

Bulletin Board

Contents

APR. 30, 2021

(click on page numbers for links)

CHEMICAL EFFECTS

The effect of reduction measures on concentrations of hazardous semivolatile organic compounds in indoor air and dust of Swedish preschools..... 3

ENVIRONMENTAL RESEARCH

Impact of a pollution breach at a coke oven factory on asthma control in nearby vulnerable adults 3

Impacts to Larval Fathead Minnows Vary between Preconsumer and Environmental Microplastics..... 4

Impact assessment of odor nuisance, health risk and variation originating from the landfill surface..... 5

OCCUPATIONAL

Interventional radiologists have a higher rate of chromosomal damage due to occupational radiation exposure: a dicentric chromosome assay 6

Genotoxic effect of exposure to polycyclic aromatic hydrocarbons (PAHs) in asphalt workers 7

Polycyclic aromatic hydrocarbons associated long non-coding RNAs and heart rate variability in coke oven workers 8

Lack of transgenerational effects of ionizing radiation exposure from the Chernobyl accident..... 8

PHARMACEUTICAL/TOXICOLOGY

Epigenome-wide DNA methylation signature of benzo[a]pyrene exposure and their mediation roles in benzo[a]pyrene-associated lung cancer development..... 9

Life-course exposure to perfluoroalkyl substances in relation to markers of glucose homeostasis in early adulthood..... 10

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Bulletin Board

Technical

APR. 30, 2021

CHEMICAL EFFECTS

The effect of reduction measures on concentrations of hazardous semivolatile organic compounds in indoor air and dust of Swedish preschools

2021-04-20

Young children spend a substantial part of their waking time in preschools. It is therefore important to reduce the load of hazardous semivolatile organic compounds (SVOCs) in the preschools' indoor environment. The presence and levels of five SVOC groups were evaluated (1) in a newly built preschool, (2) before and after renovation of a preschool, and (3) in a preschool where SVOC-containing articles were removed. The new building and the renovation were performed using construction materials that were approved with respect to content of restricted chemicals. SVOC substance groups were measured in indoor air and settled dust and included phthalates and alternative plasticizers, organophosphate esters (OPEs), brominated flame retardants, and bisphenols. The most abundant substance groups in both indoor air and dust were phthalates and alternative plasticizers and OPEs. SVOC concentrations were lower or of the same order of magnitude as those reported in comparable studies. The relative Cumulative Hazard Quotient (HQcum) was used to assess the effects of the different reduction measures on children's SVOC exposure from indoor air and dust in the preschools. HQcum values were low (1.0-6.1%) in all three preschools and decreased further after renovation and article substitution. The SVOCs concentrations decreased significantly more in the preschool renovated with the approved building materials than in the preschool where the SVOC-containing articles were removed.

Authors: Sarka Langer, Cynthia A de Wit, Georgios Giovanoulis, Jenny Fäldt, Linnéa Karlson

Full Source: Indoor air 2021 Apr 20. doi: 10.1111/ina.12842.

ENVIRONMENTAL RESEARCH

Impact of a pollution breach at a coke oven factory on asthma control in nearby vulnerable adults

2021-04-21

Background: Previous studies relate sulfur dioxide (SO₂) exposure with asthma exacerbations. We utilized the University of Pittsburgh Asthma Institute registry (AIR) to study associations of asthma exacerbations between two geographically distinct adult asthma populations.

Bulletin Board

Technical

APR. 30, 2021

Objective: The objective was to examine if asthma symptoms worsened following a significant fire event that destroyed pollution control equipment at the largest Coke Works in the United States. Methods: Two groups of asthma patients 1) those residing within 10 miles of the Coke Works Fire (CWF) "proximal group" (n=39), and 2) those beyond that range "control group" (n=44) were geocoded by residential address. Concentrations of ambient air SO₂ were generated using local AIR monitor data. Factory emissions were also evaluated. Patient historical, acute exposure survey and in-person follow-up data were evaluated. Inferential statistics were used to compare groups.

Results: In the immediate post-fire period (6-8 weeks), there was increase in SO₂ factory emissions of 25 times above typical emissions. Following the pollution control breach, the proximal cohort self-reported an increase in medication usage (RR: 1.76, 95% CI 1.1-2.8, p<0.01) and more exacerbations. In a small subset of the follow-up cohort of those who completed the acute survey only, asthma control metrics improved. Conclusions: A real world exposure to a marked increase in ambient levels of SO₂ from a pollution control breach associated with worsened asthma control in patients proximal to the event, which improved following repair of the controls. Improved spatial resolution of air pollutant measurements would enable better examination of exposures and subsequent health impacts.

