

# 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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## Technical

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## CHEMICAL EFFECTS

Genotoxicity Associated with <sup>131</sup>I and <sup>99m</sup>Tc Exposure in Nuclear Medicine Staff: A Physical and Biological Monitoring Study

2022-05-16

Nuclear medicine staff are constantly exposed to low doses of ionizing radiation. This study investigated the level of genotoxic effects in hospital employees exposed to routinely used <sup>131</sup>I and <sup>99m</sup>Tc in comparison with a control group. The study compared the results of physical and biological monitoring in peripheral blood lymphocytes. The effects of confounding factors, such as smoking status and physical activity, were also considered. Physical dosimetry monitoring revealed differences in the individual annual effective dose as measured by finger ring dosimeter and whole-body dosimeter between the <sup>131</sup>I- and <sup>99m</sup>Tc-exposed groups. The DNA damage studies revealed differences between the groups in terms of excess premature chromosome condensation (PCC) fragments and tail DNA. Physical activity and smoking status differentiated the investigated groups. When assessed by the level of physical activity, the highest mean values of tail DNA were observed for the <sup>99m</sup>Tc group. When assessed by work-related physical effort, excess PCC fragments were significantly higher in the <sup>131</sup>I group than in the control group. In the investigated groups, the tail DNA values were significantly different between non-smokers and past or current smokers, but excess PCC fragments did not significantly differ by smoking status. It is important to measure exposure to low doses of ionizing radiation and assess the potential risk from this exposure. Such investigations support the need to continue epidemiological and experimental studies to improve our understanding of the mechanisms of the health effects of radionuclides and to develop predictive models of the behavior of these complex systems in response to low-dose radiation.

Authors: Justyna Miszczyk, Aleksander Gałaś, Agnieszka Panek, Aldona Kowalska, Magdalena Kostkiewicz, Eliza Borkowska, Kamil Brudecki  
Full Source: Cells 2022 May 16;11(10):1655. doi: 10.3390/cells11101655.

Nuclear medicine staff are constantly exposed to low doses of ionizing radiation.

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## Experimental Study on the Detection of Hazardous Chemicals Using Alternative Sensors in the Water Environment

2022-04-19

Chemical accidents in rivers may be triggered by natural or anthropogenic causes and refer to the flow of large quantities of hazardous chemicals into rivers. In South Korea, domestic water is sourced from large rivers, such as the Nakdong River. However, owing to rapid industrialization, industrial facilities have become heavily concentrated in the middle and upper reaches of the Nakdong River. Therefore, severe problems could arise if harmful chemicals are leaked from industrial facilities into the river, and this contaminated river water is supplied to cities. Quantitative evaluation based on instrumental analysis during chemical accidents and prediction research based on modeling is actively being conducted however, research on the initial response is insufficient. Therefore, in this study, the variations in pH and EC were analyzed according to their chemical concentrations for seven chemicals. These seven chemicals are designated accident-preparedness substances that frequently cause chemical spills in South Korea. Additionally, we evaluated the possibility of identifying unknown substances by comparing the variations in pH and EC and statistics while diluting unknown substances. Thus, the potential of pH and EC as alternative indicators for detecting and identifying chemicals was evaluated in this study. NaF, NH<sub>4</sub>HF<sub>2</sub>, NaCN, and NH<sub>4</sub>OH were classified by comparing their spatial distributions in a pH-EC relation curve. However, H<sub>2</sub>SO<sub>4</sub>, HCl, and SOCl<sub>2</sub> showed similar spatial distributions in the pH-EC curves and were difficult to identify. The results of this study provide information for chemical detection and identification using alternative sensors that permit easy and rapid field measurements in the event of a chemical spill and could be used as preliminary data for rapidly responding to accidents.

Authors: Su-Han Nam, Tae-Geom Ku, Ye-Lim Park, Jae-Hyun Kwon, Do-Sung Huh, Young-Do Kim

Full Source: Toxics 2022 Apr 19;10(5):200. doi: 10.3390/toxics10050200.

