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"UNEP Centre of Excellence for Environmental and Industrial Toxicology".

Common Issues Related to Children's Environmental Health in the Asia-Pacific Region

The Asia-Pacific Regional Meeting on Children's Environmental Health was organized in Bangkok by the Chulabhorn Research Institute (CRI, Thailand) and the United States National Institute of Environmental Health Sciences (US NIEHS) in collaboration with the World Health Organization South-East Asia Regional Office (WHO SEARO) and the United Nations Children's Fund, East Asia and Pacific Regional Office (UNICEF EAPRO), and focused on cross-cutting issues and commonalities among countries/regions, discussion of lessons learnt, exploring opportunities for policy-relevant research collaborations, and reviewing available educational tools to help translate research findings into tangible outputs.

The meeting brought together scientists, researchers, policy makers, and practitioners to focus on the current gaps in research on children's environmental health in the Asia-Pacific region and involved participants from Brunei Darussalam, Cambodia, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand and Vietnam, as well as from Botswana. The objectives included raising the awareness of environmental threats to the health of children and development of recommendations for moving forward.

The common children's environmental health issues faced by countries in the Asia-Pacific region include indoor and outdoor air pollution; unregulated and inadequate waste management; chemical and infectious agents in water used for drinking and cooking; hazardous pesticide use; and climate change and extreme weather events.

Rapid globalization and industrialization means that many of the countries in the Asia-Pacific region are dealing with high levels of outdoor air pollution, including high levels of particulate matter, lead, volatile organic compounds, and other contaminants in the air. Many countries reported increases in acute respiratory infections and asthma in children living in cities with levels of air pollution that exceed air quality standards. Inefficient energy use in households, industry, the agriculture and transport sectors, coal-fired power plants, and open burning related to agriculture and waste were cited as key sources of the pollutants. Indoor air pollution was also of great concern, with cooking and heating with kerosene, dung, wood, agricultural residues, and coal being important sources in the region. Key associated health impacts included asthma, pneumonia, stroke, ischemic heart disease, lung cancer, and chronic obstructive pulmonary disease.

Countries in the region are also experiencing growing volumes of solid, liquid, hazardous, and electronic waste without robust management plans. Lack of comprehensive legislation and enforcement, as well as lack of a waste classification system were cited as issues. Another challenge is the lack of enforcement. An additional waste stream of particular concern was electronic waste, with the recycling industry being a major source of environmental contamination and exposure to hazardous chemicals not only for the recyclers, but also children, pregnant women, and other vulnerable populations living in surrounding areas. Children around e-waste sites have been found to have blood lead levels that exceed the standard WHO guidelines, putting them at risk for health effects such as IQ loss.

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Common Issues Related to Children's Environmental Health in the Asia-Pacific Region

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Contamination of surface and ground water with chemical and infectious agents that children are exposed to is a significant concern in the region. Metals like cadmium, chromium, lead, and arsenic have been found in high concentrations in the surface and ground water in certain countries in the region. Exposure to heavy metals is associated with cardiovascular disease, several cancers, kidney damage, and IQ loss. Most countries in the region are working on improving their water, sanitation, and hygiene practices, which can help reduce the number of waterborne infectious agents and thus reduce incidence of diarrheal disease, cholera, dengue, and other infectious diseases.

The countries that were represented at the meeting have large agricultural sectors that contribute to major portions of their economies. The use of pesticides is widespread, and the use of illegal pesticides is common as control across borders from neighboring countries is difficult. Agricultural runoff of pesticides poses a threat to the health of the children in the area. In some countries, DDT is still found in high concentrations in soil and sediment in numerous areas. Many countries cited abundant pesticide use and concerns about how children are at high risk of exposure.

More frequent extreme weather events were reported for the region and were possibly associated with climate change. Several countries are highly vulnerable to flooding, tsunamis, increases in temperature, erratic and intense rainfall, more intense storms, delay of the monsoon season, and drought. Flooding and rising temperatures were of utmost concern because of the increase in water-related, vector-borne, and increased exposure to contaminated water that follows flooding events. Increase in temperatures has also been associated with an increase in numbers of forest fires, as well as cases of malaria, dengue, diarrhea, and cholera.

