

Bulletin Board

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CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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CHEMICAL EFFECTS

Towards improved characterization of the fate and impact of hydraulic fracturing chemicals to better secure regional water quality

2022-04-21

Hydraulic fracturing (HF) of shale and other permeable rock formations to extract gas and oil is a water-intensive process that returns a significant amount of flowback and produced water (FPW). Due to the complex chemical composition of HF fluids and FPW, this process has led to public concern on the impacts of FPW disposal, spillage and spreading to regional freshwater resources, in particular to shallow groundwater aquifers. To address this, a better understanding of the chemical composition of HF fluid and FPW is needed, as well as the environmental fate properties of the chemical constituents, such as their persistence, mobility and toxicity (PMT) properties. Such research would support risk-based management strategies for the protection of regional water quality, including both the phase-out of problematic chemicals and better hydraulic safeguards against FPW contamination. This article presents recent strategies to advance the assessment and analysis of HF and FPW associated organic chemicals.

Authors: Biao Jin, Min Han, Chen Huang, Hans Peter H Arp, Gan Zhang
Full Source: Environmental science. Processes & impacts 2022 Apr 21;24(4):497-503. doi: 10.1039/d2em00034b.

Worst-case ranking of organic chemicals detected in groundwaters and surface waters in England

2022-04-21

The Environment Agency has been using Gas Chromatography-Mass Spectrometry (GC-MS) and Accurate-mass Quadrupole Time-of-Flight (Q-TOF) / Liquid Chromatography-Mass Spectrometry (LC-MS) target screen analysis to semi-quantitatively measure organic substances in groundwater and surface water since 2009 for GC-MS and 2014 for LC-MS. Here we use this data to generate a worst-case "risk" ranking of the detected substances. Three sets of hazard values relating to effects on aquatic organisms, namely Water Framework Directive EQSs, NORMAN Network PNECs (hereafter NORMAN PNEC) and chronic Species Sensitivity Distribution (SSD) HC50s from Posthuma et al., (2019) were used for the assessment. These hazard values were compared to the highest measured concentration for each chemical to generate a worst-case hazard

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quotient (HQ). Calculated HQs for each metric were ranked, averaged and multiplied by rank for detection frequency to generate an overall ordering based on HQ and occurrence. This worst-case approach was then used to generate ranking lists for GC-MS and LC-MS detected substances in groundwater and surface water. Pesticides in the top 30 overall ranked list included more legacy pesticides in groundwater and more current use actives in surface water. Specific uses were linked to some high rankings (e.g. rotenone for invasive species control). A number of industrial and plastics associated chemicals were ranked highly in the groundwater dataset, while more personal care products and pharmaceuticals were highly ranked in surface waters. Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) compounds were commonly highly ranked in both environmental compartments. The approach confirmed high rankings for some substance (e.g. selected pesticides) from previous prioritization exercises, but also identified novel substance for consideration (e.g. some PFAS compounds and pharmaceuticals). Overall our approach provided a simple approach using readily accessible data to identify substances for further and more detailed assessment.

Authors: David Spurgeon, Helen Wilkinson, Wayne Civil, Lorraine Hutt, Elena Armenise, Natalie Kieboom, Kerry Sims, Tim Besien

Full Source: The Science of the total environment 2022 Apr 21;835:155101. doi: 10.1016/j.scitotenv.2022.155101

ENVIRONMENTAL RESEARCH

Maternal Exposure to Polychlorinated Biphenyls and Asthma, Allergic Rhinitis and Atopic Dermatitis in the Offspring: The Environmental Health Fund Birth Cohort

2022-04-06

Background: Polychlorinated biphenyls (PCBs) are persistent organic pollutants banned for use worldwide. Due to their biodegradation resistance, they accumulate along the food chain and in the environment. Maternal exposure to PCBs may affect the fetus and the infant. PCBs are immunotoxic and may damage the developing immune system. PCBs are associated with elevated IgE antibodies in cord blood and are considered to be predictive of atopic reactions. Several studies on the association between prenatal exposure to PCBs and atopic reactions were previously published, albeit with conflicting results. Objectives: To examine the association between maternal PCBs levels and atopic reactions in their offspring. Methods: During the years 2013-2015, a prospective birth

