

Bulletin Board

Contents

MAR. 05, 2021

(click on page numbers for links)

CHEMICAL EFFECTS

Do polystyrene nanoplastics affect the toxicity of cadmium to wheat (<i>Triticum aestivum</i> L.)?.....	3
'It's all the other stuff!' How smokers understand (and misunderstand) chemicals in cigarettes and cigarette smoke	3
Is your environment making you older? Molecular biomarkers and new approaches to investigate the influences of environmental chemicals through aging	4
Early occupational exposure to lead on neutrophil-to-lymphocyte ratio and genotoxicity	5
Persistent Organic Pollutants (POPs) and Related Chemicals in the Global Environment: Some Personal Reflections	6

ENVIRONMENTAL RESEARCH

Time trends of persistent organic pollutants (POPs) and Chemicals of Emerging Arctic Concern (CEAC) in Arctic air from 25 years of monitoring.....	7
Circular economy based landfill leachate treatment with sulphur-doped microporous biochar	8

OCCUPATIONAL

Non-auditory effects of industrial chronic noise exposure on workers; change in salivary cortisol pattern.....	9
Long-term exposure to ambient PM 2.5 and stroke mortality among urban residents in northern China	10

PHARMACEUTICAL/TOXICOLOGY

Neurobehavioural and cognitive effects of prenatal exposure to organochlorine compounds in three year old children	11
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Bulletin Board

Technical

MAR. 05, 2021

CHEMICAL EFFECTS

Do polystyrene nanoplastics affect the toxicity of cadmium to wheat (*Triticum aestivum* L.)?

2020-08

There has been an increase on the research of microplastics (<5 mm in diameter) as carriers for toxic chemicals to evaluate their risks for human health and environment, but only few works focused on nanoplastics (1 nm-1000 nm in diameter) interacting with pre-existing contaminants such as heavy metals. It is still unclear whether polystyrene nanoplastics (PSNPs) could affect the toxicity of cadmium to wheat (*Triticum aestivum* L.). Here, we assessed the impact of polystyrene nanoplastics (0, 10 mg/L) on the Cd (0, 20 μ M) toxicity to wheat grown in 25% Hoagland solution for three weeks. We found that the presence of PSNPs could partially reduce Cd contents in leaves and alleviate Cd toxicity to wheat, which might be due to weakened adsorption capacity of PSNPs affected by ionic strength. In addition, PSNPs have little effect on catalase (CAT), peroxidase (POD) activities, except for decreasing superoxide dismutase (SOD) activity, which suggested that antioxidant defense systems might not be the main mechanism to reduce the oxidative damage induced by Cd in wheat. Electron paramagnetic resonance (EPR) analysis showed that PSNPs could accelerate the formation of long-lived radicals in leaves after exposure to Cd. Notably, our metabolomics profiling further indicated that the simultaneously elevated carbohydrate and amino acid metabolisms induced by PSNPs could partly alleviate Cd toxicity to wheat. Nevertheless, the present study provides important implications for the toxicological interaction and future risk assessment of co-contamination of nanoplastics and heavy metals in the environment.

Authors: Jiapan Lian, Jiani Wu, Aurang Zeb, Shunan Zheng, Ting Ma, Feihu Peng, Jingchun Tang, Weitao Liu

Full Source: Environmental pollution (Barking, Essex : 1987) 2020 Aug;263(Pt A):114498. doi: 10.1016/j.envpol.2020.114498.