Children are an important vulnerable population that when exposed to harmful environmental contaminants, including at key developmental stages, e.g. even in the mother's womb, can be affected for the entire course of their life. It is therefore important to prevent or minimize exposures as much as possible. It was agreed that there was a need for multi-sectoral involvement in each country to develop frameworks and guidelines, raise public awareness of risk, and manage exposures to tackle these common issues. Networking will allow countries to learn from each other and enhance their efforts to protect not only the health of children, but also that of the rest of the population at risk.

Source: Reviews on Environmental Health, Vol. 35, No. 1, Pages 3-8, March 2020.

Global Environment Outlook 6 (GEO-6)

The UN Environment's sixth Global Environment Outlook (GEO-6), under the theme "Healthy Planet, Healthy People", was published in time for the Fourth United Nations Environmental Assembly (2019). It calls on decision makers to take immediate action to address pressing environmental issues to achieve the Sustainable Development Goals (SDGs) as well as other internationally agreed environment goals, such as the Paris Agreement.

GEO-6 aims to provide a sound, evidence-based source of environmental information to help policymakers and all sectors of society to achieve the environmental dimension of the 2030 Agenda for Sustainable Development and internationally agreed environmental goals, and to implement the multilateral environmental agreements. It does so by assessing recent scientific information and data, analyzing current and past environmental policies and identifying future options to achieve sustainable development by 2050.

GEO-6 shows that a healthy environment is the best foundation for economic prosperity and for human health and well-being. Human behavior has had various impacts on biodiversity, atmosphere, oceans, water and land. Environmental degradation, which ranges from serious to irreversible, has had a negative impact on human health. Atmospheric pollution has had the most severe negative impact, followed by degradation of water, biodiversity, ocean and land environment.

It is therefore important that opportunities for prosperity and well-being that maintain or regain the integrity of ecosystems should be attained through sustainable development pathways that are shared and pursued globally.

UN Environment launched the first Global Environment Outlook (GEO) in 1997. The GEO is a series of studies that inform environmental decision-making for governments and other stakeholders. The GEO report is the result of a consultative and participatory process to prepare an independent assessment of the state of the environment, the effectiveness of the policy response in addressing environmental challenges and the possible pathways to achieving various internationally agreed environmental goals.

Source: UN Environment. Global Environment Outlook 6. Available at https://www.unenvironment.org/resources/global-environment-outlook-6.

Adverse Effects of Pesticides on Immune System

Pesticides provide many benefits by controlling organisms that are considered to be harmful. Their use has resulted in improved crop yield and quality, in expanded disease control, and in monetary savings due to the protection of commodities from infestation and contamination.

Unfortunately, pesticides also have a variety of adverse health effects, causing increased concerns for the well-being of farm workers in particular. Constant exposure to relatively large amounts of pesticides is now recognized as a serious occupational hazard in the farm sector.

A wide variety of pesticides exists, including organochlorines (OCs), organophosphates (OPs), carbamates (CBs), pyrethroids, chlorophenoxys, triazines and phthalimides. These substances and their residues are easily released into the environment where they tend to be environmentally persistent.

Pesticides have become suspect as possible causes of cancer, respiratory disease and disorders of the immune and endocrine systems, among others.

The immune system is responsible for defense against disease. Its dysregulation by pesticides may be closely associated with a predisposition to some types of disease.

For instance, immunotoxicity was reported to be more evident in farmers during the pesticide spraying season. Specifically, the DNA of B and T lymphocytes showed more damage in farmers than in non-farmers, indicating that pesticides have the potential to cause immunotoxicity via their genotoxic effects on humans.

The immune system can be classified into the innate (antigen-nonspecific) and the adaptive (antigen-specific) immune systems, or humoral immunity and cell-mediated immunity.