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cohort was recruited at the delivery rooms of Shamir Medical Center (Assaf Harofeh) and "Dana Dwek" Children's Hospital. Four PCBs congeners were investigated: PCBs 118, 138, 153, and 180. In 2019, when children reached the age of 4-6 years, mothers were interviewed using the ISAAC questionnaire to assess symptoms of atopic reactions, including asthma, allergic rhinitis, and atopic dermatitis. Results: One hundred and fifty mother-child dyads were analyzed. No significant differences were found in the median serum PCBs concentrations of each studied congener or total PCBs for asthma, allergic rhinitis, atopic dermatitis diagnosis, or parent-reported symptoms. No association was found between exposure to total PCBs and the risk for asthma symptoms or diagnosis, adjusted to maternal age and family member with atopic condition: aOR = 0.94, 95%CI: (0.88; 0.99). No association was observed between each studied PCB congener and asthma symptoms or diagnosis. The same results were found also for other studied outcomes-allergic rhinitis and atopic dermatitis. Conclusion: Our study joins a series of previous studies that attempt to shed light on environmental exposures in utero as influencing factors for atopic conditions in children. Our results reflect the complexity of the pathophysiology of these phenomena. No relationship between maternal serum PCBs levels was demonstrated for asthma, allergic rhinitis, or atopic dermatitis. However, additional multi-participant studies, with longer, spanning into later pediatric age follow up are needed.

Authors: Maya Berlin, Hadar Flor-Hirsch, Elkana Kohn, Anna Brik, Rimona Keidar, Ayelet Livne, Ronella Marom, Amit Ovental, Dror Mandel, Ronit Lubetzky, Pam Factor-Litvak, Josef Tovbin, Moshe Betser, Miki Moskovich, Ariela Hazan, Malka Britzi, Itai Gueta, Matitiahu Berkovitch, Ilan Matok, Uri Hamiel

Full Source: *Frontiers in pharmacology* 2022 Apr 6;13:802974. doi: 10.3389/fphar.2022.802974.

PHARMACEUTICAL/TOXICOLOGY

Possible role of lead in breast cancer - a case-control study

2022-04-29

Numerous risk factors have been associated with breast cancer (BC), exposure to metalloestrogen, like lead, being such. Since lead involvement in BC is still equivocal, we focused on lead levels in three compartments of BC patients, blood, healthy, and malignant tissues. Also, as the cholesterol role in cancer development was recognized at the beginning of the twentieth century and led to involvement in lipid profile impairment, we further extend our research on lipid profile and enzymes responsible for

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maintaining lipid balance in BC patients. Fifty-five women diagnosed with BC were enrolled in the study. Forty-one healthy women represented the control group. Lead levels in blood, healthy surrounding and malignant tissue, and lipid profile parameters in serum, were determined. Higher lead levels were obtained in surrounding healthy tissue samples compared to cancerous tissue samples, while blood lead levels of BC women did not differ significantly from the control group. The altered lipid profile scheme in women diagnosed with breast cancer contained significantly higher triglycerides levels ($P < 0.001$). Moreover, logistic regression analysis revealed triglycerides as a significant predictor of BC (OR = 2.6; $P < 0.01$). Although statistical significance was missing for lower paraoxonase-1 (PON-1) activities observed in BC women, multivariate logistic regression singled out PON-1 activities as significant BC predictors. The result of the present study further indicated oxidative status imbalance and tissue levels bioelements perturbation. Obtained results in the present study propose possible lead involvement in BC onset accompanied with bioelements redistribution and oxidative stress occurrence.

Authors: Milena Anđelković, Aleksandra Buha Djordjevic, Dragana Javorac, Katarina Baralić, Danijela Đukić-Čosić, Aleksandra Repić, Aleksandra Zeljković, Jelena Vekić, Nataša Čolaković, Zorica Bulat

Full Source: *Environmental science and pollution research international* 2022 Apr 29. doi: 10.1007/s11356-022-20439-z.

Long-term effects of melatonin and resveratrol on aging rats: A multi-biomarker approach

2022-05

Aging-related impaired body structure and functions may be, at least partially, caused by elevated oxidative stress. Melatonin (MEL) and resveratrol (RSV) may act as antioxidant and anti-aging compounds, but these actions in experimental animals and humans are controversial. Herein, a rat model of aging was used to study the long-term sex-related effects of MEL and RSV treatment on body mass and blood/plasma parameters of DNA damage, oxidative status (glutathione and malondialdehyde levels), and concentrations of sex hormones. Starting from the age of 3mo, for the next 9mo or 21mo male and female Wistar rats ($n = 4-7$ per group) were given water to drink (controls) or 0.1 % ethanol in water (vehicle), or MEL or RSV (each 10 mg/L vehicle). DNA damage in whole blood cells was tested by comet assay, whereas in plasma, glutathione, malondialdehyde, and sex hormones were determined by established methods. Using statistical analysis of data by ANOVA/Scheffe post hoc, we observed a similar sex- and aging-dependent

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rise of body mass in both sexes and drop of plasma testosterone in control and vehicle-treated male rats, whose pattern remained unaffected by MEL and RSV treatment. Compared with controls, all other parameters remained largely unchanged in aging and differently treated male and female rats. We concluded that the sex- and aging-related pattern of growth and various blood parameters in rats were not affected by the long-term treatment with MEL and RSV at the estimated daily doses (300-400 µg/kg b.m.) that exceed usual moderate consumption in humans.

