional study of 940 adults aged 19-44 years from the Young Taiwanese Cohort (2017-2019) to assess associations of urinary bisphenol A and analogues (BPAF, BPS, BPF, BPB) with hematological indices and anemia risk. Urinary bisphenols were quantified, and hematological parameters including hemoglobin (Hb), hematocrit (Hct), mean corpuscular indices, ferritin, total iron-binding capacity (TIBC), serum iron, and transferrin saturation (TSAT) were analyzed using single-and multi-pollutant regression models to explore exposure effects and sex, age, and body mass index (BMI)-specific differences. Results: Prevalence of anemia, iron deficiency, and iron deficiency anemia (IDA) was 8.9% (13.7% in women, 2.5% in men), 16.9% (28.0% in women, 1.8% in men), and 5.9% (9.2% in women, 1.3% in men), respectively. Higher urinary BPAF, BPS, and BPF were associated with lower hemoglobin, hematocrit, ferritin, and serum iron, and higher odds of anemia and iron-deficiency anemia. Associations were stronger in women. Conclusion: Exposure to BPA substitutes (BPAF, BPS, BPF) was associated with disrupted iron metabolism and increased anemia risk, particularly in women. https://doi.org/10.1016/j.envint.2026.110101

Systematic review of human developmental health effects following exposure to polychlorinated biphenyl mixtures in early life,
Christensen, K. Y., Meeker, J. D. and Lehmann, G. M., *International Journal of Hygiene and Environmental Health*, Apr 2026, Vol. 273.

Polychlorinated biphenyls (PCBs) are a class of persistent environmental pollutants that exist in the environment as complex mixtures linked to a variety of adverse health effects. This review compiles and organizes human studies of selected health endpoints (early life size and growth; offspring mortality; birth defects) following developmental exposure to PCB mixtures to identify areas of robust research, as well as areas of uncertainty and research needs. We developed a Population, Exposures, Comparators, and Outcomes (PECO) statement to direct the literature search, screening, and study evaluation. We identified n = 154 relevant studies, the majority of which focused on birth weight or other aspects of early life size and growth, with fewer studies evaluating size and growth into adolescence or adulthood. These studies often reported decrements in size at birth associated with higher maternal measures of exposure, although the evidence was less clear for size and growth in later childhood. There were fewer human studies of pregnancy loss or birth defects, and the evidence was generally less consistent for these outcomes.
https://doi.org/10.1016/j.ijheh.2026.114759

Prenatal exposure to persistent organic pollutants and sex-specific neonatal outcomes in the ENVIRONAGE birth cohort,
Csteresznye, A., Den Ouden, F., Engelen, L., Maris, E., Bamai, Y. A., De Paepe, E., Poma, G., Derrien, M., Vila, A. V., Hemeryck, L. Y., Pero-Gascon, R., De Saeger, S., Raes, J., Nawrot, T. S., Vanhaecke, L. and Covaci, A., *Environmental Research*, Feb 15 2026, Vol. 291.

Early-life exposure to environmental contaminants, such as endocrine disrupting persistent organic pollutants (POPs), including polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and organochlorine pesticides (OCPs), is linked to adverse neonatal outcomes. However, the sex-specific effects of POP mixtures and the potential mediating roles of biological pathways, such as inflammation, remain insufficiently understood. This study aimed to investigate these aspects within the ENVIRONAGE birth cohort. The study population consisted of newborns (n = 402) from the ENVIRONAGE birth cohort, of which cord plasma levels of POPs were quantified using GC-ECNI/MS. Neonatal birth outcomes were derived from anthropometric measurements obtained at birth and via questionnaires completed postpartum. Among the 28 targeted POPs, nine were found in more than 50 % of the samples with CB 170, 180 and 153 detected in over 98 % of them. In single-pollutant models, several PCBs were inversely associated with ponderal index, while CB 118 was positively associated with head circumference in males (FDR-adjusted $p < 0.05$). Weighted Quantile Sum (WQS) regression revealed that in males, the POP mixture was inversely associated with birth weight (beta = -141.21, $p < 0.05$) and ponderal index (beta = -0.11, $p < 0.01$) and positively associated with head circumference (beta = 0.53, $p < 0.01$) and the odds of preterm birth (OR = 2.91, $p < 0.05$). Conversely, among females, the POP mixture was associated with reduced odds of small-for-gestational-age (SGA) (OR = 0.21, $p < 0.05$) and below normal APGAR scores (OR = 0.39, $p < 0.05$). Mediation analysis indicated that the association between p,p'-dichlorodiphenyldichloroethylene (p,p'-DDE) and reduced birth weight/length was significantly mediated by eosinophil levels. https://doi.org/10.1016/j.envres.2025.123572

The influence of paternal preconception health on birth defects and head circumference: A scoping review,
Dennis, C. L., Mcqueen, K., Dol, J., Dennis-Grantham, A., Singla, D. R., Nkurunziza, A., Abbass-Dick, J., Birken, C. S. and Shorey, S., *Plos Global Public Health*, Feb 13 2026, Vol. 6, no. 2.

While paternal environmental exposures and lifestyle factors can influence sperm epigenetic states and affect fetal development, this area of research remains relatively underexplored. This comprehensive scoping review aimed to identify, compile, and analyze the literature on paternal preconception health and its impact on fetal development, specifically related to congenital birth defects (CBDs) and head circumference. We conducted a scoping review following the Joanna Briggs Institute methodology and a published protocol. Five databases were searched for articles that included men in the preconception period and outcomes for CBDs and head circumference. Studies were published in English up to July 16, 2025. Two independent reviewers screened titles and abstracts and extracted data from eligible studies using Covidence. Forty-eight studies were included in the review. We identified several paternal factors associated with CBDs, including paternal physical health (metabolic syndrome, viral infections, cancer), smoking and alcohol use, and environmental exposures (solvents, metals, pesticides). Most medications were not associated with increased risks; however, metformin and diazepam were identified as potential risk factors for increased CBD risk. The limited studies on head circumference also suggest a potential relationship; however, the findings are not widely applicable due to the small number of included studies. We also identified important knowledge gaps and methodological limitations that require further research to advance this field. Our findings indicate that paternal preconception health and exposures-particularly paternal health, substance use, environmental factors, and certain medications-significantly influence offspring health outcomes, including congenital defects and infant head circumference. These findings highlight the need to expand preconception counselling and preventive strategies to explicitly include fathers, with targeted efforts to improve paternal health, eliminate tobacco and alcohol use, and reduce occupational and environmental exposures. Incorporating paternal health into preconception frameworks is essential to understanding mechanistic pathways, decreasing congenital risks, and developing precision strategies for improving reproductive and neonatal outcomes. https://doi.org/10.1371/journal.pgph.0005953

Early life phthalate and replacement plasticizer exposures and changes in early childhood brain functional connectivity and structural morphology,
Engel, S. M., Li, T. F., Werder, E. J., Liu, C. W., Pacyga, D. C., Thistle, J., Yin, W. Y., Rager, J. E., Wu, Z. W., Sun, Z. H., Wang, L., Bankoski, A., Gilmore, J. H., Piven, J., Li, G., Zhu, H. T., Lu, K. and Lin, W. L., *Environment International*, Feb 2026, Vol. 208.

Phthalates and replacement plasticizers (PRPs) are ubiquitous exposures in daily life across all age ranges. Exposure to phthalates has been linked to changes in cognitive and behavioral development and associated with increased risk of some developmental disabilities. We examined the extent to which early life exposure to PRPs was associated with changes in connection strength of resting state functional networks or impacted structural morphologies of cortical regions of interest that underlie basic and higher order cognitions. We utilized the UNC Chapel Hill enrollment in the Baby Connectome Project, a longitudinal study of normative brain development of children between 2 weeks and 5 years of age. Non-sedated structural and resting state functional magnetic resonance imaging of the brain during natural sleep were obtained longitudinally, along with urine samples that were analyzed for 17 PRP metabolites. Using kernal weighted estimating equations and generalized linear models, we identified multiple PRP metabolites were associated with alterations in within-network connection strengths in the executive control and dorsal attention networks, with directionality often differing between boys and girls. PRP exposure among boys tended to be

associated with lower functional connectivity, whereas PRP exposure among girls tended to be associated with higher functional connectivity. Among girls, MiBP metabolite concentrations were also significantly associated with cortical thinning in several regions of interest in the temporal lobe. Our results indicate that exposure to PRPs in early life has a measurable impact on the developmental trajectory of brain maturation, with potentially important differences by child sex. https://doi.org/10.1016/j.envint.2026.110119

Long-term exposure to particulate air pollution and components in relation to breast cancer risk: A nested case-control study in the E3N-Generations cohort,
Fareh, T., Mercoeur, B., Coudon, T., Grassot, L., Le Provost, B., Leffondre, K., Faure, E., Giampiccolo, C., Amadou, A., Severi, G., Mancini, F. R., Couvidat, F., Fervers, B. and Praud, D., *Environment International*, Jan 2026, Vol. 207.

Background: Previous studies on the association between airborne particulate matter (PM), particularly PM2.5 and PM10, and breast cancer have shown inconsistent results, potentially due to variations in particle composition. To address this, we investigated the relationship between breast cancer and exposure to individual PM2.5 and PM10 components, as well as their combined effects, in the French E3N-Generation cohort. Methods: We conducted a nested case-control study within the cohort (1990-2011), including 5,222 incident breast cancer cases matched to 5,222 controls. Annual mean concentrations (mu g/m3) of pollutants at residential addresses were estimated using the CHIMERE chemistry-transport model from 1990 to the index date. Exposure assessment included nine PM components: ammonium, sulfate, black carbon, polychlorobiphenyl-153 (PCB153), nitrate, benzo[a]pyrene, cadmium, dioxins, and Saharan dust. We evaluated single-pollutant effects using logistic regressions, and mixture effects using Quantile G-computation (QGC) and Bayesian Kernel Machine Regression (BKMR). Results: Significant positive associations with breast cancer (Odds Ratios and confidence intervals for one SD increase (controls distribution) were found for ammonium (OR = 1.19; 95%CI: 1.05-1.35), sulfate (OR = 1.17; 95%CI: 1.02-1.35), PCB153 (OR = 1.17; 95%CI: 1.08-1.26), nitrate (OR = 1.16; 95%CI: 1.01-1.33), black carbon (OR = 1.12; 95%CI: 1.05-1.20), cadmium (OR = 1.05; 95%CI: 1.00-1.11). QGC showed a positive association with breast cancer for a one-quartile increase in joint exposure (OR = 1.22; 95% CI: 1.00-1.50) with cadmium and nitrate as major contributors. BKMR confirmed a significant positive association between the exposure to the mixture and breast cancer. Conclusion: The consistency between single-pollutant and mixture analyses supports a role for multiple PM components acting jointly on breast cancer risk. These results suggest that the chemical composition of PM, rather than individual pollutants alone, is a key determinant of breast cancer risk, highlighting the importance of considering pollutant composition in air pollution research. https://doi.org/10.1016/j.envint.2025.109987

Nonlinear relationship between urinary benzophenone-3 and diabetes risk among American adults: a cross-sectional study,
Guo, L. L., Li, J., Cai, L. N., Hu, L. and Zhou, Y. S., *Bmc Endocrine Disorders*, Dec 19 2025, Vol. 26, no. 1.

*Background Some epidemiological studies suggest that exposure to bisphenol A is associated with diabetes; however, there is limited evidence of a dose-response relationship between urinary benzophenone-3 (BP-3) and diabetes. The aim of this study was to investigate the association between urinary BP-3 levels and the risk of diabetes in American adults.
 Methods A cross-sectional study utilized data from the National Health and Nutrition Examination Survey (NHANES) to assess participants aged 20 and older in the United States from 2005 to 2016. The exposure variable was urinary BP-3 and the outcome diabetes risk. Multivariate logistic regression and subgroup analyses were performed to assess the independent association between urinary BP-3 and*

*diabetes risk. Smooth curve fits were applied to examine the non-linear relationship. We performed several sensitivity analyses to evaluate the robustness of our results.
 Results Our study included 8027 participants, 50.3% of whom were male, and with a mean age of 49.3 +/- 17.3 years. After adjustment for potential confounders, the analysis indicated that each unit increase in log,-transformed BP-3 was associated with a 5% reduction in diabetes risk (OR = 0.95 , 95% CI: 0.93-0.97, P < 0.001) Compared to the Q1 group, the risk of developing diabetes was significantly lower in the Q4 group (OR = 0.63 , 95% CI: 0.52-0.78, P < 0.001) L-shaped relationship was observed between log, BP-3 and diabetes in adults in the USA, with an inflection point of 6.801 ng/ml (OR = 0.916 , 95% CI: 0.885-0.949, P < 0.001) Our sensitivity analyses confirmed the stability of our results.
 Conclusions Urinary BP-3 levels exhibited an L-shaped relationship with diabetes risk in the United States, with an inflection point at approximately 6.801 ng/ml.*
https://doi.org/10.1186/s12902-025-02133-6

Sex-specific associations of prenatal and postnatal exposure to 15 endocrine-disrupting chemical exposures with visual impairment at age three: the Korean Children's Environmental Health Study (Ko-CHENS),
Ham, D., Kim, S. Y. and Bae, S., *Environment International*, 2026/04/01/ 2026, Vol. 210, p. 110194.

Background Endocrine-disrupting chemicals (EDCs) have been linked to pediatric outcomes, but evidence on visual development and sex differences is scarce. We examined whether prenatal and postnatal EDC exposures were associated with visual impairment at age 3. Methods Participants were drawn from the Korean Children's Environmental Health Study, with urinary biomarkers measured at early pregnancy (n = 340), late pregnancy (n = 454), 24 months (n = 344), and 36 months (n = 713). A subset with complete data at all windows (n = 115) was analyzed using generalized estimating equations. Fifteen biomarkers (phthalate metabolites, bisphenols, parabens, triclosan) were assessed, and logistic regression models with inverse probability weighting estimated window-specific and population-averaged effects. Mixture effects were evaluated using weighted quantile sum regression and quantile g-computation. Visual acuity at 36 months was measured on the decimal scale, with impairment primarily defined as <0.5 in either eye, alongside alternative definitions for robustness. Results Girls showed more consistent adverse associations between higher EDC concentrations and increased impairment risk. Each unit increase in mono-(3-carboxypropyl) phthalate was associated with higher odds of impairment during late pregnancy (OR = 2.47, 95% CI: 1.97, 3.12), at 24 months (OR = 1.64, 95% CI: 1.38, 1.95), and at 36 months (OR = 1.36, 95% CI: 1.14, 1.61), while bisphenol A at 36 months also conferred elevated risk (OR = 1.48, 95% CI: 1.32, 1.67). Boys generally exhibited weaker or inverse associations, except for mono-(carboxyoctyl) phthalate at 24 months (OR = 1.34, 95% CI: 1.19, 1.52). Mixture models were largely null, though weights consistently highlighted phthalates. Conclusions Early-life EDC exposures were associated with visual impairment at age 3 in a sex-specific manner, with stronger and more consistent effects in girls. https://doi.org/https://doi.org/10.1016/j.envint.2026.110194

Interaction of extreme temperature events and fine particulate matter components on pregnancy outcomes in women undergoing assisted reproductive technology: A longitudinal study in Eastern China,
Huang, K., He, Y. S., Dai, S. W., Li, Z. H., Hu, C. Y., Geng, H., Zhang, X. J. and Cao, Y. X., *Ecotoxicology and Environmental Safety*, Jan 1 2026, Vol. 309.

Accumulating evidence linked extreme temperature events (ETEs) and air pollutants to adverse pregnancy outcomes. However, it is still unclear how ETEs and fine particulate matter (PM2.5) components interact to affect pregnancy outcomes, especially in women undergoing assisted reproductive technology (ART). This study included 14,326 women undergoing in vitro fertilization

(IVF) or intracytoplasmic sperm injection (ICSI) in China from 2018 to 2020 to assess the independent and synergistic effects of ETEs and PM2.5 components exposure 1 year prior to oocyte retrieval (Period 1), during ART treatment (Period 2), and during gestation (Period 3). After obtaining high-resolution PM2.5 components data and calculating apparent temperature (AT) metrics, we evaluated the associations of ETEs, PM2.5 components with live birth using generalized linear mixed effects models (GLMM). The results showed that prolonged exposure to heatwave (97.5th-3d; OR=0.891, 95 % CI=0.867-0.916) and cold spell (2.5th-3d; OR=0.928, 95 %CI=0.901-0.955) were associated with lower live birth rates, especially during pregnancy stage (Period 3). In addition, with increasing ETE exposure threshold and duration, the adverse effects of each IQR increment in PM2.5 and its components intensified progressively (Period 3-PM2.5: 2.5th-4D, OR=0.972; 5th-4D, OR=0.978; 7.5th-4D, OR=0.984; 10th-4D, OR=0.992; 90th-4D, OR=0.972; 92.5th-4D, OR=0.968; 95th-4D, OR=0.968; 97.5th-4D, OR=0.971), and the synergistic effect was observed between ETEs and PM2.5 components exposure. Subgroup analyses showed that women aged >= 35 years (97.5th-4d; OR=0.902, 95 %CI=0.845-0.962), overweight (2.5th-4d; OR=0.945, 95 %CI=0.913-0.978), and less educated (7.5th-4d; OR=0.971, 95 %CI=0.944-0.999) had higher susceptibility to ETEs. Our findings contribute to clarifying that the interaction of ETEs and PM2.5 components exposure may jointly affect ART pregnancy outcomes, and there is an urgent need to incorporate environmental risk mitigation into clinical guidelines and public health policies to protect vulnerable populations. https://doi.org/10.1016/j.ecoenv.2025.119597

Organochlorines and breast cancer risk: revisiting evidence through a meta-analytic approach, Jena, P., Pattnayak, S. P., Panda, A. K., Prusty, B. a. K. and Banerjee, B. D., *International Journal of Environmental Health Research*, 2026.

The risk of breast cancer in human subjects is associated with the exposure to organochlorines, although the findings have somewhat been inconclusive. A meta-analysis of published peer-reviewed articles was conducted to draw a definitive conclusion about exposure to organochlorine compounds and the incidence of breast cancer, taking into account hospital and population-based case-control studies. Scopus, MEDLINE and Web of Science databases were examined to gather retrospective case-control studies, wherein 16 case-control studies meeting the criteria were included, involving 2960 cases and 2777 controls. Heterogeneity tests, publication bias, sensitivity analysis and trial sequence analysis test were also performed. Chlorinated compounds such as p,p' DDE (p = 0.000, SDM = 4.027: lipid-unadjusted; p = 0.001, SDM = 1.145: lipid adjusted), HCB (p = 0.002, SDM = 2.718), cis-Nonachlor (p = 0.006, SDM = 3.558) and p,p' DDT (p = 0.015, SDM = 1.536: lipid-unadjusted), imposed a significant and positive association with breast cancer. Although compounds like Heptachlor, Dieldrin, gamma-HCH, Oxychlordane, and trans-Nonachlor did not reach significant levels, they indicated a possible role in the risk of breast carcinoma. This meta-analysis supports the hypothesis that several organochlorine compounds contribute to an increased incidence of breast cancer. https://doi.org/10.1080/09603123.2025.2609868

Exposure to endocrine-disrupting chemicals in follicular fluid: implications for assisted reproductive technology outcomes,
Jiang, Y. X., Long, X. Y., Hao, Y. X., Chen, L. X., Tian, T. and Zhao, Y., *Reproductive Biomedicine Online*, Mar 2026, Vol. 52, no. 3.

Research question Are endocrine-disrupting chemicals (EDC) in follicular fluid associated with assisted reproductive technology (ART) outcomes among women undergoing ART treatment? Design This prospective cohort study involved 176 women who underwent ART treatment in China. The concentrations of 76 EDC, across five categories, in follicular fluid were quantified. Generalized linear models (with and without restricted cubic splines to account for non-linear relationships) and

Bayesian kernel machine regression (BKMR) models were utilized. Results Fifteen EDC exhibited significant negative associations with at least one conventional IVF/intracytoplasmic sperm injection (ICSI) outcome. Notably, mono (2-ethyl-5-carboxypentyl) phthalate (MECPP) was consistently associated with reductions in all conventional IVF/ICSI outcomes, including the numbers of retrieved oocytes, mature oocytes, two pronuclear zygotes, blastocysts and high-quality embryos. Similarly, 3,5-di-tert-butyl-4-hydroxybenzoic acid (BHT-COOH) was negatively associated with all conventional IVF/ICSI outcomes except the number of blastocysts. No significant negative associations were observed between individual EDC and pregnancy outcomes, including the live birth rate. BKMR model analyses revealed that combinations of EDC were significantly associated with reductions in the numbers of retrieved oocytes and mature oocytes, and the probability of biochemical pregnancy. Among EDC combinations, phthalates (PAE) and bisphenol S (BPS) were identified as dominant contributors to adverse conventional IVF/ICSI outcomes and the biochemical pregnancy rate, respectively. Stratified and interaction analyses further indicated that stronger associations with conventional IVF/ICSI outcomes were observed among women aged <= 33 years. Conclusions Elevated concentrations of EDC in follicular fluid were associated with adverse ART outcomes, both as individual compounds and in combination. MECPP, BHT-COOH, PAE and BPS were identified as key EDC. Moreover, the associations were modified by age, with stronger adverse effects observed in younger women. https://doi.org/10.1016/j.rbmo.2025.105341

Investigating Birth and Thyroid Outcomes of Maternal-Fetal Environmental Exposures (IBM-E): A Cohort Protocol for Dietary Iodine and Endocrine Disruptors,
Jung, Y. J., Shin, J. E., Yoon, J. H., Kim, S., Kwon, H., Shim, S., Shin, D. Y., Gim, M., Kho, Y. and Lee, J., *Endocrinology and Metabolism*, Dec 2025, Vol. 40, no. 6, p. 940-949.

Background: Endocrine-disrupting chemicals (EDCs) are environmental pollutants that may impair maternal and fetal health by disrupting hormonal systems, including the thyroid. Both iodine deficiency and excess are associated with thyroid dysfunction and adverse obstetrical outcomes. However, the combined impacts of EDCs and iodine exposure on maternal-fetal thyroid homeostasis remain undetermined. We established the Investigating Birth and Thyroid Outcomes of Maternal-Fetal Environmental Exposures (IBM-E) cohort to prospectively assess the effects of maternal exposures to dietary iodine and EDCs on thyroid function, pregnancy complications, and offspring growth and development. Methods: In this prospective observational study, we aim to enroll 556 pregnant women between 2024 and 2027 at a tertiary hospital in Korea. Maternal blood and urine samples will be collected at six time points, spanning from early pregnancy through 15 months postpartum, with infant samples collected at three time points. EDCs will be quantified using ultra-high performance liquid chromatography-tandem mass spectrometry. Thyroid function and urinary iodine concentration will be measured in both mothers and infants. Results: As of the current interim analyses of 193 mothers and 229 neonates, 15.0% of mothers had thyroid dysfunction and 11.4% developed preeclampsia. Preterm birth occurred in 23.8% of cases, and 16.6% of neonates were small for gestational age. Conclusion: The IBM-E cohort is designed to enable the longitudinal assessment of gestational environmental exposures and their potential impacts on maternal and fetal thyroid function, as well as pregnancy and neonatal outcomes. The findings of this study may inform preventive strategies and guide policy development in perinatal environmental health. https://doi.org/10.3803/EnM.2025.2475

Fetal phthalate exposure and asthma outcomes from infancy to adolescence: Individual participant data meta-analysis in the EU Child Cohort Network,
Karramass, T., Duijts, L., Avraam, D., Blaauwendraad, S., Carrasco, P., Güil-Oumrait, N., Irizar, A., Kadawathagedara, M., Karachaliou, M., Lopez-Espinosa, M. J., Myridakis, A., Rouxel, E., Sakhi, A. K.,

Thomsen, C., Vainqueur, C., Vrijheid, M., Warembourg, C., Welten, M., Zabaleta, C., Trasande, L. and Jaddoe, V., *Environment International*, Feb 2026, Vol. 208.

Objective: Early-life exposure to phthalates, widely used in consumer products, may induce developmental lung adaptations and predispose to respiratory morbidity throughout childhood. We assessed the associations of fetal phthalate exposure with wheezing, asthma, and lung function from birth to adolescence. Methods: We performed 1-stage individual participant data meta-analyses with data from six European birth cohorts (3,745 mother-child pairs) to assess associations of pregnancy-averaged maternal urinary concentrations of 7 phthalate metabolites and 3 phthalate groups (high- and low-molecular-weight phthalate metabolites and sum of di-2-ethylhexyl phthalate metabolites) with wheezing in infancy (0-1 years) and at preschool age (1-5 years), and asthma and lung function at school age (5-12 years). Results: Higher maternal pregnancy urine phthalate concentrations were not associated with wheezing in infancy or preschool age. Higher maternal pregnancy urine mono-benzyl phthalate concentrations were associated with an increased risk of asthma at school age (odds ratio (95% confidence interval): 1.13 (1.01-1.26) per natural log interquartile range unit increase in concentration), but not with wheezing or lung function and attenuated into non-significance after multiple testing correction. Higher maternal pregnancy concentrations of mono-2-ethyl-5-hydroxyhexyl phthalate, mono-iso-butyl phthalate, mono-n-butyl phthalate and low-molecular-weight phthalate metabolites were associated with higher FEV1, FEV1/FVC and FEF75 z-scores after multiple testing correction. Conclusion: Fetal exposure to higher phthalate concentrations is associated with lung function adaptations, while overall no consistent associations were observed with childhood wheezing or asthma. Future studies are needed to assess the causality of the observed associations, to identify the underlying mechanisms, and to assess potential respiratory consequences in adult life. https://doi.org/10.1016/j.envint.2026.110069

Characterization of select salon chemical exposures among Black and Latina U.S. hairdressers serving women of color,
Kavi, L. K., Newmeyer, M. N., Pool, W., Randolph, K., Louis, L. M., Rule, A. M., Prasse, C. and Quirós-Alcalá, L., *Journal of Environmental Exposure Assessment*, Dec 2025, Vol. 4, no. 4.

Hairdressers are continually exposed to chemicals, including many endocrine-disrupting chemicals (EDCs), yet few studies have assessed these exposures among U.S. hairdressers despite the potential health risks. We quantified concentrations of five biomarkers-four EDC exposure biomarkers [2-naphthol, methylparaben (MeP), ethylparaben, and propylparaben] and capsaicin-in post-shift urine samples from 23 female hairdressers of color (Black/Latina) serving a primarily ethnic clientele in the Maryland/Washington DC metropolitan area. Results from hairdressers were compared to those from 17 female office workers of similar race/ethnicity and to a representative sample of 431 similarly aged women in the U.S. general population. We also assessed exposure determinants for highly detected biomarkers among hairdressers. Overall, hairdressers had higher biomarker concentrations than office workers and women in the U.S. general population. Geometric mean (GM) concentrations of 2-naphthol and MeP were 2-3 times higher in hairdressers than in office workers (2-naphthol:17.4 vs. 7.59 ng/mL; MeP: 150 vs. 48.9 ng/mL; both $P < 0.01$), and 1.5-2.5 times higher than in U.S. women (2-naphthol: 15.5 vs. 6.31 ng/mL; MeP: 134 vs. 87.0 ng/mL). Hairdressers serving predominantly Black clientele had higher biomarker concentrations than those serving a predominantly Latinx clientele. Select salon services and products (e.g., chemical straightening/relaxing, semipermanent hair color, hair extensions, hairspray) were associated with higher 2-naphthol and MeP concentrations, while hair bleach use and braiding were associated with lower concentrations. Mask use during chemical-intensive services was associated with reduced MeP concentrations (GM: 117 vs. 159 ng/mL). Larger studies are needed to comprehensively assess exposures and reduce health risks for this workforce. https://doi.org/10.20517/jeea.2025.47

Exposure to Phthalates and Alterations in Reproductive Hormones in Pregnant Women, Khelfi, A., Ibrahim, S. N., Haddi, N. and Azzouz, M., *Ecohealth*, 2026.