## Determination of cytotoxicity following oxidative treatment of pharmaceutical residues in wastewater

2022-05-23

Pharmaceutical residues are released in the aquatic environment due to incomplete removal from wastewater. With the presence of multiple chemicals in sewage waters, contaminants may adversely affect the

Chemical accidents in rivers may be triggered by natural or anthropogenic causes and refer to the flow of large quantities of hazardous chemicals into rivers.

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effectiveness of a wastewater treatment plant (WWTP). In certain cases, discharged metabolites are transformed back into their pristine structure and become bioactive again. Other compounds are persistent and can withstand conventional wastewater treatment. When WWTP effluents are released in surface waters, pristine and persistent chemicals can affect the aquatic environment. To complement WWTPs and circumvent incomplete removal of unwanted chemicals or pharmaceuticals, on-site wastewater treatment can contribute to their removal. Advanced oxidation processes (AOPs) are very powerful techniques for the abatement of pharmaceuticals, however, under certain circumstances reactive toxic by-products can be produced. We studied the application of on-site AOPs in a laboratory setting. It is expected that treatment at the contamination source can eliminate the worst pollutants. Thermal plasma and UV/H<sub>2</sub>O<sub>2</sub> oxidation were applied on simulation matrices, Milli-Q and synthetic sewage water spiked with 10 different pharmaceuticals in a range of 0.1 up to 2400 µg/L. In addition, untreated end-of-pipe hospital effluent was also subjected to oxidative treatment. The matrices were activated for 180 min and added to cultured HeLa cells. The cells were 24 h and 48 h exposed at 37 °C and subsequently markers for oxidative stress and viability were measured. During the UV/H<sub>2</sub>O<sub>2</sub> treatment periods no toxicity was observed. After thermal plasma activation of Milli-Q water (150 and 180 min) toxicity was observed. Direct application of thermal plasma treatment in hospital sewage water caused elimination of toxic substances. The low cytotoxicity of treated pharmaceutical residues is likely to become negligible if plasma pre-treated on-site wastewater is further diluted with other sewage water streams, before reaching the WWTP. Our study suggests that AOPs may be promising technologies to remove a substantial portion of pharmaceutical components by degradation at the source. Further studies will have to be performed to verify the feasibility of upscaling this technology from the benchtop to practice.

Authors: Martien H F Graumans, Hedwig van Hove, Tom Schirris, Wilfred F L M Hoeben, Maurice F P van Dael, Rob B M Anzion, Frans G M Russel, Paul T J Scheepers

Full Source: Chemosphere 2022 May 23;135022. doi: 10.1016/j.chemosphere.2022.135022.

Pharmaceutical residues are released in the aquatic environment due to incomplete removal from wastewater.

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## ENVIRONMENTAL RESEARCH

### An Interactive Online App for Predicting Diabetes via Machine Learning from Environment-Polluting Chemical Exposure Data

2022-05-10

The early prediction and identification of risk factors for diabetes may prevent or delay diabetes progression. In this study, we developed an interactive online application that provides the predictive probabilities of prediabetes and diabetes in 4 years based on a Bayesian network (BN) classifier, which is an interpretable machine learning technique. The BN was trained using a dataset from the Ansung cohort of the Korean Genome and Epidemiological Study (KoGES) in 2008, with a follow-up in 2012. The dataset contained not only traditional risk factors (current diabetes status, sex, age, etc.) for future diabetes, but it also contained serum biomarkers, which quantified the individual level of exposure to environment-polluting chemicals (EPC). Based on accuracy and the area under the curve (AUC), a tree-augmented BN with 11 variables derived from feature selection was used as our prediction model. The online application that implemented our BN prediction system provided a tool that performs customized diabetes prediction and allows users to simulate the effects of controlling risk factors for the future development of diabetes. The prediction results of our method demonstrated that the EPC biomarkers had interactive effects on diabetes progression and that the use of the EPC biomarkers contributed to a substantial improvement in prediction performance.