This immune cells, which form the immune system, are called white blood cells or leukocytes. These are further divided into neutrophils, eosinophils, basophils, lymphocytes which include T cells, B cells, and natural killer (NK) cells, and monocytes. The different types of immune cells have inherent functional characteristics which interact in an elaborate manner within the immune system.

This review discusses the toxic effects of pesticides in major vertebrate immune cells such as T cells, B cells, NK cells and macrophages with a view to address the direct mechanisms underlying pesticide-derived immunotoxicity.

Alterations in immune system function generated by pesticides imply immunotoxicity. Generally, pesticide-induced immunotoxicity is associated with the compromised survival, proliferation, and differentiation of immune cells and their signaling pathways.

In this regard, oxidative stress, mitochondrial dysfunction, endoplasmic reticulum stress, disruption of the ubiquitin-proteasome system and autophagy are the main modes of action through which pesticides impair immune cells.

Atrazine (ATR), carbamate, two OP compounds, Dimethyl 2,2-dichloro-vinyl phosphate (DDVP) and chlorpyrifos (CPF) inhibit T cell proliferation and cytokine production.

Additionally, ATR, dihydro-rotenone (DHR), tributyltin (TBT), acetamiprid, and DDVP induce B cell apoptosis, inhibit B cell proliferation, or reduce antibody production by hindering B cell differentiation to plasma cells.

For NK cells, carbamates including ziram, ATR, penta-chlorophenol (PCP), and TBT induce apoptosis or inhibit the lytic function by reducing ATP levels and granule release from NK cells.

For Macrophages, bifenthrin and cypermethrin, the pyrethroid pesticides, and nanoparticles induce cell cycle arrest and apoptosis or phagocytic activity. These compounds also affect the production of cytokines that induce the antiviral and inflammatory activities of macrophages.

In such ways, the pesticides discussed in this review were found to inhibit the survival and growth of immune cells by inducing apoptosis or cell cycle arrest. They interfered with the specific functions of each type of leukocyte.

Although the adverse effects of various pesticides were mainly identified in *in vitro* cellular or *in vivo* murine models, the outcomes of previous studies suggest their immunotoxicity toward specific immune cells.

To substantiate the systemic immune hazards of pesticides, more information related to other immunological toxicities should be collected and thoroughly analyzed. If necessary, toxicity tests should be conducted in an environment similar to the conditions under which the pesticides are used.

Based on comprehensive analysis, regulations for the use of and alternatives to highly-immunotoxic pesticides should be developed.

Source: Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology, Vol. 235, Article 108789, September 2020.

Fine Particulate Matter Exposure and Renal Function Among Pregnant Women in China

Fine particulate matter ($PM_{2.5}$) is the most serious environmental threat worldwide. The nephrotoxicity of $PM_{2.5}$ has been demonstrated in older adults, but no study has addressed the impacts of $PM_{2.5}$ exposure on renal function in pregnant women, who are recognized to be vulnerable and susceptible to $PM_{2.5}$ exposure.

It is proposed that different chemical compositions of $PM_{2.5}$ have differing effects on renal function. However, no study has assessed the relative effects of each chemical constituent on renal function.

Research exploring which chemical constituents are more responsible for impaired renal function is needed in order to accurately inform air pollution control policy aimed at preventing air pollution-related renal function decline among pregnant women.

Renal function during pregnancy is closely tied to pregnancy outcome. Sufficient renal function is critical for maintaining normal pregnancy. Moderate to severe renal insufficiency has been associated with a higher risk for maternal pre-eclampsia, fetal growth restriction and preterm birth.

The present study investigated whether exposures to $PM_{2.5}$ total mass and its chemical constituents during pregnancy were associated with a decline in renal function among pregnant women residing in Shanghai, China.