Phthalates are ubiquitous environmental contaminants known for their endocrine-disrupting properties. Pregnancy is a particularly vulnerable period during which exposure to these compounds may adversely affect maternal health and fetal development. This study aimed to evaluate the exposure of pregnant women to phthalates, specifically diethyl phthalate (DEP), di-(2-ethylhexyl) phthalate (DEHP), and di-n-butyl phthalate (DnBP), and to investigate potential associations between urinary concentrations of their metabolites (MEP (monoethyl phthalate), MEHP (mono-(2-ethylhexyl) phthalate), and MnBP (mono-n-butyl phthalate)) and circulating reproductive hormone levels. A cross-sectional study was conducted on 384 pregnant women. Reproductive hormones (LH, FSH, testosterone, progesterone, estradiol, and prolactin) were quantified by electrochemiluminescence. Urinary concentrations of phthalate metabolites were measured using LC-MS/MS and normalized to creatinine levels. Phthalate metabolites were detected in the majority of samples (MEP: 97.4%; MEHP: 95.6%; MnBP: 92.9%). Mean concentrations were 83.50 +/- 89.13 & micro;g/g creatinine for MEP, 37.92 +/- 41.08 & micro;g/g for MEHP, and 44.64 +/- 48.17 & micro;g/g for MnBP. Phthalate detection frequencies did not differ significantly across residential regions, except for urinary MEHP concentrations, which were higher among women residing in the Eastern region of Algiers (53.039 & micro;g/g creatinine). No significant differences in detection frequencies between 2022, 2023, and 2024 were observed; however, the highest urinary MEHP concentrations were recorded in 2022 (47.922 & micro;g/g creatinine). Significant inverse associations were observed between urinary MEP and MEHP concentrations and plasma progesterone and testosterone levels (beta MEP-progesterone: - 0.216; beta MEHP-progesterone: - 0.523; beta MEP-testosterone: - 0.001; beta MEHP-testosterone: - 0.001). Estradiol levels were also negatively associated with MEP (beta = - 23.301) and MnBP (beta = - 33.241). Maternal exposure to phthalates was associated with alterations in reproductive hormone levels during pregnancy. These findings underscore the need to further investigate the potential implications of such hormonal disruptions for both maternal and fetal health. https://doi.org/10.1007/s10393-026-01778-6

Prenatal Exposure to Mixtures of Nonpersistent Endocrine-Disrupting Chemicals and Angiogenic Biomarkers, Placental Function, and Fetal Growth, Knox B, V. M., And Coll., *Environmental Science & Technology*, 9 mars 2026.

Exposure to endocrine-disrupting chemicals (EDCs) during pregnancy may influence the placenta and fetal growth; however, evidence is scarce regarding EDC mixtures, newer chemicals, and the role of angiogenic biomarkers and fetoplacental hemodynamics. We aimed to examine the associations between nonpersistent EDC mixtures and fetal growth, fetoplacental hemodynamics, and angiogenic biomarkers. We included 734 pregnant participants from the Barcelona Life Study Cohort (BiSC), Spain (2018–2021). Metabolites of phthalates, DINCH, insecticides, polycyclic aromatic hydrocarbons, pesticides, flame retardants, and parent compounds of phenols and parabens were measured in pools of week-long maternal urine samples at 18 and 34 weeks' gestation. Penalized LASSO-type multigroup Bayesian Weighted Quantile Sum Regression estimated associations with fetal growth, fetoplacental hemodynamics, and angiogenic biomarkers. Birthweight z-score decreased with low-molecular-weight phthalate (LMWP) (β = −0.119; CrI −0.224, −0.008) mixtures and increased with organophosphate mixtures (β = 0.143; CrI 0.042, 0.245). LMWP exposure was also associated with altered hemodynamics and angiogenic biomarkers; angiogenic biomarkers mediated the relationship with birthweight z-score (ACME = −0.032; 95% CI −0.062, −0.009; p = 0.002). This comprehensive study suggests that mixtures of low-molecular-weight phthalates and organophosphate compounds may alter fetal growth and that

angiogenic biomarkers may play a role as mediator. https://doi.org/https://pubs.acs.org/doi/10.1021/acs.est.5c13234

Associations of paraben exposures measured by repeated urinary biomarkers with sperm DNA damage and apoptosis,
Li, X. T., Miao, Y., Zhang, M., Zeng, J. Y., Liu, P. H., Li, Y. J., Liu, A. X., Zhu, J. Q., Zhang, N., Ge, L., Ye, H. Q., Chen, P. P. and Zeng, Q., *Environmental Research*, Feb 15 2026, Vol. 291.

Experimental evidence has demonstrated that parabens exhibit male reproductive toxicity, including induced sperm DNA damage or apoptosis, yet epidemiological evidence remains limited and inconclusive. We aimed to elucidate the relationships of paraben exposures with sperm DNA damage and apoptosis. Four paraben levels in two urine specimens and sperm DNA damage and apoptosis parameters were detected in Chinese men seeking semen quality evaluation from an infertility clinic in Wuhan, between March and June 2013. Generalized linear models (GLMs) and Bayesian kernel machine regression (BKMR) models were employed to analyze the relationships of single and joint paraben exposures with sperm DNA damage and apoptosis. We observed significant and positive associations of each ln-unit increase in urinary butyl hydroxybenzoate (BuP) concentration with increased tail length (TL) and tail distributed moment (TDM) (P < 0.01), and the positive exposure-response trends persisted when BuP exposure was included as quartiles. Furthermore, stratified analyses revealed that the associations were more pronounced among overweight or obese (BMI >= 24 kg/m(2)) and younger subjects (aged <30 years). Additionally, BKMR results indicated a positive trend of paraben mixtures with the percentage of PI+ sperm. Our results indicate that exposure to BuP and paraben mixtures may detrimentally impact on sperm function. https://doi.org/10.1016/j.envres.2025.123603

Association of emerging alternatives to per- and polyfluoroalkyl substances with polycystic ovary syndrome among Chinese women: a case-control study,
Li, Y. M., Kang, S. Y., Xu, H., Zhang, Y., Li, H., Yan, J. and Zhou, L. P., *Scientific Reports*, Jan 16 2026, Vol. 16, no. 1.

Per- and polyfluoroalkyl substances (PFAS) have been previously associated with polycystic ovary syndrome (PCOS). However, the health effects of emerging PFAS alternatives on PCOS remain unclear. This study aims to examine the associations between exposure to emerging PFAS alternatives and the odds of PCOS, while also exploring the combined effects of PFAS mixture exposure. From 2019 to 2024, we conducted a case-control study in Jiangsu Province, China, including 94 women diagnosed with PCOS and 81 healthy controls. Serum concentrations of 25 PFAS were quantified using liquid chromatography-tandem mass spectrometry. Firth penalized maximum likelihood estimation and Bayesian kernel machine regression (BKMR) were used to assess associations between individual PFAS, PFAS mixture, and PCOS, as well as potential interactions among PFAS. After adjusting for potential confounders, 14 PFAS were identified as being associated with PCOS. Specifically, 2 emerging alternatives (FTSA (6/2) and HFPO-DA (GenX)), one precursor (FBSA), one long-chain legacy (PFNA), and 2 short-chain (PFHpA and PFPeS) were positively associated with increased odds of PCOS. HFPO-DA (GenX) exhibited the highest odds ratio (OR: 9.26; 95% CI: 4.16, 20.59). In contrast, the alternative F-53B(8/2) was negatively associated with PCOS (OR: 0.40; 95% CI: 0.25, 0.63). The BKMR model suggested that the PFAS mixture had a significant positive overall effect on PCOS. No significant interactions were observed. This study suggests that environmental exposure to PFAS mixtures was associated with an increased odds of PCOS, particularly with emerging PFAS alternatives. These findings highlight the need for further research on the health effects of PFAS and their regulatory implications. https://doi.org/10.1038/s41598-025-33836-4

Associations of Semen Quality with Essential and Non-Essential Elements in Seminal Fluid, Massadeh, A. M., Batiha, O., Diak, W. E. A., Hammouri, H. M., Diak, R. A. and Nawafleh, M., *Biological Trace Element Research*, 2026.

Extended exposure to heavy metals, even at low concentrations, can negatively affect human semen quality and may contribute to male infertility. Therefore, this study was designed to provide firsthand information on the prevalence of elements in human seminal plasma and identify potential associations between levels of elements and semen quality parameters (motility, count, and morphology) of the Jordanian population. The concentrations of 17 elements in 97 seminal plasma samples were determined simultaneously using inductively coupled plasma mass spectrometry (ICP-MS). Among all analyzed elements, 48Ca and 52Cr were found to be the most abundant in the seminal fluid. No significant associations were observed between the concentration of essential elements and sperm morphology or count. However, elevated concentrations of 115In and 114Cd were strongly associated with reduced sperm motility and abnormal sperm morphology, indicating their potential reproductive toxicity. Moreover, significant associations were observed between low sperm motility and higher concentrations of 51V and 75As. Interestingly, semen samples with normal parameters exhibited higher levels of 69Ga, whereas samples with reduced motility were associated with elevated levels of essential elements including 55Mn, 52Cr, and 48Ca. The validation parameters showed good reliability for the ICP-MS method, with good linearity (R2 > 0.997), and relative standard deviations (%RSD) below 5% for all target elements. This study examined several elements that have not been previously reported in the literature regarding seminal fluid, thereby providing new insights and contributing novel data to the existing body of scientific knowledge. https://doi.org/10.1007/s12011-025-04969-4

Effects of Perfluorobutane Sulfonate (PFBS) on Female Reproduction, Pregnancy, and Birth Outcomes,
Mellouk, N., Marchese, M. J., Gao, F. M., Liang, S. and Feng, L. P., *Obstetrical & Gynecological Survey*, Oct 2025, Vol. 80, no. 10, p. 657-672.

Importance: Perfluorobutane sulfonate (PFBS) is a short-chain per- and polyfluoroalkyl substance (PFAS) that has emerged as a significant public health concern due to its widespread environmental contamination and persistent nature. While PFBS is considered to have a shorter half-life in the environment and human body compared to other PFAS compounds, there are still growing concerns about its potential impacts on human health, particularly on female reproduction and birth outcomes. Objective: This literature review critically examines the impact of PFBS exposure on female reproductive health, pregnancy outcomes, and fetal development, synthesizing the most recent data from both human and animal studies. Evidence Acquisition: A comprehensive literature search was conducted using data from peer-reviewed articles, clinical trials, animal models, and regulatory reports. Results: These studies suggest that PFBS may have adverse effects on fertility, pregnancy health, and fetal development. It also explores the current regulatory landscape for PFBS, focusing on policies in Europe, the United States, and Asia while emphasizing the growing global efforts to establish more stringent guidelines and develop effective treatment technologies to mitigate PFBS exposure. Given the bioaccumulative properties of PFBS and its increasing detection through environmental surveillance, ongoing research, especially targeted studies in human populations, is urgently needed to fully elucidate its reproductive toxicity, including its potential transgenerational effects. Conclusion and Relevance: This review underscores the importance of understanding PFBS mechanisms of action at the molecular and epigenetic levels, as this knowledge will be essential for informing public health strategies, shaping regulatory policies, and developing interventions to reduce human and environmental exposure. Target Audience: Obstetricians and

gynecologists, family physicians Learning Objectives: After participating in this activity, the learner will be better able to evaluate the scientific evidence regarding the effects of PFBS exposure on pregnancy outcomes, including gestational age, birth weight, and potential developmental outcomes for the child; identify which women are most commonly and most severely impacted by PFBS exposure; describe the potential mechanisms by which PFBS influences female reproductive health, pregnancy, and birth outcomes; and explain the key public health recommendations and regulatory efforts aimed at reducing PFBS exposure, particularly in pregnant women and women of reproductive age. https://doi.org/10.1097/ogx.0000000000001440

Exposure to Endocrine-Disrupting Chemicals and Early Onset of Menarche: A Systematic Review, Njoku, A., Al-Hassan, M., Tohura, S., Albert, K., Pierce, T. and Sawadogo, W., *Pollutants*, Dec 1 2025, Vol. 5, no. 4.

There has been a decline in the age at which girls experience menarche worldwide. Research suggests that exposure to endocrine-disrupting chemicals is linked to negative health consequences, including early onset of menarche. This systematic review examined the association between exposure to endocrine-disrupting chemicals (EDCs) and the early onset of menarche. Comprehensive searches of the PubMed, Embase, Web of Science, and Scopus databases were conducted to find relevant studies published from inception to November 2024. Exposure to certain EDCs, such as particulate matter and phthalates, showed significant associations with earlier menarche onset, while exposure to other EDCs (e.g., pyrethroids) was linked to delayed menarche timing. Overall, there were mixed findings in the relationships between various EDC exposures and menarche onset. Few studies investigated how exposure to EDCs and early menarche differed by race and ethnicity. This underscores the need for more studies that examine the relationship between early menarche onset and exposure to endocrine-disrupting substances. Education and policy approaches are also warranted to address this issue. https://doi.org/10.3390/pollutants5040045

Glyphosate exposure and metabolic syndrome: A scoping review of epidemiological and mechanistic evidence,
Otaru, S. and Carpenter, D. O., *Environmental Research*, Apr 1 2026, Vol. 296.

Background: Glyphosate, the active ingredient in many widely used herbicides, is a pervasive environmental contaminant due to extensive agricultural and residential use. Initially deemed safe, emerging evidence suggests chronic glyphosate exposure may impair metabolic health. This scoping review maps the evidence linking glyphosate exposure with metabolic syndrome (MetS), type 2 diabetes (T2DM), and related outcomes, integrating findings from human, animal, and cellular studies. Methods: We reviewed studies published from 2004 in PubMed and Google Scholar that examined glyphosate exposure in relation to metabolic outcomes. Thirteen epidemiological (cross-sectional and cohort) and 25 experimental (animal or in vitro) studies were included. Key data were extracted and synthesized narratively. Results: Most human studies, primarily cross-sectional analyses of U.S. NHANES data, reported positive associations between glyphosate biomarkers and metabolic risk factors. Higher exposure was consistently linked to elevated liver enzymes, insulin resistance, hyperglycemia, and increased odds of MetS. Two longitudinal studies supported these associations, while one occupational cohort found an inverse association with T2DM. Experimental models demonstrated that glyphosate induces hepatic steatosis, inflammation, oxidative stress, and mitochondrial dysfunction, disrupts glucose metabolism and insulin signaling, alters the gut microbiome, and modulates endocrine and epigenetic pathways, supporting its role as a metabolic disruptor. Conclusion: While predominantly cross-sectional human data limit causal inference, the convergence of epidemiological associations and mechanistic findings indicate that glyphosate may be an environmental risk factor for metabolic syndrome and related conditions. Given its

widespread use, even modest metabolic effects warrant further investigation through longitudinal studies with robust exposure assessment. https://doi.org/10.1016/j.envres.2026.123992

Associations between serum per- and polyfluoroalkyl substance concentrations and β-cell function and insulin resistance in adult females,
Palaniyandi, J., Bruin, J. E., Fisher, M., Borghese, M. M., Hoyeck, M. P., Panagiotopoulos, C., Guay, M. and Ashley-Martin, J., *Journal of Clinical Endocrinology & Metabolism*, 2026.

Context Epidemiological evidence of exposure to precursor and alternative per- and polyfluoroalkyl substances (PFASs) and metabolic health outcomes is lacking. Objective To quantify associations between concentrations of 31 PFAS and metabolic biomarkers of glucose homeostasis and beta-cell function. Methods We used data from a 2018-2021 follow-up of the Maternal-Infant Research on Environmental Chemicals (MIREC) study, which included measurements of serum concentrations of PFAS and metabolic biomarkers in samples provided by 274 adult female participants. Our primary outcomes were composite measures of pancreatic beta-cell function (proinsulin:insulin [PI:INS] and proinsulin:C-peptide [PI:CP] ratios) and insulin resistance (homeostatic model assessment for insulin resistance [HOMA-IR] and triglyceride-glucose [TyG] index). We used multivariable linear regression models to quantify the percent difference in outcome measures. Per- and polyfluoroalkyl substances with >50% detection (n = 17) were log2-transformed; PFAS with 10-50% detection (n = 14) were dichotomized at the limit of detection. We used quantile g-computation (qgcomp) and weighted quantile sum (WQS) regression to evaluate PFAS mixtures. We also modeled arithmetic sums of 17 PFAS detected in >50% of participants (Sigma 17PFAS) and 7 PFAS specified in the National Academies of Sciences, Engineering and Medicine report (Sigma 7PFAS). Results Each doubling of Sigma 7PFAS, PFOS, and PFHxS was associated with a 5-9% increase in PI:INS ratio. Sigma 7PFAS, but not the Sigma 17PFAS, was also positively associated with the PI:INS ratio in qgcomp models. We observed inverse associations between Sigma 7PFAS and HOMA-IR and fasting insulin. Many results were of small magnitude or imprecise. Conclusion In this cross-sectional analysis, exposure to certain legacy, alternative, and precursor PFAS were associated with beta-cell dysfunction. https://doi.org/10.1210/clinem/dgag015

Environmental contaminants and endocrine disrupting chemicals in female infertility: a systematic review,
Sairat, F., Mediani, A., Hussin, N. M. H., Widyanto, R. M. and Sharif, R., *Middle East Fertility Society Journal*, Jan 26 2026, Vol. 31, no. 1.

Background Infertility affects a substantial proportion of women of reproductive age worldwide. Increasing epidemiological evidence indicates that exposure to environmental contaminants (ECs) and endocrine-disrupting chemicals (EDCs) is associated with female reproductive health outcomes. However, systematic syntheses focusing specifically on human observational evidence remain limited. This systematic review therefore aimed to evaluate associations between EC and EDC exposure and female reproductive health outcomes, including infertility. Methods This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. PubMed/MEDLINE, Cochrane, and Scopus databases were searched for studies published between January 2020 and May 2025. Eligible studies included observational designs involving well-characterized populations of fertile or infertile women. Randomized trials, reviews, animal studies, and studies restricted to male infertility were excluded. Primary outcomes included reproductive hormone parameters and fecundability-related measures. Study quality was assessed using the Newcastle-Ottawa Scale. Results Of 1,074 records identified, 38 studies met the inclusion criteria. The studies examined exposures to phthalates, bisphenols, per- and polyfluoroalkyl substances (PFAS), heavy metals, and persistent organic pollutants (POPs).

Across studies, EC and EDC exposures were consistently associated with adverse reproductive indicators. Phthalates were associated with alterations in reproductive hormone profiles and oocyte-related outcomes. Bisphenol exposure was associated with hormonal changes and polycystic ovary syndrome (PCOS). POP exposure was associated with reduced oocyte yield, while heavy metal exposure was associated with PCOS risk. Conclusion Evidence from recent observational studies indicates consistent associations between exposure to selected ECs and EDCs and female reproductive health outcomes. These associations may involve endocrine-related pathways, although causal inference remains limited by study design. Further longitudinal and mechanistic studies are warranted to clarify exposure-response relationships and underlying biological mechanisms. https://doi.org/10.1186/s43043-026-00298-1

Association between pesticide exposure and breast cancer : a two-sample Mendelian randomization study,
Sang, Y., Huang, D., Chen, X., Lin, X. and Et, C., *International Archives of Occupational and Environmental Health*, 2026, Vol. 99, no. 1, p. 7.

Cette étude utilise une approche de randomisation mendélienne à deux échantillons pour explorer l'association entre l'exposition aux pesticides et le risque de cancer du sein. L'analyse est basée sur des données de génétique humaine : les variants génétiques associés à une exposition globale aux pesticides, déclarée comme contact professionnel et/ou environnemental dans l'UK Biobank (88 141 participants d'ascendance européenne) ont été utilisés comme échantillons, puis mis en relation avec des données du Breast Cancer Association Consortium pour le cancer du sein global. L'analyse principale par méthode « inverse variance weighted » montre une association causale significative entre exposition génétiquement aux pesticides et le risque accru de cancer du sein. Les auteurs discutent ces résultats à la lumière d'épidémiologie et de données expérimentales suggérant des effets cancérogènes et perturbateurs endocriniens de certains pesticides, et recommandent de réduire les expositions, notamment professionnelles, par des équipements de protection, des pratiques de gestion intégrée des ravageurs et des actions de formation (mélange, application, stockage, accès) et de surveillance des produits et process. Les auteurs mettent aussi en avant les limites de l'étude : population exclusivement européenne, absence de détail sur les classes de pesticides ou les doses, choix d'instruments principalement statistiques. En conclusion l'étude fournit un argument génétique supplémentaire en faveur d'un rôle causal des pesticides dans la carcinogenèse mammaire et encourage des stratégies de prévention ciblant ces expositions.
https://doi.org/, https://portaildoc.inrs.fr/Default/doc/SYRACUSE/767435/association-between-pesticide-exposure-and-breast-cancer-a-two-sample-mendelian-randomization-study-
https://doi.org/10.1007/s00420-025-02192-1

The influence of environmental exposures during the preconception period on offspring outcomes: a systematic review,
Steel, A., Lee, W. R., Xu, Z. W., Carè, J., Cortes-Ramirez, J., Thomson-Casey, C. and Vilcins, D., *Frontiers in Public Health*, Dec 17 2025, Vol. 13.

Introduction: Health behaviors and exposures to environmental hazards among individuals of reproductive age prior to pregnancy can influence maternal and child health outcomes. While research attention has focused on preconception health behaviors, such as diet and lifestyle, there is emerging evidence that environmental exposures may also be important to consider. Methods: A search strategy (PROSPERO # CRD42021240069) was developed for MEDLINE (OVID), EMBASE (OVID), Maternity and Infant Care (OVID), CINAHL (EBSCO), and PsycINFO (EBSCO). Searches were conducted from database inception until 21 May 2021. Studies were included that investigated male or female exposure to any environmental hazard during the preconception period and reported

neonatal or child health outcomes. No limit to date of publication, language or comparator were applied. Studies were critically appraised using the Newcastle-Ottawa Quality Assessment Scale for Cohort studies. Results: The review identified 63 studies that met the inclusion criteria, published between 1974 and 2021. They encompassed studies that covered ambient exposures (n = 23), chemical exposures (n = 26), and other exposures (n = 24). For ambient exposures, all studies examined the outcomes associated with air pollution and one study also explored associations with exposure to hot and cold ambient temperature. Studies investigating chemical exposures encompassed endocrine-disrupting chemicals (n = 4), pesticides (n = 10), persistent organic pollutants (n = 4), and organic solvents (n = 7). Other exposures studied were categorized as radiation (n = 9), metals (n = 4) and undifferentiated products or compounds (n = 14). Outcomes measured by the included studies covered congenital malformations, adverse birth outcomes and childhood illness. There was a high level of heterogeneity across the included studies that precluded meta-analysis. Various associations between exposures and outcomes were identified. Discussion: There is growing evidence of adverse outcomes in offspring associated with maternal and paternal environmental exposures during the pre-conception period. While there are some topics that have received focused attention from research teams in the last 50 years, most studies appear to be standalone and have not continued to develop as part of wider research programs. There is need to develop a field-wide approach to create an agenda for environmental preconception health exposures and outcomes that supports more coordinated, targeted and strategic research efforts. https://doi.org/10.3389/fpubh.2025.1633266

Intrauterine Exposure to Endocrine-disrupting Chemicals and Risk of Hypospadias: A Pilot Study, Tillotson, C. V., Fisher, A. S., Nguyen, K., Antal, Z., Yan, B. Z., Carpenter, C. P., Vuguin, P., Herbstman, J. and Oberfield, S., *Journal of the Endocrine Society*, Jan 2026, Vol. 10, no. 1.

Context Hypospadias is a common malformation, which can be caused by a disruption of hormone signaling during development. Endocrine disrupting chemicals (EDCs) cross the placenta and can interfere with hormone synthesis and metabolism.Objective To evaluate whether intrauterine exposure to environmental phenols and/or parabens is associated with hypospadias.Methods This was a case-control pilot study of term infant males with (n = 6) and without (n = 16) hypospadias. Meconium was tested for bisphenol-A (BPA), bisphenol-S (BPS), bisphenol-F (BPF), methylparaben (MePb), and propylparaben (PrPb) using a novel lab procedure.Results BPA concentrations were higher in cases vs controls, though this difference was not statistically significant. Higher meconium concentration of BPA was associated with shorter Anogenital distance (AGD); higher BPS and BPA were associated with shorter stretched penile length (SPL). There were no significant differences for BPS, BPF, MePb, or PrPb.Conclusion This study demonstrated that EDCs were present in meconium samples, supporting the hypothesis that maternal exposure results in fetal exposure during a time of critical fetal urogenital development. Our data suggests a pattern of higher BPA in cases of hypospadias compared to controls while BPA and BPS were inversely related to AGD and SPL. However, the study is limited by small sample size and therefore was underpowered to detect conclusive differences between the 2 groups. Further studies in EDC exposure and genitourinary differences are warranted. https://doi.org/10.1210/jendso/bvaf208

Research advances on the risk of prostate cancer from phthalates exposure: from epidemiological evidence to multidimensional prevention and control, Wang, B. B., Cao, H. L., Li, S. X., Tang, Z. J., Huang, G. C., Li, Z. H., Ma, Y. T., Wei, W. and Chen, M., *Frontiers in Cell and Developmental Biology*, Jan 12 2026, Vol. 13.

Prostate cancer (PCa) poses a significant threat to men's health worldwide, with persistently high incidence and mortality rates. Phthalates (PAEs), typical environmental endocrine disruptors (EDCs),

are ubiquitous in the environment and readily accumulate in the human body due to their widespread use in plastics and consumer products. Their potential role in PCa development has drawn considerable attention. This review systematically summarizes the epidemiological associations between PAEs and PCa, their potential mechanisms of action, long-term risks, and corresponding prevention and control strategies. Epidemiological studies confirm that high-molecular-weight PAEs (e.g., di(2-ethylhexyl) phthalate [DEHP], dibutyl phthalate [DBP]) are significantly associated with increased PCa risk, with abdominally obese men identified as a susceptible population. Urinary PAE metabolites (e.g., mono(2-ethylhexyl) phthalate [MEHP], mono-n-butyl phthalate [MnBP]) serve as non-invasive biomarkers for assessing PAE exposure in prostate tissue. Mechanistically, PAEs may regulate PCa progression through multiple pathways, including disrupting the androgen/estrogen signaling balance, inducing epigenetic abnormalities (DNA hypomethylation, microRNA dysregulation), activating pro-proliferative/invasive signaling pathways (MAPK/AP-1, Wnt/beta-catenin pathways), and inducing oxidative stress and facilitating epithelial-mesenchymal transition (EMT). Concurrently, PAEs may pose long-term carcinogenic risks through developmental programming and synergistic interactions with obesity to exacerbate PCa risk. Furthermore, this review proposes a multi-tiered prevention and control system comprising industrial source control, targeted protection of susceptible populations, occupational safeguards, and clinical integration. Future research should focus on core scientific questions, such as identifying key PAE subtypes that may be carcinogenic to the prostate, elucidating transgenerational epigenetic mechanisms underlying PAE-induced PCa susceptibility, and verifying the reversibility of PAE-obesity interactions in PCa development, to provide more substantial evidence for mitigating PAE-associated PCa risk. https://doi.org/10.3389/fcell.2025.1740894

Exploring the mechanism link between endocrine disrupting chemicals and metabolic diseases: Observational and GWAS evidence,
Wang, L., Liu, X. Y., Xiang, C. Y., Shu, X. P., Liu, X. R., Zhao, J. N., Li, S. Q., Xu, R. B., Chen, B., Kang, B. and Peng, D., *Ecotoxicology and Environmental Safety*, Jan 1 2026, Vol. 309.

Endocrine disrupting chemicals (EDCs) are widespread environmental contaminants that may contribute to the development of metabolic diseases. However, their causal roles and biological mechanisms remain unclear. This study aimed to investigate the associations between EDC exposure and metabolic disorders by integrating epidemiological and genetic approaches. A pooled analysis of 53 observational studies, comprising 109394 participants, demonstrated that EDC exposure significantly increased the risk of metabolic diseases (OR=1.38, 95 %CI=1.28-1.48, I-2=82.3 %, P < 0.01). Positive associations were observed across several metabolic outcomes, including hypertension, non-alcoholic fatty liver disease (NAFLD), type 2 diabetes mellitus (T2DM), and polycystic ovary syndrome (PCOS). Subgroup analyses by age, sex, and geographic region revealed generally consistent associations across populations. In addition, an dose-related association analysis for bisphenol A (BPA) suggested an increasing exposure-risk trend. To further explore the causality, we conducted a two-sample Mendelian randomization (MR) analysis using Genome-Wide Association Study (GWAS) data from 15 EDCs and 9 metabolic outcomes. After false discovery rate correction, MR results supported robust causal relationships between specific EDCs and coronary atherosclerosis, hypertension, and testicular dysfunction. In addition, suggestive associations were observed for obesity, fasting plasma glucose, and PCOS. Pathway enrichment analysis implicated phospholipase D signaling and MAPK signaling as potential biological pathways underlying EDC-related metabolic dysfunction. Our findings provide robust epidemiological and genetic evidence linking EDC exposure to metabolic disease risk and highlight the need for regulatory policies to reduce EDC-related health burdens. https://doi.org/10.1016/j.ecoenv.2026.119742

Associations of maternal exposure to nonylphenol and bisphenols with precocious puberty in girls: A nested case-control study,
Yan, M. M., Wan, Y. J., Li, R. J., Li, J. H., Qin, X. Y., Li, Y. Y., Liu, H. X., Xu, S. Q., Zhou, Q. R., Huang, S. and Xia, W., *Environmental Research*, Mar 15 2026, Vol. 293.