Authors: Rosy Oh, Hong Kyu Lee, Youngmi Kim Pak, Man-Suk Oh

Full Source: International journal of environmental research and public health 2022 May 10;19(10):5800. doi: 10.3390/ijerph19105800.

The early prediction and identification of risk factors for diabetes may prevent or delay diabetes progression.

### Chemical Mixtures in Household Environments: In Silico Predictions and In Vitro Testing of Potential Joint Action on PPAR $\gamma$ in Human Liver Cells

2022-04-19

There are thousands of chemicals that humans can be exposed to in their everyday environments, the majority of which are currently understudied and lack substantial testing for potential exposure and toxicity. This study aimed to implement in silico methods to characterize the chemicals that co-occur across chemical and product uses in our everyday household environments that also target a common molecular mediator, thus

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representing understudied mixtures that may exacerbate toxicity in humans. To detail, the Chemical and Products Database (CPDat) was queried to identify which chemicals co-occur across common exposure sources. Chemicals were preselected to include those that target an important mediator of cell health and toxicity, the peroxisome proliferator activated receptor gamma (PPAR $\gamma$ ), in liver cells that were identified through query of the ToxCast/Tox21 database. These co-occurring chemicals were thus hypothesized to exert potential joint effects on PPAR $\gamma$ . To test this hypothesis, five commonly co-occurring chemicals (namely, benzyl cinnamate, butyl paraben, decanoic acid, eugenol, and sodium dodecyl sulfate) were tested individually and in combination for changes in the expression of PPAR $\gamma$  and its downstream target, insulin receptor (INSR), in human liver HepG2 cells. Results showed that these likely co-occurring chemicals in household environments increased both PPAR $\gamma$  and INSR expression more significantly when the exposures occurred as mixtures vs. as individual chemicals. Future studies will evaluate such chemical combinations across more doses, allowing for further quantification of the types of joint action while leveraging this method of chemical combination prioritization. This study demonstrates the utility of in silico-based methods to identify chemicals that co-occur in the environment for mixtures toxicity testing and highlights relationships between understudied chemicals and changes in PPAR $\gamma$ -associated signaling.

Authors: Celeste K Carberry, Toby Turla, Lauren E Koval, Hadley Hartwell, Rebecca C Fry, Julia E Rager

Full Source: *Toxics* 2022 Apr 19;10(5):199. doi: 10.3390/toxics10050199.

### Environmental Health Needs Among Latinas in Cleaning Occupations: A Mixed Methods Approach

2022-05-19

In the U.S., approximately half of maids and housekeeping cleaners are Latino or Hispanic, while the vast majority are women (88.3%). This largely immigrant, underserved workforce faces complex factors, which may contribute to adverse health outcomes. To understand relevant barriers and challenges, this mixed-methods study explored the environmental health needs of a heterogeneous group of Latinas in New Jersey (NJ) who clean occupationally, and consisted of 3 focus groups (N = 15) with a cross-sectional survey (N = 9), both conducted in Spanish. Participants were recruited from community-based English as a Second Language classes in Hackensack, NJ. Analysis of focus group audio recordings included descriptive and in vivo coding followed by inductive coding to explore

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thematic analysis. The survey responses were evaluated using descriptive statistics. As per the survey results, the environmental health needs of this population include sore muscles, back problems, asthma, other respiratory issues, migraine or headache, and skin issues (rash, etc.). In the group discussions, the roles of genetics, food, and chemical exposures in cancer etiology were of great interest and a variety of opinions on the topic were explored. Both the focus group discussions and survey responses suggested that this population also faces barriers including lack of training, chemical exposures and inadequate personal protective equipment (PPE). These barriers are compounded by daily environmental exposures from personal home cleaning practices. The development of culturally- and linguistically-appropriate interventions are warranted to better protect the health of essential occupational cleaners who keep homes, businesses and schools clean.