Authors: Davorka Breljak, Vedran Micek, Marko Gerić, Goran Gajski, Saša Kralik Oguić, Dubravka Rašić, Dean Karaica, Ivana Vrhovac Madunić, Marija Ljubojević, Tatjana Orct, Jasna Jurasović, Ivana Novak Jovanović, Maja Peraica, Lucia Nanić, Ivica Rubelj, Ivan Sabolić

Full Source: Mutation research. Genetic toxicology and environmental mutagenesis Apr-May 2022;876-877:503443. doi: 10.1016/j.mrgtox.2022.503443.

OCCUPATIONAL

Oxidative stress in the freshwater shrimp *Caridina africana* following exposure to atrazine

2022-04-27

The toxicity of pesticides to non-target organisms continues to be important in understanding the dynamic interactions between anthropogenic chemicals and ecosystem health. This study assesses biochemical markers to determine the effects that varying concentrations of atrazine (13.1-5557 µg/l) have on the freshwater shrimp, *Caridina africana*. Exposure and oxidative stress biomarkers were analysed and followed by univariate, integrated biomarker response v2 (IBRv2) and Kendall Tau correlation statistical analyses, to gain insight into the concentration-dependent responses. Oxidative stress biomarkers such as reduced glutathione content (GSH), glutathione-S-transferase activity (GST), superoxide dismutase activity (SOD) and catalase activity (CAT) were significantly correlated with increasing atrazine exposure concentration ($p < 0.01$). Bimodality has been seen when looking at both the univariate statistically significant differences as well as the IBRv2, with the first peak at 106.8 µg/l and the second peak at 5557 µg/l atrazine. The results indicate that while individual responses may indicate statistically

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significant differences, using correlation and integrated statistical analysis can shed light on trends in the adaptive response of these.

Authors: Gregg J van Rensburg, Victor Wepener, Suranie Horn, Richard Greenfield

Full Source: Bulletin of environmental contamination and toxicology 2022 Apr 27. doi: 10.1007/s00128-022-03526-2.

Exposure to chemical substances and particles emitted during additive manufacturing

2022-04-29

Additive manufacturing is an innovative technology that allows the production of three-dimensional objects replicating digital models. The aim of this study was to identify whether the use of this technology in a room without mechanical ventilation system may pose a health risk to its users due to the emission of chemical compounds and fine particles. Measurements were conducted in a furnished space with natural ventilation only, during additive manufacturing on a fused deposition modeling printer with 9 different filaments. Both chemicals and particles were sampled. Volatile organic compounds and phthalic acid esters were determined by gas chromatography-mass spectrometry detection. Carbonyl compounds were determined using the high-performance liquid chromatography with diode-array detection method. Fine particle emission studies were carried out using a DiSCmini particle counter (Testo). In the air samples, numerous chemical substances were identified including both the monomers of the individual materials used for printing such as styrene and other degradation products (formaldehyde, toluene, xylenes). Moreover, 3D printing process released particles with modal diameters ranging from 22.1 to 106.7 nm and increased the number concentration of particles in the workplace air. The results of analyses, depending on the type of material applied, showed the presence of particles and chemical substances in the working environment that may pose a risk to human health. Most of the identified substances can be harmful when inhaled and irritating to eyes and skin.

Authors: Elżbieta Dobrzyńska, Dorota Kondej, Joanna Kowalska, Małgorzata Szewczyńska

Full Source: Environmental science and pollution research international 2022 Apr 29. doi: 10.1007/s11356-022-20347-2.

Additive manufacturing is an innovative technology that allows the production of three-dimensional objects replicating digital models.

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The Placental Epigenome as a Molecular Link Between Prenatal Exposures and Fetal Health Outcomes Through the DOHaD Hypothesis

2022-04-29

Purpose of review: The developmental origins of health and disease (DOHaD) hypothesis posits that the perinatal environment can impact fetal and later life health. The placenta is uniquely situated to assess prenatal exposures in the context of DOHaD because it is an essential ephemeral fetal organ that manages the transport of oxygen, nutrients, waste, and endocrine signals between the mother and fetus. The purpose of this review is to summarize recent studies that evaluated the DOHaD hypothesis in human placentas using epigenomics, including DNA methylation and transcriptomic studies of mRNA, lncRNA, and microRNAs.