'It's all the other stuff!' How smokers understand (and misunderstand) chemicals in cigarettes and cigarette smoke

2021-02-24

Many people understand chemicals as entities that do not occur naturally, and which are also invariably toxic. Tobacco control messages liberally use the term 'chemicals' to evoke these meanings and create concern among

Bulletin Board

Technical

MAR. 05, 2021

smokers. This may reinforce misunderstandings, potentially leading to smokers making harmful choices. To investigate smokers' understandings of chemicals, we conducted qualitative research using 18 individual interviews and three focus groups with Australian smokers and recently quit smokers. The research was guided by the 'mental models' framework and the recently developed Context, Executive, and Operational Systems theory. We discerned two clusters of mental models: the first cluster focused on combustion as the overarching cause of harm (and were largely consistent with the science) and the second cluster focused on additives as causes of harm. We found most participants displayed limited knowledge of the causes of harm from smoking and some held mutually incompatible beliefs. Most participants believed that cigarettes differ significantly in harmfulness according to whether or not they were believed to contain additives. Only a minority understood that the bulk of the toxicants to which smokers are exposed are combustion products. These findings are directly relevant to tobacco control but also have broader relevance to risk communications about toxic exposures.

Authors: Bill King, Ron Borland, Kylie Morphett, Coral Gartner, Kelly Fielding, Richard J O'Connor, Kim Romijnders, Reinskje Talhout
Full Source: Public understanding of science (Bristol, England) 2021 Feb 24;963662521991351. doi: 10.1177/0963662521991351.

Is your environment making you older? Molecular biomarkers and new approaches to investigate the influences of environmental chemicals through aging

2021-02-23

Aging is characterized by a gradual and progressive decline in system integrity that occurs with advancing chronological age. Although it is a physiological process, aging is associated with a myriad of age-related diseases (ARDs), including frailty, sarcopenia, chronic obstructive pulmonary disease, cardiovascular disease, cancer, and neurodegenerative diseases. While not exclusively ARDs, many of these diseases lead to death, a lesser quality of life, and increased healthcare costs for individuals and systems. ARDs share several underlying molecular mechanisms, such as cellular damage, inflammation, DNA methylation changes, stem cells exhaustion, and DNA mutations, which have been outlined as hallmarks of aging. Evidence suggests that environmental exposures, including but not limited to metals, air pollution, endocrine-disrupting chemicals, and noise, may accelerate biological aging. Over the past few years, aging research has identified new molecular biomarkers of the aging process. When applied to investigate environmental influences, these biomarkers can

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Bulletin Board

Technical

MAR. 05, 2021

help identify individuals who are particularly susceptible to the influences of environmental exposures on aging processes and therefore guide in implementing possible preventive measures.

Authors: Diddier Prada, Daniel Belsky, Andrea Baccarelli

Full Source: La Medicina del lavoro 2021 Feb 23;112(1):8-14. doi: 10.23749/mdl.v112i1.10826.

Early occupational exposure to lead on neutrophil-to-lymphocyte ratio and genotoxicity

2021-02-19

Background: Lead (Pb) is known to induce detrimental health effects in exposed populations, including hematotoxicity and genotoxicity. Complete blood count (CBC) is a cost-effective and easy way to determine toxicity, and variations in proportion of different types of leukocytes: neutrophil-to-lymphocyte ratio (NLR) and lymphocyte-to-monocyte ratio (LMR) are further evidence of hematotoxicity. However, few studies have been conducted to systematically evaluate effects of occupational Pb exposure on NLR and LMR, and their associations with genotoxicity. **Objectives:** Our study was aimed to systematically assess the effects of current occupational Pb exposure on NLR and LMR, and their associations with genotoxicity.

Methods: Our investigation was performed on 1176 workers from a newly built battery factory in North China. The workers had just entered their current job position in recent years and most of them had no previous history of occupational exposure to Pb. Blood lead levels (BLLs) and leukocytes indices were detected for all participants. Cytokinesis-blocked micronucleus assay (MN; n = 675) and alkaline comet assay (% tail DNA; n = 869) were used to assess genotoxicity. Multivariate linear and Poisson regression analyses were conducted to examine associations between leukocytes indices, genotoxic biomarkers and BLLs with adjustment for covariates. Spearman correlation and mediation analyses were used to investigate relationships between NLR and genotoxicity.