The results showed that exposures to $PM_{2.5}$ total mass and its chemical constituents of organic matter (OM), black carbon (BC), nitrate (NO_3^-) and ammonium (NH_4^+) were associated with increased serum levels of urea nitrogen (UN) and uric acid (UA), and decreased estimated glomerular filtration rate (eGFR).

Moreover, the magnitude of associations from exposures to OM, BC, NO_3^-, NH_4^+ were comparable to or even larger than that of $PM_{2.5}$ total mass.

These 4 components were commonly derived from a number of combustion processes. OM and BC were mainly emitted in vehicular exhaust from gasoline, diesel fuels combustion and residential combustion in urban settings. At the same time, NH_4^+ and NO_3^- were derived mainly from photochemical transformation of precursor pollutants.

Clearly, control of fossil-fuel combustion-derived particles could be an effective strategy for reducing the detrimental effects of $PM_{2.5}$ exposure on renal function.

In this study, $PM_{2.5}$ exposure during the second and third trimester showed the strongest and most significant associations with UN. Late pregnancy is a vulnerable gestational window for the impacts of $PM_{2.5}$ exposure on UN, while early pregnancy may be a critical window of susceptibility to $PM_{2.5}$ exposure and higher levels of uric acid (UA).

The study reported significant decreases in eGFR in association with $PM_{2.5}$ exposure. Although the estimated decrease in eGFR was small, it may have greater public health implications, given that pregnant women in developing countries are exposed to much higher levels of air pollution.

This represents the first population-based study in China to examine the effects of $PM_{2.5}$ exposure on renal function among pregnant woman.

Source: Environment International, Vol. 141, Article 105805, August 2020.

Developing a Health Impact Model for Adult Lead Exposure and Cardiovascular Disease Mortality

Lead (Pb) is a highly toxic pollutant that can damage neurological, cardiovascular, immunological, developmental, and other major organ systems.

Recent evidence points to continuing adverse cardiovascular impacts in adults exposed Pb, including increases in hypertension, coronary heart disease, cardiovascular disease (CVD), and CVD-related mortality.

Mechanisms by which Pb may increase risk of death due to CVD have been studied *in vitro* and *in vivo*. The potential deadly mechanisms include increased oxidative stress, altered function of vascular cells, inflammation, and disrupted calcium homeostasis.

The objective of this paper is to present a rigorous approach for identifying concentration-response functions and using them to inform and ultimately, to derive a health impact model (HIM) that relates adult Pb exposures to CVD mortality.

The researchers define an HIM as a scalable, quantitative representation of the relationship between an exposure to a chemical and the human health response due to that exposure.

Specifically, an HIM is able to relate a unit change in exposure to a unit change in the resulting outcome. HIMs are crucial tools for evaluating benefits, for adjudicating, for assessing the effectiveness of interventions, and for developing burden-of-disease estimates.

The HIM aims to provide a generalized function useful to stakeholders to the HIM translates the findings of epidemiological studies into forms that enable stakeholders to estimate benefits obtained when deaths due to CVD have been avoided by reducing Pb exposures.

Environmental conservationists have tended to focus mainly on quantifying the impact of Pb on the child intelligence quotient. By contrast, impacts in adults have often been discussed only qualitatively.

This model demonstrates that decreased Pb exposure can result in substantial benefit for adults. The HIM presented in this paper makes possible a more complete and concrete understanding of the potential impact of Pb exposure on public health, as demonstrated with a proof-of-concept example.

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Environmental Exposures and Breast Cancer Risk: A Systematic Review

The increase in breast cancer (BC) incidence rates over time points to a potential role of the environment in underlying BC etiology.

While many studies have examined the role of environmental chemical exposures in BC risk, only a fraction of human BC studies have specifically focused on particular windows of susceptibility (WOS), including the prenatal, pubertal, pregnancy, and menopausal periods.

In addition, studies which focus on individuals at average risk for BC, may be less sensitive to signs of environmental chemical exposures.

A prior family history of BC increases risk from 1.8 fold for women with one first degree relative to over 4-fold for women with three or more first-degree relatives with BC.