Authors: Erin Speiser, Genevieve Pinto Zipp, Deborah A DeLuca, Ana Paula Cupertino, Evelyn Arana-Chicas, Elli Gouna Paleoudis, Traci N Bethea, Benjamin Kligler, Francisco Cartujano-Barrera

Full Source: *Environmental health insights* 2022 May 19;16:11786302221100045. doi: 10.1177/11786302221100045.

### Environmental Occurrence and Predicted Pharmacological Risk to Freshwater Fish of over 200 Neuroactive Pharmaceuticals in Widespread Use

2022-05-03

There is a growing concern that neuroactive chemicals released into the environment can perturb wildlife behaviour. Among these chemicals, pharmaceuticals such as antidepressants and anxiolytics have been receiving increasing attention, as they are specifically prescribed to modify behavioural responses. Many laboratory studies have demonstrated that some of these compounds can affect various aspects of the behaviour of a range of aquatic organisms; however, these investigations are focused on a very small set of neuroactive pharmaceuticals, and they often consider one compound at a time. In this study, to better understand the environmental and toxicological dimension of the problem, we considered all pharmaceuticals explicitly intended to modulate the central nervous system (CNS), and we hypothesised that these compounds have higher probability of perturbing animal behaviour. Based on this hypothesis, we used the classification of pharmaceuticals provided by the British National Formulary (based on their clinical applications) and identified 210 different CNS-acting pharmaceuticals prescribed in the UK to treat a variety of CNS-related conditions, including mental health and sleep

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disorders, dementia, epilepsy, nausea, and pain. The analysis of existing databases revealed that 84 of these compounds were already detected in surface waters worldwide. Using a biological read-across approach based on the extrapolation of clinical data, we predicted that the concentration of 32 of these neuroactive pharmaceuticals in surface waters in England may be high enough to elicit pharmacological effects in wild fish. The ecotoxicological effects of the vast majority of these compounds are currently uncharacterised. Overall, these results highlight the importance of addressing this environmental challenge from a mixture toxicology and systems perspective. The knowledge platform developed in the present study can guide future region-specific prioritisation efforts, inform the design of mixture studies, and foster interdisciplinary efforts aimed at identifying novel approaches to predict and interpret the ecological implications of chemical-induced behaviour disruption.

Authors: John P Sumpter, Luigi Margiotta-Casaluci

Full Source: *Toxics* 2022 May 3;10(5):233. doi: 10.3390/toxics10050233.

### Integrated Framework for Identifying Toxic Transformation Products in Complex Environmental Mixtures

2017-02-14

Complex environmental mixtures consist of hundreds to thousands of unknown and unregulated organic compounds that may have toxicological relevance, including transformation products (TPs) of anthropogenic organic pollutants. Non-targeted analysis and suspect screening analysis offer analytical approaches for potentially identifying these toxic transformation products. However, additional tools and strategies are needed in order to reduce the number of chemicals of interest and focus analytical efforts on chemicals that may pose risks to humans and the environment. This brief review highlights recent developments in this field and suggests an integrated framework that incorporates complementary instrumental techniques, computational chemistry, and toxicity analysis, for prioritizing and identifying toxic TPs in the environment.

Authors: Leah Chibwe, Ivan A Titaley, Eunha Hoh, Staci L Massey Simonich

Full Source: *Environmental science & technology letters* 2017 Feb 14;4(2):32-43. doi: 10.1021/acs.estlett.6b00455.

Complex environmental mixtures consist of hundreds to thousands of unknown and unregulated organic compounds that may have toxicological relevance, including transformation products (TPs) of anthropogenic organic pollutants.