Results: Among all the exposed workers, NLR increased with increasing BLLs. However, WBC and LMR did not change significantly. Significant and dose-dependent increases in both MN frequencies and % tail DNA were observed among groups with different exposure doses. Compared with the normal NLR group ($1.48 \leq \text{NLR} < 4.58$), the high NLR group ($\text{NLR} \geq 4.58$) had higher % tail DNA. In addition, there was a significant and positive association between NLR and % tail DNA among all the workers, and % tail DNA mediated 15% of the effect of Pb on increasing NLR.

Background: Lead (Pb) is known to induce detrimental health effects in exposed populations, including hematotoxicity and genotoxicity.

Bulletin Board

Technical

MAR. 05, 2021

Conclusion: Our large-scale population study shows that Pb exposure increased NLR and induced genotoxicity. There was an association between elevated NLR and DNA damage. In addition, the mediation effect of % tail DNA on the relationship between BLLs and NLR provided mechanistic evidence that certain mechanisms, e.g. inflammation, may be involved in elevation of NLR from Pb exposure. Therefore, NLR may be a convenient and sensitive biomarker for indication of Pb toxicity. Further studies are needed to validate the proposed mechanism and NLR as a biomarker.

Authors: Yu Meng, Kan Wang, Tuanwei Wang, Yuting Tu, Shiyang Gong, Yunxia Zhang, Guanghui Zhang, William Au, David C Christiani, Zhao-Lin Xia

Full Source: Environment international 2021 Feb 19;151:106448. doi: 10.1016/j.envint.2021.106448.

Persistent Organic Pollutants (POPs) and Related Chemicals in the Global Environment: Some Personal Reflections

2021-02-20

Persistent organic pollutants (POPs) and related chemicals are fascinating because of their combination of physical-chemical properties and complex effects. Most are man-made, but some also have natural origins. They are persistent in the environment, but they can be broken down variously by biodegradation, atmospheric reactions, and abiotic transformations. They can exist in the gas or particle phases, or both, in the atmosphere and in the dissolved or particulate phases, or both, in water. These combinations mean that they may undergo long-range transport in the atmosphere or oceans, or they may stay close to sources. Hence, emissions from one country are frequently a source of contamination to another country. They are also usually lipophilic, so combined with persistence-this means they can accumulate in organisms and biomagnify through food chains. We all have a baseline of POPs residues in our tissues, even the unborn fetus via placental transfer and the newly born baby via mother's milk. POPs in biological systems occur in mixtures, so confirming effects caused by POPs on humans and other top predators is never straightforward. Depending on which papers you read, POPs may be relatively benign, or they could be responsible for key subchronic and chronic effects on reproductive potential, on immune response, as carcinogens, and on a range of behavioral and cognitive end points. They could be a factor behind diseases and conditions which have been increasingly reported

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Bulletin Board

Technical

MAR. 05, 2021

and studied in modern societies. In short, they are endlessly fascinating to scientists and a nightmare to regulators and policy makers.

Authors: Kevin C Jones

Full Source: Environmental science & technology 2021 Feb 20. doi: 10.1021/acs.est.0c08093.

ENVIRONMENTAL RESEARCH

Time trends of persistent organic pollutants (POPs) and Chemicals of Emerging Arctic Concern (CEAC) in Arctic air from 25 years of monitoring

2021-02-04

The long-term time trends of atmospheric pollutants at eight Arctic monitoring stations are reported. The work was conducted under the Arctic Monitoring and Assessment Programme (AMAP) of the Arctic Council. The monitoring stations were: Alert, Canada; Zeppelin, Svalbard; Stórhöfði, Iceland; Pallas, Finland; Andøya, Norway; Villum Research Station, Greenland; Tiksi and Amderma, Russia. Persistent organic pollutants (POPs) such as α - and γ -hexachlorocyclohexane (HCH), polychlorinated biphenyls (PCBs), α -endosulfan, chlordane, dichlorodiphenyltrichloroethane (DDT) and polybrominated diphenyl ethers (PBDEs) showed declining trends in air at all stations. However, hexachlorobenzene (HCB), one of the initial twelve POPs listed in the Stockholm Convention in 2004, showed either increasing or non-changing trends at the stations. Many POPs demonstrated seasonality but the patterns were not consistent among the chemicals and stations. Some chemicals showed winter minimum and summer maximum concentrations at one station but not another, and vice versa. The ratios of chlordane isomers and DDT species showed that they were aged residues. Time trends of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) were showing decreasing concentrations at Alert, Zeppelin and Andøya. The Chemicals of Emerging Arctic Concern (CEAC) were either showing stable or increasing trends. These include methoxychlor, perfluorohexane sulfonic acid (PFHxS), 6:2 fluorotelomer alcohol, and C9-C11 perfluorocarboxylic acids (PFCAs). We have demonstrated the importance of monitoring CEAC before they are being regulated because model calculations to predict their transport mechanisms and fate cannot be made due to the lack of emission inventories. We should maintain long-term monitoring programmes with consistent data quality in order

