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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".

Chulabhorn Research Institute Organizes an Executive Seminar and Training Course on Environmental Toxicolgy for Safe and Sustainable Development in the Kingdom of Bhutan

(June 20-26, 2007)

On the invitation of His Majesty the King of Bhutan, Her Royal Highness Princess Chulabhorn, President of CRI, led a term of international experts to give this executive seminar and training course specially designed to meet the needs of Bhutanese officials.

This event was organized by Chulabhorn Research Institute (CRI), Thailand, Bhutan Trust Fund for Environmental Conservation (BTF), and National Environment Commission (NEC).

In her opening address, Her Royal Highness said that in recent years it had become increasingly apparent in developing countries in the region that there was a serious shortage of trained and qualified personnel in the area of toxicology to cope with the rapid increase in the use of chemicals. Thus for the last 18 years, the Chulabhorn Research Institute has successfully operated a capacity building program in collaboration with governments of many countries in the region, appropriate to the needs of different countries.

The training course designed specifically for officials of the Kingdom of Bhutan covered the following topics:

- Concepts and Principles of Toxicology
- Chemical Carcinogenesis
- Pesticides and Industrial Chemicals
- Toxicological Basis for Regulating Chemical Exposure
- Risk Assessment and Management of Chemicals
- Panel Discussion: How to Use Toxicology Standards and Risk Assessment in Policy Making

CHANGES IN BLOOD LEAD LEVELS ASSOCIATED WITH USE OF CHLORAMINES IN WATER TREATMENT SYSTEMS

Environmental lead exposure occurs through ingestion or inhalation of lead particles. Most childhood lead uptake in the United States results from exposure to deteriorating lead paint in household dust and soil, and to lead in soil from historic deposition from mobile sources, and drinking water can also be a source of chronic exposure. Although drinking water is not the primary route of exposure for most children, the U.S. Environmental Protection Agency (EPA) has estimated that 14-20% of total childhood lead exposure in the United States is from drinking water.

In 1991, the U.S. EPA set a maximum contaminant level goal for lead in drinking water of zero and an action level of 15 ppb. Although water supplies themselves can be contaminated with lead, most lead in drinking water comes from residential plumbing. Lead piping was uncommon after the 1930s, but lead soldering was common and legal until 1986, and some plumbing fixtures today still contain lead. Lead is soluble in water, and this solubility is markedly increased by high water softness and acidity.

Drinking water preparation can differ significantly across water systems, depending on the type and quality of source water, and is intended to protect the public from microbial pathogens, prevent dental caries, reduce harmful disinfection by-products, and reduce metal contamination from pipes. To achieve these goals, drinking water treatment systems generally process water using a number of additives, including fluoride, disinfectants (historically primarily chlorine), coagulants to precipitate fine solids, and anticorrosivity agents to reduce leaching of metals from plumbing into the water. The corrosivity of water can be highly sensitive to small fluctuations in pH, alkalinity, temperature, oxidation potential, and concentrations of individual chemical species.

Trihalomethanes, by-products of chlorine-based disinfection processes, have long been recognized as carcinogenic, neurotoxic, and teratogenic. Concerned over the enduring presence of these chlorination by-products, in 1998 the U.S. EPA published its *Stage I Disinfection By-products Rule,* requiring water treatment systems to reduce the formation of these disinfection by-products. Exceedance of the U.S. EPA trihalomethane standard has led an increasing number of municipal water treatment facilities to switch from chlorine to chloramine use.

Chloramines alter water chemistry and often must be accompanied by other changes to water treatment. Several recent studies provided evidence that the introduction of chloramines to water systems with lead-containing pipes, fixtures, or solder may increase the amount of dissolved lead in water because of changes in water chemistry; interactions with additives such as coagulants or fluoridation agents may remove lead dioxide scales originally formed during decades of chlorine-based disinfection. This leaching might be managed to some extent by the addition of anticorrosivity agents during the water treatment process; however, the details of all the related environmental chemistry are not fully understood and are highly dependent on the particular chemical interactions found in each water treatment and distribution system.