Authors: Brandy M Byrwa-Hill, Albert A Presto, Sally Wenzel, James P Fabisiak

Full Source: The Journal of allergy and clinical immunology 2021 Apr 21;S0091-6749(21)00649-7. doi: 10.1016/j.jaci.2021.04.011.

Impacts to Larval Fathead Minnows Vary between Preconsumer and Environmental Microplastics

2021-04-20

Microplastics are a complex suite of contaminants varying in size, shape, polymer, and associated chemicals and are sometimes referred to as a "multiple stressor." Still, the majority of studies testing hypotheses about their effects use commercially bought microplastics of a uniform size, shape, and type. We investigated the effects of polyethylene and polypropylene microplastics purchased as preproduction pellets (referred to as "preconsumer") and a mixture of polyethylene and polypropylene collected from the environment (environmental microplastic). Embryo-stage fathead minnows were exposed to either the physical plastic particles and their leachates or the chemical leachates alone at an environmentally relevant (280 particles/L) or high (2800 particles/L)

Microplastics are a complex suite of contaminants varying in size, shape, polymer, and associated chemicals and are sometimes referred to as a "multiple stressor." Still, the majority of studies testing hypotheses about their effects use commercially bought microplastics of a uniform size, shape, and type.

Bulletin Board

Technical

APR. 30, 2021

concentration for 14 d. The effects of microplastics differed by polymer type and presence of environmental contaminants, and effects can be driven by the physical particles and/or the chemical leachates alone. Larvae exposed to preconsumer polyethylene experienced a decrease in survival, length, and weight, whereas preconsumer polypropylene caused an increase in weight. Environmental microplastics caused a more drastic increase in length and weight and almost 6 times more deformities as the preconsumer microplastics. Although preconsumer microplastics caused effects only when organisms were exposed to both the particles and the chemical leachates, the environmental microplastics caused effects when organisms were exposed to the chemical leachates alone, suggesting that the mechanism of effects are context-dependent. The present study provides further support for treating microplastics as a multiple stressor and suggests that testing for effects with pristine microplastics may underestimate the true effects of microplastics in the environment. *Environ Toxicol Chem* 2021;00:1-12. © 2021 SETAC.

Authors: Kennedy Bucci, Jacqueline Bikker, Kathleen Stevack, Trudy Watson-Leung, Chelsea Rochman

Full Source: *Environmental toxicology and chemistry* 2021 Apr 20. doi: 10.1002/etc.5036.

Impact assessment of odor nuisance, health risk and variation originating from the landfill surface

2021-04-20

Many researchers are concerned that municipal solid waste (MSW) threatens public health, causing them to increasingly focus on odor pollution. In this study, the odor nuisance and health risk impacts of landfill surface gas on eight sensitive receptors were assessed. The emission rates of odor and 145 volatile organic compounds (VOCs) were acquired by considering various landfilling operations, including high-density polyethylene (HDPE) membrane removal (MR), landfill tipping area (TA), temporary HDPE membrane cover (MC), top of the HDPE membrane (LM) and dumping platform (DP). Furthermore, differences in landfill surface geometry, such as emission height and source area, and variations in residential living floors were considered in odor assessment with the air dispersion model. Based on these uncertain factors, normal-, medial-, and worst-case scenarios were defined to elucidate the odor nuisance effect and health risk impact. Four of the eight sensitive receptors, which were 2.6 km away from the landfill surface, basically experienced odor nuisance and health risk impacts. Dichloromethane exerted an indelible and crucial impact on body health based on a comprehensive investigation

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Bulletin Board

Technical

APR. 30, 2021

of aromatics, halocarbons, and other chemicals. The odor nuisance and health risk impacts were notable near the landfill, and the local environment was remarkably damaged.

Authors: Yan Zhang, Xiaoyu Ning, Yaohuang Li, Jianzhuang Wang, Huanwen Cui, Jie Meng, Changyun Teng, Gen Wang, Xibin Shang
Full Source: *Waste management (New York, N.Y.)* 2021 Apr 20;126:771-780.
doi: 10.1016/j.wasman.2021.03.055.

