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CHEMICAL EFFECTS

Effects of endocrine disrupting chemicals on gonad development: Mechanistic insights from fish and mammals

2021-09-09

Over the past century, evidence has emerged that endocrine disrupting chemicals (EDCs) have an impact on reproductive health. An increased frequency of reproductive disorders has been observed worldwide in both wildlife and humans that is correlated with accidental exposures to EDCs and their increased production. Epidemiological and experimental studies have highlighted the consequences of early exposures and the existence of key windows of sensitivity during development. Such early in life exposures can have an immediate impact on gonadal and reproductive tract development, as well as on long-term reproductive health in both males and females. Traditionally, EDCs were thought to exert their effects by modifying the endocrine pathways controlling reproduction. Advances in knowledge of the mechanisms regulating sex determination, differentiation and gonadal development in fish and rodents have led to a better understanding of the molecular mechanisms underlying the effects of early exposure to EDCs on reproduction. In this manuscript, we review the key developmental stages sensitive to EDCs and the state of knowledge on the mechanisms by which model EDCs affect these processes, based on the roadmap of gonad development specific to fish and mammals.

Authors: G Delbes, M Blázquez, J I Fernandino, P Grigorova, B F Hales, C Metcalfe, L Navarro-Martín, L Parent, B Robaire, A Rwigemera, G Van Der Kraak, M Wade, V Marlatt

Full Source: Environmental research 2021 Sep 9;204(Pt B):112040. doi: 10.1016/j.envres.2021.112040.

Over the past century, evidence has emerged that endocrine disrupting chemicals (EDCs) have an impact on reproductive health.

Reevaluating tear gas toxicity and safety

2021-09-12

Tear gases, or chemical demonstration control agents (DCA), were originally created as weapons that could severely disable or kill enemy troops. Though banned in war, these chemicals are still used in domestic policing. Here we review the available scientific literature on tear gas, summarizing findings from animal and environmental studies as well describing data from new human studies. We find a lack of scientific evidence supporting the safety of tear gas, especially regarding its long-term impacts on human health and the environment. Many of

the available studies were published decades ago, and do not parse data by variables such as chemical type and exposure time, nor do they account for the diversity of individuals who are exposed to tear gas in real-life situations. Due to the dearth of scientific research and the misinterpretation of some of the available studies, we conclude that a serious reevaluation of chemical DCA safety and more comprehensive exposure follow-up studies are necessary.
Authors: Jennifer L Brown, Carey E Lyons, Carlee Toddes, Timothy Monko, Roman Tyshynsky
Full Source: Inhalation toxicology 2021 Sep 12;1-16. doi: 10.1080/08958378.2021.1963887.

Prenatal exposure to endocrine disrupting chemicals is associated with altered DNA methylation in cord blood

2021-09-16
Prenatal exposure to endocrine disrupting chemicals can interfere with development, and has been associated with social-cognitive functioning and adverse health outcomes later in life. Exposure-associated changes of DNA methylation (DNAm) patterns have been suggested as a possible mediator of this relationship. This study investigated whether prenatal low-dose exposure to polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) is associated with altered DNAm patterns across the genome in a Western urban-industrial population. In 142 mother-infant pairs from the Duisburg Birth Cohort Study, PCBs and PCDD/Fs levels were quantified from maternal blood during late pregnancy and associated with DNAm levels in cord blood using the Illumina EPIC beadchip. The epigenome-wide association studies (EWAS) identified 32 significantly differentially methylated positions (DMPs) and eight differentially methylated regions (DMRs) associated with six congeners of PCB and PCDD in females or males (FDRs < 0.05). DMPs and DMRs mapped to genes involved in neurodevelopment, gene regulation, and immune functioning. Weighted gene correlation network analysis (WGCNA) showed 31 co-methylated modules (FDRs < 0.05) associated with one congener of PCDF levels in females. Results of both analytical strategies indicate that prenatal exposure to PCBs and PCDD/Fs is associated with altered DNAm of genes involved in neurodevelopment, gene expression and immune functioning. DNAm and gene expression levels of several of these genes were previously associated with EDC exposure in rodent models. Follow-

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up studies will clarify whether these epigenetic changes might contribute to the origin for adverse mental and health outcomes.
Authors: Katharina Mattonet, Nikola Nowack-Weyers, Vanessa Vogel, Dirk Moser, Sascha Tierling, Monika Kasper-Sonnenberg, Michael Wilhelm, Michael Scherer, Jörn Walter, Jan G Hengstler, Axel Schölmerich, Robert Kumsta
Full Source: Epigenetics 2021 Sep 16;1-18. doi: 10.1080/15592294.2021.1975917.