Few studies have explored the association of prenatal exposure to typical endocrine disrupting chemicals such as nonylphenol (NP) and bisphenols with the odds of precocious puberty (PP) in girls. To evaluate the associations of maternal exposure to NP and bisphenols during pregnancy with the odds of PP [including central PP (CPP) and incomplete PP (IPP) subtypes] in girls, this study included 87 CPP cases, 109 IPP cases, and 588 matched (1: 3) controls based on a Wuhan birth cohort (2012-2014). Maternal urinary concentrations of three bisphenols and two NP metabolites [including oxo-NP and hydroxy-NP (OH-NP)] were measured before delivery. Multivariable logistic regression and weighted quantile sum regression were applied to evaluate the relationships of the individual phenols and their mixture with the PP odds in the girls. Non-linear dose-response relationships were observed between oxo-NP and OH-NP and the PP odds (p for non-linearity <0.05). Specifically, after false discovery rate (FDR) correction, the third quartile of OH-NP [odds ratio (OR): 1.42, 95 % confidence interval (CI): 1.09-1.87; pFDR = 0.01] and oxo-NP (OR: 1.52, 95 % CI: 1.17-1.98; pFDR = 0.002) showed significant associations with the overall PP odds. For PP subtypes, oxo-NP was significantly associated with CPP (the third quartile OR: 1.77, 95 % CI: 1.17-2.68; pFDR = 0.04). NP metabolites were identified as the major contributors to the phenol mixture associated with the CPP odds. Prenatal NP exposure may non-linearly increase the odds of PP in girls, particularly that of CPP, at moderate exposure levels, underscoring the need to reduce prenatal exposure and clarify the underlying mechanisms. https://doi.org/10.1016/j.envres.2026.123730

Unraveling Plastic-Related Chemical Exposures during Pregnancy and Their Associations with Pregnancy Outcomes Using Suspect Screening Analysis,
Yang, J. J., Abrahamsson, D., Edwards, J., Wang, M. M., Trowbridge, J., Morello-Frosch, R., Demicco, E., Park, J. S. and Woodruff, T. J., *Environment & Health*, 2026.

Plastic production has increased sharply in recent decades, releasing numerous chemicals through degradation and additive leaching. We evaluated prenatal exposure to plastic-related chemicals and their associations with pregnancy outcomes using suspect screening analysis in 200 pregnant participants recruited between 13 and 27 weeks of gestation. We detected 441 chemicals in maternal serum samples (9 identified at confidence level 1 and 432 tentatively identified at level 2), using liquid chromatography-quadrupole time-of-flight mass spectrometry (LC-QTOF/MS) with an in-house database of 5267 plastic-related chemicals. We compiled the in-house database with predicted spectra and RTs for 4272 chemicals without available spectra, improving the reliability of suspect screening. Three level 1 chemicals-1,3-diphenylguanidine, undecanedioic acid, and 1-octyl-2-pyrrolidone-and 230 level 2 chemicals have not been widely reported, with fewer than 10 publications in the existing literature. Among level 1 chemicals, an interquartile range increase in acetyl tributyl citrate, progesterone, diisobutyl phthalate, 8-hydroxyquinoline, and PFOS was associated with higher odds of preterm birth. PFOS and undecanedioic acid were associated with increased odds of gestational diabetes mellitus (GDM) in logistic regression models adjusted for maternal age and race/ethnicity. We observed associations between four level 2 chemicals and GDM, and eight were associated with gestational hypertension. Exposure levels varied significantly by education, race/ethnicity, and nativity, with higher PFOS observed in participants with higher educational attainment and in non-Hispanic White groups. Our findings highlight novel chemical exposures and their associations with pregnancy complications, raising concerns about gaps in the monitoring of plastic-related chemicals and their potential impacts on maternal health.
https://doi.org/10.1021/envhealth.5c00197

Prenatal exposure to essential and toxic elements in relation to infant growth trajectories, Yim, G., Heggeseth, B. C., Gilbert-Diamond, D., Peacock, J. L., Margetaki, K., Baker, E. R., Palys, T. J., Jackson, B. P., Madan, J. C., Romano, M. E., Karagas, M. R. and Howe, C. G., *Environmental Health*, Jan 9 2026, Vol. 25, no. 1.

Background Metal exposures have been associated with adverse growth in utero, but impacts on postnatal growth are not well-understood. Objectives To examine relationships between prenatal metal exposures and infant growth trajectories in a rural U.S. pregnancy cohort. Methods Participants included 783 mother-infant pairs in the New Hampshire Birth Cohort Study, a rural cohort of pregnant people and their children in northern New England with homes served by private unregulated drinking water. Essential and toxic element concentrations were measured in maternal toenail clippings collected at 3 weeks postpartum, reflecting exposures during pregnancy. Weight and length measures were abstracted from medical records between birth and 18 months. Weight-for-length growth trajectories were identified separately for male and female infants using growth mixture modeling. Relative risk ratios and 95% confidence intervals were estimated to evaluate associations between each element and growth trajectory assignments. Results Four weight-for-length trajectories were identified for male and female infants: Stable-slow, Late-moderate, Stable-moderate, and Rapid growth. The Stable-slow trajectory aligned most closely with the median World Health Organization infant growth curve and was selected as the reference. Among male infants, higher maternal mercury and lead were each associated with a higher likelihood of following a growth pattern that deviated from the reference. Additionally, male infants whose mothers fell in the lowest tertile for manganese, compared with the middle tertile, were more likely to follow the Stable-moderate growth trajectory, rather than the reference. No statistically significant associations were identified for female infants. Discussion Growth during the first 18 months of life may be accelerated in male infants exposed to higher levels of mercury or lead or to lower levels of manganese in utero. Given that accelerated growth during infancy increases risk for obesity, male infants who experience these element exposure patterns may be more susceptible to obesity later in life. https://doi.org/10.1186/s12940-025-01252-w

Unveiling the endocrine-disrupting chemicals-lung adenocarcinoma in never-smokers: A mixture exposure and network toxicology study, Zheng, Y. Y., Zhu, X. Y., Xu, M. Y., Huang, K. Q., Jiang, X. Q., Liu, W. L., Lin, B. H., Yang, Y. J., Deng, H., Alhazmi, N., Liu, K., Ma, S. T., Bai, Y. S. and Wang, H. H., *Journal of Hazardous Materials Advances*, Feb 2026, Vol. 21.

Background: The incidence of lung cancer in never-smokers (LCINS), predominantly manifesting as lung adenocarcinoma (LUAD) in females, has shown a steady rise. While endocrine-disrupting chemicals (EDCs) represent potential risk factors for LCINS, their specific contributions and underlying toxicological mechanisms remain poorly characterized. Methods: We conducted a case-control study involving 196 LCINS cases (including 166 LUAD) and 191 healthy controls. Serum concentrations of 19 EDCs across five categories (alkylphenols, bisphenols, parabens, benzophenones, and antibacterial agents) were quantified. Associations were evaluated using both single-exposure models (logistic regression with FDR adjustment) and mixture exposure models (generalized weighted quantile sum, gWQS) to identify high-risk EDC categories and key individual EDC links to LUAD in never-smokers. Roles of systemic inflammation were assessed through effect modification and mediation analysis, and network toxicology approaches were employed to elucidate pathways and hub genes. Results: EDC mixture showed significant positive associations with LUAD risk in never-smokers, particularly for Sigma alkylphenols (OR = 1.34, q < 0.05) and Sigma bisphenols (OR = 1.28, q < 0.05), with 4-tert-octylphenol (4-tert-OP) and bisphenol A (BPA) identified

as key drivers. While neutrophil-to-lymphocyte ratio (NLR) exhibited a dosedependent relationship with LCINS risk (OR = 1.38, P = 0.007), neither interaction (Pinteraction > 0.05) nor mediation (Pmediation > 0.05) effect was observed between key EDCs and NLR. Integrative network toxicology revealed two mechanistic axes for 4-tert-OP/BPA-induced LUAD, including ligand-receptor interactions, cell proliferation, endocrine and cancer-related pathways. Hub gene analysis identified ESR1, AKT1, CASP3, and PTGS2 as central to BPA-LUAD associations, and AKT1, PTGS2, ESR1, MMP9, HSP90AA1, and BCL2 implicated in 4-tert-OP and LUAD interactions. These hub genes exhibited higher expressions in LUAD tissues and correlated with poor survival (HR > 1, P < 0.05). Conclusions: Our findings implicate alkylphenols (especially 4-tert-OP) and bisphenols (notably BPA) as key risk factors for LUAD in never-smokers, operating through endocrine disruption and carcinogenic pathways rather than systemic inflammation. The identified hub genes may serve as potential biomarkers for EDC-associated LUAD risk stratification.
https://doi.org/10.1016/j.hazadv.2026.101009

Toxicité sur l'homme

Bisphenol A as a local immune disruptor in the male reproductive tract,
Aghapour, A., Sabzehban, R., Pourazad, S., Moghadam, M. B., Koushaeian, L. and Yousefi, M., *Journal of Reproductive Immunology*, Feb 2026, Vol. 173.

Male infertility has become a worldwide concern. Millions of couples today struggle with reproductive problems that result in infertility. While in many cases the underlying cause is unknown, in some cases the problem is with the man. The gradual increase in male fertility problems in recent decades suggests that factors beyond genetics or lifestyle may be involved. In recent years, exposure to environmental pollutants, including endocrinedisrupting chemicals, has attracted the attention of many researchers. One such substance is bisphenol A, which has been the subject of a flood of research due to its widespread use in everyday materials such as plastics, food containers, and thermal paper. This substance is capable of affecting the endocrine system by interfering with hormonal systems. Although bisphenol A has been discussed as a disruptor until now, emerging evidence suggests that its impact is much greater. The testes have a unique immune setting, known as the testicular immune microenvironment (TIM), which maintains a balance between immune tolerance and the protection of germ cells. Studies suggest that BPA can disturb this balance by altering macrophage behavior, changing cytokine patterns, activating mast cells, and affecting T cell function. These immune changes can weaken testicular immune privilege and disturb sperm development. This review looks at BPA as a local immune disruptor in the male reproductive tract, linking hormonal effects with immune imbalance. Understanding BPA from this angle may help explain unexplored aspects of male infertility and guide future prevention effort.
https://doi.org/10.1016/j.jri.2026.104838

Endocrine-disrupting chemicals and thyroid cancer,
Aksu, Ö. and Sahin, M., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

Environmental endocrine-disrupting chemicals (EDCs) have emerged as a critical global health concern because of their role in various diseases, including thyroid cancer. Defined as exogenous substances that disrupt endocrine system functions, EDCs can affect multiple generations through mechanisms such as hormone receptor modulation, altered hormone synthesis, and epigenetic modifications. The increasing global incidence of thyroid cancer has heightened interest in environmental factors, with EDC exposure recognized as a significant contributor. Compounds such as heavy metals, persistent organic pollutants, per-and polyfluoroalkyl substances, and bisphenol A play crucial roles in disrupting thyroid homeostasis. Emerging evidence underscores the synergistic

effects of multiple EDC exposures, further amplifying cancer risk. This review explores the relationship between EDC exposure and thyroid carcinogenesis, focusing on key chemical compounds and their mechanisms of action. Understanding these links is essential for guiding public health policies and shaping future research aimed at preventing and improving the management of this malignancy. https://doi.org/10.55730/1300-0144.6126

Endocrine-disrupting chemicals and thyroid cancer,
Aksu, Ö. and Sahin, M., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

Environmental endocrine-disrupting chemicals (EDCs) have emerged as a critical global health concern because of their role in various diseases, including thyroid cancer. Defined as exogenous substances that disrupt endocrine system functions, EDCs can affect multiple generations through mechanisms such as hormone receptor modulation, altered hormone synthesis, and epigenetic modifications. The increasing global incidence of thyroid cancer has heightened interest in environmental factors, with EDC exposure recognized as a significant contributor. Compounds such as heavy metals, persistent organic pollutants, per-and polyfluoroalkyl substances, and bisphenol A play crucial roles in disrupting thyroid homeostasis. Emerging evidence underscores the synergistic effects of multiple EDC exposures, further amplifying cancer risk. This review explores the relationship between EDC exposure and thyroid carcinogenesis, focusing on key chemical compounds and their mechanisms of action. Understanding these links is essential for guiding public health policies and shaping future research aimed at preventing and improving the management of this malignancy. https://doi.org/10.55730/1300-0144.6126

Bisphenol A (BPA) Modifies Cancer Signaling Pathways: A Neglected Global Health Threat,
Al-Ani, M., Al-Ani, Y., Ibrahim, S. S., Ibrahim, R. S., Kubatka, P. and Büsselberg, D., *Journal of Xenobiotics*, Dec 4 2025, Vol. 15, no. 6.

Bisphenol A (BPA), a synthetic industrial compound widely found in plastics and other materials, has been linked to cancer development. As human exposure increases, BPA may pose potential carcinogenic concerns. Although BPA binds to estrogen receptors with much lower affinity than natural estrogens, its accumulation in human tissues can cause harmful effects. This review summarizes current evidence on BPA's role in cancer initiation and progression, with a focus on its effects on cancer signaling pathways. These effects involve modulating pathways involved in cell growth, movement, invasion, survival, and adhesion. BPA acts as an estrogen ligand, binding to estrogen receptors and activating related pathways. The main route of exposure is through dietary intake of canned and plastic-packaged foods, with migration rates increasing at higher temperatures. To raise awareness of BPA's harmful effects, industries have proposed "BPA-free" alternatives, some of which use derivatives like bisphenol S (BPS) and bisphenol F (BPF), which, unfortunately, may have even worse effects on human health. Given the ongoing challenges of eliminating BPA and similar harmful compounds, future research should focus on identifying safe substitutes, developing more effective removal technologies, and strengthening stringent regulations to mitigate public health risks. https://doi.org/10.3390/jox15060207

Silent Invaders: the emerging impact of micro-, nanoplastics and plasticizers on human placental development and pregnancy outcomes,
Alice, M., Andrea, P., Sara, F., Michael, G., Silini, A. R. and Ornella, P., *Journal of Hazardous Materials Advances*, Feb 2026, Vol. 21.

The placenta is a multifunctional organ essential for fetal growth, immune tolerance, and endocrine regulation. Increasing evidence indicates that micro- and nanoplastics (MNPs), and their chemical

additives like bisphenols and phthalates can cross biological interfaces, accumulate in placental tissues, and impair their structure and function. Given the central role of the placenta in pregnancy maintenance, these findings raise concern regarding the potential consequences of ubiquitous plastic pollution for reproductive health. This manuscript first provides a brief overview of placental architecture, and physiological roles, followed by a summary of the physicochemical characteristics of plastics, major routes of human exposure, and mechanisms of systemic transport and translocation to the placenta. The core of the review focuses on experimental evidence from in vitro and in vivo models describing how MNPs and chemicals are internalized by placental cells, alter cellular homeostasis, and impair vascular, metabolic, endocrine, and immune functions. Particular attention is given to size- and surface chemistry-dependent uptake, oxidative stress, inflammation, hormonal disruption, and epigenetic alterations. Finally, we identify key research gaps and outline future directions, including the need for environmentally relevant exposure models, studies on combined contaminant effects, biomarker development, and regulatory actions to reduce exposure. Through this synthesis, we aim to clarify current understanding of how pervasive plastic pollutants may threaten placental health and, ultimately, maternal and fetal well-being.
https://doi.org/10.1016/j.hazadv.2026.101034

Micro- and nanoplastics and brain sexual differentiation: An emerging neurodevelopmental threat within the DOHaD framework,
Arena, A. C., Jorge, B. C., Manoel, B. D., Stein, J., Kassuya, C. a. L. and Hisano, H., *Reproductive Toxicology*, Mar 2026, Vol. 140.

Micro- and nanoplastics (MNPs) have been increasingly detected in human tissues, including the placenta and, more recently, the brain. Their capacity to cross biological barriers such as the placenta and the blood-brain barrier raises significant concern for sexually dimorphic neurodevelopment. Brain sexual differentiation, orchestrated by steroid hormones, neuroimmune signaling, and epigenetic programming during early life, represents one of the most hormonally sensitive and developmentally critical targets of environmental disruption. In this narrative review, we synthesize evidence positioning MNPs as potential endocrine and epigenetic disruptors that may reprogram hypothalamic circuits governing reproduction and socioemotional behavior within a DOHaD framework. Evidence is stronger in animal and cellular models, implicating oxidative stress, neuroinflammation, apoptosis, and disrupted neurotransmission as central mechanisms; however, sex-specific endpoints remain underexplored and human data are still limited. This review adds a novel integrative perspective by focusing on sexually dimorphic hypothalamic nuclei and by outlining testable, sex-informed hypotheses. We highlight key methodological priorities for future research, including environmentally relevant exposures, explicit consideration of sex as a biological variable, multi-omics approaches, and longitudinal designs.
https://doi.org/10.1016/j.reprotox.2026.109158

Effects of Pharmacological and Agrochemical Endocrine Disruptors on Human Sperm Mitochondrial Respiration: Evidence from Ex Vivo Bioenergetic Profiling,
Assalve, G., Lunetti, P., Zara, V. and Ferramosca, A., *Journal of Xenobiotics*, Feb 9 2026, Vol. 16, no. 1.

Background: Human exposure to endocrine-disrupting chemicals (EDCs) is increasingly linked to male reproductive dysfunction, but underlying mechanisms remain unclear. This study aimed to evaluate how selected pharmacological (dihydroxyflutamide, 2OH-FTA; bicalutamide, BIC) and agrochemical (lindane, beta HCH; permethrin, PERM; mancozeb, MNZ; tributyltin oxide, TBTO) EDCs affect mitochondrial function in human spermatozoa with parameters within World Health Organization (WHO) reference ranges. Methods: Human sperm cells were exposed ex vivo to 0.1-

1000 nM of each compound. Mitochondrial respiration was measured using polarography, assessing oxygen consumption in active (V3) and resting (V4) states, and the respiratory control ratio (RCR) was calculated as an index of mitochondrial coupling. Results: Both 2OH-FTA and BIC reduced RCR in a concentration-dependent manner, mainly due to increases in V4, with BIC showing the strongest effect. beta HCH produced a similar pattern, elevating V4 and decreasing RCR. In contrast, PERM, MNZ, and TBTO caused near-complete collapse of both V3 and V4 even at sub-nanomolar concentrations, indicating severe, concentration-independent mitochondrial toxicity. Conclusions: Sperm mitochondria are highly sensitive to EDCs, and distinct compounds exert different bioenergetic effects. Mitochondrial respiration assays provide a useful tool for ex vivo toxicological screening and risk assessment. https://doi.org/10.3390/jox16010031

Computational profiling of toxic mixtures associated with type 2 diabetes mellitus development: identification of key protective agents,
Baralic, K., Jerotijevic, J., Pantelic, M., Zivanovic, J. and Dukic-Cosic, D., *Food and Chemical Toxicology*, Mar 2026, Vol. 209.

The aim of the current research was to assess the association between the exposure to plastic-related chemicals and toxic metals with the development of type 2 diabetes mellitus using an in silico approach, while also exploring the protective potential of antioxidant vitamins and phytochemicals, including Vitamin C, Vitamin E, sulforaphane, resveratrol, curcumin, naringin, and quercetin. CTD database, GeneMANIA server, and Toppgene portal were used as the main in silico tools in this study. Six common genes (BAX, CASP3, CAT, IL6, SOD1, TNF) were identified for all toxic substances, indicating potential shared mechanisms of toxicity (apoptosis, inflammation, oxidative stress). Additionally, phthalates and bisphenols affected cell growth, lipid and energy metabolism, and vascular functions, while toxic metals were linked to apoptosis regulation, DNA repair, insulin regulation, and glucose uptake. All tested protective substances, except naringin, affected all six common genes for all toxic substances, with vitamin C, vitamin E, and sulforaphane showing the most consistent protective effects. This study highlights the complex mechanisms in type 2 diabetes pathogenesis induced by toxic substances and provides a foundation for further research on the preventive effects of tested protective substances, emphasizing their varying protective potentials depending on the toxic compounds. https://doi.org/10.1016/j.fct.2025.115893

Endocrine disruptors, obesity, and metabolic syndrome,
Barlas, T., Altinova, A. E., Coskun, M. and Cerit, E. T., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

The global prevalence of obesity and metabolic syndrome (MetS) is rising worldwide, and increasing evidence suggests that chemical exposures-particularly endocrine disruptors (EDs)-represent a significant contributing factor. EDs can act as obesogens, increasing the risk of weight gain and related metabolic conditions, including type 2 diabetes, dyslipidemia, hypertension, and cardiovascular disease. They may also alter the basal metabolic rate, gut microbiota composition, and hormonal regulation of appetite and satiety. EDs are reported to exert their effects mainly through the peroxisome proliferator-activated receptor gamma pathway, which is primarily expressed in adipose tissue and is a key regulator of adipogenesis. Common consumer products such as plastic bottles, metal food cans, detergents, toys, cosmetics, and pesticides frequently contain EDs. Humans can be exposed to these chemicals via multiple routes, including transplacental transfer, breast milk, inhalation, ingestion, and dermal absorption. Bisphenols, tributyltin, phthalates, per- and polyfluoroalkyl substances, polycyclic aromatic hydrocarbons, and heavy metals are among the known EDs that have been associated with obesity and MetS. The need for further investigation and stricter regulations to mitigate the public health consequences of

environmental exposure to EDs is consistently emphasized in recent literature. Understanding the mechanisms by which EDs affect various hormones and systems is essential for developing effective prevention and intervention strategies. In this review, we discuss the relationship between obesity, MetS, and EDs, along with exposure pathways and preventive strategies.
https://doi.org/10.55730/1300-0144.6120

The effects of endocrine on the female,
Baykal, R. G. and Ersoy, R., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

Endocrine-disrupting chemicals (EDCs) are a diverse, comprehensive group of mostly synthetic chemicals that disrupt many physiological functions in humans and animals. EDCs are particularly disruptive to the female reproductive system. Reproductive function in women is a dynamic process regulated by the hypothalamic-pituitary-ovarian axis. EDCs show their effects on the reproductive system through estrogenic, antiestrogenic, androgenic, and antiandrogenic effects or by directly affecting gonadotropin-releasing hormone secretion. Disruption in the menstrual cycle, decrease in fertility, infertility, increased risk of miscarriage, polycystic ovary syndrome, endometriosis, early or delayed puberty, and hormone-sensitive cancers can be listed as the main negative effects of endocrine disruptors on the female reproductive system. In this review, findings on the effects of the most studied EDCs, bisphenol A, phthalates, methoxychlor ethane, tetrachlorodibenzo-pdioxin, atrazine, per-and polyfluoroalkyl substances, and micro-and nanoplastics on the female reproductive system are summarized. https://doi.org/10.55730/1300-0144.6125

Neonicotinoids and the Androgen Receptor: Structural Dynamics and Potential Signaling Disruption,
Beg, M. A., Beg, M. A., Zargar, U. R., Zughaibi, T., Abuzenadah, A. M. and Sheikh, I. A., *Biology-Basel*, Jan 10 2026, Vol. 15, no. 2.

Neonicotinoids are synthetic nicotine-like compounds extensively used globally as insecticides for agricultural and urban purposes. Neonicotinoid-contaminated produce is a major public health concern worldwide. Limited epidemiological studies have shown an association of neonicotinoid exposure with abnormal semen analysis. This study aimed to elucidate the potential disruption of the androgen receptor (AR) by eight common neonicotinoids, including imidacloprid (IMI), acetamiprid, clothianidin, thiamethoxam, dinotefuran, thiacloprid (THI), nitenpyram, and nithiazine using docking and molecular dynamics (MD) simulation. The results showed good binding strength of all compounds (except THI) with AR, as indicated by high binding energy, high binding affinity, and number of bonding interactions. The results of MD simulation supported the conformational stability and structural dynamic behavior of the AR-IMI (receptor-neonicotinoid) complex upon binding. This was indicated by root mean square deviation showing stability of the complex; the root mean square fluctuation showing minimized residual fluctuations upon binding; the radius of gyration showing greater compactness of the protein structure; the solvent-accessible surface area showing no changes upon binding; and the Gibbs funnel energy of the landscape showing a stable conformation state with minimum energy and slight change in size and position of the sampled energy basin of the AR, with a stable equilibrium. Taken together, the structural dynamics results showed that neonicotinoids are bound stably in the same ligand-binding domain of the AR as the native ligand testosterone. This may perturb the natural binding of testosterone with the AR and potentially disrupt downstream signaling and biological pathways, leading to male reproductive dysfunction. https://doi.org/10.3390/biology15020126

Assessment of endocrine disruptor impact on carbohydrate metabolism in the HepaRG human hepatic cell line,

Bernal, K., Tête, A., Le-Grand, B., Balaguer, P., Kim, M. J., Coumoul, X. and Blanc, E. B., *Archives of Toxicology*, 2026.

Endocrine-disrupting chemicals (EDCs) are increasingly implicated in the development of metabolic disorders such as type 2 diabetes mellitus (T2DM). As hepatic dysfunction is a hallmark of early metabolic disease, we investigated how EDCs may contribute to glucose dysregulation using human HepaRG cells. Ten EDCs-bisphenol A (BPA), bisphenol F (BPF), bisphenol S (BPS), cadmium chloride (CdCl2, 1 mu M), butylparaben (BP), 1,1-dichloro-2,2-bis(4-chlorophenyl)ethene (p,p '-DDE), dibutyl phthalate (DBP), di(2-ethylhexyl) phthalate (DEHP), perfluorooctanoic acid (PFOA), and perfluorooctanesulfonic acid (PFOS)-were tested at 25 mu M for 5 days. We assessed multiple endpoints related to carbohydrate metabolism, including gene expression, mitochondrial function, glycogen content, glucose export, glycolytic capacity, and lactate release. Among the tested compounds, p,p '-DDE induced the most pronounced metabolic disruption, significantly reducing glycogen storage, glycolytic capacity, lactate export, and the expression of key genes involved in glucose metabolism. Using luciferase-based reporter cell lines, p,p '-DDE was found to activate primarily the nuclear receptors constitutive androstane receptor (CAR) and pregnane X receptor (PXR). However, siRNA-mediated knockdown of these receptors did not reverse the changes induced by p,p '-DDE in gene expression, suggesting a more complex or alternative mechanism of action. These findings demonstrate that p,p '-DDE perturbs hepatic carbohydrate metabolism and may contribute to the pathogenesis of T2DM, highlighting the need for further mechanistic investigation. https://doi.org/10.1007/s00204-025-04291-x

Extracellular Vesicles and Endocrine Disruption: How Environmental Pollutants Modulate the Loading and Release of Extracellular Vesicles for Cancer Promotion and Progression,
Buján, S., Esquivel-Ruiz, S., Olivas-Martínez, A., Miret, N. V., Fernández, M. F. and Randi, A., *International Journal of Molecular Sciences*, 2026, Vol. 27, no. 5, p. 2100.
https://www.mdpi.com/1422-0067/27/5/2100

Heavy Metal Air Pollution: Human Health Effects and Nanomaterial Strategies for Monitoring and Remediation,
Fahim, Y. A., Boughdady, H. M., Othman, W. A., Mostafa, S. M., Helmi, L. M., Elsayed, A. A., Hamouda, O. S., Gad, O. M. and Sallam, R. M., *Biological Trace Element Research*, 2026.

Heavy metal air pollution represents a critical global environmental and public health challenge due to its persistence, bioaccumulation, and diverse toxic effects. Lead, mercury, cadmium, and arsenic are among the most hazardous, disrupting biological systems through oxidative stress, chronic inflammation, and interference with cellular signaling. These mechanisms drive the onset of acute and chronic diseases, damaging multiple organ systems and reducing overall health quality. The respiratory system is highly susceptible, as inhalation of fine and ultrafine particulates induces oxidative injury, inflammation, fibrosis, and progressive loss of lung function. Cardiovascular disorders such as endothelial dysfunction, hypertension, and atherosclerosis arise from oxidative stress and calcium signaling disruption, while endocrine toxicity occurs when heavy metals displace essential elements, disturbing hormone synthesis and metabolic balance. Reproductive toxicity manifests through reduced fertility, impaired gametogenesis, and abnormal embryonic development, often mediated by epigenetic alterations. Neurological consequences include cognitive decline, behavioral changes, and neurodegenerative progression, driven by apoptosis, oxidative damage, and altered neurotransmission. Addressing these risks, recent advances in nanotechnology offer promising solutions for air quality management. Engineered nanomaterials including metal nanoparticles, carbon-based adsorbents, and metal organic frameworks demonstrate high efficiency in capturing and neutralizing airborne heavy metals. Nanostructured

catalysts can transform toxic particulates into less harmful forms, while nanosensor platforms enable real-time monitoring at ultra-trace levels. This review synthesizes current evidence on the health impacts of heavy metal exposure, with particular emphasis on air pollution and emerging nanotechnology-based strategies for monitoring and remediation.
https://doi.org/10.1007/s12011-026-05019-3

Obesogens in Prostate Cancer: An Endocrine and Metabolic Threat,
Feijó, M., Fonseca, L. R. S., Kiss-Toth, E., Socorro, S. and Correia, S., *Current Obesity Reports*, Feb 25 2026, Vol. 15, no. 1.

