CRI/ICEIT NEWSLETTER

VOL. 29 NO. 3 – July 2019
ISSN 0858-2793
BANGKOK, THAILAND

Chulabhorn Research Institute

INTERNATIONAL CENTRE FOR ENVIRONMENTAL AND INDUSTRIAL TOXICOLOGY (ICEIT)

CRI's ICEIT has been designated as a
"UNEP Centre of Excellence for Environmental and Industrial Toxicology".

Asia-Pacific Regional Meeting on Children's Environmental Health (CEH)

May 27th - 28th, 2019

Chulabhorn Research Institute, Bangkok, Thailand

The Chulabhorn Research Institute (CRI, WHO Collaborating Center for Capacity Building and Research on Environmental Health Science and Toxicology) and the United States National Institute of Environmental Health Sciences (US NIEHS, WHO Collaborating Center for Environmental Health Sciences), jointly organized an **Asia-Pacific Regional Meeting on Children's Environmental Health (CEH)** in collaboration with WHO SEARO and UNICEF EAPRO on May 27th - 28th, 2019 at the Chulabhorn Research Institute, Bangkok, Thailand.

The objectives of the meeting were to discuss cross-cutting issues and commonalities among countries/regions; to discuss lessons learnt and explore policy-relevant research collaborations; to review availability of and discuss educational tools to help translate research findings into tangible outputs; and to help set the agenda for the International Conference in Children's Environmental Health that will be organized by the Global Network of WHO Collaborating Centres for CEH.

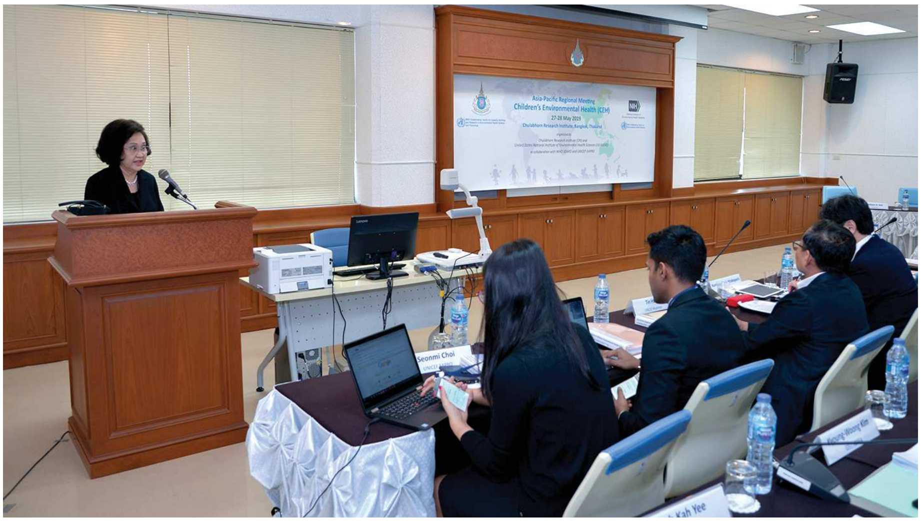
The regional meeting also provided a platform for networking of scientists, researchers, policymakers, and practitioners in the Asia-Pacific region and increasing awareness of the issue of the environmental threats to children's health with the ultimate goal of improving children's environmental health, both regionally and globally.

The meeting was attended by 55 participants from 13 countries - Botswana, Brunei Darussalam, Cambodia, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand and Vietnam and resource persons from Australia, Japan, Republic of Korea, Uruguay, the UK and the US, as well as representatives from UNICEF, the US NIEHS and WHO.

(Continued on page 2)

Asia-Pacific Regional Meeting on Children's Environmental Health (CEH)
May 27th - 28th, 2019 at the Chulabhorn Research Institute, Bangkok, Thailand

(Continued from page 1)



The two-day meeting was sub-divided into 8 sessions:

Session 1 included reports from 3 previous meetings on CEH held in Bangkok (2016), New Delhi (2017) and Republic of Korea (2019) to set the stage for the discussions.