A systematic comparison of neurotoxicity of bisphenol A and its derivatives in zebrafish

2021-09-08
As more and more countries have prohibited the manufacture and sale of plastic products with bisphenol A (BPA), a number of bisphenol analogues (BPs), including BPS, BPF and BPAF, have gradually been used as its primary substitutes. Ideally, substitutes used to replace chemicals with environmental risks should be inert, so it makes sense that the risk of the similar chemical substitutes (BPS, BPF, and BPAF) should be assessed before they used. Therefore, in the present study, the neurotoxicity of four BPs at environmentally relevant concentration (200 μg/L) were systematically compared using zebrafish as a model. Our results showed that the four BPs (BPA, BPS, BPF and BPAF) exhibited no obvious effect on the hatchability, survival rate and body length of zebrafish larvae, noteworthily a significant inhibitory effect on spontaneous movement at 24 hpf was observed in the BPA, BPF and BPAF treatment groups. Behavioral tests showed that BPAF, BPF and BPA exposure significantly reduced the locomotor activity of the larvae. Additionally, BPAF treatment adversely affected motor neuron axon length in transgenic lines hb9-GFP zebrafish and decreased central nervous system (CNS) neurogenesis in transgenic lines HuC-GFP zebrafish. Intriguingly, BPAF displayed the strongest effects on the levels and metabolism of neurotransmitters, followed by BPF and BPA, while BPS showed the weakest effects on neurotransmitters. In conclusion, our study deciphered that environmentally relevant concentrations of BPs exposure exhibited differential degrees of neurotoxicity, which ranked as below: BPAF > BPF ≈ BPA > BPS. The possible mechanisms can be partially ascribed to the dramatical changes of multiple neurotransmitters and the inhibitory

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effects on neuronal development. These results suggest that BPAF and BPF should be carefully considered as alternatives to BPA.
Authors: Jie Gu, Min Guo, Xiaogang Yin, Caoxing Huang, Lingling Qian, Linjun Zhou, Zhen Wang, Lei Wang, Lili Shi, Guixiang Ji
Full Source: The Science of the total environment 2021 Sep 8;805:150210. doi: 10.1016/j.scitotenv.2021.150210.

ENVIRONMENTAL RESEARCH

Dissipation, Fate, and Toxicity of Crop Protection Chemical Safeners in Aquatic Environments

2021-09-17
Safeners are a group of chemicals applied with herbicides to protect crop plants from potential adverse effects of agricultural products used to kill weeds in monocotyledonous crops. Various routes of dissipation of safeners from their point of applications were evaluated. Despite the large numbers of safeners (over 18) commercially available and the relatively large quantities (~2 × 106 kg/year) used, there is little information on their mobility and fate in the environment and occurrence in various environmental matrices. The only class of safeners for which a significant amount of information is available is dichloroacetamide safeners, which have been observed in some rivers in the USA at concentrations ranging from 42 to 190 ng/L. Given this gap in the literature, there is a clear need to determine the occurrence, fate, and bioavailability of other classes of safeners. Furthermore, since safeners are typically used in commercial formulations, it is useful to study them in relation to their corresponding herbicides. Common routes of dissipation for herbicides and applied safeners are surface run off (erosion), hydrolysis, photolysis, sorption, leaching, volatilization, and microbial degradation. Toxic potencies of safeners vary among organisms and safener compounds, ranging from as low as the LC50 for fish (Oncorhynchus mykiss) for isoxadifen-ethyl, which was 0.34 mg/L, to as high as the LC50 for Daphnia magna from dichlormid, which was 161 mg/L. Solubilities and octanol-water partition coefficients seem to be the principal driving force in understanding safener mobilities. This paper provides an up-to-date literature review regarding the occurrence, behaviour, and toxic potency of herbicide safeners and identifies important knowledge gaps in our understanding

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of these compounds and the potential risks posed to potentially impacted ecosystems.
Authors: Femi F Oloye, Oluwabunmi P Femi-Oloye, Jonathan K Challis, Paul D Jones, John P Giesy
Full Source: Reviews of environmental contamination and toxicology 2021 Sep 17. doi: 10.1007/398_2021_70.