Purpose of Review This review addresses the contribution of obesogenic endocrine-disrupting chemicals (EDCs) to prostate carcinogenesis. It provides an in-depth overview of obesogens, tracing their mechanisms of action and effects impacting prostate cell fate. The direct effects of obesogens in disrupting adipose tissue and metabolic homeostasis, as well as disturbing prostate cells, are discussed, along with the potential indirect effects mediated by the dysregulation of the adipose tissue. Recent Findings Obesogens represent a group of EDCs that interfere with endocrine and metabolic processes, underpinning the spread of obesity. Moreover, the ubiquitous presence in the environment, the ability to accumulate in adipose tissue and the broad range of effects targeting several biological pathways highlight that obesogens can be detrimental to human health beyond their action on promoting obesity. Prostate cancer (PCa) is a hormone-dependent cancer for which environmental influences and obesity are established risk factors, with emerging evidence suggesting that obesogens may affect its development and progression. Summary The available data indicate that obesogens may contribute to the development of PCa. They can have direct actions in prostate cells modulating signalling pathways that drive tumour aggressiveness. Moreover, the adipose tissue dysregulated by obesogens can acquire an obesity-like phenotype, which may play a crucial role in facilitating tumour growth. Further research is needed to clarify the liaison between obesogen-induced dysregulation of the periprostatic adipose tissue depot and PCa aggressiveness. Unravelling this complex crosstalk will be pivotal for identifying novel therapeutic strategies and preventing aggressive PCa, especially in obese patients.
https://doi.org/10.1007/s13679-026-00690-y

Immunomodulatory effects of Tritan copolyester on human neutrophils,
Goulet, S. M., Chalifour, M., Gignac, J., Leblanc, P. O., Breton, Y. and Pelletier, M., *Environmental Research*, Apr 1 2026, Vol. 296.

Eastman TritanTM copolyester, a novel plastic used as a replacement for bisphenols and manufactured utilizing three monomers, can be released from products, potentially entering biological fluids, and could exert estrogenic activity. Since neutrophils are inflammatory cells that express hormone receptors, we hypothesized that Tritan compounds could modulate neutrophil metabolism and function. Human neutrophils from the blood of healthy male and female donors were exposed in vitro to Tritan monomers, alone or combined with pro-inflammatory cytokines, and assessed for viability, metabolism, surface marker expression, and antimicrobial functions. Tritan compounds did not affect neutrophil viability but increased metabolic activity under inflammatory conditions. The production of CCL4/MIP-1 beta was reduced, while CXCL8/IL-8 was unchanged. Phagocytosis and reactive oxygen species production were altered in a dose-dependent manner, with the effect more pronounced in male neutrophils at lower doses and female neutrophils at higher doses. The expression of CD11b and CD16, adhesion and functional markers, was also modulated by Tritan monomers. These results indicate that Tritan and its monomers can alter neutrophil phenotype and function, potentially impairing host defence or contributing to dysregulated inflammation. These findings raise concerns about the safety of Tritan as an

alternative plasticizer. Further research is needed to better understand the potential health risks of Tritan and its monomers, to help develop or update evidence-based regulations that protect public health. https://doi.org/10.1016/j.envres.2026.123966

Endocrine-disrupting chemical exposure during differentiation alters the proliferation-maturation balance in stem-cell islets,
Gudmestad, J. H., Unger, L., Paulo, J. A., Ghila, L. and Legoy, T. A., *Toxicological Sciences*, Jan 2026, Vol. 209, no. 1.

Exposure to endocrine-disrupting chemicals (EDCs) is increasingly recognized as a risk factor for diabetes, primarily through disruption of pancreatic beta-cell function and insulin signaling. These effects can arise not only from adult exposure but also during development, as many EDCs can cross the placental barrier. However, models that accurately mimic human pancreatic islet development are limited. In this study, we reported the first toxicological application of stem cell islets (SC-islets) to investigate the developmental effect of EDCs. Using human-induced pluripotent stem cells (iPSCs), we generated SC-islets and exposed them to a mixture of bisphenol A, bisphenol S, and trans-nonachlor during differentiation. EDC exposure resulted in SC-islets with an altered transcriptional profile, characterized by reduced expression of beta-cell maturity markers, increased proliferation markers, and elevated KI67-positive cell counts. These features resembled earlier developmental stages and deviated from mature human islet profiles, suggesting a delay in differentiation. Our findings establish SC-islet differentiation as a novel and relevant in vitro model for assessing the developmental toxicity of EDCs, with outcomes consistent with in vivo studies. This model opens new avenues for mechanistic studies and chemical safety assessment in endocrine development. https://doi.org/10.1093/toxsci/kfaf163

Endocrine-disrupting chemicals in metabolic bone diseases, including osteoporosis,
Gündüz, B., Kan, E. K. and Atmaca, A., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

Endocrine disruptors are chemical substances widely utilized across various industrial sectors. Due to their structural similarity to natural ligands, they bind to receptors and influence the endocrine system via agonist-antagonist mechanisms. Exposure occurs through the consumption of contaminated food and water, inhalation of polluted air and dust, and dermal contact. Owing to their dynamic remodeling capacity, bones represent potential targets for endocrine-disrupting chemicals. These chemicals can disrupt bone formation, skeletal development, hormonal regulation, and calcium metabolism. Sensitivity to endocrine-disrupting chemicals is greatest during the prenatal and early postnatal periods. This review summarizes the effects of endocrine-disrupting chemicals on bone tissue. https://doi.org/10.55730/1300-0144.6128

Systematic analyses uncover endocrine-disrupting chemical-responsive genes linked to endometriosis,
Hong, Y. G., Zhang, T. S., Zhou, J. X., Wang, L. F., Wang, Y. R., Shu, W. Y., Wang, H. B. and Chen, H. Y., *Reproductive Toxicology*, Mar 2026, Vol. 140.

Endometriosis is a chronic, estrogen-dependent disorder influenced by both genetic and environmental factors, including endocrine-disrupting chemicals (EDCs). This study aimed to identify EDC-responsive genes contributing to endometriosis risk by integrating Mendelian randomization (MR), Bayesian colocalization, and singlecell RNA sequencing (scRNA-seq). We first compiled a list of EDC-responsive genes using curated chemicalgene interaction databases. MR and Bayesian colocalization analyses were applied to integrate gene expression quantitative trait loci (eQTL) data with genome-wide association study (GWAS) data for endometriosis. We identified eight genes

(PRLR, SULT1B1, DIP2B, FBXO5, CDCA2, AGPAT1, PDE5A, and VPS13B) with strong evidence for causal association and shared genetic regulation. The scRNA-seq revealed that these genes are differentially expressed across key cell types, including mesenchymal, epithelial, and smooth muscle cells. PRLR was enriched in mesenchymal cells, while PDE5A showed high expression in smooth muscle cells. The chemicalgene interaction network further highlighted specific EDCs linked to these genes, such as perfluorooctanoic acid, triphenyl phosphate, and bisphenol A. This study uncovers molecular pathways by which EDCs may influence endometriosis risk and identifies potential biomarkers and therapeutic targets. The findings also establish a scalable approach for studying gene-environment interactions in other hormone-sensitive conditions.
https://doi.org/10.1016/j.reprotox.2025.109148

Epigenetic Mechanisms of Reproductive Dysfunction Induced by Endocrine-Disrupting Chemicals: Evidence From Molecular Studies,
Hwang, S., Kang, H. B., Kim, D. H. and Park, M. H., *Frontiers in Bioscience-Landmark*, Jan 16 2026, Vol. 31, no. 1.

Endocrine-disrupting chemicals (EDCs), including bisphenol A (BPA), phthalates, organochlorine pesticides, and heavy metal ions, pose serious threats to reproductive health by interfering with hormonal balance and molecular signaling pathways. Recent research had expanded our understanding of these compounds has beyond their traditional role in hormone receptor interference. EDCs can trigger lasting epigenetic changes, including abnormal DNA methylation, histone modifications, RNA methylation, and altered regulation of non-coding RNA, which can impair reproductive functions such as gametogenesis, folliculogenesis, steroidogenesis, and embryo implantation. Importantly, EDC-mediated epigenetic alterations have been linked to various reproductive disorders, including polycystic ovary syndrome (PCOS), endometriosis, reduced ovarian reserve, and impaired spermatogenesis. For example, BPA exposure alters DNA methylation in estrogen signaling and aromatase gene expression, whereas phthalates disrupt histone acetylation and methylation in hormone synthesis pathways. Similarly, pesticides and heavy metal ions may influence microRNA expression and histone structure, further disrupting endocrine-regulated gene networks. These alterations may occur during sensitive developmental windows and can lead to long-term or transgenerational effects on reproductive health. Understanding how EDCs exert their toxicity through epigenetic mechanisms is essential for early detection of exposure, identification of molecular biomarkers, and development of targeted therapies to reduce reproductive risks. Here, we discuss the emerging molecular evidence that provides a comprehensive overview of how EDCs impair reproductive health through epigenetic pathways, thereby offering a framework for future research and translational applications. https://doi.org/10.31083/fbl42777

Reproductive Toxicity of the Fungicide Pyraclostrobin: Endocrine-Disrupting and Mechanistic Insights,
Jiao, F., Wang, Q., Zhao, Y., Yue, Q., Li, Z., Zeng, Z., Lin, W., Han, L., Wei, L., Tao, Y. and Xing, B., *Environmental Science & Technology*, 2026/03/12 2026.

Pyraclostrobin (PYR), a widely used strobilurin fungicide, persists in aquatic environments and has been linked to reproductive toxicity in nontarget organisms. However, the mechanisms underlying its chronic reproductive effects remain unclear. Here, we show that chronic exposure of zebrafish to environmentally relevant PYR concentrations (3–18 μg/L) for 120 days causes PYR accumulation in gills, ovaries, and liver, leading to reduced fecundity, impaired fertilization, and abnormal offspring development. These outcomes stem from ovarian histopathological changes, disrupted oocyte maturation, mitochondrial dysfunction with oxidative stress and apoptosis, and altered sex hormone homeostasis via elevated cyclic adenosine monophosphate (cAMP) signaling. In vitro and

in silico analyses indicate that PYR disrupts steroidogenesis through dual mechanisms, involving upstream antagonism of protein kinase A (PKA) that suppresses aromatase expression and direct interaction with aromatase that inhibits its enzymatic activity, while showing no direct binding to sex hormone receptors. This multitarget disruption advances the understanding of endocrine interference by strobilurin fungicides and highlights risks to fish populations and aquatic ecosystem stability. https://doi.org/10.1021/acs.est.6c00003

Novel mechanisms of atrazine endocrine disruption: an integrated approach reveals progesterone and glucocorticoid receptor targeting.
Jin, C., Hao, R., Ren, X. and Shen, J., no. 2050-6511 (Electronic).

BACKGROUND: Atrazine is a widely used herbicide with reported endocrine-disrupting effects, yet the molecular targets and pathway-level mechanisms remain to be fully elucidated. We aimed to build an integrated, hypothesis-generating workflow to prioritize candidate atrazine targets by combining literature curation, network analysis, machine-learning–based prioritization, and molecular docking. METHODS: Candidate endocrine-related genes were compiled from the Comparative Toxicogenomics Database and PubMed literature screening, yielding 78 genes. A protein–protein interaction (PPI) network was constructed and analyzed to identify a connected subnetwork of 26 genes. Gene Ontology (GO) and KEGG enrichment analyses were performed to characterize overrepresented biological processes and pathways. To prioritize candidate genes within the 26-gene subnetwork, we engineered composite network features and trained a weakly supervised model using three literature-labeled seed positives (ESR1, CYP19A1, and AR) versus the remaining genes as putative negatives, with internal cross-validation for exploratory assessment. Molecular docking was conducted for selected receptors to evaluate potential binding signals. RESULTS: Network topology and enrichment analyses highlighted endocrine-related and steroid hormone–associated biological functions within the atrazine-associated gene set. In exploratory internal cross-validation on the 26-gene subnetwork, an ensemble model showed high apparent discrimination. The prioritization step ranked NR3C1 and PGR among the top candidates for follow-up. Docking simulations suggested moderate binding affinities between atrazine and PGR (− 6.495 kcal/mol) and NR3C1 (− 6.248 kcal/mol), providing complementary in silico evidence consistent with these candidates and motivating investigation of progesterone- and glucocorticoid-related signaling. CONCLUSIONS: This integrative in silico workflow supports a network-informed prioritization of potential atrazine endocrine targets and highlights NR3C1 and PGR as candidates warranting further investigation. Because the machine-learning component is trained on a very limited literature-labeled set and no external test set is available, the findings should be interpreted as hypothesis-generating and require validation in biological models (in vitro and/or in vivo). SUPPLEMENTARY INFORMATION: The online version contains supplementary material available at 10.1186/s40360-026-01096-1. https://doi.org/10.1186/s40360-026-01096-1

Bisphenol TMC exhibits greater estrogenic activity than Bisphenol A and three other structural analogues exemplified by higher estrogen receptor α-mediated gene expression and breast cancer cell proliferation,
Joos, F. L., Van Diest, R. E., Smiesko, M., Jäger, M. C., Kley, M., Odermatt, A. and Bouitbir, J., *Toxicology*, Mar 2026, Vol. 521.

Bisphenol A (BPA) and its structural analogues are widely used in plastics production, raising concern due to endocrine-disrupting properties. While many analogues share structural similarities with BPA, their endocrinedisrupting effects remain insufficiently characterized. Cyclo-di-bisphenol A diglycidyl ether (cyclo-di-BADGE), tetrabromobisphenol S (TBBPS), bisphenol SIP (BPSIP), and bisphenol TMC (BPTMC) are particularly understudied. We assessed the estrogenic activity of these

four BPA analogues compared to BPA. Transactivation assays in HEK-293 cells expressing estrogen receptor alpha (ER alpha) revealed that BPTMC was a more potent ER alpha agonist than BPA, with an EC50 of 87 +/- 20 nM versus 400 +/- 100 nM for BPA, while the other tested analogues showed no significant agonistic activity. In silico analysis attributed this higher affinity to greater hydrophobicity and a bulkier bridging group between its phenolic rings. None of the compounds inhibited 17 beta-hydroxysteroid dehydrogenase type 1 (17 beta-HSD1) activity. However, BPTMC selectively inhibited 17 beta-HSD2 (IC50 = 4.8 +/- 0.6 mu M) but not BPA. Importantly, 24 h exposure of ER alpha-positive MCF-7 breast cancer cells to 1 mu M BPTMC upregulated the expression of the ER alpha target genes GREB1, TFF1, and PGR, comparable to 10 nM E2, which was abolished by 100 nM of the ER alpha antagonist fulvestrant. Moreover, BPTMC stimulated MCF-7 cell proliferation at nanomolar concentrations over 72 h, and cell count analyses confirmed this effect. BPA also increased cell numbers, and both effects were reversed by fulvestrant. Collectively, we identified BPTMC as a potent ER alpha agonist capable of eliciting transcriptional and mitogenic responses at low concentrations, raising concerns about its endocrinedisrupting and breast cancer-promoting effects. https://doi.org/10.1016/j.tox.2025.154393

When Testosterone Fades: Leydig Cell Aging Shaped by Environmental Toxicants, Metabolic Dysfunction, and Testicular Niche Crosstalk,
Kaltsas, A., Dimitriadis, F., Zachariou, A., Koukos, S., Chrisofos, M. and Sofikitis, N., *Cells*, Jan 15 2026, Vol. 15, no. 2.

Declining Leydig cell steroidogenesis contributes to late-onset hypogonadism and to age-associated impairment of male reproductive health. Determinants of dysfunction extend beyond chronological aging. This review synthesizes recent experimental and translational evidence on cellular and molecular processes that compromise Leydig cell endocrine output and the interstitial niche that supports spermatogenesis. Evidence spanning environmental endocrine-disrupting chemicals (EDCs), obesity and metabolic dysfunction, and testicular aging is integrated with emphasis on oxidative stress, endoplasmic reticulum stress, mitochondrial dysregulation, apoptosis, disrupted autophagy and mitophagy, and senescence-associated remodeling. Across model systems, toxicant exposure and metabolic stress converge on impaired organelle quality control and altered redox signaling, with downstream loss of steroidogenic capacity and, in some settings, premature senescence within the Leydig compartment. Aging further reshapes the testicular microenvironment through inflammatory shifts and biomechanical remodeling and may erode stem and progenitor Leydig cell homeostasis, thereby constraining regenerative potential. Single-cell transcriptomic atlases advance the field by resolving Leydig cell heterogeneity, nominating subsets that appear more vulnerable to stress and aging, and mapping age-dependent rewiring of interstitial cell-to-cell communication with Sertoli cells, peritubular myoid cells, vascular cells, and immune cells. Many mechanistic insights derive from rodent in vivo studies and in vitro platforms that include immortalized Leydig cell lines, and validation in human tissue and human clinical cohorts remains uneven. Together, these findings frame mechanistically informed opportunities to preserve endogenous androgen production and fertility through exposure mitigation, metabolic optimization, fertility-preserving endocrine stimulation, and strategies that target inflammation, senescence, and regenerative capacity. https://doi.org/10.3390/cells15020158

Effects of endocrine disruptors on the neurological system,
Karatoprak, K. and Cander, S., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

Background/aim: There is increasing interest in endocrine disrupting chemicals because of the potential effects on neurological health. These chemicals are widely found in various consumer products and industrial processes, and can lead to serious disorders of the endocrine system by

disrupting hormone synthesis, expression, and function. The aim of this review was to examine epidemiological and experimental findings by investigating the link between exposure to endocrine disrupting chemicals and adverse neurological outcomes. Materials and methods: In the preparation of this review, a PubMed literature search was conducted using the words "endocrine disruptors," "neuroendocrine effects," "neurobehavioral effects," and "neurodevelopmental effects" and articles containing relevant studies were examined. Results: Recent studies have shown a strong correlation between exposure to endocrine disrupting chemicals and the development of neurodegenerative diseases such as Alzheimer's and Parkinson's disease, and neurodevelopmental diseases such as autism spectrum disorder and attention deficit hyperactivity disorder. The effects of common pollutants such as pesticides, bisphenol A, polychlorinated biphenyls, and heavy metals on the endocrine system have been especially emphasized. Conclusion: In conclusion, understanding the role played by endocrine disrupting chemicals in the development of neurological diseases will be of critical importance in the development of new strategies to prevent these diseases.
https://doi.org/10.55730/1300-0144.6127

Understanding the Impact of Endocrine Disrupting Chemicals (EDCs) and Mechanisms of Microbial Biodegradation: A Review,
Kaur, A. and Patowary, R., *Water Air and Soil Pollution*, Feb 12 2026, Vol. 237, no. 9.

Increase in anthropogenic activities, and rapid industrialization have led to the release of effluents which consists of severe constituents that may lead to threat to the environment and its components. Endocrine-disrupting chemicals (EDCs) are a broader group of exogenous substances that can potentially hinder the endocrine networking in humans, animals, and even plants leading to adverse metabolic syndrome and malfunctioning of the system. They include chemicals such as bisphenol A (BPA), phthalates, pesticides, and industrial pollutants which can mimic, change or shut down the synthesis, metabolism, or action of hormones which are the prime signalling molecules for initiation of various metabolic pathways. It is a need for development of strategies to degrade these harmful chemicals for a sustainable environment and reduce their impacts on the ecosystem. The present review discusses the adverse effects of EDCs and elaborates the mechanism of biodegradation of EDCs from contaminated environment. The tripartite interaction amongst soil, plants and microbes has also been incorporated as it actually plays a significant role in the removal or neutralization of contaminants from environment. Lastly, the review throws light into the future perspectives and research scopes in the concerned area so that efficient removal techniques and monitoring methods can be developed for creating a sustainable environment.
https://doi.org/10.1007/s11270-026-09181-1

Developmental exposure to polystyrene nanoplastics induces persistent neurobehavioral changes and alters later-life susceptibility to hexabromocyclododecane in zebrafish,
Kim, J., Im, J. and Choi, J., *Ecotoxicology and Environmental Safety*, Jan 15 2026, Vol. 310.

Micro- and nanoplastic pollution poses a global threat due to environmental accumulation, poor reversibility, and adverse effects on humans and wildlife. Nanoplastics can cross the blood-brain barrier (BBB) and induce neurotoxicity, yet studies investigating the developmental effects of nanoplastic exposure during early life (a period vulnerable to environmental stressors) and their influence on later-life outcomes remain limited. This study examined whether early-life exposure to polystyrene nanoplastics (PS-NPs) during embryonic and larval stages has lasting effects and alters susceptibility to hexabromocyclododecane (HBCD), a brominated flame retardant globally detected in aquatic environment, in zebrafish. Developmental exposure to PS-NPs led to reduced locomotor activity in both larvae (5 dpf) and adults (157 dpf). Furthermore, early PS-NP exposure modified behavioral response to HBCD in adulthood: adult fish exposed to HBCD for the first time exhibited

hyperactivity, whereas those previously exposed to PS-NPs showed no significant change. These differential responses were strongly correlated with altered expressions of neurological and neurodevelopmental genes (e.g., drd2a, glud1a, fezf2) and global DNA methylation levels. Our findings suggest that epigenetic processes may contribute to the observed differences in adult locomotor behavior and susceptibility to subsequent HBCD exposure. This study highlights the need for further research into locus-specific epigenetic regulation of neural genes during development and their quantitative relationship to adverse outcomes. In light of the conservation of epigenetic mechanisms across species and the widespread presence of environmental substances from industrial and consumer products that can disrupt these pathways, our study underscores the broader implications for environmental health. https://doi.org/10.1016/j.ecoenv.2026.119754

What known about endocrine disrupting chemicals and bone metabolism,
Koçak, G. and Dinçel, A. S., *International Journal of Environmental Health Research*, 2026.

Endocrine disruptors are chemicals that alter the synthesis, transport, release, binding, and degradation of natural hormones involved in reproduction and development. Scientific research conducted in recent years has significantly advanced understanding of the health effects of these chemicals. Many endocrine disruptors to which we are unknowingly exposed in our daily lives may affect our tissues, organs, and even bones. When the studies are examined, it is seen that exposure to endocrine-disrupting chemicals (EDCs) even in the prenatal period leads to delayed ossification, growth retardation, changes in bone length and size, and decreases in bone mineral density and mineral content. Information regarding bone health, development, growth, and mineral content reveals that EDCs negatively impact these processes at both clinical and molecular levels. This review addresses the effects of bisphenols, alkylphenols, organotin compounds, dioxins and dioxin-like compounds, phthalate esters, and per- and polyfluoroalkyl substances on bone. The selection of these substances is based on key characteristics such as persistence, environmental prevalence, endocrine activity, and their potential to cause changes in bone development, metabolism, and structural integrity. This review summarizes the effects of endocrine disruptors on bone metabolism, but further research is needed as these mechanisms are not yet fully understood.
https://doi.org/10.1080/09603123.2026.2621904

What known about endocrine disrupting chemicals and bone metabolism,
Koçak, G. and Dinçel, A. S., *International Journal of Environmental Health Research*, 2026.

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https://doi.org/10.1080/09603123.2026.2621904

Interplay between aryl hydrocarbon and estrogen receptor signaling-A possible explanation of endocrine-disrupting and immunomodulatory effects of mycotoxins,
Kowalska, K., Elesh, I. F. I. and Marko, D., *Journal of Hazardous Materials*, Jan 1 2026, Vol. 501.

Although the endocrine-disrupting (ED) and immunomodulatory effects of mycotoxins are well documented, both in vitro and in vivo, little is known about their detailed molecular mechanisms. Here, we elucidated two known effects of mycotoxins: ED and immunomodulatory, and proposed the possible linker: the interplay between aryl hydrocarbon receptor (AhR) and estrogen receptor (ER) signaling pathways. We reviewed in detail the immunomodulatory role of both AhR and ER signaling pathways and suggested their possible interaction, which might result in ED and immunomodulatory effects. This research may serve as a future direction for both mycotoxin and other environmental toxin research, paving the way for comprehensive mechanistic insights that link risk assessment, toxicology, and molecular biology.
https://doi.org/10.1016/j.jhazmat.2025.140838

Bisphenols and their role in female infertility and hormone-related cancer,
Koziel-Leszczynska, M. J. and Piastowska-Ciesielska, A. W., *Endocrine*, Jan 6 2026, Vol. 91, no. 1.

Various types of external chemicals can disrupt the endocrine system, interfering with normal hormone function and causing a broad spectrum of negative health effects. Endocrine-disrupting chemicals (EDCs) are a diverse group of natural and synthetic chemicals that are known to contaminate the environment. It is postulated that these agents can contribute to the development of many diseases, including infertility and cancer, because of their ability to interfere with estrogen receptors (ERs). Bisphenols (BPs) are a group of compounds that belong to EDCs, the most common of which is bisphenol A (BPA). Due to restrictions on the use of BPA in industry, analogues such as bisphenol S (BPS) and bisphenol F (BPF) have been introduced. However, some reports indicate that BPA analogues also have negative effects on the endocrine system in both humans and animals because of their structural similarity. This review summarises current knowledge related to BPA, its analogues and their role in female infertility and hormone-related cancers. Furthermore, this review also points to the problem of exposure to more than one estrogenic agent and highlights the importance of considering exposure to multiple chemicals when assessing health effects and setting daily limits. https://doi.org/10.1007/s12020-025-04521-3

Platelet mitochondrial DNA methylation mediates the association of bisphenol, phthalate, and paraben exposures with type 2 diabetes mellitus: An exploratory nested case-control study,
Li, W. X., Shi, S. H., Yu, Y. Y., Chen, B., Zhao, L., Lin, Z., Ni, J. Y., Li, X. Q., Song, S. J., Li, P. H., Hou, S. K. and Guo, L. Q., *Ecotoxicology and Environmental Safety*, Mar 1 2026, Vol. 312.

Exposure to environmental pollutants has been found to be associated with epigenetic modifications of platelet mitochondria, which may influence the risk of type 2 diabetes mellitus (T2DM). However, research on the relationship between exposure to environmental endocrine disrupting chemicals (EDCs) and T2DM remains very limited at the molecular level of mitochondrial epigenetic alterations. This study aims to investigate the impact of mixed exposure to bisphenols (BPs), phthalates (PAEs), and parabens (PBs) on T2DM and platelet mitochondrial DNA (mtDNA) methylation, using a nested case-control study design. Levels of BPs, PAEs, and PBs metabolites were quantified using high-performance liquid chromatography-mass spectrometry (HPLC-MS). We used weighted quantile sum (WQS) and bayesian kernel machine regression (BKMR) models to assess the association between individual and mixed exposure to multiple EDCs and T2DM. Methylation levels of mitochondrial coding genes were measured by bisulfite pyrosequencing. In

logistic regression models, MT-COX1 methylation levels were significantly negatively associated with T2DM risk, whereas MT-COX3 methylation levels were significantly positively associated. Both WQS and BKMR models indicated that mixed exposure to BPs, PAEs, and PBs was positively linked to T2DM, with DnPrP and DEHP identified as the primary contributors. Mediation analysis demonstrated that MT-COX3 methylation significantly mediated the associations of DEP, DMP, DEHP, DnPrP, DAlP, and MP with T2DM. Our findings indicate that both individual and mixed exposure to PAEs and PBs are positively associated with T2DM risk. Platelet mtDNA methylation mediates the association between EDCs exposure and T2DM risk, suggesting its potential utility as a biomarker. https://doi.org/10.1016/j.ecoenv.2026.119908

Effects of Thyroid Hormones on Brain Development: Cytoarchitecture and Neurodevelopmental Disorders,
Li, X. A., Yao, S. M., Pan, P., Zhou, J. W. and Wang, J. H., *Faseb Journal*, Jan 23 2026, Vol. 40, no. 2.

Thyroid hormones (THs) are endocrine factors that play an important role in brain development by modulating several neurodevelopmental processes, including neuronal migration, synaptogenesis, and myelination. Therefore, adequate regulation of these hormones is important for the structure and function of the brain. Recently, a close association between THs deficiency or dysfunction has been found with several neurodevelopmental disorders, including autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD). These results imply that thyroid hormones play an important role in the occurrence of neurodevelopmental disorders. In this review, we thoroughly investigate the biosynthetic pathways and regulatory mechanisms involved in thyroid hormones production. We also assess the importance of thyroid hormones during different periods of brain development, as well as the underlying molecular processes. Finally, we extend our discussion to explore the relationship between thyroid hormones and neurodevelopmental disorders. The objective is to provide mechanistic and clinical insights and to identify promising research avenues that could facilitate earlier diagnosis and intervention for these conditions.
https://doi.org/10.1096/fj.202503736R

Endogenous 15(S)-hydroxyeicosatetraenoic acid mediates amplified estrogenic responses under nanoplastic-homosalate coexposure,
Li, Z. M., Chen, X. Q., Yang, X. H., Huang, X. Y., Ye, R. Y., Du, J. X., Tang, S. Q., Qiu, A. Q., Huang, Y. J., Deng, Y. H., Zhong, Y. Z., Liang, B. X., Hui, C. Y., Chen, D. and Huang, Z. L., *Environment International*, Feb 2026, Vol. 208.