The long-term time trends of atmospheric pollutants at eight Arctic monitoring stations are reported.

Bulletin Board

Technical

MAR. 05, 2021

to evaluate the effectiveness of chemical control efforts taken by countries worldwide.

Authors: Fiona Wong, Hayley Hung, Helena Dryfhout-Clark, Wenche Aas, Pernilla Bohlin-Nizzetto, Knut Breivik, Michelle Nerentorp Mastromonaco, Eva Brorström Lundén, Kristín Ólafsdóttir, Árni Sigurðsson, Katrin Vorkamp, Rossana Bossi, Henrik Skov, Hannele Hakola, Enzo Barresi, Ed Sverko, Phil Fellin, Henrik Li, Alexander Vlasenko, Mikhail Zapevalov, Dmitry Samsonov, Simon Wilson

Full Source: The Science of the total environment 2021 Feb 4;775:145109. doi: 10.1016/j.scitotenv.2021.145109.

Circular economy based landfill leachate treatment with sulphur-doped microporous biochar

2021-02-22

There is now increasing interest in the creation of a more 'circular economy', with a particular aim to eliminate waste - by design, within which products are optimised to be reused, restored or returned. Here, a sulphur functionalised microporous biochar was synthesised from an abundant biomass waste material (cherry kernels), for the selective removal of Pb(II) from landfill leachate as a representative heavy metal. The production process utilises renewable waste material and removes toxic chemicals. Characterisation of the biochar showed that pyrolysis and functionalisation formed an adsorbent with a microporous structure and rich surface chemical functionality. The adsorption process was optimised using a 'response surface methodology - Box-Behnken Design'. Lead removal efficiency approached 99.9% under optimised experimental conditions, i.e., where the solution pH was 6.0, the biochar dose was 4.0 g/L and the contact time was 47 min. The adsorption process was best described using a Freundlich model. The maximum amount of Pb(II) adsorbed was 44.92 mg/g. The main adsorption mechanisms occurred through outer-sphere (electrostatic attraction) and inner-sphere complexation. Desorption studies showed that three successful regeneration cycles (with acidic deionised water) could be used post pyrolysis. The biochar removed 97% of Pb(II) from landfill leachate samples, as compared to 9.4%, and 7.6% for two commercial activated carbon adsorbents. These findings demonstrate the high selectivity of this biochar towards Pb(II) and its applicability even in the presence of high

There is now increasing interest in the creation of a more 'circular economy', with a particular aim to eliminate waste - by design, within which products are optimised to be reused, restored or returned.

Bulletin Board

Technical

MAR. 05, 2021

concentrations of many potentially interfering inorganic and organic ions and compounds.

Authors: Sabolc Pap, Kenneth G Boyd, Mark A Taggart, Maja Turk Sekulic
Full Source: Waste management (New York, N.Y.) 2021 Feb 22;124:160-171.
doi: 10.1016/j.wasman.2021.01.037.

OCCUPATIONAL

Non-auditory effects of industrial chronic noise exposure on workers; change in salivary cortisol pattern

2021-01-14

Background: Noise has different auditory and non-auditory effects on human. In noisy environments, noise as a non-specific stressor can activate the hypothalamic-pituitary-adrenal axis (HPA, cortisol). The aim of this study was to evaluate the effect of chronic exposure to noise on salivary cortisol on industrial workers.