Now a team of researchers from Duke University has measured the potential effect of switching from chlorine to chloramines on blood lead levels.

The scientists used geographic information system-based software to link blood lead data, housing data (dissolved lead in water can occur only when a lead source is present, a condition that is much more likely in older housing), drinking water sources, and census data for 7,270 children in Wayne County, North Carolina. Blood lead data were obtained from a statewide registry of all blood lead screens conducted on North Carolina children under the age of six. The authors noted that the lead-screened children were well distributed across different ages of housing in Wayne County.

The county has two main public water systems. About 70% of the residential tax parcels get drinking water through Wayne Water Systems, which uses chlorine for disinfection. Another 28% of parcels get drinking water through the Goldsboro Water System, which has used chloramines for disinfection since March 2000.

The Goldsboro Water System's change to chloramines was associated with an increase in children's blood lead levels, suggesting that use of chloramines could lead to an increase in lead exposure. The impact of the change to chloramines was progressively mitigated in newer housing, however. In houses built after 1950, the newness of the home was a stronger influence on blood lead than the use of chloramines.

Much uncertainty still surrounds the underlying environmental chemistry of how combinations of disinfectants, anticorrosives, coagulants, and fluoridation agents combine with water qualities such as pH, alkalinity, temperature, oxidation potential, and concentrations of other chemical species to affect lead in drinking water. Nevertheless, the results of this study provide guidance to both water systems and health departments on which houses should be targeted for monitoring of lead in both water and residents' blood.

Source: Environmental Health Perspectives, Vol. 115, February 2007.

Methylmercury Interaction with Lymphocyte Cholinergic Muscarinic Receptors in Developing Rats

Methylmercury (MeHg) is a widespread environmental and food contaminant whose primary source of human exposure is represented by the consumption of seafood and fish products.

The central nervous system (CNS) is well recognized as the most susceptible target for MeHg toxicity, especially during the developmental period. Indeed, several epidemiological and experimental data have demonstrated that prenatal exposure to environmental levels of MeHg can affect attention, sensory and motor function, and other aspects of the neurodevelopmental function.

Although MeHg molecular mechanisms of neurotoxicity have not been clearly elucidated, possibly because of the multiple nature of its targets, altered neurotransmission systems including the cholinergic muscarinic system may underlie some behavioral deficits observed following low to moderate *in utero* MeHg exposure. *In vitro* and *in vivo* evidence indicate that the cholinergic muscarinic system can be affected by MeHg at low doses. Moreover, significant changes in the density of cerebral muscarinic receptors (MRs) have been recently reported in both adult and weaning offspring following perinatal oral administration of MeHg (1 mg/kg/day) to rat dams from gestational day 7 (GD7) to postnatal day 7 (PND7).

A large body of evidence suggests that, in mammalian species, most of the cholinergic components found in nervous system, including acetylcholine (ACh), choline acetyltransferase (ChAT), high affinity choline transporter, acetylcholinesterase, as well as muscarinic and nicotinic ACh receptors are also expressed in nonneuronal tissues including lymphocytes isolated from peripheral blood, thymus, lymph nodes, and spleen. Indeed, investigating parameters of neural cell function in peripheral blood cells has been proposed as a promising strategy to develop biomarkers of CNS alterations due to neurological diseases or to neurotoxicant exposure. Accordingly, some neurotransmission parameters including cholinergic MRs in the lymphocytes have been shown to mirror equivalent changes in these biochemical end-points in the CNS following exposure to neurotoxicants and muscarinic agonistic/antagonistic drugs. It has been demonstrated that in adult rats, the number of both brain and lymphocyte MRs is affected by the oral administration of 0.5 and 2 mg/kg/day MeHg for 2 weeks. Interestingly, the change in peripheral MR binding even preceeded that observed in the brain, thus suggesting that lymphocyte MRs might serve as peripheral biomarkers for similar CNS changes induced by MeHg.