Micro-and nanoplastics (MNPs) can enhance the toxicity of co-occurring chemicals via a proposed "Trojan horse" effect, yet the underlying mechanisms remain unclear. Here, we investigated the estrogenic effects of coexposure of ultraviolet filter homosalate (HMS) and polystyrene nanosphere (PNS) using ovariectomized mice (HMS: 0.1 and 1 mg/kg; PNS: 2.5 mg/kg) and human cell models (HMS: 0.01-1 mu M; PNS: 1 mg/L). In mice, HMS-PNS coexposure significantly increased uterine weight, promoted mammary gland proliferation, and upregulated estrogen receptor 1 and its downstream targets amphiregulin and progesterone receptor. Integrated metabolomic and transcriptomic analyses identified endogenous 15(S)-hydroxyeicosatetraenoic acid (15(S)-HETE) as a key mediator of these effects in mammary glands. In MCF-7 cells, HMS-PNS coexposure elevated 15 (S)-HETE levels, promoting cell proliferation via the estrogen receptor alpha-arachidonate 15-lipoxygenase (ER alpha- ALOX15) axis. At a concentration of 100 nM 15(S)-HETE, pharmacological inhibition of phosphoinositide 3-ki-nase/protein kinase B (PI3K/AKT) abrogated cell proliferation and serum and glucocorticoid-regulated kinase 1 (SGK1) activation. Moreover, immunoprecipitation and docking analyses suggested a direct interaction between 15(S)-HETE and SGK1. Knockdown of ALOX15, or PI3K/AKT inhibition, suppressed HMS-PNS-induced cell proliferation. Taken together,

these results demonstrated that HMS-PNS coexposure amplifies estrogenic responses through ER alpha-ALOX15-dependent 15(S)-HETE production and PI3K/AKT/SGK1 signaling. Our findings uncover a mechanistic pathway beyond the canonical "Trojan horse" effect, providing new insight into how MNPs modulate endocrine-disrupting activity of co-occurring contaminants and informing future risk assessment of combined environmental exposures.
https://doi.org/10.1016/j.envint.2026.110083

Exploring the Impact of Polychlorinated Biphenyls (PCBs) on the Development of MASLD: A Comprehensive Review,
Longo, V., Augello, G., Aloi, N., Cusimano, A., Licata, A., Cannizzaro, E., Cervello, M., Soresi, M., Colombo, P. and Giannitrapani, L., *Cells*, Feb 18 2026, Vol. 15, no. 4.

Highlights Experimental, epidemiological, and mechanistic evidence links polychlorinated bi-phenyl (PCB) exposure to liver injury, steatosis/steatohepatitis, fibrosis, and hepato-carcinogenesis, with a focus on congener profiles and susceptibility factors (e.g., sex, metabolic comorbidities). PCB-driven molecular pathways in hepatocytes and hepatic non-parenchymal cells, specifically in aryl hydrocarbon receptor (AhR), constitutive androstane receptor (CAR), and pregnane X receptor (PXR) signaling, oxidative stress, mitochondrial dysfunction, lipid metabolism reprogramming, inflammatory/immune responses, have implications for liver disease progression. What are the main findings? Chronic PCB exposure is consistently associated with liver dysfunction and MASLD phenotypes in both humans and experimental models. PCBs disrupt hepatic homeostasis by converging on a limited set of pathways (AhR, CAR/PXR), inducing oxidative and ER stress, mitochondrial impairment, and the dysregulation of lipid and glucose metabolism. What are the implications of the main findings? There is an impact on public health and clinical practice. We suggestcandidate biomarkers and therapeutic targets.Highlights Experimental, epidemiological, and mechanistic evidence links polychlorinated bi-phenyl (PCB) exposure to liver injury, steatosis/steatohepatitis, fibrosis, and hepato-carcinogenesis, with a focus on congener profiles and susceptibility factors (e.g., sex, metabolic comorbidities). PCB-driven molecular pathways in hepatocytes and hepatic non-parenchymal cells, specifically in aryl hydrocarbon receptor (AhR), constitutive androstane receptor (CAR), and pregnane X receptor (PXR) signaling, oxidative stress, mitochondrial dysfunction, lipid metabolism reprogramming, inflammatory/immune responses, have implications for liver disease progression. What are the main findings? Chronic PCB exposure is consistently associated with liver dysfunction and MASLD phenotypes in both humans and experimental models. PCBs disrupt hepatic homeostasis by converging on a limited set of pathways (AhR, CAR/PXR), inducing oxidative and ER stress, mitochondrial impairment, and the dysregulation of lipid and glucose metabolism. What are the implications of the main findings? There is an impact on public health and clinical practice. We suggestcandidate biomarkers and therapeutic targets.Highlights Experimental, epidemiological, and mechanistic evidence links polychlorinated bi-phenyl (PCB) exposure to liver injury, steatosis/steatohepatitis, fibrosis, and hepato-carcinogenesis, with a focus on congener profiles and susceptibility factors (e.g., sex, metabolic comorbidities). PCB-driven molecular pathways in hepatocytes and hepatic non-parenchymal cells, specifically in aryl hydrocarbon receptor (AhR), constitutive androstane receptor (CAR), and pregnane X receptor (PXR) signaling, oxidative stress, mitochondrial dysfunction, lipid metabolism reprogramming, inflammatory/immune responses, have implications for liver disease progression. What are the main findings? Chronic PCB exposure is consistently associated with liver dysfunction and MASLD phenotypes in both humans and experimental models. PCBs disrupt hepatic homeostasis by converging on a limited set of pathways (AhR, CAR/PXR), inducing oxidative and ER stress, mitochondrial impairment, and the dysregulation of lipid and glucose metabolism. What are the implications of the main findings? There is an impact on public health and clinical practice. We suggestcandidate biomarkers and therapeutic targets.Abstract Metabolic dysfunction-associated

steatotic liver disease (MASLD), formerly known as non-alcoholic fatty liver disease (NAFLD), is becoming the most common liver disease, affecting between 30 and 40% of the global population. MASLD is a multifaceted disease spectrum that is closely associated with obesity, insulin resistance, type 2 diabetes mellitus and, more broadly, metabolic syndrome. All these conditions increase the risk of liver-related mortality, which explains the intense research efforts in recent years to better elucidate its pathogenesis. The crucial impact of environmental pollutants on the development of MASLD is now well recognized. Polychlorinated biphenyls (PCBs) are environmental contaminants that act as endocrine disruptors. Recently, they have been associated with the development of diabetes, obesity, MASLD, and cancer. The association between liver diseases, namely toxicant-associated steatotic liver disease and steatohepatitis (TASLD and TASH, respectively), and occupational exposure to PCBs and other industrial chemicals has been documented by several lines of evidence, whereas the potential role of low-level environmental pollution in liver disease and in MASLD remains incompletely understood. Previous studies on animal models have shown that PCB exposure is associated with steatosis/steatohepatitis, fibrosis, cirrhosis, hepatocellular carcinoma (HCC), altered liver enzymes, and mortality in exposed populations. This review investigates the mechanisms underlying hepatic steatogenesis in preclinical and animal models and analyzes the existing literature on the possible role of PCBs, together with the other conventional risk factors, in the development of MASLD in humans. https://doi.org/10.3390/cells15040364

In Silico Identification of Molecular Interactions of the Emerging Contaminant Octyl Methoxycinnamate (OMC) on HPT Axis: Implications for Humans and Zebrafish,
Lorigo, M., Breitenfeld, L., Monteiro, M. S., Soares, A., Quintaneiro, C. and Cairrao, E.,
Pharmaceuticals, Dec 16 2025, Vol. 18, no. 12.

Background/Objectives: Thyroid hormones (THs) regulate almost all physiological processes in vertebrates via specific mechanisms exercised spatiotemporally throughout the lifespan. The TH signalling can be impaired by thyroid-disrupting chemicals (TDCs) capable of disrupting the hypothalamic-pituitary-thyroid (HPT) axis. Octyl methoxycinnamate (OMC) (also designated octinoxate), one of the most widely used ultraviolet (UV) filters, has emerged as an environmental contaminant and has raised significant concerns recently due to its disruptive effects as TDC on humans and animals. Although the disruption of TH homeostasis has been reported, its exact modes of action (MoA) remain largely unknown. Our study aimed to provide a comparative information on the molecular interactions of OMC on TH signalling in humans and zebrafish. Methods: In silico approaches were performed comparing OMC with endogenous thyroid hormone T3 and the anti-thyroid drug propylthiouracil (PTU). Results: Our findings suggested a key role of OMC on the corticotrophin-releasing hormone receptor (crhr2), thyrotropin receptor (TSHR/tshr), and thyroid nuclear receptors (TR/tr-alpha and -beta). At the hypothalamic level, a favourable binding of OMC to zebrafish crhr2 was found, involving ALA86, CYS44, HIS89, ILE63, ILE64, LEU92, PRO87, PRO88, SER48, and THR47. At the pituitary level, OMC was bound to human TSHR by the amino acid residues ASN590, GLU506, ILE583, ILE640, LEU570, MET572, PRO571, SER505, TYR667, VAL502, VAL586, ALA644, LEU587, MET637, SER641, and TYR582 and to zebrafish tsrh by ASN589, ILE639, MET636, ILE582, LEU569, LEU586, VAL501, and VAL585. Concerning nuclear receptors, OMC showed a more favourable binding energy of T3, involving the shared residues PHE218 and MET259 with T3 in both species. For human TR beta, OMC shared T3 with residues ILE 275, ILE276, LEU346, PHE269, PHE272, THR273, ALA279, ASN331, HIS435, LEU330, MET310, MET313, and PHE455. No similar residues were obtained for zebrafish tr beta compared with the humans. Conclusions: Overall, the action of OMC seems to agree with primary hypothyroidism (anti-thyroid action) mimicking the T3 hormone. This investigation demonstrates that OMC acts as a potential TDC and provides new insights into its disruptive action on the HPT axis.
https://doi.org/10.3390/ph18121897

Nuclear Receptor Networks as the Central Hub of Endocrine-Disrupting Chemical Neurotoxicity: A System Toxicology Perspective,
Lu, Y. T., Ren, L., Yu, J., Zhang, T. H. and Zhang, J., *Environmental Science & Technology*, Feb 10 2026, Vol. 60, no. 5, p. 3767-3783.

Endocrine-disrupting chemicals (EDCs) are ubiquitous environmental contaminants linked to rising neurodevelopmental disorders, yet the neurotoxicity of real-world low-dose mixtures remains poorly understood. This review establishes a conceptual framework positioning the nuclear receptor (NR) superfamily as the central integrative hub, where structurally diverse EDC signals converge. Transcending traditional single-chemical paradigms, we detail how mixtures co-opt the NR network through molecular crosstalk, heterodimer competition, and epigenetic reprogramming. Such disruptions trigger pathogenic cascades, including dysregulated neuroinflammation, impaired synaptic plasticity, and bioenergetic collapse, that compromise brain development. We critically evaluate state-of-the-art experimental and computational models, from brain organoids to microphysiological systems, advocating for an integrated systems toxicology approach. Leveraging time-series multiomics and dynamic network modeling is essential to identify mechanistic thresholds and assess potential transgenerational risks. This NR-centered framework provides a robust foundation for evolving the discipline from descriptive toxicology to predictive, next-generation risk assessment, ultimately safeguarding brain health in an increasingly complex chemical environment.
https://doi.org/10.1021/acs.est.5c14620

Role of Bisphenol A and its Analogues on Epigenetics and their Impact on the Developmental Origins of Female and Male Reproductive Disorders,
Martínez-Ibarra, A., Martínez-Razo, L. D., Morales-Pacheco, M., González-Sánchez, I., Rodríguez-Dorantes, M. and Cerbón, M., *Archives of Medical Research*, Apr 2026, Vol. 57, no. 3.

Reproductive disorders may originate from many factors including exposure to environmental chemicals in the womb or during the early stages of postnatal life. Throughout these stages, the exposure to endocrine-disrupting chemicals (EDCs), such as bisphenols, can disrupt reproductive function. These compounds cross the placenta and cause long-term epigenetic alterations in the fetus. Bisphenols are a large class of chemicals mainly used in the plastic industry and epoxy resin production. Bisphenol A (BPA) was the first and most widely used compound; however, it acts as a hormone by binding to estrogen receptors (ERs), affecting estrogen-dependent functions. As a result, BPA has been replaced by analogues or similar compounds, such as bisphenol F (BPF), bisphenol S (BPS), bisphenol B (BPB), and bisphenol AF (BPAF), among others. Although these compounds were originally synthesized to be safe for human use, they have also exhibited endocrine-disrupting activity similar to BPA, which affects reproductive function. BPA analogues also induce epigenetic changes, such as DNA methylation, histone modification, chromatin remodeling, and non-coding RNA regulation. These changes can lead to reproductive disorders and negative long-term and transgenerational consequences. This narrative review includes in vivo, in vitro, and human cohort studies that examine how BPA and its analogues affect male and female reproductive function through epigenetic mechanisms. Through this pathway, these chemical compounds have the potential to modify developmental programming. (c) 2026 Instituto Mexicano del Seguro Social (IMSS). Published by Elsevier Inc. All rights are reserved, including those for text and data mining, AI training, and similar technologies.
https://doi.org/10.1016/j.arcmed.2026.103380

Consequences and Functional Alterations of Endocrine Disruptors on Women's Health,

Mishra, D., Singh, R., Nandakumar, U. P., Pradhan, R. and Chand, S., *Current Womens Health Reviews*, 2026 2026, Vol. 22, no. 2.

Endocrine-disrupting chemicals (EDCs) are anthropogenic compounds that have garnered significant research consideration due to their harmful effects on human health. These compounds disrupt normal physiological homeostasis by interfering with processes such as hormone synthesis, transport, metabolism, and excretion. Even at low concentrations, EDCs can contribute to severe health issues, including life-threatening cancers and metabolic disorders in humans and animals. Consequently, monitoring EDCs in human populations is a critical area of focus. Preclinical and in vitro studies have established the impact of EDCs on hormonal pathways, particularly in male and female gonadal development. Furthermore, biomonitoring studies have detected EDCs in various biological matrices, including those of foetuses, children, and pregnant women. Exposure to EDCs has been associated with complications in the female reproductive system, like premature ovarian failure, precocious puberty, and polycystic ovary syndrome. This review provides a comprehensive summary of the associations between EDC exposure and female reproductive dysfunction, emphasizing potential mechanisms underlying these effects.
https://doi.org/10.2174/0115734048361078250515192658

Placental toxicity of alternative plasticizers: Current knowledge and future directions, Nadeem, M., Jojy, M., Meschia, M. and Warner, G. R., *Reproductive Toxicology*, Mar 2026, Vol. 140.

Phthalates, a class of plasticizers, are known endocrine-disrupting chemicals that can negatively impact reproduction and development, including placental development and function. In response to growing concerns, various groups of chemicals, including but not limited to terephthalates, citrates, and cyclohexane dicarboxylic acids, have been developed as phthalate replacements. However, significant research gaps remain in understanding how these new chemicals affect humans. This review aims to synthesize existing research on how phthalate alternatives affect the placenta, a transient yet critical organ that supports fetal growth and development during pregnancy. Disruptions to placental structure and function can cause pregnancy complications and alter fetal programming. Herein, we review findings from biomonitoring, in vivo and in vitro experiments, as well as epidemiological studies to assess potential impacts. Although biomonitoring and house dust studies have identified the presence of alternative plasticizers, many identified chemical groups lack studies on their effects during pregnancy and on the placenta. Given the rising levels of these chemicals and their metabolites in urine and blood, further investigation into their mechanisms of toxicity is necessary. Notably, some alternatives may have the capability to alter pregnancy outcomes similar to traditional phthalates, such as by increasing the likelihood to develop conditions like gestational diabetes mellitus, although the majority of alternative plasticizers lack data. Understanding these impacts will inform public policy aimed at protecting maternal and fetal health, facilitate the development of safer consumer products, and prevent further emergence of regrettable replacements. https://doi.org/10.1016/j.reprotox.2025.109143

Placental toxicity of alternative plasticizers: Current knowledge and future directions, Nadeem, M., Jojy, M., Meschia, M. and Warner, G. R., *Reproductive Toxicology*, Mar 2026, Vol. 140.

Phthalates, a class of plasticizers, are known endocrine-disrupting chemicals that can negatively impact reproduction and development, including placental development and function. In response to growing concerns, various groups of chemicals, including but not limited to terephthalates, citrates, and cyclohexane dicarboxylic acids, have been developed as phthalate replacements. However, significant research gaps remain in understanding how these new chemicals affect humans. This review aims to synthesize existing research on how phthalate alternatives affect the

placenta, a transient yet critical organ that supports fetal growth and development during pregnancy. Disruptions to placental structure and function can cause pregnancy complications and alter fetal programming. Herein, we review findings from biomonitoring, in vivo and in vitro experiments, as well as epidemiological studies to assess potential impacts. Although biomonitoring and house dust studies have identified the presence of alternative plasticizers, many identified chemical groups lack studies on their effects during pregnancy and on the placenta. Given the rising levels of these chemicals and their metabolites in urine and blood, further investigation into their mechanisms of toxicity is necessary. Notably, some alternatives may have the capability to alter pregnancy outcomes similar to traditional phthalates, such as by increasing the likelihood to develop conditions like gestational diabetes mellitus, although the majority of alternative plasticizers lack data. Understanding these impacts will inform public policy aimed at protecting maternal and fetal health, facilitate the development of safer consumer products, and prevent further emergence of regrettable replacements. https://doi.org/10.1016/j.reprotox.2025.109143

High-throughput screening of estrogen receptor activity in personalized mixtures of persistent organic pollutants detected in the blood of Swedish adults,
Reis, L., Strand, D., Höglund, A., Lundgren, B., Bergdahl, I. A., Martin, J. W. and Karlsson, O., *Environmental Research*, Feb 1 2026, Vol. 290.

Toxicological studies of single chemicals overlook the real-world complexity of human exposure, where multiple compounds may interact to disrupt biological processes such as endocrine signaling. Moreover, the chemical exposome, the sum of an individual's chemical burden, varies markedly between people, yet its biological implications remain unclear. To address this gap, we reconstructed individualized human chemical exposomes to assess their effects on estrogen receptor (ER) activity. Sixteen exposomes comprising 24 persistent organic pollutant (POP) were derived from blood profiles of participants in the Swedish Va<spacing diaeresis>sterbotten Intervention Programme. Using automated, non-contact acoustic liquid dispensing, we reconstructed 14 personalized mixtures (PMs) reflecting individual blood compositions and two formulated mixtures (FM) representing the cohort's median and maximum population exposure levels. ER activity was assessed in VM7Luc4E2 cells using a high-throughput 384-well adaption of the OECD No. 455 assay at 1x, 10x and 100x blood concentrations. While most individual POPs showed no or weak ER activity, three mixtures induced ER agonism. The PM-High, corresponding to the individual with the highest total POP levels, and the FM-Median activated the ER at 100x, while the FM-Maximum induced activation at 10x and 100x. Removing beta-HCH and trans-nonachlor from the active mixtures abolished or reduced ER activity. Co-treatment with physiological estradiol levels increased ER responses in six mixtures, PM#1 (1x and 10x), PM#4 (100x), PM#8 (10x), PM#9 (100x), PM#10 (1x) and the FM-Median (1x), indicating potentiation of endogenous hormonal signaling. Overall, this study reveals endocrine activity in real-world POP mixtures and advances high-throughput screening as a scalable approach for individualized exposome-based health risk evaluation. https://doi.org/10.1016/j.envres.2025.123388

Binding activities of bisphenol analogues toward TTR and TBG and their potential to disrupt thyroid hormone homeostasis☆,
Ren, X. M., Liu, X. X., Ma, Y. W., Zhang, X. C., He, H., Xu, Z. X., Yang, G., Huang, B. and Pan, X. J., *Environmental Pollution*, Apr 1 2026, Vol. 394.

Bisphenol analogues (BPs) are widely used industrial chemicals, raising concern regarding their potential disruption of the thyroid hormone (TH) system. This study systematically evaluated the binding properties and interference potential of 21 structurally diverse BPs toward transthyretin (TTR) and thyroxine-binding globulin (TBG). Fluorescence polarization assays showed that TTR

binding was primarily driven by bridging-group rigidity, halogen substitution, and hydroxyl number, whereas TBG affinity was more dependent on molecular polarity and steric volume. Molecular docking supported the roles of halogenation and structural complementarity in stabilizing ligand-protein interactions. A quantitative in vitro to in vivo extrapolation (QIVIVE) model predicted that environmentally relevant exposure levels of most BPs cause negligible alterations in serum free T4, and mixture effects were approximately additive. Toxicological Priority Index (ToxPi) integration identified highly halogenated congeners as dominant high-risk candidates, with substantially greater potential impacts under occupational high-exposure scenarios. Overall, this work establishes a multi-tiered framework linking molecular binding characteristics to in vivo hormone perturbations, providing scientific support for evaluating TH-disrupting risks and guiding the identification of safer BP alternatives. https://doi.org/10.1016/j.envpol.2026.127768

Exploratory identification of COL1A1 as a potential gene linking endocrine-disrupting chemicals and lung adenocarcinoma: a bioinformatics and machine learning analysis,
She, T. Y., Sun, F. T., Xie, Z., Cao, Y. Z. and Xu, H. T., *Bmc Pharmacology & Toxicology*, Feb 16 2026, Vol. 27, no. 1.

BackgroundEndocrine-disrupting chemicals (EDCs) are common environmental pollutants that affect human health. These chemicals have been linked to the development and progression of many types of cancer. However, the mechanism by which EDCs affect the development of lung adenocarcinoma (LUAD) remains unclear.MethodsBioinformatics and machine learning approaches were used to explore the connection between 13 EDCs and LUAD. Target genes for the 13 EDCs were retrieved from the ChEMBL, STITCH, and SwissTargetPrediction databases. Differentially expressed genes (DEGs) in LUAD were identified from GEO datasets. Weighted gene co-expression network analysis (WGCNA) and protein-protein interaction (PPI) networks were used to identify key gene modules related to LUAD. Machine learning methods were employed to select important genes associated with both LUAD and EDC exposure. Gene Set Enrichment Analysis (GSEA) and Gene Set Variation Analysis (GSVA) were performed to assess relevant biological pathways. Immune cell infiltration was analyzed using CIBERSORT to explore changes in the immune microenvironment of LUAD.ResultsA total of 1,818 putative target genes for the 13 EDCs were initially identified. WGCNA refined this list to 93 candidate genes, among which COL1A1 was prioritized as a robust feature gene via machine learning algorithms. Functional enrichment analysis indicated that COL1A1 is involved in critical pathways, including cytokine-cytokine receptor interaction, ECM-receptor interaction, and fatty acid metabolism. Furthermore, immune infiltration profiling revealed distinct correlation patterns: COL1A1 expression was positively correlated with the abundance of M0 and M2 macrophages, while showing a negative correlation with monocytes and eosinophils.ConclusionThis study identifies COL1A1 as a key feature gene associated with EDC-targeted pathways in LUAD. The findings characterize its involvement in ECM-related signaling and its correlation with specific immune cell infiltration patterns, providing a computational framework for understanding EDC-associated molecular changes in LUAD. https://doi.org/10.1186/s40360-026-01101-7

Another pleiotropic effect of SGLT2 inhibitors: Is it a new frontier in thyroid function regulation?,
Szklarz, M., Wolos-Klosowicz, K., Szulc, J., Górny, J., Modzelewski, R. and Matuszewski, W., *Thyroid Research*, Jan 5 2026, Vol. 19, no. 1.

In our review, we present possible hypotheses that might explain how sodium glucose cotransporter 2 (SGLT2) inhibitors affect thyroid function. We describe mutual interactions between thyroid hormones and the development of diabetes and obesity. We show the effects of other antihyperglycemic drugs on thyroid hormone changes. We demonstrate how endocrine-disrupting chemicals (EDCs) may act as potential triggers for the development of thyroid disease, obesity and

diabetes, and how SGLT2 inhibitors may constitute a potential protective barrier against their negative effects. We describe mechanisms of the immunomodulatory and antioxidant effects of flozins, that may reduce the risk of autoimmune thyroid disease (AITD). We describe beneficial effects of flozins on heart and kidney function, that may also contribute to thyroid protection. Finally, we present a hypothesis of a possible favourable effect of SGLT2 inhibitors on Graves' orbitopathy (GO), myocardial protection in hyperthyroidism, and a reduction in the risk of thyroid cancer. Aim of our work is to summarise current evidence and hypotheses regarding SGLT2 inhibitors and thyroid function. However, it should be borne in mind that there are still limited clinical evidence about impact of flozins on thyroid metabolism.Clinical trial number Not applicable. https://doi.org/10.1186/s13044-025-00282-3

Xenobiotic modalities impacting the thyroid 3H framework of hormonogenesis, homeostasis, and human health,
Tater, A., Rudresh, B. B. and Gaonkar, S. L., *Drug and Chemical Toxicology*, 2026.

The thyroid gland is a central endocrine organ regulating growth, metabolism, and energy balance, and is increasingly vulnerable to interference by diverse xenobiotic compounds from pharmaceuticals, environmental pollutants, diet, and consumer products. This review introduces a thyroid '3H' framework - hormonogenesis, homeostasis, and human health - to integrate current understanding of how thyroid endocrine-disrupting chemicals (Thy-EDCs) perturb thyroid physiology and the hypothalamic-pituitary-thyroid axis. A systematic literature search was conducted using PubMed, Scopus, and Web of Science, supplemented by reference screening to ensure comprehensive coverage of mechanistic and toxicological evidence. The synthesis indicates that various exogenous compounds - including tyrosine kinase inhibitors, immune checkpoint inhibitors, heavy metals, industrial endocrine disruptors, and certain dietary phytochemicals - affect thyroid function through multiple molecular initiating events. These include inhibition of thyroperoxidase, disruption of iodine uptake and organification, altered deiodinase activity, modulation of thyroid hormone receptor signaling, and immune-mediated effects on thyroid tissue. Such perturbations lead to abnormalities in hormone synthesis, metabolism, and systemic hormone homeostasis. Emerging structure-activity relationship (SAR) and computational modeling approaches provide further insight into how specific chemical features determine thyroid-disruptive potential, supporting the advancement of predictive toxicology and risk assessment. The novelty of this review lies in its integrated 3H perspective, linking physiological, molecular, immunological, and toxicological dimensions of thyroid disruption. This conceptual framework supports improved diagnosis of thyroid dysfunction, promotes safer chemical and drug design, and informs regulatory strategies aimed at protecting endocrine health. https://doi.org/10.1080/01480545.2025.2606102

The influence of endocrine disruptors on the gut microbiota,
Ugur, K., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

Endocrine disruptors (EDs) are closely associated with the second brain, the microbiota-derived enteric nervous system, commonly referred to as the gut microbiota. The microbiota plays a crucial role in human health and the development of diseases. In today's industrialized world, the presence of EDs in air, water, and soil leads to primary human exposure through dermal contact and ingestion. The impact of these EDs on the microbiota remains unclear. EDs that disrupt the balance of the gut microbiota may contribute to a range of disorders, including metabolic (obesity, diabetes mellitus), cardiovascular (vascular stenosis, cerebrovascular disease), reproductive (infertility, ovarian and testicular tumors), neurological (dysfunction of the amygdala, cortex, and cerebellum), and behavioral disorders (dementia, depression, anxiety, and schizophrenia). This review examines the effects of commonly encountered environmental EDs on the gut microbiota and summarizes the

most recent findings on this topic. The concept of the microbiota-derived enteric nervous system and the modulation of the hormonal system through interactions between microorganisms and environmental chemicals have prompted specialists in endocrinology and metabolism to reconsider patient management and treatment strategies. This necessitates a comprehensive evaluation of treatment options that incorporate microbiome data. The information presented in this review will help illuminate future research directions and serve as a valuable resource for subsequent studies. https://doi.org/10.55730/1300-0144.6124

Exposure to environmental xenobiotics and lung tissue function: A comprehensive review on biological mechanisms and pathways,
Wu, X. J., Lin, L., Yan, H. Y., Zheng, F. S., Ding, Y. Y. and Yao, H. S., *Ecotoxicology and Environmental Safety*, Dec 2025, Vol. 308.