Methods: This cross-sectional study had a case/control design. 136 male workers (68 workers were exposed to chronic industrial noise, and 68 other workers were exposed to background noise) voluntarily enrolled in the study. The equivalent noise level was measured at workstations and salivary cortisol for both case and control groups was measured at the beginning (6 AM) and also at the end of work shift (4 PM). The amount of change in the average of the values of the two groups were compared with each other.

Results: The measured Leq8h (equivalent continuous sound level) in case and control groups were 87.43 dB-A and 67.6 dB-A, respectively. Comparison of salivary cortisol levels change in groups shows a significant differences in control groups for salivary cortisol in the morning and in the evening samples ($p < 0.05$); but not in the case group ($p = 0.052$). Also, comparison of salivary cortisol levels changes with noise exposure experience in the case subgroups revealed no significant difference ($p > 0.05$).

Conclusion: This study showed that chronic exposure to industrial noise can lead to a change in pattern of salivary cortisol secretion especially in the evening (at the end of the work shift), in a way that instead of its normal decrease, an increase happened.

Authors: Behzad Fouladi Dehaghi, Fazlollah Khademian, Kambiz Ahmadi Angali

Full Source: Journal of preventive medicine and hygiene 2021 Jan 14;61(4):E650-E653. doi: 10.15167/2421-4248/jpmh2020.61.4.1380.

Background: Noise has different auditory and non-auditory effects on human.

Bulletin Board

Technical

MAR. 05, 2021

Long-term exposure to ambient PM 2.5 and stroke mortality among urban residents in northern China

2021-02-24

Evidence is still limited for the role of long-term PM2.5 exposure in cerebrovascular diseases among residents in high pollution regions. The study is aimed to investigate the long-term effects of PM2.5 exposure on stroke mortality, and further explore the effect modification of temperature variation on the PM2.5-mortality association in northern China. Based on a cohort data with an average follow-up of 9.8 years among 38,435 urban adults, high-resolution estimates of PM2.5 derived from a satellite-based model were assigned to each participant. A Cox regression model with time-varying exposures and strata of geographic regions was employed to assess the risks of stroke mortality associated with PM2.5, after adjusting for individual risk factors. The cross-product term of PM2.5 exposure and annual temperature range was further added into the regression model to test whether the long-term temperature variation would modify the association of PM2.5 with stroke mortality. Among the study participants, the annual mean level of PM2.5 concentration was 66.3 $\mu\text{g}/\text{m}^3$ ranging from 39.0 $\mu\text{g}/\text{m}^3$ to 100.6 $\mu\text{g}/\text{m}^3$. For each 10 $\mu\text{g}/\text{m}^3$ increment in PM2.5, the hazard ratio (HR) was 1.31 (95% CI: 1.04-1.65) for stroke mortality after multivariable adjustment. In addition, the HRs of PM2.5 decreased gradually as the increase of annual temperature range with the HRs of 1.95 (95% CI: 1.36-2.81), 1.53 (95% CI: 1.06-2.22), and 1.11 (95% CI: 0.75-1.63) in the low, middle, and high group of annual temperature range, respectively. The findings provided further evidence of long-term PM2.5 exposure on stroke mortality in high-exposure settings such as northern China, and also highlighted the view that assessing the adverse health effects of air pollution might not ignore the role of temperature variations in the context of climate change.

Authors: Xueli Yang, Liwen Zhang, Xi Chen, Fangchao Liu, Anqi Shan, Fengchao Liang, Xuejun Li, Hui Wu, Mengfan Yan, Zhao Ma, Guanghui Dong, Yamin Liu, Jie Chen, Tong Wang, Baoxin Zhao, Yang Liu, Dongfeng Gu, Naijun Tang

Full Source: Ecotoxicology and environmental safety 2021 Feb 24;213:112063. doi: 10.1016/j.ecoenv.2021.112063.