Given the notion that (i) in adult rats lymphocyte MRs may serve as putative biomarkers of the same endpoint in the CNS following repeated low level MeHg exposure and that (ii) in PND21 rats perinatal exposure to low MeHg levels results in an altered number of brain MRs, the principal aim of the present study was to investigate whether, after developmental exposure to MeHg, splenic MRs of weanling rats display changes reflecting those occurring in the brain and may thus be used as peripheral indicators of brain MR effects.

The effects of MeHg were evaluated on rat lymphocyte MR binding (using [^{3}H]QNB as specific muscarinic ligand) *in vivo* (after perinatal exposure) and *in vitro*. For comparison, *in vitro* studies were also performed on human lymphocytes.

Exposure to 1 mg MeHg/kg/day during pregnancy and lactation (from GD7 to PND7) significantly enhanced lymphocyte MR density in both adult and young rats 21 days after delivery, with a more pronounced effect in the mothers (B_{max} increase of 139%) than in the male offspring (+49%) and female offspring (+73%) as compared with their respective controls (33+4, 41+8, and 37+4 fmol/million cells), in accordance with the higher Hg levels detected in the adult blood (11.3+2.2 μg/mL) than in pups (1.3+0.4 μg/mL in both genders). A lower MeHg dose (0.5 mg/kg/day) was without any effect on lymphocyte MRs. In *in vitro* studies, MeHg was an almost equipotent inhibitor of [^{3}H]QNB binding to rat and human lymphocyte MRs (IC_{50} values were 4.1+0.29, 5.2+0.51, and 5.0+0.9 μM for total rat lymphocytes, rat T lymphocytes, and total human lymphocytes, respectively). Notably, the IC_{50} values for MeHg to lymphocyte MRs were comparable to the Hg levels reached in blood (5-50 μM) of the PND21 rats exposed to MeHg.

The finding that the MR binding is a target for the effects of MeHg in peripheral blood cells is in accordance with previous data in brain, and supports the use of this peripheral endpoint as a biomarker of MeHg-induced cerebral muscarinic alterations. The similarity of MeHg IC_{50} binding data between human and rat in peripheral tissues suggests the possible application of such biomarker to humans exposed to environmental chemicals.

Source: Environmental Research, Vol. 103, February 2007.

AIR POLLUTION, SMOKING, AND PLASMA HOMOCYSTEINE

A number of epidemiologic studies have demonstrated that ambient air pollution is associated with increased risk of cardiovascular disease. In particular, acute increases in ambient particulate matter (PM) levels have been associated with myocardial infarction, stroke, and other adverse effects on cardiovascular function. These studies have demonstrated that high plasma levels of total homocysteine (tHcy) are an independent risk factor for vascular disease, including coronary artery, cerebrovascular, and peripheral occlusive disease. In addition to fasting tHcy measurements, tHcy determination after oral methionine load is used to identify individuals with mild impairment of Hcy metabolism, in whom fasting tHcy may be normal but postmethionine-load (PML) tHcy concentration is increased.

Alveolar and systemic inflammation has been proposed as a central component in the series of events linking the exposure to inhaled pollutants to the observed increases in cardiovascular morbidity and mortality. However, whether air pollution exposure is correlated with increased tHcy levels has never been determined.

Now a study carried out in Lombardia, Italy, investigates the effects of air pollution levels on fasting and PML tHcy in a cohort of over one thousand and examines potential effect modification by cigarette smoking of the relation between air pollution and tHcy.

From January 1995 to August 2005, 1,218 healthy individuals, who were partners or friends of patients with thrombosis, attended the Thrombosis Center of the University of Milan, Italy, and agreed to undergo thrombophilia screening on a voluntary basis. Only individuals resident in the Lombardia region were chosen. Previous thrombosis was excluded with a validated structured questionnaire. On the day of the visit, the participants attended the Thrombosis Center at 09:00 hr, when a first fasting blood sample was taken. A standardized questionnaire was administered including demographic data and questions on education, occupation, smoking, alcohol consumption, diet, reproductive history, and hormone use (oral contraceptives or hormone replacement therapy). Plasma tHcy was measured in EDTA anticoagulated blood samples. Blood was withdrawn after overnight fasting for at least 8 hr, and again 4 hr after an oral methionine load (3.8 g/m^2 body surface area). Blood samples were immediately placed on ice to prevent the artifactual *in vitro* increase in plasma tHcy levels and centrifuged at 1,600g at 4 ^{o}C for 15 min within 1 hr. The supernatant platelet-poor plasma was stored at -80 ^{o}C. Plasma tHcy was measured by high performance liquid chromatography and fluorescence detection.