Sessions 2 and 4 consisted of presentations on on-going research in the area of CEH on the topics of air pollution and infectious agents in respiratory diseases, challenges and opportunities in children's cohorts, maternal and paternal exposures as determinants of child health, advances in molecular epidemiology to reduce childhood exposure, remediation technologies to reduce environmental exposures, and the importance of biodiversity in human health and well-being.

Session 3 was dedicated to country profile reports for the 13 countries represented at the meeting.

In **session 5**, the unique and common CEH issues presented in the country reports, including cross-cutting issues, priority issues and lessons learnt were summarized and discussed.

In **session 6**, Ms. Siriwan Chandanachulaka from the Thai Ministry of Public Health presented the Asia-Pacific Regional Strategic Plan for Children's Environmental Health,

Ms. Seonmi Choi from UNICEF EAPRO discussed opportunities for increasing the profile of CEH on the international stage, and participants were then split up into groups to discuss some of the priority issues in the region that should be acknowledged and addressed by the international community.

Session 7 provided information on the CEH Global Network, including tools available to help translate research findings into tangible outputs.

Session 8 was a roundtable discussion on the multi-disciplinary nature of research and training on CEH to reduce the burden of disease and was moderated by Dr. William A. Suk (US NIEHS) and Professor Mathuros Ruchirawat (CRI, Thailand).

(Continued on page 3)

Training Course on "Occupational and Environmental Health"

May 30th to June 1st, 2019 in Hanoi, Vietnam

A team of international training experts in the field of Occupational and Environmental Health, led by the Chulabhorn Research Institute (CRI), traveled to Hanoi, Vietnam to conduct in-country training on **"Occupational and Environmental Health"**, in collaboration with the National Institute of Occupational & Environmental Health (NIOEH), Vietnam from May 30th - June 1st, 2019 with support from Thailand International Development Cooperation Agency (TICA), Ministry of Foreign Affairs, Thailand, and CRI.

The course was designed to provide information on current occupational and environmental hazards and the diseases they cause with particular emphasis on emerging hazards and hazards in South-East Asia, the scientific methodologies used in occupational and environmental health to assess toxic hazards and to establish linkages between hazards and diseases.

This in-country training course was attended by 62 participants from various governmental agencies and academic institutions.

The teaching faculty included Dr. William A. Suk (National Institute of Environmental Health Sciences, USA),

Professor Roberto Lucchini (Icahn School of Medicine at Mount Sinai, USA), Professor Melissa A. McDiarmid (University of Maryland School of Medicine, USA), Associate Professor Dr. Doan Ngoc Hai (NIOEH, VIetnam), as well as Associate Professor Dr. Jutamaad Satayavivad, CRI Associate Vice-president for Scientific Affairs, and Dr. Panida Navasumrit, research scientist from CRI's Laboratory of Environmental Toxicology.

As part of its capacity building programme, CRI regularly conducts in-country training in developing countries in the Asia-Pacific region in the areas of chemical safety, environmental health, toxicology and risk assessment in response to requests made from the respective country, either directly through an agency/institution with existing collaborations with CRI, or through an international organization such as the WHO, e.g. through the respective regional office at SEARO or WPRO.

For more information on CRI's capacity building programme, including a calendar of training events, please visit https://www.cri.or.th/en/ac_actcalendar.php

Asia-Pacific Regional Meeting on Children's Environmental Health (CEH)
May 27th - 28th, 2019 at the Chulabhorn Research Institute, Bangkok, Thailand

(Continued from page 2)

Some of the priority issues in CEH identified by participants at this regional meeting to be focused on in the next 5 years included: development of policy and decision support tools to drive efforts on the issue (including harmonized data collection systems across regions, health outcomes, indicators and vital statistics collected); increasing capacity for data analysis and interpretation, including training of new data interpretation experts; increasing coordination among all involved agencies (e.g. health, environment, etc.); increasing awareness on CEH (including harmonizing CEH onto the national, regional and global agendas); strengthening of multi-disciplinary research and research collaborations; and identification of funding sources (e.g. national funding priorities, donors like the ADB, and local community engagement funded through community fundraising).

Childhood Lead Exposure and Lifelong Mental Health

Millions of adults now entering middle age were exposed to high levels of lead as children, a phenomenon that accompanied the peak use of lead in gasoline worldwide from the 1940s through the early 1990s.