Evidence is still limited for the role of long-term PM2.5 exposure in cerebrovascular diseases among residents in high pollution regions.

Bulletin Board

Technical

MAR. 05, 2021

PHARMACEUTICAL/TOXICOLOGY

Neurobehavioural and cognitive effects of prenatal exposure to organochlorine compounds in three year old children

2021-02-26

Background: We report data of a Belgian observational prospective cohort study regarding cognitive and behavioural development until the age of 36 months in relation to internal exposure to organochlorine pollutants [sum of polychlorinated biphenyls (sum PCB), dioxin-like activity, PCB118, PCB170, hexachlorobenzene (HCB) and p,p'-dichlorodiphenyldichloroethylene (DDE)] measured in cord blood. Methods: Participants were recruited as part of an Flemish Environmental Health Survey (2002-2006). Two hundred and six mother-child pairs were recruited. Hundred twenty five toddlers [Reynell Taal Ontwikkelings Schalen (language development, RTOS), Snijders-Oomen Niet-verbale intelligentietest (non-verbal intelligence, SON), Bayley Scales, milestones, Infant Behaviour Questionnaire (IBQ), gender specific play behaviour, Neurobehavioral Evaluation System (NES)-attentional task] and their mothers [Home Observation Measurement of the Environment (HOME), Wechsler Abbreviated Scale of Intelligence (WASI), State-Trait Anxiety Inventory (STAI), general questionnaires] were tested. Statistical analysis was performed with the SPSS program. Much attention was paid to confounding factors. Results: In the first years of development, higher organochlorine pollutants were associated with less active children (delayed crawling: sum PCB*HCB ($p < 0.05$), sumPCB*DDE ($p < 0.1$); delayed first steps alone: sum PCB ($p < 0.5$), PCB118 ($p < 0.01$), PCB170 ($p < 0.01$), HCB ($p < 0.01$); less switching between toys: sum PCB ($p < 0.01$); less switching between toys in boys: PCB118 ($p < 0.01$), sum PCB ($p < 0.01$)). At 12 months children with higher dioxin-like activity tended to show less fear responses ($p < 0.1$) (IBQ 12 months). At 36 months, a slower development of language comprehension (RTOS) was related to all organochlorine exposure parameters ($p < 0.1$ or $p < 0.05$) except DDE. Lower nonverbal IQ scores (SON) were related to PCB118 in boys only ($p < 0.05$ or $p < 0.01$). Less masculine and more non-gender specific play behaviour was associated with sum PCB in boys and girls at 36 months ($p < 0.1$). Moreover, PCB118 ($p < 0.05$), PCB170 ($p < 0.1$), HCB ($p < 0.05$) and DDE ($p < 0.05$) were associated with diminished masculine play behaviour in boys.

Background: We report data of a Belgian observational prospective cohort study regarding cognitive and behavioural development until the age of 36 months in relation to internal exposure to organochlorine pollutants [sum of polychlorinated biphenyls (sum PCB), dioxin-like activity, PCB118, PCB170, hexachlorobenzene (HCB) and p,p'-dichlorodiphenyldichloroethylene (DDE)] measured in cord blood.

Bulletin Board

Technical

MAR. 05, 2021

Conclusion: Our data confirm the observations that neurobehavioral development of young children is adversely influenced by environmental concentrations of PCBs, especially in boys. In this context, observation of play behaviour seems to be a reliable, easy to perform and sensitive test to detect neurotoxic effects of chemicals like PCB's and dioxin-like compounds in very young children. On the basis of our results, we hypothesize that an underarousal pattern may play a role in the spectrum of effects measured in toddlers prenatally exposed to PCBs and dioxin-like compounds.

Authors: Griet Vermeir, Adrian Covaci, Nik Van Larebeke, Greet Schoeters, Vera Nelen, Gudrun Koppen, Mineke Viaene

Full Source: BMC pediatrics 2021 Feb 26;21(1):99. doi: 10.1186/s12887-021-02533-2.