As such, studies that are unselected for BC family history or for higher absolute risk in general, may lack sufficient statistical power to adequately examine associations between environmental chemical exposures and BC risk, particularly for women at intermediate or high absolute BC risk.

Women with higher absolute risk have more mutations and/or genetic variants in DNA repair genes, which can result in poorer capacity to repair DNA damage from carcinogens.

The present systematic review focuses on studies that have examined environmental chemical exposures and BC risk in terms of higher absolute BC risk either through study design or analysis.

Specifically, the review focuses on studies or subgroup analyses conducted in women at higher absolute BC risk, based on three types: BC family history (Type 1); early onset BC (Type 2); and/or genetic susceptibility (Type 3).

Type 1 and Type 2 studies support a statistically significant association between environmental chemical exposures and BC risk, including studies of polycyclic aromatic hydrocarbon (PAH), indoor cooking, nitrogen dioxide (NO_2), dichloro-diphenyltrichloro-ethane (DDT), poly-chlorinated biphenyls (PCBs), perfluoro-octane sulfonamide (PFOSA), metals, personal care products; and occupational exposure to industrial dyes.

Type 3 studies support statistically significant associations for PAHs, traffic-related air pollution, PCBs, phthalates, and PFOSAs in subgroups of women with greater genetic susceptibility due to variants in carcinogen metabolism, DNA repair, oxidative stress, cellular apoptosis and tumor suppressor genes.

The association between environmental chemical exposures and BC risk has mostly been studied in average risk cohorts and outside relevant WOS. Many epidemiological studies, particularly those using population-based findings, do not include a substantial proportion of women with a BC family history. If, however, the risk gradient depends on underlying genetic susceptibility, such an approach may impact the ability to identify associations between BC and environmental chemical exposures.

Precision can be readily improved by sampling more individuals. However, increasing sample size without ensuring that a sufficient number of individuals at higher risk are sampled limits the ability to investigate whether modifiable exposures can in fact alter BC risk across the entire risk spectrum.

Future studies of environmental exposures and BC risk should consider enriched cohorts as a possibly more efficient study design.

This systematic review supports the link between various environmental chemical exposures and increased BC risk, and highlights the utility of epidemiologic studies conducted in high-risk populations.

Source: Environmental Research, Vol. 187, Article 109346, August 2020.

Developing a Health Impact Model for Adult Lead Exposure and Cardiovascular Disease Mortality

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This HIM clearly shows that, regardless of the concentration–response function selected, the impact of Pb on CVD mortality is substantial.

Using population and CVD mortality rates for individuals 40 to 80 years old in 2014, the researchers estimated that 34,000-99,000 deaths were avoided due to the lowering of blood Pb levels from 1999 to 2014.

Based on these values, the researchers estimated that during that 15 year period, approximately 16-46% of the decreased CVD-related death rate may be attributable to decreased blood Pb levels.

Given the absence of a well-established quantitative approach for evaluating the impact of Pb exposure in adults, the HIM presented in this paper, along with the selected concentration-response functions, can strengthen regulatory impact assessments and burden-of-disease estimates.

Those results demonstrate that decreases in Pb exposure can be highly beneficial to adult populations. The researchers have provided an HIM that can be used in a variety of applications from burden-of-disease estimates to regulatory impact assessments. The sensitivity of the HIM to the choice of concentration-response function has also been established.

Using this HIM will allow for a more complete characterization of the impacts of Pb exposure and will clarify the benefits of reductions in Pb.

Quantifying CVD mortality in adults takes us a step closer to understanding the full effects of Pb on the health of populations. It also makes possible an expanded consideration of the benefits of reduced Pb exposures beyond young children.

Source: Environmental Health Perspectives, Vol. 128, No. 9, Article EHP6552, September 2020.

Levels of Phthalate Exposure and Associations with Obesity in Elderly Population

Obesity is one of the most critical global public health problems. In 2016, the World Health Organization estimated that 39% of adults were overweight and 13% were obese worldwide (WHO, 2018).