OCCUPATIONAL

Interventional radiologists have a higher rate of chromosomal damage due to occupational radiation exposure: a dicentric chromosome assay

2021-04-19

Objectives: There are growing concerns regarding radiation exposure in medical workers who perform interventional fluoroscopy procedures. Owing to the nature of certain interventional procedures, workers may be subjected to partial-body radiation exposure that is high enough to cause local damage. We aimed to investigate the level of radiation exposure in interventional radiologists in South Korea by performing cytogenetic biodosimetry, particularly focusing on partial-body exposure. Methods: Interventional radiologists (n = 52) completed a questionnaire, providing information about their work history and practices. Blood samples were collected and processed for a dicentric chromosome assay. We determined Papworth's U-value to assess the conformity of dicentrics with the Poisson distribution to estimate the partial-body exposures of the radiologists.

Results: Radiologists had a higher number of dicentrics than the normal population and industrial radiographers. Indeed, subjects with a U-value of > 1.96, an indicator of heterogeneous exposure, were observed more frequently; $4.67 \pm 0.81\%$ of their body was irradiated at an average dose of 4.64 ± 0.67 Gy. Logistic regression analysis revealed that the total duration of all interventional procedures per week was associated with partial-body exposure levels.

Conclusions: Our findings suggest that interventional radiologists had greater chromosomal damages than those in other occupational groups, and their partial-body exposure levels might be high enough to cause local damage. Use of special dosimeters to monitor partial-body exposure, as well as restricting the time and frequency of interventional procedures, could help reduce occupational radiation exposure.

Objectives: There are growing concerns regarding radiation exposure in medical workers who perform interventional fluoroscopy procedures.

Bulletin Board

Technical

APR. 30, 2021

Key points: • Interventional radiologists had a higher number of dicentric than the normal population and industrial radiographers.
• The level of partial-body exposure of interventional radiologists might be high enough to cause occupational local damage such as a skin cancer in fingers.

• Restricting the duration and frequency of interventional procedures might be helpful in reducing occupational radiation exposure.

Authors: Younghyun Lee, Won Jin Lee, Young Woo Jin, Seongjae Jang
Full Source: European radiology 2021 Apr 19. doi: 10.1007/s00330-021-07883-0.

Genotoxic effect of exposure to polycyclic aromatic hydrocarbons (PAHs) in asphalt workers

2021-03-16

Asphalt workers are at risk due to exposure to asphalt fumes containing polycyclic aromatic hydrocarbons (PAHs). The main purpose of this study was to measure the urinary metabolite of PAHs and to determine its effect on micronucleus (MN) formation as an indicator of genotoxic damage. In this cross-sectional study, the MN frequency in 48 male asphalt workers exposed to PAHs was measured and compared with 48 male non-exposed employees. PAHs exposure was evaluated by determining urinary 1-Hydroxypyrene (1-OHP). The mean concentrations of 1-OHP in the exposed and non-exposed groups were 0.58 ± 0.41 $\mu\text{mol/mol}$ creatinine and 0.38 ± 0.25 $\mu\text{mol/mol}$ creatinine, respectively. 1-OHP concentration was significantly higher in smokers compared with non-smokers in both exposed and non-exposed groups. Moreover, the mean MN frequency in the exposed group was significantly higher than in the non-exposed group. The MN frequency was significantly higher in asphalt workers with a work history of ≥ 15 years compared to workers with lower work history. In a fully adjusted model, there was a statistically significant association between exposure to PAHs, with MN and 1-OHP concentration, and between smoking status with 1-OHP. The findings of the present study indicated that occupational exposure to PAHs was associated with increased urinary 1-OHP as well as DNA damage in the asphalt workers.

Authors: Fatemeh Kargar-Shouroki, Mohammad Miri, Mohammad Javad Zare Sakhvidi, Seyedeh Zahra Hosseini Sangchi, Farzan Madadzadeh
Full Source: EXCLI journal 2021 Mar 16;20:686-697. doi: 10.17179/excli2021-3487.

Asphalt workers are at risk due to exposure to asphalt fumes containing polycyclic aromatic hydrocarbons (PAHs).