Air pollution and weather data were obtained from the Regional Environmental Protection Agency (ARPA Lombardia) recordings of hourly air pollution data measured from January 1994 to September 2005 by monitors located at 53 different sites throughout Lombardia. The 53 stations included in this study were selected by ARPA Lombardia from the approximately 200 monitors of the Regional Air Monitoring Network on the basis of their location, reliability, determined by standardized quality control procedures and by correlation with *in situ* measurements and continuity of recording. Nine different study areas in the region characterized by homogenous within-area air pollution concentrations were identified. Within each study area, levels of air pollutants measured by different monitors were highly correlated. The urban and suburban Milan areas included approximately 65% of the study subjects and had between-monitor correlations with r>0.80 for all pollutants. In the remaining areas, between monitor correlations generally were >0.70, with a few exceptions. In particular, correlations tended to be lower (r between 0.40-0.80) in area 3, which comprises two cities (Bergamo and Brescia) in a peculiar geographic location, partially enclosed in valleys at the Alps foothills. Although the analyses on pollution station data suggest that pollutant levels were quite heterogeneous in area 3, because only 18 subjects (1.5% of the total study population) were residents of this area, the general strategy for exposure assignment was not modified. In addition, mobile monitoring in each of the study areas during the study period showed high concordance with measurements taken by the permanent monitors in the same area. For each study area, the mean hourly concentrations of PM with an aerodynamic diameter <10 μm (PM_{10}), carbon monoxide, nitrogen dioxide, sulphur dioxide, and ozone were averaged using an algorithm that combined levels reported by multiple monitoring locations. These average concentrations for exposure assessment were used after assigning each of the study subjects to one of the nine pollution areas, based on the subjects' residence. Most air pollution stations also obtained data on weather, including air temperature, relative humidity, barometric pressure, intensity, and wind direction.

Linear visibility data were used to calculate the extinction coefficient, which was shown to be a good predictor of fine particle concentrations. In most of the areas, total suspended particles (TSPs) rather than PM_{10} were measured in the earlier years of the study period (1995-1998). TSP measurements were continued in the study area after PM_{10} recording was introduced. The penalized splines were used to allow for nonlinear associations with PM_{10} concentrations. The analyses performed throughout this study were done including the predicted data. When predicted data were excluded from the analyses, the point estimates obtained were similar to those including predicted data, but had wider confidence intervals (CIs).

In this study, air pollution levels measured in the week preceding the study did not show overall consistent associations with fasting and PML tHcy. However, it was found that PM_{10} interacted with cigarette smoking in determining increased tHcy levels. PM_{10} levels, particularly those in the 24 hr before the study, were associated with increased fasting and PML tHcy in smokers but not in nonsmokers.

Tobacco smoking is one of the strongest risk factors for cardiovascular disease. Previous studies indicate that smoking is

(Continued on page 8)

AIR POLLUTION AND INFLAMMATION IN TYPE 2 DIABETES: A MECHANISM FOR SUSCEPTIBILITY

Particulate air pollution has been associated with several adverse cardiovascular health outcomes, and people with diabetes may be especially vulnerable.

Outdoor air quality standards worldwide are intended to protect the most sensitive people in the population, yet studies linking outdoor pollution and health have observed associations even at pollutant levels well below the standards. One important regulated pollutant is particles <2.5 μm in aerodynamic diameter ($PM_{2.5}$), formed as a result of fossil-fuel combustion by motor vehicles and stationary sources such as power plants. These fine particles are of concern for health as they can deposit in the lower airways and gas-exchanging portions of the lung, even reaching the circulatory system. Exposure to increased levels of outdoor particulate air pollution has been consistently linked to cardiovascular morbidity and mortality, and to changes in subclinical indicators of cardiovascular function. Inflammation due to oxidative stress may be one responsible mechanism, as suggested by both animal and human studies.