Overweight and obesity are increasingly being associated with rising mortality rates due to cardiovascular disease, hypertension, dyslipidemia, diabetes, stroke, and cancer. Environmental factors appear as well to be implicated. Hence, environmental endocrine disruptors (EEDs) have been getting much more attention.

The phthalates (PAEs), are one class of widely produced EEDs. These synthetic organic chemicals, are used in a wide range of applications and constitute common source of environmental pollution.

Humans are mainly exposed to PAEs by inhalation and ingestion, and by dermal contact and medical intervention. The elderly may be more frequently exposed to PAEs because they tend more often to visit hospitals whom they typically come in contact with equipment and medicines. This puts them at greater risk of contamination.

It has been reported that PAEs can interfere with thyroid function, activate PPAR receptors, and exert antiandrogenic effects, disturbing the body's energy metabolism balance and leading to overweight and obesity.

Different epidemiological studies have reported positive associations between concentrations of certain PAE metabolites and obesity in adults, adolescents, and children.

The purpose of the present study is to assess phthalate exposure levels and to explore the connections between such exposures and obesity, using samples from elders in Chinese communitries.

General obesity was determined, based on body mass index. Abdominal obesity was calculated, based on waist circumference. Of 942 elderly individuals, 52.9% were defined as generally obese, while 75.5% were judged to be abdominally obese.

Measuring concentrations of seven PAE metabolites in urine samples revealed an association between higher PAE metabolite levels and an increased risk of obesity in the elderly population.

After adjusting for covariates, a positive association was found between abdominal obesity and one of the seven measured metabolites. At the same time, general obesity was strongly positively associated with four of the seven metabolites.

Exposure to PAEs is more strongly associated with obesity in males than in females.

The elderly population in China experienced higher levels of exposure to LMW (low-molecular-weight) PAEs than to HMW (high-molecular-weight) PAEs.

Given the ongoing epidemic of obesity among the elderly population and the fact that these chemicals are everywhere, it is important to further explore the potential role of PAEs in the development of obesity in order to discover why exposure to PAEs impacts males more than females.

Source: Ecotoxicology and Environmental Safety, Vol. 201, Article 110749, September 2020.

Using Rice as a Remediating Plant to Deplete Bioavailable Arsenic from Paddy Soils

In soil, arsenic (As) is a toxic carcinogen which is readily absorbed by rice plants. As rice is a staple food for many Asian countries, arsenic contaminated paddy soils are a threat to food safety.

Rice plants efficiently accumulate arsenic when the contaminant is released during flood conditions.

Compared to wheat and barley, rice is more efficient in absorbing arsenic. Under the submerged conditions of the paddy field, arsenic is released from soil during the reductive dissolution of Fe oxides. In such condition, arsenic is mostly present as arsenite (As(III)) and is readily taken up by rice plants through silicon (Si) pathways. This unique set of circumstances leads to the efficient accumulation of arsenic in rice plants, which in turn may help remove bioavailable arsenic from paddy soils.

The present study proposed to use rice plants (*Oryza sativa* L.) to deplete bioavailable arsenic from paddy soils by removing the roots after harvest. With this object in view, the depletion process of soil arsenic was mapped two-dimensionally during the rice growing reason with zirconium-oxide diffusive gradients, using a thin films (DGT) technique in a rhizotron experiment. In parallel, a key biochemistry control of arsenic availability in the soil was examined to better understand the fundamental drivers for soil arsenic depletion. Results from this work can help to provide a practical and cost-effective means of reducing available arsenic in paddy soils.