Transformation products of pharmaceuticals in the environment: Their fate, (eco)toxicity and bioaccumulation potential

2021-08-27
Nowadays, a huge scientific attention is being paid to the chemicals of emerging concern, which may pose a significant risk to the human and whole ecosystems. Among them, residues of pharmaceuticals are a widely investigated group of chemicals. In recent years it has been repeatedly demonstrated that pharmaceuticals are present in the environment and that some of them can be toxic to organisms as well as accumulate in their tissues. However, even though the knowledge of the presence, fate and possible threats posed by the parent forms of pharmaceuticals is quite extensive, their transformation products (TPs) have been disregarded for long time. Since last few years, this aspect has gained more scientific attention and recently published papers proved their common presence in the environment. Also the interest in terms of their toxicity, bioconcentration and stability in the environment has increased. Therefore, the aim of our paper was to revise and assess the current state of knowledge on the fate and effects resulting from the presence of the pharmaceuticals' transformation drugs in the environment. This review discusses the metabolites of compounds belonging to six major pharmaceutical groups: SSRIs, anticancer drugs, antibiotics, antihistamines, NSAIDs and opioids, additionally discussing other individual compounds for which literature data exist. The data presented in this paper prove that some TPs may be as harmful as their native forms, however for many groups of drugs this data is still insufficient to assess the risk posed by their presence in the environment.
Authors: Jakub Maculewicz, Dorota Kowalska, Klaudia Świacka, Michał Toński, Piotr Stepnowski, Anna Białk-Bielińska, Joanna Dołżonek
Full Source: The Science of the total environment 2021 Aug 27;802:149916. doi: 10.1016/j.scitotenv.2021.149916.

Nowadays, a huge scientific attention is being paid to the chemicals of emerging concern, which may pose a significant risk to the human and whole ecosystems.

Microplastics as an aquatic pollutant affect gut microbiota within aquatic animals

2021-09-01

The adverse impact of microplastics (MPs) on gut microbiota within aquatic animals depends on the overall effect of chemicals and biofilm of MPs. Thus, it is ideal to fully understand the influences that arise from each or even all of these characteristics, which should give us a whole picture of consequences that are brought by MPs. Harmful effects of MPs on gut microbiota within aquatic organisms start from the ingestion of MPs by aquatic organisms. According to this, the present review will discuss the ingestion of MPs and its following results on gut microbial communities within aquatic animals, in which chemical components, such as plastic polymers, heavy metals and POPs, and the biofilm of MPs would be involved. This review firstly analyzed the impacts of MPs on aquatic organisms in detail about its chemical components and biofilm based on previous relevant studies. At last, the significance of field studies, functional studies and complex dynamics of gut microbial ecology in the future research of MPs affecting gut microbiota is discussed.

Authors: Weixin Li, Xiaofeng Chen, Minqian Li, Zeming Cai, Han Gong, Muting Yan

Full Source: Journal of hazardous materials 2021 Sep 1;423(Pt B):127094. doi: 10.1016/j.jhazmat.2021.127094.

The adverse impact of microplastics (MPs) on gut microbiota within aquatic animals depends on the overall effect of chemicals and biofilm of MPs.

OCCUPATIONAL

Respiratory Symptoms and Pulmonary Function of Workers in the Waste Management Industry

2021-08-09

Introduction: Waste handling workers are exposed to air pollutants and toxic compounds produced during waste management and processing that can cause respiratory symptoms and lung function impairment. This study aimed to evaluate the respiratory health of exposed workers in a waste management plant in Attica, Greece.

Methods: 50 field workers exposed to outdoor pollutants (exposure group) and 32 office clerks with no exposure (control group) were evaluated. Upper and lower respiratory symptoms were documented and spirometry was performed.

Results: There was no statistically significant difference between the exposure and the control group in forced expiratory volume in one second (FEV1)%, forced vital capacity (FVC)%, FEV1/FVC% predicted values.

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Workers had lower maximal mid-expiratory flow (MMEF)% predicted values compared to controls (82% vs 94%, p=0.019). No difference was observed regarding the respiratory symptoms between the two groups. Conclusion: Lower MMEF values were observed in the exposure group. Low MMEF can be indicative of small airway disease, thus smoking cessation, close follow-up, and the use of personal protective equipment are recommended.

Authors: Chrysovalantis V Papageorgiou, Petros Savourdos, Eleni Douna, Vasiliki E Georgakopoulou, Sotiria Makrodimitri, Georgios Dounias

Full Source: Cureus 2021 Aug 9;13(8):e17027. doi: 10.7759/cureus.17027.