Individuals with diabetes are at greater risk of dying and being hospitalized for heart disease during periods of high air pollution. Long-term exposure to $PM_{2.5}$ was associated with a higher relative risk of mortality among people with diabetes compared with the general population. Hence, those with diabetes may be considered a sensitive population. Examining the potential biological mechanisms responsible for this enhanced susceptibility, and identifying specific air pollution sources that may be more toxic, is therefore a priority for researchers and policy makers. Obesity is prevalent among people with diabetes and involves an increased inflammatory burden, thus lending plausibility to the idea that inflammation is involved in sensitivity to the cardiovascular effects of particles.

Inflammation is a key pathway leading to atherosclerosis and subsequent adverse cardiovascular events, and several blood markers of inflammation are being evaluated for their ability to predict prevalent or incident cardiovascular disease. These include the intercellular adhesion molecule 1 (ICAM-1) and the vascular cell adhesion molecule 1 (VCAM-1), which are expressed on cell surfaces and are also found, in soluble form, in the plasma. Another inflammatory marker is von Willebrand factor (vWF): a polypeptide involved in the thrombotic pathway, and a marker of endothelial damage or dysfunction. Increased plasma levels of soluble ICAM-1 and VCAM-1, and vWF have been associated with inflammatory, cardiovascular and neoplastic disease outcomes, although VCAM-1 associations have been less consistent than for ICAM-1. Prospective studies have linked vWF with risk of heart attack and coronary heart disease. Increased levels of vWF and soluble VCAM-1 and ICAM-1 are also associated with diabetes prevalence and higher VCAM-1 and ICAM-1 levels are associated with development of type 2 diabetes and its complications.

A few toxicological and epidemiological studies have examined the associations between ICAM-1, VCAM-1, and/or vWF levels and particle exposures, but none focused specifically on individuals with diabetes. Now a new study examines whether ambient levels of airborne particles are associated with inflammation, as marked by increased ICAM-1, VCAM-1 and vWF plasma levels, among people with diabetes residing in metropolitan Boston, Massachusetts, USA.

In this cross-sectional study, participants were enrolled in four clinical trials conducted at the Joslin Diabetes Center and Beth Israel Deaconess Medical Center, Boston, Massachusetts, USA, to examine the effects of drugs and vitamin E supplementation on various indicators of cardiovascular health. Data taken at baseline examinations (before randomization to treatment) between May 1998 and December 2002 were pooled for this analysis. Study participants analyzed for the present study had type 2 diabetes as defined by American Diabetes Association criteria. Although people without diagnosed diabetes were included in some of the trials, sample sizes were small, limiting the ability to make useful comparisons, and the current goal was to evaluate potential mechanisms only among the group already identified as being susceptible in previous population-based studies.

Daily average ambient levels of air pollution fine particles $PM_{2.5,}$ black carbon (BC) and sulphates were measured approximately 500 m from the patient examination site and evaluated for associations with ICAM-1, VCAM-1 and vWF. Linear regressions were fit to plasma levels of ICAM-1, VCAM-1 and vWF, with the particulate pollutant index, apparent temperature, season, age, race, sex, glucosylated haemoglobin, cholesterol, smoking history and body mass index as predictors.

Air pollutant exposure measures showed consistently positive point estimates of association with the inflammatory markers. Among participants not taking statins and those with a history of smoking, associations between $PM_{2.5}$, BC and VCAM-1 were particularly strong.

This cross-sectional study contributes to a growing body of literature that suggests that inflammation may be an explanatory factor for the greater risk for adverse cardiovascular consequences due to exposure to airborne particles in people with diabetes. Additional studies with larger sample size in differing locales with higher pollution levels, or different pollutant mixes, would be needed to confirm these findings. However, the present evidence is consistent with other studies showing greater air pollution sensitivity among individuals with diabetes. If the preponderance of evidence continues to confirm this potential susceptibility, environmental, in addition to lifestyle and medical, interventions may need to be considered to improve the quality of life among the growing population of people with diabetes.