Environmental xenobiotics, encompassing a wide spectrum of chemical pollutants such as particulate matter-bound polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), persistent organic pollutants (POPs), heavy metals, endocrine-disrupting chemicals (EDCs), pesticides, and emerging contaminants like nanomaterials and microplastics, have been increasingly implicated in impairing lung tissue function. These agents enter the body primarily through inhalation, particularly via outdoor air pollution, indoor contaminants, and occupational exposures, with additional contributions from ingestion and dermal absorption. Studies investigating these pollutants employ diverse exposure assessment methods, including environmental and biological monitoring, model-based estimations, and questionnaire-based tools. Lung function assessment spans from clinical spirometry and imaging to experimental histopathology and molecular biomarker analyses. Mechanistic evidence reveals that xenobiotics induce lung injury through oxidative stress, inflammation, mitochondrial dysfunction, epithelial barrier disruption, and epigenetic alterations. These processes lead to chronic respiratory diseases such as asthma, chronic obstructive pulmonary disease (COPD), pulmonary fibrosis, and lung cancer. Key signaling pathways implicated include activation of NF-kappa B, AP-1, and the aryl hydrocarbon receptor (AhR), promoting pro-inflammatory and cytotoxic responses. Furthermore, pollutant-induced epithelial permeability and fibrotic remodeling via TGF-beta signaling exacerbate lung tissue damage and functional decline. While spirometry is widely used in population studies, it lacks sensitivity for early pathophysiological changes, necessitating integration with molecular and imaging approaches. Experimental models and in vitro studies provide valuable mechanistic insight, though challenges remain in translating findings to human populations. Current research underscores the complexity of real-world exposure scenarios and highlights the need for harmonized, multidisciplinary approaches combining environmental, biological, and molecular data. This comprehensive review synthesizes evidence across epidemiological and experimental studies, aiming to elucidate the biological pathways by which xenobiotic exposure compromises lung tissue function and to inform future research and regulatory strategies. https://doi.org/10.1016/j.ecoenv.2025.119438

Nuclear receptors-mediated lipid metabolism dysregulation: A potential mechanism linking PFOA/PFOS to hepatocellular carcinoma,
Xu, S. J., Qiao, S. K., Zhang, S., Liu, C., Chen, L., Dai, B. H., Yang, C. Q., Xia, L., Xiong, G. S., Zhao, L. Y. and Li, J., *Ecotoxicology and Environmental Safety*, Jan 15 2026, Vol. 310.

Hepatocellular carcinoma (HCC), a prevalent liver malignancy, is closely associated with dysregulated lipid metabolism. Endocrine disrupting chemicals (EDCs) can bind to nuclear receptors (NRs) and potentially induce carcinogenesis, but their specific influence on HCC progression remains unclear. To investigate this relationship, we combined bioinformatic analyses with experimental validation in the present study. Differential expression analysis of public HCC datasets (GSE14323,

GSE17548, and GSE25097) identified candidate genes, which were further refined via weighted gene co-expression network analysis (WGCNA) and machine learning algorithms (RF and SVM-RFE), pinpointing NPY1R and CLEC1B as key genes. Their downregulation in HCC was validated in an independent dataset (GSE54236) and in clinical liver tissues (n = 118). Molecular docking and dynamics simulations prioritized perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) as high-affinity binders to the proteins encoded by these genes. In vitro, exposure to PFOA/PFOS dose-dependently suppressed NPY1R and CLEC1B expression in HepG2 cells. Chromatin immunoprecipitation assays revealed that PFOA/ PFOS inhibit the binding of estrogen receptors (ER alpha and ER beta) to the promoters of these genes, leading to reduced transcription and increased lipid accumulation. Knockdown of ER alpha/ER beta exacerbated, while their overexpression rescued, the lipid-metabolic disruption induced by PFOA/PFOS. These findings indicate that EDCs such as PFOA and PFOS may promote HCC progression by disrupting lipid metabolism via interference with NR-dependent gene regulation, highlighting a novel environmental-toxicological axis in hepatocarcinogenesis. https://doi.org/10.1016/j.ecoenv.2026.119773

ENDOCRINE DISRUPTORS AND PREGNANCY,
Yigit Yalçin, B., Bilik Oyman, G. and Kubat Üzüm, A., *Turkish Journal of Medical Sciences*, 2025 2025, Vol. 55.

Background/aim: Sensitivity to endocrine disruptors is higher in early life. Endocrine disruptor chemicals can be passed from pregnant women to their babies through the placenta or breast milk during lactation, leading to long-term and potentially permanent adverse effects. Materials and methods: This review evaluates the effects of endocrine-disrupting chemicals (EDCs) on pregnancy by summarizing findings from experimental and observational studies. Exposure routes, reproductive outcomes, fetal development implications, and potential preventive strategies are analyzed. Results: Exposure to EDCs during pregnancy has been linked to various complications, including infertility, implantation defects, premature birth, spontaneous abortions, gestational hypertension, and gestational diabetes. Intrauterine exposure to these chemicals may lead to metabolic disorders, congenital anomalies, low birth weight, and delayed physical and mental development in offspring depending on the level and timing of exposure. Conclusion: Due to the significant impact of endocrine disruptors on maternal and fetal health, it is critical to implement protective measures to reduce exposure during pregnancy and lactation. Increased awareness and preventive strategies can help mitigate adverse effects. https://doi.org/10.55730/1300-0144.6123

Association of metal and metalloid exposure with cardiovascular-kidney-metabolic syndrome: mediation by inflammation, oxidative stress, and aging,
Zhang, S., Tang, H. H., Pan, L. Q. and Zhou, M. L., *Bmc Public Health*, Dec 12 2025, Vol. 26, no. 1.

BackgroundMetal and metalloid exposure has been linked to various health impairments; however, its association with Cardiovascular-Kidney-Metabolic (CKM) syndrome has not been systematically investigated. This study aims to evaluate this relationship.MethodsThis cross-sectional study analyzed data from the National Health and Nutrition Examination Survey (NHANES) spanning 1999-2018. Urinary concentrations of nine metal and metalloid species (barium, cadmium, cobalt, cesium, molybdenum, lead, antimony, thallium, and tungsten) were examined. Weighted multinomial logistic regression was used to assess associations between individual metals and CKM syndrome stages. Additionally, mixture models including quantile g-computation (Qgcomp), weighted quantile sum (WQS), and Bayesian kernel machine regression (BKMR) were applied to evaluate combined effects of metals and metalloids. Mediation analyses explored whether inflammation, oxidative stress, and biological aging may partially mediate these associations. Subgroup analyses were conducted by sex, age, and race. Sensitivity analyses including urinary

arsenic were also conducted (2003-2018 NHANES cycles).ResultsAfter applying exclusion criteria, a total of 6,650 participants were included (3,358 men and 3,292 women; mean age 47.3 years, SD = 16.5). CKM syndrome exhibited a high prevalence in the U.S. population. Except for lead, higher CKM stages were generally associated with higher urinary metal levels. Multiple statistical models consistently indicated significant positive associations between exposure to several metals and CKM syndrome. Barium, thallium, and antimony were significantly associated with the overall odds of CKM syndrome, as well as with the risks of Stage 1 and Stage 2 CKM, with barium showing the highest weight. For advanced CKM stages, antimony had the greatest contribution, followed by tungsten and cobalt. Significant variations were observed by sex, age, and race. Mediation analyses suggested that inflammation, oxidative stress, and biological aging may partially explain the observed associations between metal co-exposure and CKM syndrome. In the sensitivity analysis, inorganic arsenic showed the strongest positive association with CKM syndrome and contributed most prominently in the mixture models.ConclusionsExposure to metal and metalloid species is closely associated with the prevalence of CKM syndrome at different stages. Inflammation, oxidative stress, and biological aging may play partial mediating roles in these associations. As NHANES reflects exposure patterns in the U.S. general population, the findings are most applicable to community-level environmental exposures and should not be directly extrapolated to high-exposure occupational groups. Further validation in prospective cohort studies and mechanistic research is warranted. https://doi.org/10.1186/s12889-025-25894-0

Méthodes

New approach methodologies (NAMs) for improved developmental and reproductive toxicity (DART) assessment with focus on endocrine disruption - a PARC project,
Ardenkjær-Skinnerup, J., Baert, Y., Bajard, L., Blum, J., Brion, F., Coppola, L., Fini, J. B., Fritsche, E., Holbech, H., Hurem, S., Jacobs, M. N., Johansson, H. K. L., Knapen, D., Koch, K., Lyche, J. L., Mai, P. N. T., Neuhaus, W., Nikolov, N. G., Nurani, A., Papageorgiou, K., Poulsen, R., Ramhoj, L., Rehurková, E., Rosenmai, A. K., Rüegg, J., Sovadinová, I., Tait, S., Van De Pette, M., Vanhaecke, T., Vergauwen, L., Wedebye, E. B., Xu, E. G. and Svingen, T., *Frontiers in Toxicology*, Feb 3 2026, Vol. 8.

Endocrine disruptors (EDs) are implicated in adverse developmental and reproductive outcomes, yet their identification remains a major challenge in chemical safety assessment. Current testing strategies rely heavily on animal models, which are constrained by ethical concerns, interspecies differences, and limited mechanistic resolution but justified by the complexity of the endocrine system and its physiology. Capturing the complex biology of intact organisms and incorporating toxicokinetic properties in alternative test methods is challenging. To address this, the European Partnership for the Assessment of Risks from Chemicals (PARC) is advancing the development and regulatory integration of new approach methodologies (NAMs). This project specifically contributes by developing and validating human-relevant NAMs to identify key aspects of endocrine disruption relevant to developmental and reproductive toxicity (DART). Key innovative activities include predictive modeling, refinement of zebrafish and amphibian embryo assays, and establishment of advanced in vitro systems for assessing toxicity in the oocyte, testis, placenta, and brain. By combining mechanistic insights with multi-modality and high throughput testing strategies, this work aims to improve the predictive power and regulatory utility of NAMs for ED identification within the One Health paradigm. https://doi.org/10.3389/ftox.2026.1736963

Chemical Selection for the Thyroid Validation Study Coordinated by EURL ECVAM and EU-NETVAL Laboratories,
Bernasconi, C., Sampani, S., Beronius, A., Coecke, S., Langezaal, I., Pistollato, F., Paini, A., Muñoz, A., Asturiol, D., Kienzler, A., Baron, G., Munn, S., Kandarova, H. and Whelan, M., *Altex-Alternatives to Animal Experimentation*, 2026 2026, Vol. 43, no. 1, p. 24-48.

The aim of the Thyroid Validation Study, coordinated by EURL ECVAM and involving EU-NETVAL laboratories, was to validate selected non-animal methods for the identification of chemicals that can potentially disrupt the thyroid hormone system in humans. The validation study was organized in two parts: Part 1 was to assess method performance and develop standard operating procedures, where needed, and Part 2 was to assess the mechanistic relevance of the methods using a set of validation chemicals. This paper describes the stepwise process to select this validation set of chemicals, mainly based on extensive literature review and expert judgment elicitation to identify chemicals for which there was evidence to show their (lack of) ability to perturb the thyroid hormone signaling mechanisms or modes of action covered by the methods. A unique contribution of the study lies in its mechanistic coverage of molecular targets within the thyroid gland but also regulatory mechanisms in peripheral tissues, reflecting a multifaceted perspective on thyroid hormone action. The validation set consisted of 30 chemicals, providing a balanced representation across a broad chemical space and offering insights into the mechanistic relevance of the selected methods. Once validated, these methods will contribute to advancing the identification and evaluation of endocrine disruptors, informing regulatory decisions, and promoting alternative testing strategies. Plain language summary This manuscript provides important insights thatwill allow the progression of non-animal methods for thyroid hormone disruption and their use in the regulatory context. The selection of chemicals used in a validation study is of paramount importance and will impact on the overall performance of the methods being validated. The selection approach is described in detail and provides a relevant and useful guide for possible future validation studies. https://doi.org/10.14573/altex.2501152

Endocrine Toxicity of Micro- and Nanoplastics, and Advances in Detection Techniques for Human Tissues: A Comprehensive Review,
Bossio, S., Ruffolo, S. A., Lofaro, D., Perri, A. and La Russa, M. F., *Endocrines*, May 14 2025, Vol. 6, no. 2.

Background: Plastic pollution driven by human activities has become a critical global issue for human health. A growing literature demonstrates that micro- and nanoplastics (MNPs) contain endocrine-disrupting chemicals (EDCs) and other harmful compounds that enter the body easily, acting as agonists or antagonists for a wide range of hormonal receptors, and promoting endocrine toxicity. Endocrine disruption induced by MNPs occurs through the aberrant activation/inhibition of different signaling pathways that in addition to directly interfering with hormonal balances, trigger apoptosis, oxidative stress, and inflammation in endocrine cells. However, to date, the molecular mechanisms of these contaminants remain not completely elucidated. Furthermore, given the unanimous consensus on the negative impact of MNPs on human health, several methodologies have been developed to detect MNPs and contaminants not only in the environment but also in biological fluids and human tissues. Results: This review comprehensively summarizes the emerging experimental and clinical evidence explaining the mechanisms underlying the toxicity related to chronic plastic pollution in relation to the endocrine system. In addition, the review illustrates the new methodological approaches to detect MNPs in human biological samples, highlighting that employing complementary methods enables the precise characterization and quantification of MNPs. Conclusions: Future studies employing experimental, epidemiological, epigenetic, and multi-omics approaches are essential for understanding the short and long-term effects of MNPs on

endocrine glands and developing effective strategies to mitigate their impact on human health. https://doi.org/10.3390/endocrines6020023

Methodological approach for a simultaneous determination of persistent and non-persistent organic pollutants in human blood (serum/plasma) using gas chromatography and mass spectrometry techniques,
Bustamante, C. M., Ruiz, P., Rifat, A. B., Bravo, N., Grimalt, J. O. and Garí, M., *Journal of Chromatography A*, 2025/09/27/ 2025, Vol. 1759, p. 466235.

Human biomonitoring of persistent organic pollutants (POPs) remains essential for tracking long-term exposure, evaluating health risks, and assessing the effectiveness of regulatory bans. For this purpose, an experimental and analytical methodology has been optimized allowing the determination of 47 POPs, encompassing chlorinated cyclodienes, chlorobenzenes, cyclohexanes, polychlorodiphenyl derivatives, several congeners of polychlorobiphenyls (PCBs) and polybromodiphenyl ethers (PBDEs, including the deca-BDE), as well as three non-persistent chemicals (namely quintozene, tecnazene and vinclozolin). The method uses a single liquid-liquid extraction procedure with 500 µL of serum/plasma. Instrumental analysis involves gas chromatography (GC) with electron capture detection (ECD) for the analysis of organochlorines, and a subsequent injection into a GC coupled to mass spectrometry in negative chemical ionization mode (MS-NCI) for the determination of PBDEs. The analytical procedure has been successfully validated, demonstrating high sensitivity (limits of detection: 0.0016–0.012 ng/mL; limits of quantification: 0.0029–0.021 ng/mL), acceptable linearity ($R^2 > 0.9962$), good precision (coefficients of variation <25%, except for BDE-209), satisfactory accuracy (recoveries within 70–130% for 41 out of 47 compounds) and minimal matrix effects. Proficiency Testing Materials from the AMAP Ring Test for POPs in human serum confirmed the method's reliability with results within the accepted reference range. This method represents an efficient and practical approach for human biomonitoring studies, with a simplified workflow suitable for routine application. https://doi.org/10.1016/j.chroma.2025.466235

Exploring novel biomarkers for endocrine disruptor exposure: insights into extra-nuclear signaling pathways of estrogen and androgen receptors,
Cipolletti, M., Campesi, I., Pellegrini, M., Fiocchetti, M., Acconcia, F. and Marino, M., *Environmental Toxicology and Pharmacology*, Mar 2026, Vol. 122.

Synthetic chemicals classified as endocrine disruptors (EDs) pose health risks by interfering with sex-steroid hormone signaling. This study evaluated bisphenol A (BPA) for its effects on ER alpha, ER beta, and AR expression and extranuclear signaling, including ER alpha phosphorylation, in human monocytes from healthy male and female donors, and assessed ten additional chemicals in ER alpha-positive breast cancer cell lines (MCF-7, T47D). BPA increased ER alpha phosphorylation in both male and female monocytes without altering receptor levels, while modulating downstream signaling in a sex-dependent manner and attenuating DHT- or E2-induced effects. The ten other chemicals similarly enhanced ER alpha phosphorylation, often independently of direct receptor binding. These findings indicate that ER alpha phosphorylation is a sensitive, early marker of ED activity across immune and epithelial cells and support its use as a receptor-proximal endpoint to complement conventional transcriptionbased assays in next-generation ED screening strategies. https://doi.org/10.1016/j.etap.2026.104949

Zebrafish sperm toxicity tests: An emerging in vitro and in vivo model for male reproductive toxicity,

Cirqueira, F., Ribeiro, I. C., Silva, B. J. D., Nóbrega, R. H. and Rocha, T. L., *Journal of Hazardous Materials*, Jan 15 2026, Vol. 502.

Male reproductive toxicity tests are a standard component of toxicological research, regulatory and safety assessment during drug development and environmental biomonitoring. Zebrafish (Danio rerio) has emerged as a valuable model for studying male reproductive toxicity, particularly through sperm toxicity tests. Thus, this review systematically analyzed the scientific literature concerning the Zebrafish Sperm Toxicity test (ZST), focusing on the effects of environmental chemicals on sperm quality and reproductive health. Results showed that over 80 chemicals have been studied for their adverse effects on zebrafish sperm, including synthetic estrogens, metals, pesticides, and antibiotics. Several endocrine disruptors, such as bisphenol A (BPA) and tributyltin (TBT), impairing sperm count, motility, and morphology by disrupting hormonal regulation and inducing oxidative stress. Methodological approaches were discussed, including sperm collection techniques and storage media, which are critical for experimental reproducibility. Exposure times vary widely, with chronic and longterm exposures being more common in in vivo studies, while in vitro studies typically involve shorter exposure periods. The most frequently adverse effects on zebrafish sperm were reduced sperm count, volume or density https://doi.org/10.1016/j.jhazmat.2025.141006

Machine Learning Prediction of Transthyretin Binding for Thyroid Hormone Transport Disruption for Chemical Risk Assessment,
Hou, S., Ji, C., Reh, C. M. and Ruiz, P., *Toxics*, 2026, Vol. 14, no. 3, p. 240.
https://www.mdpi.com/2305-6304/14/3/240

Quantitative prediction of zebrafish reproductive impairment via androgen receptor-driven adverse outcome pathway,
Liu, X., Yu, H. X., Song, Y., Shi, W. and Liu, H. L., *Aquatic Toxicology*, Mar 2026, Vol. 292.

Exogenous androgenic contaminants have long been of concern and are associated with reproductive impairment in fish. Although Toxcast has screened a large number of compounds using in vitro testing, it is challenging to conduct high-throughput tests for complex effects in vivo and to assess apical endpoints such as reproduction further quantitatively. Therefore, we developed a quantitative prediction method for reproductive dysfunction in zebrafish based on the adverse outcome pathway (AOP) framework. We carried out in vitro androgen activity tests for 16 compounds and a 21-day exposure experiment of androgen receptor (AR) agonism reference chemical 17 beta-trenbolone (TB) in zebrafish. The results revealed that TB mainly affected the levels of 11-ketotestosterone, estradiol, and vitellogenin in females by mediating AR, and caused abnormal ovarian development and fecundity decline. Then, AOP leading to reproductive dysfunction in female zebrafish (ZqAOP) was assembled and quantified, and it was validated to determine the potential and reliability for chemical extrapolation. Finally, the ZqAOP model was applied for predicting the potential reproductive impairments of eight compounds in environmental concentrations and global surface water samples with AR activity. This study provides a new insight into screening and assessing large numbers of chemicals with potential endocrine-disrupting effects. https://doi.org/10.1016/j.aquatox.2026.107720

Determination of 15 phthalates metabolites and 9 bisphenols in human serum by using high-performance liquid chromatography coupled with tandem mass spectrometry,
Liu, Y. L., Wen, J., Zhang, X., Lin, X., Feng, Z. Z., Bao, D. J., Hu, X. J. and Zhu, Y., *Journal of Chromatography A*, Feb 22 2026, Vol. 1769.

Endocrine disrupting chemicals (EDCs) are a class of emerging contaminants that have raised significant public health concerns. Human co-exposure to mixtures of specific EDCs, such as phthalate and bisphenols, and the associated health risks remain poorly understood. To support biomonitoring and epidemiological studies on these compounds, there is a critical need for sensitive and reliable methods for their quantification in human specimens. Herein, we developed and validated an analytical method based on ultra-high performance liquid chromatography tandem mass spectrometry (UHPLC-MS/MS) for the simultaneous determination of 15 phthalate metabolites and 9 bisphenols in human serum. A systematic comparison between liquid-liquid extraction (LLE) and high-efficiency matrix removal (HMR) clean-up approach revealed that HMR offered advantages in terms of extraction efficiency and matrix effect reduction, and was ultimately selected as the final clean-up method for this study. The developed method demonstrated satisfactory performance, with recoveries ranging from 81 % to 115 %, with the relative standard deviations (RSD) below 18 %. The calibration curves established using isotopelabeled internal standards exhibited good linearity, with correlation coefficients (R2) consistently above 0.997. The limits of detection (LODs) and limits of quantification (LOQs) were determined to be in the range of 0.01 ng/ mL to 0.2 ng/mL and 0.04 ng/mL to 0.7 ng/mL, respectively. Both intra-day and inter-day precision were satisfactory, with RSDs values ranging from 4.2 % to 13 % and 6.9 % to 14 %, respectively. This sensitive analytical method was successfully applied to the determination of target analytes in human serum samples from 15 pregnant women, demonstrating its applicability for monitoring of these emerging contaminants in human serum.
https://doi.org/10.1016/j.chroma.2026.466728

Thèse - Développement de méthodes d'intelligence artificielle pour déterminer les modalités de perturbation du système endocrinien par les composés chimiques,
Ollitrault, G., *BFA (UMR_8251 / U1133) - Unité de Biologie Fonctionnelle et Adaptative* (8 octobre 2025),
Le système endocrinien constitue l'ensemble des organes, glandes et tissus régulés par des messagers chimiques appelés hormones, qui assurent la coordination des fonctions vitales de l'organisme. Le système endocrinien est une machinerie complexe, dont certaines cibles, notamment les œstrogènes, androgènes, thyroïde et stéroïdogenèse (EATS), peuvent être impactés par des perturbateurs endocriniens (PE) dans des processus biologiques essentiels. Les perturbateurs endocriniens sont des substances chimiques capables d'interférer avec les processus homéostatiques du système endocrinien. Ils peuvent avoir des effets néfastes sur la reproduction, le développement et représentent un enjeu majeur de santé publique. Dans ce contexte, le développement de nouvelles méthodes in vitro et in silico pour la détection rapide de substances chimiques susceptibles de présenter un risque pour l'organisme constitue une solution efficace pour une évaluation toxicologique plus durable et plus éthique. Ces méthodes s'inscrivent dans le paradigme des 3R (Remplacer, Réduire, Raffiner), visant à développer des alternatives aux expérimentations animales. L'objectif de cette thèse a été de développer et d'appliquer de nouvelles approches bioinformatiques in silico, notamment en concevant des modèles d'apprentissage automatique et d'intelligence artificielle utilisant des données transcriptomiques d'expression génique, afin de prédire et de caractériser l'effet PE de différentes molécules. Dans un premier temps, nous avons appliqué des méthodes classiques de bioinformatique pour développer des modèles de prédiction de propriétés ADME (Absorption, Distribution, Métabolisme, Excrétion), notamment la bioaccessibilité orale et le volume de distribution, que nous avons couplés à un modèle de prédiction de la demi-vie d'élimination. Ces modèles ont été appliqués à des listes de perturbateurs endocriniens afin de déterminer certains facteurs pharmacocinétique associé à ses PEs. Nous avons également utilisé des approches de modélisation moléculaire pour caractériser l'effet de molécules pharmaceutiques sur la stéroïdogenèse. Ces méthodes ont permis une meilleure compréhension de l'exposition de l'organisme à des PE ainsi qu'une caractérisation plus précise du

risque associé à l'utilisation de certaines molécules pharmaceutiques courantes. Dans un second temps, nous avons combiné des approches d'apprentissage automatique avec des données d'expression génique pour développer des modèles prédictifs de l'effet des molécules sur les modalités EAT, ainsi qu'un modèle d'intelligence artificielle capable de générer de nouvelles molécules induisant une réponse biologique souhaitée. Ce modèle a été appliqué pour identifier de nouvelles molécules présentant un effet potentiel de perturbation endocrinienne. Les méthodes développées ont permis de mieux comprendre et prédire l'exposition et l'action des molécules sur des cibles clés du système endocrinien. Ce travail met en évidence l'efficacité de l'intégration de données transcriptomiques pour analyser la réponse biologique et souligne le potentiel des approches in silico dans l'évaluation du risque perturbateur endocrinien des substances chimiques.
https://hal.science/tel-05462754v1

Integrating Measures of Pollutant Exposure in Human Biology Research,
Schell, L. M. and Gallo, M. V., *American Journal of Human Biology*, Feb 7 2026, Vol. 38, no. 2.

This toolkit paper describes the value of including pollutant measurements in human biology research and describes considerations to implement such research. Human biologists study populations that are exposed to a variety of pollutants including metals and organic compounds used in agriculture and pest control. These pollutants can affect biological outcomes investigated by human biologists. Considering the impact of one or more of these pollutants in our investigations involves careful attention to properties of each pollutant and how the body metabolizes and stores them. Assessing exposure to many metals and organic compounds is best done by bio-sampling, usually of blood, but other media include hair, fingernails, and urine. Appropriate sampling media differ by pollutant but many found in the bloodstream may be collected together though not necessarily stored in the same way and not analyzed in the laboratory by the same method. A team approach is recommended as specialized knowledge of the proper sampling, handling, and analysis of each toxicant is needed. Choosing a laboratory should consider at a minimum the range of congeners measured, the minimum detection level, and the turnaround time for results required for the analysis. Study participants are likely to be interested in their toxicant exposure. The distribution of results should include careful description and interpretation to allow non-scientists to understand and take action if needed. Litigation by study participants against polluters is possible making it necessary to scrupulously preserve records of collection and analysis for possible court subpoena.
https://doi.org/10.1002/ajhb.70210

Prioritizing steatogenic chemicals through integration ToxCastTM data, machine learning, and experimental validation,
Shi, X. L., Jin, L. B., Ma, X. C., Shen, Q. Y., Feng, J. F., Liu, Y., Wang, Y. X., Zhang, Q. and Wang, C., *Environment International*, Feb 2026, Vol. 208.