From 1976 to 1980, the average child living in the United States had blood lead levels (BLLs) 3 times higher (>15 μg/dL) than the current reference value for clinical attention (5 μg/dL).

Lead-exposed children experience disrupted cognitive and behavioral development. Childhood lead exposure linked to lower child IQ, poorer academic achievement, and greater rates of child behavior problems, particularly inattention, hyperactivity, and antisocial behavior.

However, long-term mental and behavioral health consequences of early-life lead exposure have not been fully characterized.

The present study was conducted to examine whether childhood lead exposure is associated with greater psychopathology and difficult adult personality traits across life.

The prospective cohort study undertook the longest and largest psychiatric follow-up to date in adults who were lead exposed and lead tested as children. The study included the only follow-up to use (1) repeated clinical interviews assessing psychopathology symptoms across adulthood up to 38 years of age; (2) comprehensive, dimensional measures of psychopathology that account for severity, comorbidity, and reoccurrence; and (3) a broad measure of adult personality (Big Five Personality Inventory) that did not rely on self-report.

Big Five Personality Inventory includes assessing neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness.

This multidecade, longitudinal analysis of the association between childhood blood lead levels (BLLs) and adult mental health and personality generated 3 findings.

First, across nearly 3 decades of follow-up, childhood BLLs were associated with higher levels of general psychopathology, driven primarily by greater rates of internalizing and thought disorder symptoms.

Second, childhood BLLs were associated with higher neuroticism, lower agreeableness, and lower conscientiousness.

Third, childhood BLLs were associated with greater externalizing and internalizing symptoms assessed contemporaneously with BLL measurement at 11 years of age.

These results suggest that early-life lead exposure in the era of leaded gasoline experienced by individuals who are currently adults may have contributed to subtle, lifelong differences in emotion and behavior that are detectable at least up to 38 years of age.

Lead-related alterations in emotion and behavior may demonstrate heterotypic continuity in their psychiatric presentation. That is, one class of psychiatric disorders can create conditions that may lead to another class, for example, when hyperactivity elicits harsh parenting, it may lead to anxiety and depression, on the other hand, the same underlying condition, for example, a general liability to psychopathology, may present differently across different developmental windows.

In conclusion, higher childhood BLLs were associated with greater psychopathology across the life course and difficult adult personality traits as well. Childhood lead exposure may have long-term consequences for adult mental health and personality.

For policymakers and practitioners, the findings suggest that the generation of adult patients with a history of childhood lead exposure may benefit from increased screening and access to mental health services.

As the generation of lead-exposed individuals age, it is also possible that bone loss during menopause and osteoporosis may result in childhood lead stored in bone being recirculated throughout the body. This could suggest a testable hypothesis that the long-term consequences of childhood lead exposure may evolve or expand over time.

Source: JAMA Psychiatry, Vol. 76, No. 4, Page 418-425, April 2019.

Early-life Cadmium Exposure and Bone-related Biomarkers

Chronic cadmium exposure has been associated with osteotoxicity in adults. Primarily in the upper-middle-aged to elderly, chronic low-level cadmium exposure has, besides the well-known kidney effects, been associated with decreased bone mineral density and increased risk of osteoporosis and fractures.

But little is known concerning the effects of exposure on early growth, which has been shown to be impaired by cadmium. How cadmium affects bone in children, who might be particularly susceptible during rapid growth and bone accrual, is not clear.

It is becoming increasingly evident that cadmium may affect children's growth because prenatal exposure to cadmium has been associated with smaller size at birth as well as with height and weight at preschool age. In addition, childhood cadmium exposure has been inversely associated with height, weight, and growth velocity at 5 years of age.

The present study aimed to elucidate the impact of early-life cadmium exposure on bone-related biomarkers and anthropometry at 9 years of age. It was conducted in the same Bangladeshi mother-child cohort as earlier studies which had shown increased cadmium exposure to be associated with reduced anthropometry at birth and at 5 years of age.

Cadmium exposure was assessed by concentrations in the children's urine (U-Cd, long-term exposure) and erythrocytes (Ery-Cd, ongoing exposure) at 4.5 and 9 years of age, and in their mothers during pregnancy.