Recent findings: Between 2016 and 2021, 28 articles evaluated associations between prenatal exposures and placental epigenomics across broad exposure categories including maternal smoking, psychosocial stressors, chemicals, air pollution, and metals. Sixteen of these studies connected exposures to health outcome such as birth weight, fetal growth, or infant neurobehavior through mediation analysis, identification of shared associations between exposure and outcome, or network analysis. These aspects of infant and childhood health serve as a foundation for future studies that aim to use placental epigenetics to understand relationships between the prenatal environment and perinatal complications (such as preterm birth or fetal growth restriction) or later life childhood health. Placental DNA methylation and RNA expression have been linked to numerous prenatal exposures, such as PM2.5 air pollution, metals, and maternal smoking, as well as infant and childhood health outcomes, including fetal growth and birth weight. Placental epigenomics provides a unique opportunity to expand the DOHaD premise, particularly if research applies novel methodologies such as multi-omics analysis, sequencing of non-coding RNAs, mixtures analysis, and assessment of health outcomes beyond early childhood.

Authors: Samantha Lapehn, Alison G Paquette

Full Source: Current environmental health reports 2022 Apr 29. doi: 10.1007/s40572-022-00354-8.

Purpose of review: The developmental origins of health and disease (DOHaD) hypothesis posits that the perinatal environment can impact fetal and later life health.

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Occupational disease claims and non-occupational morbidity in a prospective cohort observation of nickel electrolysis workers

2022-04-30

Exposure to nickel aerosol in the nickel production is associated with greater occupational risk, yet little is known how many workers will develop an occupational disease and claim compensation. The aim of this analysis was to prospectively observe a cohort of nickel electrolysis workers and quantitatively assess confirmed occupational disease claims. We observed a cohort of nickel electrolysis workers (N = 1397, median age 39, 68% males) from 2008 till 2020 in one of the largest nickel producers in the Russian High North. Cumulative incidence of confirmed occupational disease claims in seven occupational groups, including electrolysis operators, hydrometallurgists, crane operators, final product cleaners, metalworkers, electricians and 'other' was analyzed and supplemented with Cox proportional hazards regression, yielding hazard ratios (HR) with their 95% confidence intervals (CI) of occupational disease claims for each group. N patients with occupational disease claims varied from 1 in 2016 to 22 in 2009, and in total 87 patients developed one or more occupational diseases (cumulative incidence 6.2%, $p < 0.001$ between seven groups). Accounting for 35,527 person-years of observation in total, cleaners exhibited the greatest risk (HR 2.58 (95% CI 1.43-4.64)), also adjusted for smoking, number of non-occupational diseases and group 2 (hydrometallurgists). Smoking was independently associated with having an occupational disease claim in all groups ($p < 0.001$), as was the number of non-work-related diseases in six groups of seven. Despite consistent improvement in the exposure control measures in nickel production, occupational morbidity persists. More effort is needed to reduce exposure in final product cleaners.

Authors: Sergei Syurin, Denis Vinnikov

Full Source: Scientific reports 2022 Apr 30;12(1):7092. doi: 10.1038/s41598-022-11241-5.

TSCA risk evaluation-directed characterization of occupational exposures during formaldehyde manufacturing, use as an intermediate, and compounding of formaldehyde-based polymers

2022-04-25

In 2020, the U.S. EPA initiated TSCA risk evaluations for 20 High Priority chemicals, as required by the Lautenberg Act. In addition to consumer

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exposures, the evaluations include quantitative assessments of worker exposures, hazards and risk. The EPA evaluations of worker exposures, and authority over corrective action to address unacceptably high workplace exposures, overlap OSHA's authority for regulating workplace exposures. This dual federal regulatory authority for risk evaluation and risk management, presents new challenges for industrial hygienists, exposure/risk assessors, and risk managers. One of the chemicals identified as High Priority by the EPA is formaldehyde. In response to these challenges, Celanese supplemented its regular OSHA compliance sampling for formaldehyde with a one-time comprehensive sampling at our sole U.S. formaldehyde manufacturing facility. The sampling characterized all worker populations at the facility, including office workers. Although the EPA assessment is ongoing and may reach different conclusions related to an acceptable exposure limit, 126 full-shift monitoring results demonstrated compliance with the OSHA Formaldehyde Standard (29 CFR 1910.1048) for health protection. Methodologies used to identify workers for exposure monitoring, to characterize multiple EPA-specified worker populations, as well as potential challenges related to the dual regulatory authority for assessing and managing worker exposures are discussed.

Authors: James H Sherman, Gary M Rowen, J Tyler Tanniehill

Full Source: Regulatory toxicology and pharmacology : RTP 2022 Apr 25;105173. doi: 10.1016/j.yrtph.2022.105173.