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### PHARMACEUTICAL/TOXICOLOGY

#### Urinary concentrations of phenols, oxidative stress biomarkers and thyroid cancer: Exploring associations and mediation effects

2022-10

Phenols have been shown to influence the cellular proliferation and function of thyroid in experimental models. However, few human studies have investigated the association between phenol exposure and thyroid cancer, and the underlying mechanisms are also poorly understood. We conducted a case-control study by age- and sex-matching 143 thyroid cancer and 224 controls to investigate the associations between phenol exposures and the risk of thyroid cancer, and further to explore the mediating role of oxidative stress. We found that elevated urinary triclosan (TCS), bisphenol A (BPA) and bisphenol S (BPS) levels were associated with increased risk of thyroid cancer (all P for trends < 0.05), and the adjusted odds ratios (ORs) comparing the extreme exposure groups were 3.52 (95% confidence interval (CI): 2.08, 5.95), 2.06 (95% CI: 1.06, 3.97) and 7.15 (95% CI: 3.12, 16.40), respectively. Positive associations were also observed between urinary TCS, BPA and BPS and three oxidative stress biomarkers measured by 8-hydroxy-2'-deoxyguanosine (8-OHdG), 8-iso-prostaglandin F2 $\alpha$  (8-isoPGF2 $\alpha$ ) and 4-hydroxy-2-nonenal-mercapturic acid (HNE-MA), as well as between urinary 8-isoPGF2 $\alpha$  and HNE-MA and the risk of thyroid cancer. Mediation analysis showed that urinary 8-isoPGF2 $\alpha$  mediated 28.95%, 47.06% and 31.08% of the associations between TCS, BPA and BPS exposures and the risk of thyroid cancer, respectively (all P < 0.05). Our results suggest that exposure to TCS, BPA and BPS may be associated with increased risk of thyroid cancer and lipid peroxidation may be an intermediate mechanism. Further studies are warranted to confirm the findings.

Authors: Pan-Pan Chen, Pan Yang, Chong Liu, Yan-Ling Deng, Qiong Luo, Yu Miao, Min Zhang, Fei-Peng Cui, Jia-Yue Zeng, Tian Shi, Ting-Ting Lu, Da Chen, Long-Qiang Wang, Chun-Ping Liu, Ming Jiang, Qiang Zeng

Full Source: *Journal of environmental sciences (China)* 2022 Oct;120:30-40. doi: 10.1016/j.jes.2022.01.009.

Phenols have been shown to influence the cellular proliferation and function of thyroid in experimental models.

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### OCCUPATIONAL

#### Combined Exposure to Birch Pollen and Thunderstorms Affects Respiratory Health in Stockholm, Sweden-A Time Series Analysis

2022-05-11

**Background:** Thunderstorm asthma is a term used to describe surges in acute respiratory illnesses following a thunderstorm and is often attributed to an intense exposure to aeroallergens. Several episodes of thunderstorm asthma have been observed worldwide; however, no such cases have been described in Sweden. In Sweden, the most prominent exposure to air-borne pollen occurs during the blooming of the birch. We aimed to explore the associations between respiratory health and the combined exposure to thunderstorms and birch pollen. **Methods:** We investigated the association between the daily numbers of outpatient visits due to respiratory cases and the combined exposure to thunderstorms and birch pollen during the period of 1 May-31 September in 2001-2017, in Stockholm County, Sweden, by using time series analysis with log linear models. **Results:** We detected noticeable increases in the number of outpatient visits on both the same day (max 26%; 95% CI 1.16-1.37) and the day after (max 50%; 95% CI 1.32-1.70) the occurrence of a thunderstorm, when the concentrations of birch pollen and the number of lightning discharges were within the highest categories. **Conclusions:** It is possible that co-exposure to heavy thunderstorms and high concentrations of birch pollen affects the respiratory health of the Stockholm population. To the best of our knowledge, this is the first study addressing the thunderstorm-related respiratory illnesses in Sweden and the effects of birch pollen. Our study may be important for future public health advice related to thunderstorm asthma.

Authors: Mare Löhmus, Tomas Lind, Laura MacLachlan, Agneta Ekeboom, Björn Gedda, Pia Östensson, Antonios Georgelis

Full Source: International journal of environmental research and public health 2022 May 11;19(10):5852. doi: 10.3390/ijerph19105852.

**Background:** Thunderstorm asthma is a term used to describe surges in acute respiratory illnesses following a thunderstorm and is often attributed to an intense exposure to aeroallergens.