Bulletin Board

Technical

APR. 30, 2021

Polycyclic aromatic hydrocarbons associated long non-coding RNAs and heart rate variability in coke oven workers

2021-04-22

Epidemiological studies have showed that polycyclic aromatic hydrocarbons (PAHs) were associated with heart rate variability (HRV), but the role of long non-coding RNAs (lncRNAs) in the association is unknown. We aimed to identify PAHs-related lncRNAs and assess their associations with HRV among coke oven workers. Differential lncRNAs expression between 12 exposed workers and 12 controls was tested by Human 8X60k lncRNA Arrays in discovery stage, then selected NR_024564 was validated in 353 workers using droplet digital RT-PCR. Microarray results showed that 1234 lncRNAs were downregulated with 805 lncRNAs upregulated in exposed group (≥ 2 -fold change). In validation stage, no significant association was observed between NR_024564 and PAH exposure or HRV in total subjects, while urinary 2-hydroxyfluorene (2-OHFlu) was inversely related to root mean square successive difference (RMSSD). However, in current smokers, NR_024564 was inversely related to urinary 2-OHFlu, 2-hydroxyphenanthrene, 1-hydroxypyrene (1-OHP), and total PAHs metabolites ($\Sigma\text{OH-PAHs}$), of which 1-OHP accounted for the strongest estimation for interaction with smoking status (Pinteraction = 0.011). Also, the positive associations of NR_024564 with RMSSD and high frequency power showed an interaction with smoking status (Pinteraction = 0.034 and 0.023, respectively). Also, urinary 2-OHFlu and $\Sigma\text{OH-PAHs}$ were inversely associated with RMSSD in current smokers. In addition, elevated NR_024564 was dose-responsive related to increased RMSSD in above high-PAHs groups among smokers (all Ptrend < 0.05). Our results revealed that NR_024564 and its interactions with smoking status might act as novel mechanisms regulating the adverse effects of PAHs on HRV.

Authors: Jie Yu, Qin Fang, Miao Liu, Xiaomin Zhang

Full Source: Environmental science and pollution research international 2021 Apr 22. doi: 10.1007/s11356-021-13967-7.

Lack of transgenerational effects of ionizing radiation exposure from the Chernobyl accident

2021-04-22

Effects of radiation exposure from the Chernobyl nuclear accident remain a topic of interest. We investigated whether children born to parents employed as cleanup workers or exposed to occupational and environmental ionizing radiation post-accident were born with more germline de novo mutations (DNMs). Whole-genome sequencing of 130

Epidemiological studies have showed that polycyclic aromatic hydrocarbons (PAHs) were associated with heart rate variability (HRV), but the role of long non-coding RNAs (lncRNAs) in the association is unknown.

Bulletin Board

Technical

APR. 30, 2021

children (born 1987-2002) and their parents did not reveal an increase in the rates, distributions, or types of DNMs versus previous studies. We find no elevation in total DNMs regardless of cumulative preconception gonadal paternal (mean = 365 mGy, range = 0-4,080 mGy) or maternal (mean = 19 mGy, range = 0-550 mGy) exposure to ionizing radiation and conclude over this exposure range, evidence is lacking for a substantial effect on germline DNMs in humans, suggesting minimal impact on health of subsequent generations.

Authors: Meredith Yeager, Mitchell J Machiela, Prachi Kothiyal, Michael Dean, Clara Bodelon, Shalabh Suman, Mingyi Wang, Lisa Mirabello, Chase W Nelson, Weiyin Zhou, Cameron Palmer, Bari Ballew, Leandro M Colli, Neal D Freedman, Casey Dagnall, Amy Hutchinson, Vibha Vij, Yosi Maruvka, Maureen Hatch, Iryna Illienko, Yuri Belayev, Nori Nakamura, Vadim Chumak, Elena Bakhanova, David Belyi, Victor Kryuchkov, Ivan Golovanov, Natalia Gudzenko, Elizabeth K Cahoon, Paul Albert, Vladimir Drozdovitch, Mark P Little, Kiyohiko Mabuchi, Chip Stewart, Gad Getz, Dmitry Bazyka, Amy Berrington de Gonzalez, Stephen J Chanock
Full Source: Science (New York, N.Y.) 2021 Apr 22;eabg2365. doi: 10.1126/science.abg2365.