(Continued on page 5)

Assessment of Air Pollution Caused by E-waste Burning: The Human Health Risk

E-waste recycling activities can pose a high risk to the environment and to human health. Combustion from the burning of e-waste releases into the atmosphere fine particulate matter which is linked to pulmonary and cardiovascular disease.

Particulate matter (PM), also known as particle pollution, is a key indicator of air pollution. Nowadays e-waste recycling also contributes significantly to our deteriorating air quality.

Measurement of levels of atmospheric particulate matter is a key parameter in air quality monitoring throughout the world. It has provided useful data for study of the cause-effect relationship between PM exposure levels and health impacts.

Informal recycling activities of e-waste (such as open burning, dismantling, incinerating, ash washing and acid bath etc.) release number of toxic or hazardous substances causing severe health issues to the workers engaged at the processing sites apart from the environmental pollution.

The present study was conducted over a period of three months to measure PM_{10} levels and heavy metal concentrations (Pb, Cu, Zn, Ni and Cr) in an area where illegal e-waste recycling is known to operate.

At the same time, the concentrations of the same heavy metals in human blood were measured to find out if there exists any correlation between environmental and biological exposure.

Illegal e-waste recycling was a major cause of the increase in PM_{10} concentration, which exceeded the National Ambient Air Quality standard, of 400 $\mu g/m^3$, given by Central Pollution Control Board of India at the e-waste burning site.

Crude and rudimentary methods of e-waste processing have significantly contributed to the high levels of airborne chronic exposure to air pollution due to e-waste processing, in turn, is responsible for alarming levels of toxic heavy metal exposure to local residents. This toxicity was associated with a significant prevalence of cardiovascular morbidity, namely hypertension, in the local inhabitants.

Although a direct cause and effect relationship could not be established, this study reports the highest prevalence of hypertension in the e-waste area, indicating a probable link between chronic exposure to e-waste and cardiovascular risk.

The presence of high levels of Cr, Ni, Cu and Zn in residents at the control and residential site is a matter of concern, because it raises the issue of atmospheric spread of heavy metal air pollution with serious public health concern.

The study recommended that the health risk to residents of the city should not be ignored and may be addressed through continuous environmental monitoring by local authorities and non-government agencies.

The health of the general population residing in such areas should be monitored for the long term health effects of heavy metal exposures. Timely interventions should be planned to safeguard the health of the residents.

Source: Environment International, Vol. 125, Pages 191-199, April 2019.

Early-life Cadmium Exposure and Bone-related Biomarkers

(Continued from page 4)

Biomarkers of bone remodeling, including urinary deoxypyridinoline (DPD), urinary calcium, plasma parathyroid hormone (PTH), osteocalcin, vitamin D3, insulin-like growth factor (IGF) 1, IGF binding protein 3, thyroid stimulating hormone (TSH), were measured at 9 years of age.

The results showed that childhood cadmium exposure was associated with several bone-related biomarkers. Some of the associations differed by gender.

It was found, for the first time, that cadmium exposure during childhood was associated with multiple alterations in bone-related biomarkers in prepubertal children.

Specifically, U-Cd, a marker of chronic exposure, was positively associated with urinary DPD and plasma osteocalcin and inversely associated with plasma vitamin D3.

Stratification by child gender indicated that the positive association of cadmium exposure with osteocalcin occurred only in girls, whereas the association was inverse in boys.

The underlying mechanism for this gender difference is unknown. The studied children were between 8.7 and 10 years of age. Some of the girls might have reached puberty. Thus, the possibility that the puberty-related increase in growth, including bone growth, had already begun in some of these girls. In support of this, levels of osteocalcin, as well as IGF-1, IGFBP3, and PTH were higher in the girls than in the boys.

An inverse association between maternal cadmium exposure in pregnancy with the children's plasma TSH concentrations were observed.

There were also indications that increasing U-Cd concentrations during childhood were associated with decreasing plasma concentrations of IGF-1, a strong determinant of growth in children.

In conclusion, chronic cadmium exposure during early childhood may affect bone remodeling and growth at a prepubertal age. However, more research in other populations is warranted.