Source: Occupational and Environmental Medicine, Vol. 64, June 2007.

DISTRIBUTION AND ORIGINS OF POLYCYCLIC AROMATIC HYDROCARBONS IN RIVERINE, ESTUARINE AND MARINE SEDIMENTS IN THAILAND

To assess the status of polycyclic aromatic hydrocarbon (PAH) contamination in coastal and riverine environments in Thailand, a study has been carried out in which researchers collected 42 surface sediment samples from canals, a river, an estuary, and coastal areas in Thailand in 2003 and analyzed them for PAHs with 3-7 benzene rings by gas chromatography-mass spectrometry (GC-MS). The total concentration of PAHs ranged from 6 to 8399 ng/g dry weight. The average total PAH concentrations were 2290+2556 ng/g dry weight (n = 8) in canals, 263+174 (n = 11) in the river, 179+222 (n = 9) in the estuary, and 50+56 (n = 14) in coastal areas. Comparison of the concentration range with a worldwide survey of sedimentary PAH concentrations ranked PAH contamination in Thai sediments as low to moderate. The ratio of the sum of methyl-phenanthrenes to phenanthrene (MP/P ratio) allows discrimination of PAH sources between petrogenic (>2) and pyrogenic (<0.5) origins. Sediments from urban canals in Bangkok showed the highest PAH concentrations and petrogenic signatures (MP/P ratio = 1.84+0.98 [n = 6] in canal sediments) with abundant alkylated PAHs, indicating major sources of petrogenic PAHs in the city. To identify the source of the petrogenic inputs in Thailand, triterpanes, biomarkers of petroleum pollution were analyzed in the sediment samples and in potential source materials. Hopane profiles were remarkably uniform throughout the nation, suggesting a diffuse single source (e.g. automobiles). Molecular profiles of hopanes and PAHs in sediments from the urban canals were similar to those in street dust, indicating that street dust is one of the major sources of petrogenic PAHs in the urban area. On the other hand, low levels of PAHs (~50 ng/g) with a pyrogenic signature (MP/P ratio ≈ 0.5) were widely recorded in remote areas of the coast and the Chao Phraya River. These pyrogenic PAHs may be atmospherically transported throughout the nation. Middle and lower reaches of the Chao Phraya River, the river mouth, and the upper Gulf of Thailand showed intermediate concentrations and profiles of PAHs, indicating mixtures of petrogenic and pyrogenic origins. Perylene was abundant in sediments, representing up to ~60% of total identified PAHs. High inputs of soil due to frequent heavy rains could contribute to the high perylene abundance in the sediments. Sedimentary PAH concentrations decreased offshore with a half distance of ~10 km in the upper Gulf off the mouth of the Chao Phraya River. This is probably due to active deposition of laterally transported riverborne particles.

The major findings of the study can be summarized as follows:

(1) The concentrations of PAHs found in surface sediments in Thailand (6-8399 ng/g-dry weight) indicate low to moderate contamination in relation to global levels of PAH contamination.

(2) In many remote coastal areas, low levels (~50 ng/g) of pyrogenic PAHs were detected, and inputs of petrogenic PAHs were identified at several remote locations.

(3) Intensive inputs of petrogenic PAHs were identified in urban aquatic environments, especially in canals in Bangkok, with an average MP/P ratio of 1.84+0.98. Fingerprinting of PAHs and hopanes indicated that street dust is one of the major sources of the petrogenic PAHs. Future efforts should focus on detailed identification of the sources of PAHs in street dusts and surface sediments.

(4) Perylene was abundant in the sediments, accounting for up to 60% of total identified PAHs. This abundance can be explained by active inputs of soil materials due to frequent strong rain in this tropical climatic zone.

(5) PAHs were transported offshore in the upper Gulf of Thailand with a half distance of ~10 km. To gain a comprehensive understanding of pathways of PAH transport in aquatic environments, other molecular markers will be used in future research.