Results revealed that the average DGT-arsenic encompassing the root zone decreased steeply from 331 μg/L in the seedling stage to 136 μg/L in the heading and flowering stage and further

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The Chem HelpDesk

"Strengthening capabilities for sound chemicals management"

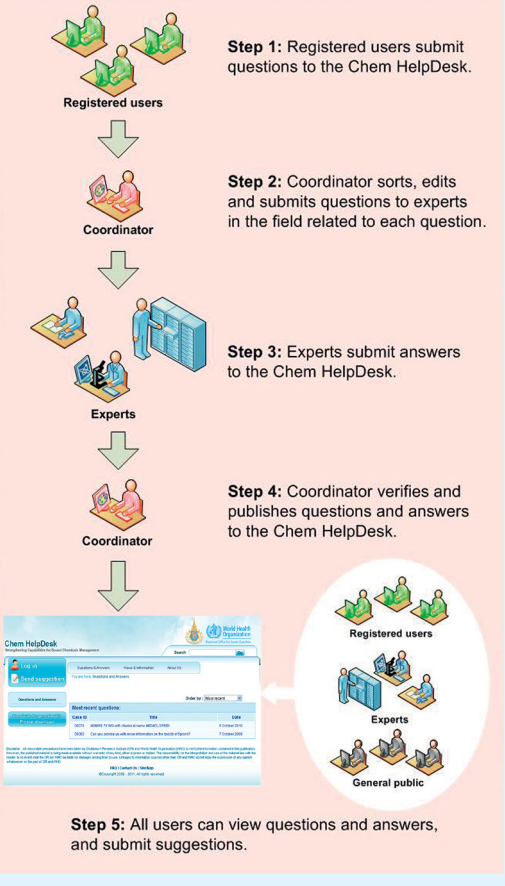
The Regional HelpDesk for Chemical Safety, or **Chem HelpDesk** was established as a joint-initiative between WHO SEARO and CRI, through the WHO Collaborating Center for Capacity Building and Research in Environmental Health Science and Toxicology. The aims of the Chem HelpDesk are to address the issue of the widening gap in the fields of chemical safety and chemicals management between developed and developing countries, and to empower countries in the South-East Asia Region to manage the import, manufacture and processing, storage, distribution, transport, use, recycling and disposal of chemicals, in ways that minimize significant adverse impacts on health and the environment.

The Chem HelpDesk is not-for-profit, and through its website provides cost-free answers to questions submitted by registered users. These answers are provided by experts in the respective fields, who supply technical and scientific advice as part of a Community of Practice (CoP). It is the aim of the Chem HelpDesk to benefit users and to help countries in areas of most need to protect human health and the environment through the safe use and management of chemicals.

In addition to the **"Questions & Answers"** service for registered users, the website also provides information on the safe use of chemicals, as well as a comprehensive list of links to other important websites related to chemicals management in the region. General users have access to the database of questions and answers, as well as all other information on the website.

For more information, please visit: http://www.chemhelpdesk.org
or e-mail: coordinator@chemhelpdesk.org

The functional workflow of the Chem HelpDesk is divided into 5 steps:



Using Rice as a Remediating Plant to Deplete Bioavailable Arsenic from Paddy Soils

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to 118 μg/L at harvest. This was altogether 26% lower than the 160 μg/L control.

During this process, rhizosphere porewater arsenic developed a dynamic profile similar to iron (Fe) and dissolved organic carbon, with the diversity of the *arrA* gene peaking at the heading and flowering stage.

The data support soil arsenic release from microbial reduction of Fe hydroxides fueled by root exudation as the carbon source.

Up to 95% of the total arsenic accumulated in rice plants was in the roots. The removal of these roots resulted in a lowing of DGT-arsenic in post-harvest soil by about 19%.

A sharp decline in arsenic accumulation in rice plants was observed in the second planting after removing one crop of rice roots.

These results demonstrate that rice, as a paddy-adapted plant, is effective in arsenic uptake in the roots, and that removing rice roots efficiently depletes bioavailable arsenic from paddy soils.

This strategy makes remediation of arsenic-affected paddy soils more cost-effective. The approach is easier to apply, considering the familiarity of farmers with rice cultivation and management.

The arsenic-enriched roots can be air-dried and incinerated. The resultant ash which will have a high arsenic concentration, can be disposed of in a landfill following proper solidification and stabilization.