Future perspectives include assessing whether these cadmium-related associations with bone biomarkers before adolescence have long-term consequences in the form of lower peak bone mass or poor bone health, for example, osteoporosis in adulthood.

Source: Environmental Health Perspectives, Vol. 127, No. 3, Pages 037003-1, March 2019.

Urban-rural and Sex Differences in Cancer Incidence and Mortality and the Relationship with $PM_{2.5}$ Exposure

Air pollution has become a major global health risk factor. Particulate matter with an aerodynamic diameter of less than 2.5 μm ($PM_{2.5}$) shortens life expectancy due to its health impact on morbidity and mortality, especially the increased risk of lung cancer and cardiovascular diseases.

In China, many studies show that short-term exposure to $PM_{2.5}$ is also associated with the rise in hospital emergency room visits, cardio-respiratory diseases and mortality in city areas. At the same time, cohort studies show that ambient particulate matter can increase the risk generally of cardiovascular and respiratory mortality.

There are two main causes of $PM_{2.5}$ health hazards: One is that the fine particles in $PM_{2.5}$ are small enough to arrive in major human organs, including the respiratory system, the circulatory system, and the reproductive system.

Another reason is that there are numerous kinds of hazardous substances in $PM_{2.5}$, including carcinogenic polycyclic aromatic hydrocarbons (PAHs), heavy metals (such as lead, mercury, chromium and cadmium), and pathogenic microorganisms (such as bacteria, viruses and fungi).

PAHs in $PM_{2.5}$ are a suspected predisposing factor for breast cancer because they disrupt BRCA-1 gene expression in estrogen receptor. A recent study conclude that PAHs in $PM_{2.5}$ have a significant impact on the increased incidence of female breast cancer in urban areas. Furthermore, the association of BRCA-1 with ovarian cancer has now been confirmed.

Therefore, it may be deduced that cancer is one of the manifestations of the health impacts of $PM_{2.5}$ in regions with a large population density, since PAHs can almost always be detected in $PM_{2.5}$ in such areas.

The $PM_{2.5}$ concentration in China has been at elevated levels for a long time. The main impacts of such hazardous substances in $PM_{2.5}$ as PAHs and heavy metals have also been identified in the increased risks to the public of some common diseases.

In this study a screen on the most common diseases is conducted to try to better understand the health effects of $PM_{2.5}$ exposure in China. Geographical and sex factors are also considered because there are spatial differences in $PM_{2.5}$ concentration and composition, mainly between urban and rural areas, as well as sex differences in sensitivity to toxic substances.

The present study was conducted to assess the health effects caused by $PM_{2.5}$ in China. The first objective was to find out which cancers are closely associated with high $PM_{2.5}$ concentrations. Then, the sex- and area-specific increased risks of those cancers in the face of high level $PM_{2.5}$ and long-term exposure were evaluated.

This study first investigated the association between the country's ten most common cancers as identified by the National Central Cancer Registry of China.

Rate of incidence and mortality associated with $PM_{2.5}$ concentration was studied to find out which cancers are closely related to $PM_{2.5}$. Time series data of yearly incidence and mortality was obtained for the ten most common cancers along with the annual mean $PM_{2.5}$ concentration in China from 2000 to 2011.

The sex- and area-specific increased cancer incidence/mortality risks from long-term exposure to high $PM_{2.5}$ concentration was then estimated, using spatiotemporal series data for the southeastern side of Hu line from 2006 to 2009.

Finally, urban-rural and sex differences in the increased risks of incidence and mortality for the ten most common cancers associated with long-term exposure to high $PM_{2.5}$ concentration were investigated.

The southeastern side of Hu line was selected as the target research region because this part of China has greater population density and more social and economic development. The air pollution caused by $PM_{2.5}$ is very serious in such areas and the data collected are more consistent with the actual situation.

The major finding showed that with every increase in rural areas of 10 μg/m^3 of annual mean $PM_{2.5}$ concentration, there was an increase in relative risk for lung cancer incidence and mortality of 15% and 23% respectively for males, and 22% and 24%, respectively for females.

In urban areas, the increase in relative risk for incidence of ovarian cancer was 9% for females while for the risk of prostatic cancer in males increased to 17%.