As hepatic steatosis driven by environmental exposures increasingly contributes to the global burden of metabolic disease, identifying and prioritizing high-potency steatogenic chemicals is critical for enabling risk-oriented toxicological and environmental regulation. Leveraging the well-established adverse outcome pathway framework for hepatic steatosis, we integrated ToxPi scores derived from 14 molecular initiating events in the ToxCastTM database with in vivo validation in zebrafish. This integrated approach enabled the construction of a training set comprising chemicals with distinct steatogenic potency. Feature selection via Kruskal-Wallis test identified 11 key bioassays, with OT_FXR_FXRSRC1_0480 and NVS_NR_hGR contributing most to model performance. Using leave-one-out cross-validation, the SVM model achieved 91.7% accuracy in the training set. External validation on 35 compounds, although based on binary activity labels, resulted in 77.1% accuracy, indicating moderate but promising generalizability. Final predictions on 345

curated ToxCastTM chemicals (from a total of 9924) were categorized as high- (37.97%), moderate- (18.84%), and null-effect (43.19%) on steatogenic potence by Random Walk with Restart algorithm. In vivo validation of 14 predicted compounds confirmed the model's robustness, and in vitro lipid staining assays in HepG2 cells further demonstrated concordance. This study revealed that several emerging contaminants, including isodecyl diphenyl phosphate, 3,3 '-dimethylbisphenol A, tetrabutyltin, tetrabromobisphenol A bis(2-hydroxyethyl) ether, trixylyl phosphate and quinoxyfen, exert high steatogenic potency. These findings underscore the utility of integrating high-throughput data with predictive modeling and experimental validation to prioritize high-potent steatogenic chemicals. https://doi.org/10.1016/j.envint.2026.110084

Agenda, actualité, politique et évaluation de l'exposition

Thèse - Étude descriptive des connaissances et pratiques des médecins généralistes en Bretagne sur la prévention aux perturbateurs endocriniens durant les 1000 premiers jours,
UBO UFR MSS - Université de Bretagne Occidentale - UFR Médecine et Sciences de la Santé - Brest (21 juillet 2025),
Introduction : L'exposition aux perturbateurs endocriniens (PE) durant les 1000 premiers jours, période de grande vulnérabilité, était reconnue comme un facteur de risque émergeant. Pourtant, les données concernant les connaissances et pratiques des médecins généralistes (MG) sur ce sujet restaient limitées. Objectif : Évaluer les connaissances et les pratiques de prévention des MG bretons concernant l'exposition aux PE durant les 1000 premiers jours. Méthodes : Une étude quantitative descriptive transversale a été menée entre septembre 2024 et janvier 2025, via un questionnaire en ligne diffusé auprès des MG exerçant en Bretagne. Le questionnaire comportait quatre volets : données sociodémographiques, connaissances sur les PE, pratiques de prévention et besoins en formation. Résultats : Parmi les 104 MG répondants, la majorité était sensibilisée aux problématiques des PE, avec une bonne identification des substances les plus médiatisées : Bisphénol A 100 %, parabènes 93,1 %. Si 96,2 % reconnaissaient les effets sur la fertilité, seuls 8,2 % abordaient systématiquement les PE en consultation périnatale. Les pratiques de prévention restaient limitées, seuls 12,1 % alertaient systématiquement les patientes enceintes sur les risques liés aux cosmétiques ou aux contenants plastiques chauffés, et 20 % conseillaient d'aérer régulièrement les pièces. La majorité exprimait un besoin en formation (93,8%). Conclusion : Bien que la problématique des PE soit identifiée, la prévention restait marginale et les outils disponibles peu connus. Ce qui soulignait la nécessité d'améliorer la diffusion des ressources et d'intégrer la prévention des PE, dans la formation des professionnels de santé. Des recherches complémentaires seraient pertinentes pour explorer les freins à la mise en oeuvre de cette prévention en pratique. Enfin, une meilleure coordination entre les professionnels en soins primaires et l'instauration d'un temps dédié à la prévention durant les périodes de vulnérabilité pourraient renforcer l'efficacité des actions de santé publique. https://dumas.ccsd.cnrs.fr/dumas-05172462v1

Thèse - Évaluation de l'impact du module Perturbateurs Endocriniens du programme e-learning SPES sur l'amélioration des connaissances et compétences des internes en médecine générale de la faculté Montpellier-Nîmes,
Thèses d'exercice et mémoires - UFR de Médecine Montpellier-Nîmes (27 aout 2025),
Dans le monde selon l'OMS, l'exposition à des facteurs environnementaux est responsable de 23 % des décès et de 25 % des maladies chroniques. En France, le PNSE4 prévoit de former à la santé environnementale tous les professionnels de santé. La faculté de médecine de Montpelier a développé le e-learning SPES pour former les internes de 1ᵉ année de médecine générale à cette thématique. En 2024, le module SPES sur les perturbateurs endocriniens a été développé. Nous

avons étudié la progression des connaissances et comportements sur les PE avant/après la formation. Méthodes : cette étude monocentrique avant-après portait sur un e-learning abordant les 4 principales pièces d'un habitat (cuisine, salle de bains, chambre et extérieur). Les connaissances ont été évaluées par des questions fermées à réponses binaires (oui/non) et les comportements par une échelle de Likert (1-5). Les analyses statitiques incluaient un test t de Student apparié pour les variables quantittives et le test de McNemar (χ^2) pour les variables qualitatives. Résultats : 78 internes ont été appariés et analysés (taux de réponse de 52 %). La satisfaction moyenne des participants pour les quatre modules principaux était de 4,0 (écart-type : 0,9) sur 5. Les scores de connaissances sur les perturbateurs endocriniens ont augmenté significativement de 56 % ($p < 0,001$). Les comportements auto-évalués ont progressé de 2,13 points sur 5 en moyenne sur l'échelle de Likert ($p < 0,001$). Conclusion : le e-learning a significativement amélioré les connaissances et comportements des internes. Il est nécessaire d'étendre cette formation à d'autres professionnels de santé. Des études complémentaires sont nécessaires pour évaluer son impact en pratique clinique et pour d'autres professionnels de santé.
https://dumas.ccsd.cnrs.fr/dumas-05226529v1

81 casques et écouteurs contaminés par des perturbateurs endocriniens : aucune marque n'est épargnée,
Les Numériques (19 février 2026),
Un consortium d'organisations de consommateurs financé par l'Union européenne vient de tester 81 casques et écouteurs de grande marque. Des substances chimiques nocives ont été retrouvées dans la totalité des produits. Voici ce que les données montrent, et ce qu'elles ne permettent pas encore de conclure. https://www.lesnumeriques.com/casque-bluetooth/81-casques-et-ecouteurs-contamines-par-des-perturbateurs-endocriniens-aucune-marque-n-est-epargnee-n251698.html

2026 National PFAS Conference,
(8-10 juin 2026),
This conference series is uniquely designed to exchange information, provide support to PFAS-affected communities, and facilitate engagement across diverse sectors involved with PFAS to accelerate the protection of health and the environment. At This Conference, they Will : Highlight local community perspectives and global impacts of PFAS. Continue collaborative conversations that integrate cutting-edge scientific discoveries with the complex social and political contexts of affected communities that are often marginalized and underserved. Identify the best methods to share findings and ensure ongoing communication between researchers, PFAS sectors, and affected communities. Share information and resources that respond to needs identified by affected communities and other diverse PFAS sectors. Strengthen existing and establish new collaborations between researchers, communities, and political and public sectors to encourage coordinated and solution-based approaches that will prevent future PFAS contamination and exposure-related health risks. https://www.nationalpfasconference.org/

Avis relatif à l'évaluation des substances inscrites au programme de travail de l'Agence dans le cadre de la deuxième stratégie nationale sur les perturbateurs endocriniens (SNPE2) : Triéthanolamine (n° CAS : 102-71-6),
ECHA (29 janvier 2026),
A l'issue de cette analyse, visant à l'origine à déterminer si la triéthanolamine (TEA) présente des propriétés de perturbation endocrinienne pour la santé humaine et/ou l'environnement, ainsi qu'à identifier les options de gestion de risques pertinentes, l'Anses conclut que :
• Sur la base des données actuellement disponibles, des effets néfastes ont été mis en évidence : o des effets cancérogènes, relevant d'une classification de cette substance au titre de sa

cancérogénicité, o des effets sur la fonction de reproduction mâle et sur le développement, relevant d'une classification de cette substance au titre de sa reprotoxicité.
En revanche, les données disponibles ne permettent pas de conclure sur la caractérisation du danger « Perturbateur endocrinien » de la TEA pour la santé humaine et pour l'environnement.
Au vu des conclusions de l'expertise, l'Anses considère qu'il serait pertinent que soit élaboré un dossier de classification harmonisée de la substance concernant les classes de danger « cancérogénicité » et « toxicité pour la reproduction » conformément au règlement CLP.
https://www.anses.fr/fr/content/REACH2021-MPEX-0148

Battelle Wins New Contract to Continue Environmental Research on Endocrine-disrupting Chemicals,
Battelle (23 février 2026),
The U.S. Environmental Protection Agency recently awarded Battelle one of three blanket purchase agreements to compete for research tasks to evaluate chemicals that may harm the endocrine system in animals and humans.
Battelle and two other companies will bid on call orders with a total ceiling value of $44 million over five years to identify potential endocrine-disrupting chemicals and evaluate hazards, exposures, and risks to human health and the environment.
The research focuses on substances that affect reproductive function, growth, and development via disruption of the interactions between the hypothalamus and pituitary in the brain, and the estrogen, androgen, and thyroid hormone systems, among others.
https://www.businesswire.com/news/home/20260223640203/en/Battelle-Wins-New-Contract-to-Continue-Environmental-Research-on-Endocrine-disrupting-Chemicals?feedref=JjAwJuNHiystnCoBq_hl-eAh7yh3ccNzLJZaxyWkP0mljpP0CpzuEOW8PSMzp0v37dI9_69nqXXndEkzoNy31peBvhKXN8xoKDPrCnMXhC58cMd5Jhr97vTYoLZQbGkSHGnYFEfW-VLubTIB9HxyrA%3D%3D

ECHA's Risk Assessment Committee adopts its opinion on PFAS restriction proposal,
ECHA (3 mars 2026),
The European Chemicals Agency's (ECHA) Risk Assessment Committee (RAC) has concluded its evaluation of the universal restriction proposal on all per- and polyfluoroalkyl substances (PFAS). Its opinion is the first part of ECHA's two-committee scientific evaluation of the proposal.
https://echa.europa.eu/-/echa-s-risk-assessment-committee-adopts-its-opinion-on-pfas-restriction-proposal#msdynmkt_trackingcontext=51f565dd-f737-4cfa-ae90-383d3bbb0200

Lutte contre les perturbateurs endocriniens : des paniers bio bientôt prescrits aux femmes enceintes vosgiennes ?,
Vosges matin (27 janvier 2026),
Un collectif de professionnels de santé locaux vient de publier une tribune afin de développer le dispositif des ordonnances vertes, afin de protéger les femmes enceintes et les futurs enfants des dangers des perturbateurs endocriniens. Et ce, grâce, notamment, à une alimentation plus saine et une meilleure information sur le sujet.
https://www.vosgesmatin.fr/environnement/2026/01/27/lutte-contre-les-perturbateurs-endocriniens-des-paniers-bio-bientot-prescrits-aux-femmes-enceintes-vosgiennes

Perturbateurs endocriniens : impact sur nos hormones,
Actualités News Environnement (16 février 2026),
Au sommaire de cette actualité : Les substances les plus répandues ; Où se cachent les perturbateurs endocriniens au quotidien ; Les effets sur la santé : un bilan alarmant ; L'effet cocktail : le danger des faibles doses combinées ; Ce que dit la réglementation (France et Europe) ; Le coût sanitaire : 157

milliards d'euros par an en Europe ; Réduire son exposition : les gestes concrets ; La recherche avance : cohortes françaises et perspectives https://www.actualites-news-environnement.com/perturbateurs-endocriniens-substances-hormones/

Qualité de l'air : les actions de l'Anses,
ANSES (18 février 2026),
L'air, qu'il s'agisse de l'air extérieur ou de celui des environnements clos, est susceptible d'être pollué par des substances chimiques, des particules ou des contaminants biologiques dangereux pour la santé. L'Anses se consacre depuis de nombreuses années à cette thématique avec un objectif : améliorer la qualité de l'air que nous respirons. Tour d'horizon des travaux réalisés pour y parvenir.
https://www.anses.fr/fr/content/actions-qualite-de-lair-anses

Updated peer review of the pesticide risk assessment of the active substance clodinafop (variant evaluated clodinafop-propargyl),
EFSA (10 mars 2026),
The conclusions of the European Food Safety Authority (EFSA) following the peer review of the initial risk assessments carried out by the competent authorities of the rapporteur Member State, Greece, and co-rapporteur Member State, Germany, for the pesticide active substance clodinafop-propargyl are reported. The context of the peer review was that required by Commission Implementing Regulation (EU) No 844/2012. The conclusions were reached on the basis of the evaluation of the representative uses of clodinafop-propargyl as a herbicide on wheat, rye and triticale. The reliable end points, appropriate for use in regulatory risk assessment, are presented. Missing information identified as being required by the regulatory framework is listed. Concerns are identified. The European Commission mandated EFSA to reconsider the acceptable operator exposure level (AOEL) setting and to update the non-dietary exposure assessment if needed. In addition, the conclusions were updated with regard to the endocrine-disrupting properties following a mandate received from the European Commission in November 2020.
https://www.efsa.europa.eu/en/efsajournal/pub/9871

Politique de la biosurveillance face aux résidus de pesticides
Vie sociale de la « chlordéconémie » en Guadeloupe et en Martinique,
Aguiton, S. A., Mathieu Marie, *Revue d'Anthropologie des Connaissances*, 2026, Vol. 20, no. 1.

La Guadeloupe et la Martinique connaissent une pollution massive au chlordécone, un pesticide organochloré et perturbateur endocrinien, non biodégradable et persistant. Il est présent sous forme de résidu dans les sols des bananeraies et se diffuse depuis les années 1970 à travers les milieux et les chaînes alimentaires. Plus de vingt ans après les premières alertes, le chlordécone est aujourd'hui au cœur de politiques publiques, de recherches et de dispositifs de santé publique dédiés. Une technique de biosurveillance nommée « chlordéconémie », reposant sur l'analyse biologique de résidus de chlordécone dans le sang humain, est devenue un outil de perceptibilité à l'échelle populationnelle et individuelle. L'article retrace la vie sociale de cette technique, depuis son essor dans les études épidémiologiques jusqu'aux mobilisations sociales visant à la rendre accessible et gratuite, en passant par les dispositifs de santé publique qui lui sont adossés. L'article montre ainsi comment des instruments technoscientifiques initialement confinés dans les laboratoires deviennent le support d'une individualisation et d'une « comportementalisation » du risque dans un contexte de pollution systémique. https://doi.org/https://journals.openedition.org/rac/41549

Towards EU regulatory hazard assessment of metabolic endocrine disrupters: Integrating new biomarkers into OECD test guidelines,

Beausoleil, C., Rousselle, C., Ozcagli, E. and Jacobs, M., *Regulatory Toxicology and Pharmacology*, 2026-05 2026, Vol. 167, p. 106041.

Exposure to 'metabolic disrupting chemicals' (MDCs) are increasingly implicated in obesity, diabetes and/or fatty liver disease; indeed, these metabolic changes may play a role in the global metabolic disorders' epidemic. To better assess and manage the health risks of MDCs, improved hazard identification is needed. This review describes how current in vivo OECD Test Guidelines (TGs) can better capture MDC effects. The biological and clinical evidence to support the inclusion of promising human relevant biomarkers, blood parameters, endpoints and relevant tissues for MDCs for potential inclusion in OECD TGs is documented. Current clinical chemistry routine requirements could be utilised further, and the additional assessment of relevant hormones such as a decrease in adiponectin, increase in resistin and leptin, which impact satiety, could be additionally included. Additionally, assessment of fatty tissue distribution in alert animals and insulin resistance, is recommended, and histological parameters in relation to the different types of adipose tissue. How specific biomarkers and endpoints could be incorporated into OECD mammalian in vivo assays, and how they can be included in the EU strategy for Endocrine Disrupting Chemicals identification and the forthcoming update to the OECD Guidance Document on the Testing and Assessment of Endocrine Disruption chemicals, are discussed. https://doi.org/10.1016/j.yrtph.2026.106041

What do people need to know about endocrine disrupting chemicals and health? A mental models approach using focus groups of community-engaged research teams and a national survey,
Boronow, K. E. and Brody, J. G., *Bmc Public Health*, Nov 22 2025, Vol. 25, no. 1.

BackgroundEndocrine disrupting chemicals (EDCs), which interfere with the body's natural hormones, are ubiquitous in everyday environments and consumer products. Nearly everyone is routinely exposed, and growing evidence links them to adverse health outcomes including cancers, impaired fertility, metabolic disorders, and neurodevelopmental effects. Major medical and scientific groups recommend exposure reduction. To make informed decisions about individual- and societal-level exposures to EDCs, people need relevant knowledge. Knowledge is one component of environmental health literacy, a multidimensional concept supporting readiness to protect health from environmental risks. This study sought to develop expert consensus about communications targets for EDCs and to learn how public knowledge matches these targets.MethodsWe convened focus groups with community-engaged research teams (n = 38) to define targets for public understanding. We coded transcripts, mapped causal pathways influencing EDC exposures and health outcomes using a mental models approach, and identified communication priorities. We then fielded a quantitative online survey among adults living in the U.S. (n = 504) to compare their knowledge with the mental model. We computed response frequencies and used multiple regression to evaluate associations between a knowledge index and participant characteristics.ResultsFocus group participants highlighted that people need to know that EDCs affect nearly all systems in the human body and that scientific evidence supports limiting exposure. They emphasized that policy controls can be more effective than personal action at reducing exposure, and that current U.S. chemicals regulations are not protective. Survey respondents were generally aware that EDCs can affect fertility, cancer, and child brain development (84-90%, n = 426-452), and they had some understanding of exposure pathways (58-86%, n = 295-435). However, most participants had large knowledge gaps about U.S. chemicals regulation and wrongly believed that chemicals must be safety-tested before being used in products (82%, n = 414), that product ingredients must be disclosed (73%, n = 368), and that restricted chemicals cannot be replaced by similar substitutes (63%, n = 317).ConclusionsU.S. adults typically understood that EDCs affect health. However, incomplete information about how people get exposed to EDCs and misconceptions about U.S.

chemicals regulations limit appropriate actions. These knowledge gaps are targets for future communications about EDCs and harmful chemicals more broadly. https://doi.org/10.1186/s12889-025-25561-4

Integrative assessment of endocrine disruption: From in vitro mechanisms to species extrapolation - Highlights of the German Pharma-Tox Summit 2025,
Hassmann, U., Gölz, L., Geci, R., Stefanidis, K., Brandt, J. L., North, E., Feiertag, K., Schopfer, C. R., Amann, S., Melching-Kollmuss, S. and Landsiedel, R., *Toxicology*, Feb 2026, Vol. 520.

Endocrine-disrupting chemicals (EDCs) are a growing focus in human and environmental risk assessment, as reflected by the new EU CLP hazard classes for endocrine disruptors. Within this context, the symposium "CrossSpecies Extrapolation in Endocrine Disruption Assessments" was held at the 10th German Pharm-Tox Summit (GPTS) 2025 in Hannover (March 11-13), which formed part of the 91st annual meeting of the German Society for Experimental and Clinical Pharmacology and Toxicology (DGPT). The symposium assembled diverse lines of research addressing endocrine disruption from complementary angles. Contributions ranged from advanced experimental model systems, such as refined zebrafish embryo assays for thyroid hormone disruption, to highthroughput in silico and in vitro-based kinetic modelling frameworks that support quantitative in vitro to in vivo extrapolation and AOP-informed risk assessment. Clinical and translational perspectives were added by targeted LC-MS/MS profiling of steroid conjugates as biomarkers for adrenal tumours. Further talks expanded the mechanistic toolbox for thyroid disruption, including enzyme- and protein-binding-based in vitro assays, and highlighted metabolic endocrine disruptors that act beyond the EATS (estrogen, androgen, thyroid and steroidogenesis) pathways. A regulatory-oriented analysis of thyroid-related modes of action across vertebrate taxa underscored the importance of clearly defining domains of applicability for cross-species extrapolation. At the same time, the discussions revealed critical gaps, including still limited taxonomic applicability domains, incomplete regulatory coverage beyond established endocrine pathways and limited transparency in predictive tools. Together, these contributions illustrate how integrated experimental, computational and regulatory science can advance mechanism-based, animal-reduced assessment of endocrine disruptors. https://doi.org/10.1016/j.tox.2025.154370

The assumption of a threshold is false in risk assessments for endocrine disrupting chemicals (EDCs) when endogenous hormones being disrupted are already above any possible threshold: a policy failure by the US FDA,
Vom Saal, F. S. and Welshons, W. V., *Environmental Health*, Jan 28 2026, Vol. 25, no. 1.

The US FDA continues to assure the public that if they are exposed to an endocrine disrupting chemical (EDC), there is a threshold daily exposure level below which everyone is safe throughout the lifespan (the Acceptable or Tolerable Daily Dose). This assurance is false when the endogenous hormone systems being disrupted by EDCs are already above a threshold for producing adverse effects or there are cumulative effects of mixtures of similar chemicals. Decades of published experimental research, and multiple mathematical analyses, demonstrate the absence of a threshold (safe) dose for hormones, hormonal drugs or EDCs. However, this entire literature has been rejected in decision making by the US FDA food safety division. We review experiments directly falsifying the threshold hypothesis for hormones, drugs and EDCs. Our analysis includes application to hormone and EDC experimental data sets of the Michaelis-Menten (MM) equation, which explains mathematically hormone (or EDC)-receptor binding that mediates normal as well as adverse effects at extremely low exposures. The MM equation regresses to zero at zero hormone or EDC dose, i.e., there is no threshold dose. We derive the MM equation in Supplemental Materials for those interested in the math. We also identify that hormone and EDC potency is the consequence of

a number of cell-specific mechanisms not included in the MM equation. We begin by reviewing the history of the now falsified assumption that a threshold exists for EDCs that are generally classified as systemic toxicants. In particular, the threshold hypothesis is problematic during fetus/infant/child development during which homeostatic defense systems have not yet fully developed, rendering them largely defenseless against the disruptive effects of EDCs. Published findings implicate EDC exposures at very low environmentally relevant doses with every non-communicable disease, which are all increasing in incidence on a global scale. We identify here the empirical and endocrinological evidence falsifying the determination by chemical regulatory agencies that there are safe daily exposure levels for EDCs below an estimated threshold that is not actually experimentally examined. These findings indicate that current human exposures to EDCs are harming the general population as well as causing widespread environmental harm. https://doi.org/10.1186/s12940-026-01265-z

Mapping and visualization of global research progress on endocrine-disrupting chemicals and fetal development: a bibliometric analysis (2014-2024),
Zhang, H. D. F., Yang, F. and Ouyang, L. X., *Journal of Environmental Science and Health Part a-Toxic/Hazardous Substances & Environmental Engineering*, Jan 28 2026, Vol. 61, no. 2, p. 88-97.

A growing body of evidence links prenatal exposure to endocrine-disrupting chemicals (EDCs) to adverse fetal outcomes, including neurodevelopmental disorders, reproductive abnormalities, and metabolic diseases. This study provides a comprehensive bibliometric analysis of global research trends in EDCs and fetal development from 2014 to 2024, highlighting key research areas and emerging hotspots. A total of 7,758 publications were retrieved from the Web of Science Core Collection and analyzed using VOSviewer, CiteSpace, and R software. The analysis revealed the USA, China, and Canada as the leading contributing countries, with major institutions including the University of California System and Harvard University. Prominent journals publishing in this field were PLoS ONE, Scientific Reports, and Environment International. Core research themes, identified through keyword analysis, centered on "prenatal exposure," "birth weight," and "growth." Notably, burst keyword analysis since 2020 identified emerging research frontiers such as "management," "impact," "transport," "proteins," "invasion," and "nutrition." These themes reflect a shift toward understanding the molecular mechanisms, broader ecological impacts, and potential mitigation strategies of EDC exposure. This analysis offers a valuable overview of the research landscape, underscoring the need for future interdisciplinary investigations that integrate toxicology, developmental biology, and public health to effectively address the risks of prenatal EDC exposure. https://doi.org/10.1080/10934529.2026.2630144

Bisphenol-A Release from Modern Resin-Based Dental Composites: A Time-Dependent In Vitro Assessment,
Aliberti, A., Di Duca, F., Piscopo, M., Ausiello, P., Ausiello, L., Acerra, A. and Grumetto, L., *Polymers*, 2026, Vol. 18, no. 6, p. 707. https://www.mdpi.com/2073-4360/18/6/707

Combining Suspect Screening with Large Language Model-Based Text Mining to Comprehensively Characterize Organic Compounds in Human Milk Associated with Pregnancy Complications,
Cheng, X., Gao, L. R., Ai, Q. F., Wang, R. Q., Hao, S. Y., Yang, Q. L., Zhang, Y. X., Lou, Y. C., Li, J. G., Zhang, L., Lyu, B. and Zheng, M. H., *Environmental Science & Technology*, Jan 13 2026, Vol. 60, no. 1, p. 257-270.

Chemical exposure contributes to maternal pregnancy complications like gestational hypertension (GH), anemia, and gestational diabetes mellitus (GDM). However, current studies remain fragmented due to limited analysis of compounds, impeding mechanistic insights. Here, we present a novel framework that integrates high-throughput analysis and large language model-based text

mining to identify organic compounds while leveraging existing massive data, thereby enabling a comprehensive understanding of pregnancy complication mechanisms and establishing an exposure atlas. Using this approach, we identified five compounds in human milk for the first time, including carbazole and 4,4 '-diphenoxybenzophenone, and 35 additional compounds not previously linked to pregnancy complications. We further employed text mining to comprehensively uncover disease-specific chemical signatures based on global data: GH with polycyclic aromatic hydrocarbons (PAHs) and derivatives (e.g., 2-methylnaphthalene and acenaphthene), anemia with nitrogen-containing compounds (e.g., 4-methoxyformanilide), and GDM with long-chain carboxylic acids (e.g., 2,4,7,9-tetramethyldec-5-yne-4,7-diol). Further analysis revealed pathogenic mechanisms: PAHs and derivatives promoted oxidative stress in GH, nitrogen-containing compounds damaged red blood cells in anemia, and long-chain carboxylic acids interfered with mitochondrial function in GDM. These findings construct an atlas of organic compounds associated with pregnancy complications and offer new leads for understanding their environmental origins.
https://doi.org/10.1021/acs.est.5c12937

Enquête sur les Pfas dans les établissements français : les points clés à retenir,
Emili, A. and Humbert, A., *Hygiène et sécurité du travail*, 2025 2025, no. 281, p. 77-89.

Les substances per- et polyfluoroalkylées (Pfas) sont des composés chimiques très stables, utilisés depuis plusieurs décennies dans de nombreux produits industriels et de consommation (textiles, emballages, cosmétiques, mousses anti-incendie…). Malgré leur large usage, les données sur l'exposition professionnelle à ces substances restent limitées. Cet article présente, dans le contexte de la prévention du risque chimique, les résultats d'une enquête réalisée au sein des établissements français potentiellement concernés par la présence ou la manipulation de Pfas. https://doi.org/, https://portaildoc.inrs.fr/Default/doc/SYRACUSE/751406/enquete-sur-les-pfas-dans-les-etablissements-francais-les-points-cles-a-retenir
https://www.inrs.fr/media.html?refINRS=NT%20127

Human dermal exposure to tetrabromobisphenol A and hexabromocyclododecanes in hand wipes: Effects of population, gender, and haze pollution,
Zhu, C. Y., He, X., Cao, Z. G., Sun, Y. X., Hu, B. B., Liu, Y., Zhang, J. W., Luo, X. J., Li, L. Z. and Yuan, H. R., *Environmental Chemistry and Ecotoxicology*, 2026 2026, Vol. 8, p. 1102-1110.

Dermal exposure to tetrabromobisphenol A (TBBPA) and hexabromocyclododecanes (HBCDDs) in humans remains insufficiently characterized. To address this gap, hand wipe samples were collected from individuals in four occupational groups, and the concentrations of TBBPA and HBCDDs were analyzed to estimate both skin absorption and oral intake risks. The median TBBPA concentrations in hand wipes from office employees, undergraduates, taxi chauffeurs, and security guards were 30,700, 11,200, 22,800, and 21,400 ng/m(2), respectively. These levels were significantly higher (p < 0.05) than those of & sum;HBCDDs, which measured 1723, 919, 1710, and 1020 ng/m(2), respectively. Undergraduates exhibited the lowest levels, likely due to their non-professional characteristics, relatively cleaner living environment, and low exposure frequency with contaminated particles. A negative linear correlation was found between the natural logarithm of brominated flame retardants (BFRs) concentrations (LnC(BFRs)) and atmospheric PM2.5, PM10, and AQI levels, although no significant difference emerged between light and heavy haze conditions. The median dermal absorption doses of TBBPA and & sum;HBCDDs were 80.6 and 6.03 ng/kg bw/day, respectively, which were several to dozen times higher than the corresponding oral intake via hand-to-mouth contact (13.4 and 1.05 ng/kg bw/day). These results underscore hand skin as a major exposure pathway for TBBPA and HBCDDs and provide critical insights into their potential health risks in diverse populations. https://doi.org/10.1016/j.enceco.2026.01.023

A Review of Biomonitoring for Atrazine and Atrazine Metabolites Using Blood, Urine, and Sweat-Based Assays,
Zielke, C., Garay, A., Kariuki, N., Wong, K. S., Gogna, S., Nguyen, C., Lau, E. A., Dualan, J. A., Callagy, K., Frozina, L. C., Koparde, R. S., Fang, R., Jacik, S., Mutatkar, S., Houston, T., Ly, T. T., Huynh, V. and Fan, V., *International Journal of Environmental Research and Public Health*, 2026, Vol. 23, no. 3, p. 317. https://www.mdpi.com/1660-4601/23/3/317

Toxicité sur les animaux

Exploratory assessment of preconception phthalate exposure on pregnancy and offspring health outcomes in mice,
Afghah, M., Elkins, A. C., Powell, P. C., Mulligan, M. E., Boland, M. C., Suggs, A. P., Walker, M. A., Brenner, G. E., Johnson, L. C., Padgett, Z. J. and Rock, K. D., *Journal of the Endocrine Society*, Mar 2026, Vol. 10, no. 3.

Understanding how endocrine-disrupting chemicals influence reproductive success requires attention to sensitive windows beyond gestation, including the understudied preconception period. In this exploratory pilot study, female CD-1 mice were exposed to a human-relevant phthalate mixture (200 µg/kg/day) for 30 days prior to mating. Although implantation and litter size were unaffected, exposed dams exhibited nonsignificant shifts in estrus cyclicity, spending more time in proestrus and less in metestrus. Maternal liver transcriptomics revealed persistent changes more than a month after exposure ceased, with differential expression of genes involved in mitochondrial metabolism, oxidative phosphorylation, and xenobiotic processing, suggesting long-term metabolic reprograming in the absence of overt toxicity. Maternal effects coincided with developmental alterations at mid-gestation. At E14.5, fetuses from exposed dams were heavier, and placentas displayed expansion of the junctional zone, a region critical for endocrine function. This early growth enhancement reversed later in life, as exposed male offspring exhibited reduced adult body weight, consistent with altered developmental programing. Transcriptomic profiling revealed pronounced sex-specific placental responses: female placentas exhibited extensive reprograming across immune, metabolic, and extracellular matrix pathways (518 differentially expressed genes [DEGs]), whereas male placentas showed minimal differential expression (9 DEGs), despite enrichment for RNA processing and mitochondrial pathways. Adult offspring livers also displayed sex-specific transcriptional signatures, with exposed females downregulating metabolic and immune-regulatory genes and exposed males upregulating inflammatory pathways. Collectively, these hypothesis-generating findings provide early evidence that preconception exposures can shape maternal physiology, placental development, and long-term offspring health, highlighting the preconception period as a critical yet understudied window of susceptibility.
https://doi.org/10.1210/jendso/bvag010

The effect of perfluorooctanoic acid on ovarian progesterone production and endometrial receptivity,
Ajdary, M., Minaeian, S., Mehdizadehkashi, A., Chaichian, S., Mehdizadeh, M., Derakhshan, R., Karimzadeh, A. and Govahi, A., *Reproductive and Developmental Medicine*, Dec 2025, Vol. 9, no. 4, p. 211-216.