However, there are two important follow-up issues to consider. That is, mechanical equipment for root removal must be developed along with appropriate treatment for disposing of the arsenic-enriched roots. More research will be needed to assist in the implementation of this strategy.

Source: Environment International, Vol. 141, Article 105799, August 2020.

Environmental Heavy Metals and Cardiovascular Diseases: Status and Future Direction

Cardiovascular diseases (CVDs) are the leading cause of morbidity and mortality globally. In 2017, approximately 18 million CVD deaths occurred worldwide, corresponding to 330 million years of life lost and another 35.6 million years lived with disability.

In the United States, CVD is the leading cause of death for both men and women. The disease has also emerged as the single greatest cause of death (40% of all deaths) in rapidly developing countries such as China and Brazil.

Clearly, identification of novel preventable risk factors is urgently needed, particularly for populations in low- and middle-income countries.

Environmental degradation and exposure to heavy metals may have a direct impact on CVD development, now one of the most pressing nemeses of individual and population health globally.

Evidence of the risk of developing CVD due to environmental exposure to heavy metals has rapidly increased over the past two decades.

Recent studies present provocative links between environmental exposure to heavy metals and increased risk of diabetes and hypertension.

Diabetes and hypertension are strong CVD risk factors. Toxic arsenic has been directly shown to cause gluconeogenesis and impairment of β-cell function. It also inhibits the expression of peroxisome proliferator-activated receptor γ, causing hyperglycemia and dyslipidemia.

Toxic metals (arsenic, cadmium, lead, and mercury) and some of the essential metals (chromium, cobalt, copper, nickel, and selenium) are metallo-estrogens and may also increase the risk of CVD through endocrine disruption.

In this review, the researchers assessed the totality, quantity, and consistency of the available epidemiological studies, linking heavy metal exposures to the risk of CVD (including stroke and coronary heart disease). The potential biological mechanisms underlying some tantalizing observations in humans are also discussed, and gaps in our knowledge base are identified for future investigation.

An accumulating body of evidence from both experimental and observational studies implicates exposure to heavy metals, in a dose-response manner, with increased risk of CVD.

Targeting perspective research studies in occupationally exposed populations in industries such as mining and alloy manufacturing may be a most cost-effective approach to investigate the role of heavy metal exposures in CVD development. It would also be a way of addressing the major gaps and limitations of the current literature discussed earlier.

The researchers proposed several directions for future studies as follows:

1. Simultaneous evaluation of the role of multiple heavy metal exposures on CVD risk;

2. Assessment of the antagonistic effect of essential metals in reducing toxic metal effect on CVD;

3. Determining the optimal body levels of essential metals that could mitigate CVD risk from toxic metals;

4. Conducting a nested case-control study in occupational populations or highly exposed general populations that include both cases and controls based on physical examinations and clinical biochemistry tests at baseline and during follow-up.

To conclude, CVD and environmental degradation are major public health problems worldwide. Understanding the preventable determinants of CVD will be critical in establishing appropriate intervention strategies for prevention and control.

Recent experimental and epidemiological studies indicate that heavy metal exposure deserves consideration as a risk factor of CVD; this association is biologically plausible.

Environmental exposure to heavy metals could also alter CVD risk by changing the dynamic interplay with genetic, nutritional, and physical activity factors.

Most existing studies are limited due to insufficient statistical power, lack of comprehensive assessment of exposure, and cross-sectional design.

Given the widespread exposure to heavy metals, investigation of these putative associations of environmental exposures becomes urgent, whether carried out independently or jointly, with incident CVD outcomes considered prospectively in well-characterized cohorts of diverse populations.

Potential strategies to prevent and control the impacts of heavy metal exposure on the cardiometabolic health outcomes of individuals and populations need to be determined.

Source: Chronic Diseases and Translational Medicine, April 2020. (https://doi.org/10.1016/j.cdtm.2020.02.005)

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