In rural areas, the increased relative risks respectively of incidence and mortality due to leukemia were 22% and 19% for females. In urban areas the increased relative risk for mortality due to leukemia was 9% for males and for incidence, 6% for females.

With increased $PM_{2.5}$ exposure, the risks for ovarian and prostatic cancer rise significantly in urban areas, while risks for lung cancer and leukemia rose significantly in rural areas.

The results demonstrate the higher, more significant risk of lung cancer and leukemia for females with increased $PM_{2.5}$ exposure. This study also suggests that the carcinogenic effects of $PM_{2.5}$ have obvious sex and urban-rural differences.

Among the ten most common cancers, the note of incidence of six and the rate of mortality of two are closely related with $PM_{2.5}$ exposure. Most effected were the cardiovascular, respiratory, reproductive, digestive, and hematopoietic systems.

With the same cancer, there can still be a big gap in the relative risk of long term $PM_{2.5}$ exposure between urban and rural areas and between males and females. For different cancers, the hazards of $PM_{2.5}$ vary in urban and rural areas.

(Continued on page 7)

STATE OF GLOBAL AIR 2019

Air Pollution - A Significant Risk Factor Worldwide

Exposure to outdoor and indoor air pollution can, on average, shorten the life of a child born today by over 20 months, according to a new global study, State of Global Air 2019.

Overall, air pollution is responsible for more deaths than many better-known risk factors such as malnutrition, alcohol abuse, and physical inactivity.

Air pollution ($PM_{2.5}$, ozone, and household air pollution) is the 5th highest cause of death among all health risks, ranking just below smoking. Each year, more people die from air pollution related diseases than from road traffic injuries or malaria.

For the first time this year's report and website estimate the effect of air pollution on life expectancy.

Worldwide, air pollution in 2017 reduced life expectancy for humans by an average of 20 months, a global impact rivaling that of smoking. Lost of life rises to over 2 years and 6 months for children born in South Asia (Bangladesh, India, Nepal, Pakistan) where air pollution is at its worst.

Long-term exposure to outdoor and indoor air pollution contributed to nearly 5 million deaths from stroke, heart attack, diabetes, lung cancer, and chronic lung disease worldwide in 2017.

Aggressive actions taken by China to fight air pollution is showing the first signs of progress in reducing exposure. $PM_{2.5}$ pollution in China has dropped markedly in recent years, but concentrations still exceed the World Health Organization's least-stringent target.

South Asian countries (Bangladesh, India, Nepal and Pakistan) by contrast led the world as the most polluted region, with over 1.5 million air-pollution related deaths.

The analysis found that China and India together were responsible for over half of the total attributable global deaths. Both countries face over 1.2 million early deaths from air pollution in 2017.

The report highlighted that nearly half of the world's population, a total of 3.6 billion people, were exposed to household air pollution in 2017. Globally, there has been progress in that the proportion of people cooking with solid fuels has declined as economies develop. However, less developed countries continue to suffer the highest exposure to household air pollution.

Household air pollution can also be a major source of impact in outdoor air, with indoor pollution emitted to the outdoor air the largest cause of health impacts among all sources in India, contributing to 1 in 4 air pollution related deaths.

Recent evidence indicates that air pollution contributes to the development of type 2 diabetes. This assessment includes estimates of the health burden relate to type 2 diabetes.

Advances in Methods and Data: As the science continues to advance, the Global Burden of Disease project has incorporated new data and methodology into its air pollution and health assessments. New methodology may result in differences between assessments from previous years. Therefore, trends over time are recalculated with each update to ensure that findings are internally consistent within each report.

The State of Global Air 2019 annual report and accompanying interactive website are designed and implemented by the Health Effects Institute in cooperation with the Institute of Health Metrics and Evaluation (IHME) at the University of Washington, the University of British Columbia, and the University of Texas at Austin.

Source: Health Effects Institute, State of the Global Air 2019, June 2019. (https://www.healtheffects.org/announcements/state-global-air-2019-air-pollution-significant-risk-factor-worldwide)

Urban-rural and Sex Differences in Cancer Incidence and Mortality and the Relationship with $PM_{2.5}$ Exposure

(Continued from page 6)

In China, long term, high concentration exposure to $PM_{2.5}$ sharply raises the risks of some cancers, at the same time, the responses of cancers to $PM_{2.5}$ are inconsistent in urban and rural areas, and in different sexes.