Objective:Perfluorooctanoic acid (PFOA), an ingredient among endocrine-disrupting chemicals, leads to a decrease in fertility. Since the relationship between exposure to these compounds and

disruption of the implantation process has been minimally explored, this research investigated the effect of oral consumption of PFOA on endometrial receptivity.Methods:After an adaptation period, thirty 8-week-old Naval Medical Research Institute (NMRI) female mice were mated with male mice of the same breed. The morning of finding the vaginal plug was considered day 1 (GD1). The mice were randomly divided into five groups: control group, sham group (receiving saline), group 2.5 (receiving 2.5 mg/kg PFOA), group 5 (receiving 5 mg/kg PFOA), and group 10 (receiving 10 mg/kg PFOA). Gavage was performed for 4 days from GD1, after which the mice were euthanized on day 4.5. Blood samples were collected to measure progesterone levels. Endometrial tissue was used to examine pinopodes via scanning electron microscopy (SEM) and the expression of interleukin (IL)-6 and IL-1 beta via quantitative real-time polymerase chain reaction (qRT-PCR).Results:The results showed that PFOA led to a decrease in serum progesterone levels. This reduction trend was statistically significant only in group 10. The decline in the number of pinopodes was dose-dependent, and with increasing doses of PFOA, the decrease in their number and extent became more pronounced. Additionally, the expression levels of IL-6 and IL-1 beta decreased; this reduction was dose-dependent and statistically significant.Conclusion:The results of this study demonstrated that PFOA altered endometrial function during the implantation stage by affecting serum progesterone levels, the number of pinopodes, and the expression levels of IL-6 and IL-1 beta. The evidence suggests that these changes are detrimental to embryo implantation. Therefore, further studies investigating the negative effects of PFOA on the endometrium are warranted.
https://doi.org/10.1097/rd9.0000000000000137

Health risk assessment of emerging PFOS substitute 8:2 Cl-PFESA: evidence from mouse spermatogenesis and derivation of a safe exposure threshold,
An, Z. W., Liu, Z. Y., Zeng, X. L., Jiang, Z. X., Chen, Z., Zhu, Y. M., Li, L. F., Sun, T. H., Zheng, C., Liu, X. H., Liu, Y., Tan, Z. Z. and Guo, H. C., *Environment International*, Feb 2026, Vol. 208.

The global decline in total fertility rate has been linked to environmental contaminants like per-and polyfluoroalkyl substances (PFASs), yet the male reproductive toxicity and health risks of the widely detected emerging substitute, 8:2 chlorinated polyfluorinated ether sulfonate (8:2 Cl-PFESA), remain poorly understood. This study aimed to investigate the testicular toxicity of 8:2 Cl-PFESA (0.04, 0.2, 1.0 mg/kg for 12 weeks) in male mice. Dose-dependent testicular damage was observed, manifested as seminiferous tubule disarray, reduced serum testosterone levels, and sperm abnormalities. Integrated omics analysis highlighted the sphingolipid signaling pathway as a core pathway, which was validated through the disruption of stress fibers and down-regulation of F-actin expression. Benchmark dose modeling predicted a BMDL10 of 0.023 mg/kg/day and a CRfD of 4.577 ng/kg/day, indicating a higher sensitivity of 8:2 Cl-PFESA compared to PFOS. Risk assessment indicated potential non-carcinogenic risks (HQ = 1.60, MOE = 0.59) for highly exposed occupational populations, while carcinogenic risk remained below the concern threshold (CR = 1.39 × 10(-7)). By innovatively coupling mechanism-driven multi-omics discovery with quantitative, health-based threshold derivation (CRfD) and probabilistic risk metrics (HQ, MOE), this study establishes a predictive and evidence-based assessment framework. This approach moves beyond traditional hazard identification to enable sensitive, early-warning risk characterization for emerging contaminants prior to widespread human exposure, thereby providing a critical scientific basis for proactive chemical regulation and preventing regrettable substitution.
https://doi.org/10.1016/j.envint.2026.110134

Maternal preconception and gestational exposure to a mixture of short half-life food chemicals altered fetoplacental development in a rabbit model, based on a French mother-child cohort, Bozec, J., Rousseau-Ralliard, D., Jovanovic, N., Ouidir, M., Angrand, L., Popping, D., Calderari, S., Dahirel, M., Fournier, N., Morin, G., Lemarie, L., Richard, C., Gelin, V., Gayrard, V., Philippat, C. and Couturier-Tarrade, A., *Environment International*, Feb 2026, Vol. 208.

Pregnant women from the general population are exposed daily to chemicals that can affect offspring's health. The current study aimed to evaluate the effects of a mixture of chemicals on maternal and fetal health in the rabbit model, which was defined based on associations between urinary concentrations of chemicals in pregnant women from the SEPAGES cohort and offspring outcomes. From the SEPAGES cohort data, a mixture including 3 phenols, 1 paraben and four phthalates was established and used in a rabbit model. Female rabbits were exposed orally from preconception to 28 days post-conception (dpc) to this mixture (PPP exposed group, PPP) or excipient (control group, C) daily at the doses, estimated from the maximum urinary concentrations observed in the cohort. Maternal and fetoplacental phenotype were characterized. Maternal glucose concentration decreased significantly in the PPP group, before mating. At 21 dpc, ultrasound monitoring showed that fetal body length and abdominal perimeter were increased in PPP group compared to C group. At 28 dpc, heart to bodyweight ratio was increased in PPP females compared to C females. At this stage, fetal blood biochemistry showed a decrease in insulin levels, while triglycerides and total protein increased, mostly in PPP males compared to controls. Exposure to a PPP mixture defined from a human mother-child cohort impacted rabbit maternal phenotype and affected fetal health in a sex-specific manner, suggesting that this mixture could induce fetal malprogramming with long-term effects. https://doi.org/10.1016/j.envint.2026.110092

PFOA and co-exposure with PFOS induce AMPK-dependent hypoglycemia in mice: integrated evidence from physiology, multi-omics, and molecular docking,
Chang, J. J., Xu, X. J., Chen, S. Y., Yan, X. L., Zhao, Y., Zhang, J. F., Zhu, Z. L., Yin, D. Q. and Qiu, Y. L., *Environment International*, Feb 2026, Vol. 208.

Per- and polyfluoroalkyl substances, notably perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), are persistent environmental contaminants with increasing evidence of metabolic toxicity. However, their effects on glucose homeostasis and the underlying mechanisms remain unclear. In this study, we investigated the metabolic consequences of PFOA, PFOS and co-exposure in male C57BL/6 mice for 28 days. Physiological indicators, including fasting blood glucose and hepatic glycogen, were evaluated, followed by transcriptomic, metabolomic, and molecular docking analyses. We found that PFOA and PFOS co-exposure significantly induced hypoglycemia and reduced hepatic glycogen content. Transcriptomic and metabolomic profiling revealed enriched pathways related to glucose metabolism, with the AMPK signaling pathway identified as a central mediator. Notably, PFOA and co-exposure upregulated glycolytic and fatty acid oxidation genes, while suppressing glycogen synthesis regulators. Molecular docking further indicated that both PFOA and PFOS could bind to adiponectin receptors (AdipoR1/2), potentially disrupting normal receptor-mediated AMPK activation. Together, these findings establish an AdipoR1/2-AMPK-mediated mechanism for PFAS-induced glucose metabolic disruption, particularly under PFOA or co-exposure. We provide the integrated physiological and mechanistic evidence linking PFAS exposure to AMPK-dependent hypoglycemia, highlighting the need for metabolic health risk assessments of PFAS mixtures in the environment. https://doi.org/10.1016/j.envint.2026.110076

Subtle morphological and molecular responses to low-dose diethylstilbestrol in the developing rat penis,
Elmelund, E., Berg, M., Pedersen, M., Svingen, T. and Draskau, M. K., *Reproductive Toxicology*, Mar 2026, Vol. 140.

Developmental exposure to estrogenic chemicals can cause hypospadias in mice. In rats and humans this link is less well-defined, and the causal relationship remains unclear. This likely pertains to uncertainties regarding direct and indirect effects of estrogens in the genital tubercle (GT) and inconsistent evaluations of potentially mild disruptions, especially in rats. In this study, we investigated the effects of late gestational exposure to the estrogenic chemical diethylstilbestrol (DES) in low doses on male rat penis differentiation. In an ex vivo GT culture system, DES caused subtle changes to GT morphology after 96 h in culture, but with no overt phenotype. Moreover, DES upregulated Ar and AR-responsive genes in the GT. When exposing rats in vivo from gestational day (GD) 7-21, DES did not cause genital malformations in the fetal males, but we observed slight abnormalities to GT morphology in mu CT scans. Our study indicates that DES may directly modulate hormone signaling in the GT during fetal masculinization.
https://doi.org/10.1016/j.reprotox.2025.109149

Dietary Glyphosate Exposure Disrupts Hepatic and Reproductive Function in Female Zebrafish at Regulatory Safe Levels,
Giommi, C., Lombó, M., Maradonna, F., Pinto, G., Sella, F., Fontanarosa, C., Habibi, H. R., Amoresano, A. and Carnevali, O., *Toxics*, Jan 7 2026, Vol. 14, no. 1.

Glyphosate (GLY), the active ingredient in widely used herbicides, was long considered specific to plants and bacteria, yet mounting evidence shows it can impair endocrine and reproductive functions in animals. Given its widespread use and environmental persistence, assessing its effects at regulatory-approved doses is critical. Here, adult female zebrafish (Danio rerio) were exposed for 21 days to different concentrations of dietary GLY at 0.5 mg/kg body weight/day (GLY0.5, acceptable daily intake, ADI), 5 mg/kg/day (GLY5), and 50 mg/kg/day (GLY50, no-observed-adverse-effect level, NOAEL). Our findings show that dietary GLY induces dose-dependent perturbations along the hepato-gonadal axis. At the highest dose, chronic stress responses were evident through elevated cortisol and cortisone, accompanied by hepatic glycogen accumulation and ferroptotic stress. Although follicle histology appeared normal, alterations in several genes involved in oocyte maturation and estrogen receptor signaling translated into reduced fertilization, revealing compromised gamete quality rather than overt follicular development abnormality. Likewise, the lowest dose triggered modifications in genes crucial for oogenesis without altering the follicle development, although in this case, potential compensatory mechanisms could have led to enhanced fertilization. GLY5 did not alter the number of fertilized eggs but significantly increased embryo mortality. Overall, dietary GLY disrupted hepatic metabolism, endocrine signaling, and reproduction in a non-monotonic manner, even at levels considered safe by EFSA. These findings highlight the need to reevaluate current safety thresholds with attention to female-specific reproductive risks. https://doi.org/10.3390/toxics14010059

Developmental exposure to a mixture of propiconazole and glyphosate induces histopathological lesions in the prostate of postpubertal rats,
Gomez, A. L., Reato, D. G., Masat, E., Kass, L. and Altamirano, G. A., *Molecular and Cellular Endocrinology*, Apr 2026, Vol. 614.

Pesticide mixture exposure during critical developmental windows is a growing public health concern, given their potential additive or synergistic effects on the male reproductive system. This

study aimed to evaluate whether developmental exposure to a mixture of propiconazole (PRO) and glyphosate (GLY) alters the postpubertal rat prostate. Pregnant rats were orally exposed to vehicle (saline) or a mixture of PRO and GLY (4 mg PRO/kg/day and 3.7 mg GLY/kg/day) from gestation day 9 until weaning. On postnatal day 60, male offspring were euthanized, and the prostate and serum samples were collected. PROGLY-exposed rats exhibited changes in the ventral and dorsolateral prostate histoarchitecture, including epithelial and stromal remodeling and increased incidence of prostate lesions. In the ventral prostate, although the relative glandular area remained unchanged, PROGLY exposure exhibited increased epithelial height and decreased luminal acinar area. Also, hyperplastic and atrophic acini were more prevalent in these animals. PROGLY exposure reduced estrogen receptor beta (ESR2) protein level, particularly in hyperplastic and atrophic acini, without affecting androgen or estrogen receptor alpha. ESR2 decrease was associated with an increased cell proliferation index in hyperplastic acini and a reduction in serum testosterone level in PROGLY-exposed rats. Stromal alterations included increased smooth muscle cell layers and reduced vimentin-positive fibroblasts, with no evidence of myofibroblast presence. This study shows that developmental exposure to PROGLY disrupts normal ventral prostate architecture and hormone signaling in postpubertal rats. These findings highlight the potential long-term risks of combined pesticide exposure on male reproductive health and the importance of evaluating mixture effects. https://doi.org/10.1016/j.mce.2026.112730

EFFECTS OF PRENATAL AND NEONATAL EXPOSURE TO GLYPHOSATE AND GLYPHOSATE-BASED FORMULATIONS ON MALE AND FEMALE OFFSPRING FERTILITY AND REPRODUCTIVE ORGANS DEVELOPMENTAL EFFECTS,
Hbous, A. M., Cercelaru, L., Blendea, A., Mitrut, R. and Docea, A. O., *Farmacia*, Nov-Dec 2025, Vol. 73, no. 6, p. 1337-1347.

A systematic search (June 2025) of PubMed and ScienceDirect identified animal studies examining prenatal and lactational exposure to glyphosate or glyphosate-based herbicides (GBHs) and subsequent reproductive outcomes. Of 272 records screened, 58 full texts were assessed, and 10 met the inclusion criteria focusing on male or female fertility endpoints. Two studies reported effects in both sexes; five studies in male offspring (mice and rats) and seven in female offspring (rats and ewes). Evidence indicates endocrine-disrupting actions of glyphosate and GBHs in males, including impaired spermatogenesis and altered Leydig cell hormone regulation at low exposure levels. In females, very low doses reduced implantation sites and induced multigenerational effects in rats and ewes. Collectively, available data demonstrate that early-life glyphosate or GBH exposure can disrupt reproductive physiology across species. https://doi.org/10.31925/farmacia.2025.6.1

Gut microbiome influences uterine development in mice,
Ibrahim, S., Ngyuen, J., Salgado, V., Chiu, K., Laws, M. J., Flaws, J. A., Bashir, S. T. and Nowak, R. A., *Reproduction*, Feb 2026, Vol. 171, no. 2.

In briefThe gut microbiome has been shown to have effects on several body axes. This study demonstrates that the gut microbiome is essential for proper uterine development in mice, whereas short-term diisononyl phthalate exposure at relevant doses shows no additional harmful effects.Diisononyl phthalate (DiNP), a plasticizer increasingly replacing di(2-ethylhexyl) phthalate, is an endocrine-disrupting chemical linked to female reproductive harm. Ingestion is the most common route of DiNP exposure, making the gastrointestinal tract and gut microbiome a direct target for endocrine-disrupting chemical exposure. This study examined the effects of acute DiNP exposure either in the absence or presence of a gut microbiome on uterine development. Female C57Bl/6 germ-free (-microbiome) 40-day-old mice were orally dosed, over 3 days, with either sterile phosphate-buffered (n = 8) to remain germ-free (GF, -microbiome) or with colon contents (n = 10) to

develop a gut-microbiome (+microbiome). This was followed by a 10-day period where half of the -microbiome and +microbiome mice were orally dosed with corn oil while half were orally dosed with 200 mu g/kg/day DiNP. The control group were specific pathogen-free conventionally housed mice born with a microbiome. Mice were euthanized in diestrus at the end of the 10 days. Uteri were collected for histological analyses. Uterine development was significantly delayed in GF mice, regardless of later microbiome reintroduction or DiNP exposure. Key findings included reduced uterine diameter, stroma area, and gland number, and thinner myometrial layers. Endometrial stromal cell proliferation was also lower in GF mice. DiNP exposure alone showed no significant effects. Estradiol levels and ovarian follicle counts were similar across groups, but GF mice had fewer, smaller litters in fertility tests. The study highlights that the gut microbiome critically influences postnatal uterine development, with its absence leading to persistent structural deficits. DiNP, at the tested dose, did not exacerbate these effects. https://doi.org/10.1093/reprod/xaag003

Black Phosphorus Nanosheets Penetrate the Blood-Testis Barrier and Induce Reproductive Toxicity in Male Mice,
Jiang, S. H., Ruan, F. K., Zhang, F. C., Long, Z. W., Ding, X. Y., Zhu, S. H., Fu, Z. N., Zuo, Z. H., Jiang, X. M. and He, C. Y., *Environment & Health*, 2026.

Black phosphorus nanosheets (BPNSs), as an emerging subclass of two-dimensional (2D) nanomaterials, have exhibited extensive applicability in electronics, optoelectronics, and medical sciences. However, its expanding application in diverse fields has raised concerns about inadvertent environmental release, which might lead to potential ecological and health risks. Herein, mice were continuously exposed at doses of 0.1 mg/kg/day (possible acceptable daily intake dose, ADI) and 1 mg/kg/day (possible occupational exposure dose) to BPNSs for 28 days. Using hyperspectral imaging and Evans blue fluorescence chromogenic assay, we confirmed that partial BPNSs penetrated the blood-testis barrier (BTB) and distributed throughout the spermatogenic microenvironment of testes. Mice exposed to BPNSs exhibited significant reproductive toxicity, evidenced by abnormal sperm parameters, disordered spermatogenic cell layers, sloughed germ cells, and disrupted sex hormone levels. Further, BPNSs promoted the steroid synthesis pathway and inhibited testosterone aromatization, leading to testicular endocrine homeostasis disorders. BPNSs also damaged germ cells in the testes via the apoptosis pathway. In conclusion, our study not only highlights the male reproductive toxicity of BPNSs but also demonstrates that BPNSs can penetrate the BTB and have bioaccumulation potential in the male reproductive system, which provides new insights into the toxicological implications of 2D nanomaterials for mammalian fertility.
https://doi.org/10.1021/envhealth.5c00379

Long-term exposure to Di(2-ethylhexyl) phthalate induced uterine histopathologic alterations in female mice,
Lee, J. Y., Kim, J. S., Zaheer, J., Chang, S. H., Choi, K., Hwang, D. W., Lee, J. S., Kim, Y. A. and Cho, Y. H., *Toxicology and Applied Pharmacology*, Apr 2026, Vol. 509.

Objective: To investigate the effects of long-term Di(2-ethylhexyl) phthalate (DEHP) exposure on the female reproductive system, employing different dosages and durations of exposure. Methods: Pregnant female CD-1 mice (F0) were orally exposed to DEHP at doses of 0, 100, and 500 mg/kg/day during gestation. Following birth, the female offspring (F1) were allocated into three groups as F0 mice. Both F0 and F1 mice were consequently subjected to ongoing DEHP exposure until they were sacrificed. Body weight, anogenital distance, anogenital index (AGI), and histopathologic outcomes of the uterus were examined at 21 and 35 weeks for F0 mice and at 10 and 24 weeks for F1 mice. Results: Both low and high DEHP exposures significantly decreased body weight in F0 at 21 weeks and in F1 at 10 and 24 weeks, while AGI was not significantly changed in response to DEHP exposure

in both F0 and F1 mice. DEHP exposure induced endometrial stromal fibrosis, endometrial hyperplasia, and myometrial atrophy in the uterus of F1mice, while cystic hyperplasia and endometrial stromal sarcoma (ESS) were seen in the F0 after DEHP exposure at 35 weeks. Conclusions: Long-term Exposure to DEHP significantly reduced body weight and induced pathological alterations in the uterus of both F0 and F1 mice. Dams exposed to high doses of DEHP developed ESS, suggesting that DEHP may have carcinogenic potential in the uterus. However, further research is necessary to confirm this finding. https://doi.org/10.1016/j.taap.2026.117738

The Protective Effect and Molecular Mechanism of Tetrandrine on Male Reproductive Damage Caused by Silicon Dioxide,
Li, H. M., Zeng, X. Q., Chang, Q., Sheng, Y. X., Pu, Y. J., Wang, Y., Cheng, B., Li, H. H., Xuan, J., Zhang, L. and Xu, H. M., *Toxics*, Jan 18 2026, Vol. 14, no. 1.

The long-term inhalation of free silica dust causes silicosis-a prevalent occupational hazard-yet its systemic effect on male reproductive toxicity remains underexplored. Tetrandrine (Tet) is the only plant-derived anti-silicosis drug approved in China. This study investigates silica (SiO2) -induced male reproductive damage and evaluates Tet's protective effects. Sixty male C57BL/6 mice (6-8 weeks) were divided into control, SiO2 exposure, and SiO2 + Tet groups. SiO2 was administered via intranasal infusion and Tet via gavage. Mice were sacrificed at day 7 (male reproductive injury model corresponding to the pulmonary inflammation stage) and day 42 (male reproductive injury model corresponding to the pulmonary fibrosis stage). Analyses included sperm morphology, testicular transcriptome sequencing, RT-qPCR, and immunofluorescence. At day 7, SiO2 exposure upregulated testicular inflammatory markers, which were partially mitigated by Tet. At day 42, SiO2 increased sperm deformity and testicular fibrosis markers (fibronectin and vimentin); Tet intervention reduced these abnormalities. Transcriptome analysis revealed distinct gene expression patterns at day 7 versus day 42, indicating time-dependent injury mechanisms. Tetrandrine alleviates silica-induced reproductive damage in male mice, suggesting potential therapeutic applications for occupational silica exposure and expanding the understanding of silica toxicity beyond the respiratory system. https://doi.org/10.3390/toxics14010087

Silent Disruptors: The Multifaceted Impact of Phthalates Across Aquatic Invertebrate and Vertebrate Taxa,
Savoca, D., Martino, C., Maccotta, A., Arizza, V., Amorello, D., Arrabito, G. and Orecchio, S., *Applied Sciences-Basel*, Dec 8 2025, Vol. 15, no. 24.

Phthalic acid esters (PAEs) are ubiquitous pollutants with reported endocrine-disruption and multiplex toxic activities in a wide range of invertebrate and vertebrate animals. In the present review, the molecular and physiological effects of phthalate exposure on invertebrates, as well as less characterized vertebrates such as amphibians, reptiles, and mammals, are thoroughly examined. PAEs induce a series of adverse effects, such as reproductive toxicity, oxidative stress, immune system impairment, and neuroendocrine disruption. The effects can extensively vary depending on the species, developmental stage, and environmental conditions, ranging from impaired hormone signaling, developmental malformations, and thyroid impairment in amphibians and reptiles to lipid metabolism disturbances and epigenetic changes in mammals. This review will place particular emphasis on transgenerational effects, mixture toxicity, and chronic low-level exposure. By integrating evidence from in vivo, in vitro, and omics studies, this review defines areas of knowledge gaps and the necessity to integrate these taxa in integrated ecological risk assessments, as well as regulatory policy. https://doi.org/10.3390/app152412937

Effects of perfluorooctane sulfonate (PFOS) and tetrabromobisphenol A (TBBPA) on reproductive development in rats,
Stub, M., Ramhoj, L., Axelstad, M., Pedersen, M. and Svingen, T., *Reproductive Toxicology*, Mar 2026, Vol. 140.

Perfluorooctane sulfonate (PFOS) and tetrabromobisphenol A (TBBPA) are environmental pollutants with known endocrine disrupting potential. Both substances display various thyroid hormone (TH) system disrupting effects, both in vitro and in vivo, but effects on the reproductive system following developmental exposure are less characterized. Recently, we described effects following perinatal exposure to PFOS (0.4 or 0.8 mg/kg bw/day) and TBBPA (250 or 500 mg/kg bw/day) on the TH system in rats, showing a complex effect pattern. Here, we report data on reproductive endpoints (anogenital distance (AGD), nipple retention (NR) and male reproductive organ weights) and steroid hormone levels in offspring from the same in vivo study. Results indicate that PFOS and TBBPA do not affect antiandrogenic endpoints such as AGD and NR at administered doses. PFOS had a modest effect on steroidogenesis, increasing estrone levels in fetuses, and in the 16-day-old pups increasing corticosterone levels in the low-dose group and progesterone levels in both dose groups, along with a small reduction in adjusted testes weight. TBBPA did not alter steroid hormone levels at the fetal stage, but hormones were disrupted in the 16-day-old pups. Here TBBPA increased progesterone levels in low-dose and testosterone levels in high-dose pups and reduced estrone levels in high-dose group to values below the limit of quantification (LOQ). These findings suggest that PFOS and TBBPA have some effects on circulating steroid hormone levels, but minimal effects on androgen-sensitive endpoints in rats. https://doi.org/10.1016/j.reprotox.2026.109170

Nonylphenol exposure and cardiovascular toxicity: Mechanistic insights and integrated risk assessment from experimental models,
Tan, Z. Z., An, Z. W., Xing, X. Q., Zhu, Y. M., Jiang, Z. X., Zeng, X. L., Chen, Z., Guo, H. C. and Zhang, X. G., *Environmental Pollution*, Feb 15 2026, Vol. 391.

Nonylphenol (NP), a widespread environmental endocrine-disrupting chemical, has been extensively studied for its reproductive and neurological toxicity; however, its cardiovascular effects and underlying mechanisms remain poorly understood, and a systematic risk assessment is still lacking. This study investigated the effects of NP exposure on cardiac function in mice and its molecular mechanisms through subacute toxicity experiments, followed by a comprehensive risk analysis using the Targeted Risk Assessment of Environmental Chemicals (TRAEC) strategy. Kunming mice (equal numbers of males and females) were orally administered NP at doses of 75, 150, and 300 mg/kg daily for 28 days. Cardiac toxicity was evaluated via echocardiography, histopathology, cardiomyocyte contractility measurements, and transcriptomic analysis. Results showed that NP exposure significantly reduced left ventricular ejection fraction and fractional shortening in female mice, induced myocardial fibrosis and collagen deposition, and markedly decreased cardiomyocyte contractile amplitude as well as depolarization/repolarization rates. Transcriptomic analysis identified 242 differentially expressed genes, with abnormal activation of the relaxin signaling pathway potentially mediating NP-induced cardiotoxicity. Further TRAEC-based risk assessment classified NP as a medium-risk compound (score: 6.50), significantly higher than other alkylphenols such as butylphenol (2.43) and octylphenol (2.95), underscoring its heightened environmental and regulatory concern. This study systematically reveals the mechanisms by NP impairs cardiac contractility, induces fibrosis, and disrupts transcriptomic regulation, while clarifying its environmental risk level through the TRAEC framework. These findings provide critical scientific evidence for environmental policy formulation. Future research should prioritize human epidemiological validation and further exploration of NP's molecular targets.
https://doi.org/10.1016/j.envpol.2025.127575

Prenatal perfluorooctanoic sulfonate exposure is associated with polycystic ovary syndrome-like and related traits in female offspring mice,
Urrutia-Lopez, C., González-Carranza, L., Barajas-Salinas, A., Bonilla, E., Rodriguez-Mercado, J. J., Aviles, A., Langley, E., Reyes-Grajeda, J. P., Casillas, F., Lopez, A., Casas, E., Betancourt, M., González-Torres, M. C. and Bahena-Ocampo, I., *Molecular and Cellular Endocrinology*, Mar 2026, Vol. 613.

Polycystic Ovary Syndrome (PCOS), is the most common female endocrine disorder affecting women of reproductive age. Its prevalence is estimated to be up to 13 % worldwide. This heterogeneous clinical condition is characterized by marked clinical and/or biochemical hyperandrogenism, ovulatory dysfunction, and frequent development of polycystic ovaries. Several studies have focused on the relationship between endocrinedisrupting pollutants and PCOS development. Perfluorooctanesulfonate (PFOS) is ubiquitously detected in the environment. Exposure to endocrine-disrupting chemicals, including PFOS, during early fetal development may lead to alterations similar to the PCOS phenotype. Using mice as a model, we compared the effects of prenatal exposure to PFOS or dihydrotestosterone (a model of PCOS induction). After analyzing steroid status, we detected delayed pubertal onset accompanied by increased testosterone concentrations in adulthood, as well as altered estrous cycles with a longer metestrus phase. At this point, two of three Rotterdam criteria have been confirmed as PCOS features. Finally, we identified endocrine disruption in the ovaries from adult females prenatally exposed to PFOS, as evidenced by altered expression of genes involved in steroidogenesis pathways, as well as altered expression of gonadotropin hormone receptors, and Amh signaling. These data support a role of PFOS in endocrine disruption and in promoting development of PCOS symptom development.
https://doi.org/10.1016/j.mce.2025.112707