Assessment of burden of disease induced by exposure to heavy metals through drinking water at national and subnational levels in Iran, 2019

2021-09-14

The burden of disease attributable to exposure to heavy metals via drinking water in Iran (2019) was assessed at the national and regional levels. The non-carcinogenic risk, carcinogenic risk, and attributable burden of disease of heavy metals in drinking water were estimated in terms of hazard quotient (HQ), incremental lifetime cancer risk (ILCR), and disability-adjusted life year (DALY), respectively. The average drinking water concentrations of arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), and nickel (Ni) in Iran were determined to be 2.3, 0.4, 12.1, 2.5, 0.7, and 19.7 µg/L, respectively, which were much lower than the standard values. The total average HQs of heavy metals in drinking water in the entire country, rural, and urban communities were 0.48, 0.65 and 0.45, respectively. At the national level, the average ILCRs of heavy metal in the entire country were in the following order: $1.06 \times 10\text{-}4$ for As, $5.89 \times 10\text{-}5$ for Cd, $2.05 \times 10\text{-}5$ for Cr, and $3.76 \times 10\text{-}7$ for Pb. The cancer cases, deaths, death rate (per 100,000 people), DALYs, and DALY rate (per 100,000 people) attributed to exposure to heavy metals in drinking water at the national level were estimated to be 213 (95% uncertainty interval: 180 to 254), 87 (73-104), 0.11 (0.09-0.13), 4642 (3793-5489), and 5.81 (4.75-6.87), respectively. The contributions of exposure to As, Cd, Cr, and Pb in the attributable burden of disease were 14.7%, 65.7%, 19.3%, and 0.2%, respectively. The regional distribution of the total attributable DALY rate for all heavy metals was as follows: Region 5> Region 4> Region 1> Region 3> Region 2. The investigation and improvement of relatively high exceedance of As levels in drinking water from the standard value,

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especially in Regions 5 and 3 as well as biomonitoring of heavy metals throughout the country were recommended.
Authors: Kazem Naddafi, Alireza Mesdaghinia, Mehrnoosh Abtahi, Mohammad Sadegh Hassanvand, Ayoub Beiki, Gholamreza Shaghaghi, Mansour Shamsipour, Fatemeh Mohammadi, Reza Saeedi
Full Source: Environmental research 2021 Sep 14;204(Pt B):112057. doi: 10.1016/j.envres.2021.112057.

PHARAMACEUTICAL/TOXICOLOGY

Absorption, distribution, and toxicity of per- and polyfluoroalkyl substances (PFAS) in the brain: a review

2021-09-17
Per- and polyfluoroalkyl substances (PFAS) are a class of synthetic chemicals colloquially known as "forever chemicals" because of their high persistence. PFAS have been detected in the blood, liver, kidney, heart, muscle and brain of various species. Although brain is not a dominant tissue for PFAS accumulation compared to blood and liver, adverse effects of PFAS on brain functions have been identified. Here, we review studies related to the absorption, accumulation, distribution and toxicity of PFAS in the brain. We summarize evidence on two potential mechanisms of PFAS entering the brain: initiating blood-brain barrier (BBB) disassembly through disrupting tight junctions and relying on transporters located at the BBB. PFAS with diverse structures and properties enter and accumulate in the brain with varying efficiencies. Compared to long-chain PFAS, short-chain PFAS may not cross cerebral barriers effectively. According to biomonitoring studies and PFAS exposure experiments, PFAS can accumulate in the brain of humans and wildlife species. With respect to the distribution of PFAS in specific brain regions, the brain stem, hippocampus, hypothalamus, pons/medulla and thalamus are dominant for PFAS accumulation. The accumulation and distribution of PFAS in the brain may lead to toxic effects in the central nervous system (CNS), including PFAS-induced behavioral and cognitive disorders. The specific mechanisms underlying such PFAS-induced neurotoxicity remain to be explored, but two major potential mechanisms based on current understanding are PFAS effects on calcium homeostasis and neurotransmitter alterations in neurons. Based on the information available about PFAS uptake, accumulation, distribution and impacts on the brain, PFAS have the potential to enter and accumulate in the brain at varying levels. The balance of existing studies shows there is some

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indication of risk in animals, while the human evidence is mixed and warrants further scrutiny.
Authors: Yuexin Cao, Carla Ng
Full Source: Environmental science. Processes & impacts 2021 Sep 17. doi: 10.1039/d1em00228g.