Specifically, the responses of lung cancer and leukemia to $PM_{2.5}$ are more significant in rural areas, while the responses of ovarian cancer and prostatic cancer are more significant in urban areas. In addition, the hazards of $PM_{2.5}$ for females are more significant.

Therefore, urban and rural differences and sex differences should be taken into account in the management of air pollution and the associated health problems.

This is the first step of a differential study of the health risks to different sexes of long term, high concentration exposure to $PM_{2.5}$ in urban-rural areas.

In order to identify more accurate exposure-response relationships between cancers and long-term $PM_{2.5}$ exposure, it is necessary to choose typical areas in which to carry on large-scale prospective cohort studies.

Source: Chemosphere, Volume 216, Pages 766-773, February 2019.

CALENDAR OF EVENTS

International Training Courses at Chulabhorn Research Institute
Schedule for 2019 - 2020

	Training Course	Date	Duration	Closing Date
1.	Environmental and Health Risk Assessment and Management of Toxic Chemicals	December 6 - 18, 2019	10 work days	October 15, 2019
2.	Principles of Toxicology, Toxicity Testing and Safety Evaluation	January 2020	8 work days	October 31, 2019
3.	Detection of Environmental Pollutants and Monitoring of Health Effects	February 2020	10 work days	November 15, 2019

Course Coordinator: *Khunying* Mathuros Ruchirawat, Ph.D.

Course Description:

1. Environmental and Health Risk Assessment and Management of Toxic Chemicals (December 6-18, 2019)

The course is an integration of science and policy, covering the fundamental basis of environmental and health risk assessment and management, from identification of hazard, assessment methods, the mode of action and human relevance framework, the inherent uncertainties in each step, the relationship between risk assessment and risk management, and the need for open, transparent and participatory acceptance procedures and credible communication methods. Emphasis is placed on human health risk assessment, although the principles of ecological risk assessment will also be covered. The course teaches the practical application of risk assessment methods to various problems, e.g. hazardous waste site release, through the use of case studies relevant to problems faced in developing countries, and describes the policy context in which decisions to manage environmental health risks are made. Teaching and learning aids such as electronic distance learning tools and IPCS risk assessment toolkit will be introduced.

Requirement: Participants should have jobs/responsibilities related to assessment of risk from the use of chemicals.

2. Principles of Toxicology, Toxicity Testing and Safety Evaluation (January 2020)

The course presents the basic concepts of toxicology, including dose-response relationships; types of harmful effects, mechanisms involved in chemical actions from the entrance of chemicals into the body until excretion; toxicokinetics; activation and detoxification of carcinogenesis and mutagenesis; the principles of testing for toxic effects; epidemiology and concepts of risk assessment.

Requirement: Participants should have work experience related to the use of basic knowledge in chemistry, biological sciences, or medicine.

Fellowships:

A limited number of fellowships are available that will cover roundtrip airfare, accommodation (on site) and meals, training materials, and health insurance.

Contact: Chulabhorn Research Institute (CRI)
54 Kamphaeng Phet 6 Rd.,
Lak Si, Bangkok 10210, Thailand
Tel: +66 2 553 8535
Fax: +66 2 553 8536
E-mail: envtox@cri.or.th

More information and application:
please visit - http://www.cri.or.th/en/ac_actcalendar.php

The ICEIT NEWSLETTER is published quarterly by the International Centre for Environmental and Industrial Toxicology of the Chulabhorn Research Institute. It is intended to be a source of information to create awareness of the problems caused by chemicals. However, the contents and views expressed in this newsletter do not necessarily represent the policies of ICEIT.

Correspondence should be addressed to:

ICEIT NEWSLETTER
Chulabhorn Research Institute
Office of Academic Affairs
54 Kamphaeng Phet 6 Road
Lak Si, Bangkok 10210, Thailand
Tel: +66 2 553 8535
Fax: +66 2 553 8536
CRI Homepage: <http://www.cri.or.th>

For back issues of our newsletter, please visit:

http://www.cri.or.th/en/envtox/et_newsletter.htm