PHARMACEUTICAL/TOXICOLOGY

Epigenome-wide DNA methylation signature of benzo[a]pyrene exposure and their mediation roles in benzo[a]pyrene-associated lung cancer development

2021-04-08

Benzo[a]pyrene (B[a]P) is a typical carcinogen associated with increased lung cancer risk, but the underlying mechanisms remain unclear. This study aimed to investigate epigenome-wide DNA methylation associated with B[a]P exposure and their mediation effects on B[a]P-lung cancer association in two lung cancer case-control studies of 462 subjects. Their plasma levels of benzo[a]pyrene diol epoxide-albumin (BPDE-Alb) adducts and genome-wide DNA methylations were separately detected in peripheral blood by using enzyme-linked immunosorbent assay (ELISA) and genome-wide methylation arrays. The epigenome-wide meta-analysis was performed to analyze the associations between BPDE-Alb adducts and DNA methylations. Mediation analysis was applied to assess effect of DNA methylation on the B[a]P-lung cancer association. We identified 15 CpGs associated with BPDE-Alb adducts (P -meta < 1.0×10^{-5}), among which the methylation levels at five loci (cg06245338, cg24256211,

Bulletin Board

Technical

APR. 30, 2021

cg15107887, cg02211741, and cg04354393 annotated to UBE2O, SAMD4A, ACBD6, DGKZ, and SLFN13, respectively) mediated a separate 38.5%, 29.2%, 41.5%, 47.7%, 56.5%, and a joint 58.2% of the association between BPDE-Alb adducts and lung cancer risk. Compared to the traditional factors [area under the curve (AUC) = 0.788], addition of these CpGs exerted improved discriminations for lung cancer, with AUC ranging 0.828-0.861. Our results highlight DNA methylation alterations as potential mediators in lung tumorigenesis induced by B[a]P exposure.

Authors: Hua Meng, Guyanan Li, Wei Wei, Yansen Bai, Yue Feng, Ming Fu, Xin Guan, Mengying Li, Hang Li, Chenming Wang, Jiali Jie, Xiulong Wu, Meian He, Xiaomin Zhang, Sheng Wei, Yangkai Li, Huan Guo
Full Source: Journal of hazardous materials 2021 Apr 8;416:125839. doi: 10.1016/j.jhazmat.2021.125839.

Life-course exposure to perfluoroalkyl substances in relation to markers of glucose homeostasis in early adulthood

2021-04-23

Objective: To investigate the prospective associations of life-course perfluoroalkyl substances (PFASs) exposure with glucose homeostasis at adulthood.

Methods: We calculated insulin sensitivity and beta-cell function indices based on 2-h oral glucose tolerance tests at age 28 in 699 Faroese born in 1986-1987. Five major PFASs were measured in cord whole blood and in serum from ages 7, 14, 22 and 28 years. We evaluated the associations with glucose homeostasis measures by PFAS exposures at different ages, using multiple informant models fitting generalized estimating equations, and by life-course PFAS exposures using structural equation models. Results: Associations were stronger for perfluorooctane sulfonate (PFOS) and suggested decreased insulin sensitivity and increased beta-cell function, e.g., β (95% CI) for log-insulinogenic index per PFOS doubling = 0.12 (0.02,0.22) for prenatal exposures; 0.04 (-0.10,0.19) at age-7; 0.07 (-0.07,0.21) at age-14; 0.05 (-0.04,0.15) at age-22; 0.04 (-0.03,0.11) at age-28. Associations were consistent across ages (P for age-interaction >0.10 for all PFASs) and sex (P for sex-interaction >0.10 for all PFASs, except perfluorodecanoic acid). The overall life-course PFOS exposure was also associated with altered glucose homeostasis ($P=0.04$). Associations for other life-course PFAS exposures were non-significant. Conclusions:

Objective: To investigate the prospective associations of life-course perfluoroalkyl substances (PFASs) exposure with glucose homeostasis at adulthood.

Benzo[a]pyrene (B[a]P) is a typical carcinogen associated with increased lung cancer risk, but the underlying mechanisms remain unclear.

Bulletin Board

Technical

APR. 30, 2021

Life-course PFAS exposure is associated with decreased insulin sensitivity and increased pancreatic beta-cell function in young adults.

Authors: Damaskini Valvi, Kurt Højlund, Brent A Coull, Flemming Nielsen, Pal Weihe, Philippe Grandjean

Full Source: The Journal of clinical endocrinology and metabolism 2021 Apr 23;dgab267. doi: 10.1210/clinem/dgab267.