Source: Marine Pollution Bulletin, Vol. 52, September 2006.

Reversal of Protein Expression as a Potential Guide for the Progression of Alzheimer's Disease

Most cases of Alzheimer's disease develop in those aged 65 or over and scientists studying the disease have established that Alzheimer's patients produce abnormally large quantities of both the 42 beta amyloid-β-peptide (Aβ) and the amyloid-β-binding alcohol dehydrogenase (ABAD) which is an intracellular binding site for Aβ. When Aβ and ABAD combine, this triggers a cascade of changes leading to the death of the nerve cell.

The over-expression of Aβ and ABAD in transgenic mice has shown that the binding of Aβ to ABAD results in exaggerating neuronal stress and impairment of learning and memory. From a proteomic analysis of the brains from these animals, researchers have identified that peroxiredoxin II levels increase in Alzheimer's diseased brain. This increase in peroxiredoxin II levels protects neurons against Aβ induced toxicity. Now a new study has demonstrated, for the first time in living animals, that the expression level of peroxiredoxin II is an indicator for the interaction of Aβ and ABAD as its expression levels return to normal if this interaction is perturbed. This indicates the possibility of reversing changes observed in Alzheimer's disease and suggests that the Aβ-ABAD interaction is a suitable drug target.

Source: Molecular and Cellular Neuroscience, Vol. 35, June 2007.

LEVELS OF CONTAMINATION OF TOXIC METALS IN WATER, SEDIMENT, AND CONSUMED FISHERY PRODUCTS FROM A FRESHWATER LAKE IN NORTHERN THAILAND

Water resources are important for human health because they are used as sources of food production and drinking water. The metal contamination in water resources can be caused by both natural and human activities. As the human population requires safe drinking water to maintain a satisfactory quality of life, safe drinking water is the means of decreasing mortality and morbidity rates in developing countries. World Health Organization (WHO) has recommended guidelines for safe drinking water for most metal parameters. Manganese (Mn) is an essential element for humans, and has been the subject of intensive study in the last decade. The Manganese Health Research Program (MHRP) has conducted a number of studies to provide knowledge about manganism. It is known that chronic exposure to a low concentration of Mn may lead to Parkinson like syndrome in the elderly, as well as in welding workers. Exposure to Mn at a toxic dose has the most notable effect on the central nervous system.

Another toxic metal that has serious effects on human health is arsenic (As). WHO reports that there are many countries in the world where contamination of As in drinking water has been detected at concentrations higher than the guideline value, 0.01 mg/L. These countries include Argentina, Australia, Bangladesh, Chile, China, Hungary, India, Mexico, Peru, Thailand, and the United States of America. Countries where adverse health effects have been extensively documented include Bangladesh, China, India (West Bengal), and the United States of America.

In Southeast and East Asia, some studies have been conducted on metal concentrations in the water resources. The Red River Delta in Hanoi, Vietnam, is one of the most productive agricultural areas of Southeast Asia. At present, there are 8 major wells supplying water in the volume of 500,000 m^3 per day.

In China, measurements have been made of metal concentrations from medicinal springs and several potable water sources in the Qinghai province. The main water resource is Qinghai lake, which is used for agricultural purposes and for human consumption. The concentrations of Fe, As, and Ni were found to be high, at a level which can cause adverse health effects if people consume the water on a daily basis.

However, there is little information on metal concentrations in freshwater lakes in Southeast Asia. For example, no study has been made of metal concentrations in Phayao lake, a major water resource in northern Thailand. Thus, the present study was conducted to design a monitoring system to detect the early metal contamination in this natural water resource, since the information obtained will facilitate further health risk assessment.

This study was undertaken to determine levels of contamination of toxic metals in water, sediment, and consumed fishery products from Phayao freshwater lake located in northern Thailand, which is a major water resource for drinking water, agriculture, and household use. Concentrations of Mn, As, and other metals were determined in water, sediment, fish tissues (*Puntius gonionotus*), and pond snails (*Filopaludina martensi*). Sampling was carried out in 3 periods (February, May, and August) in 2005. Metal analysis was performed by using inductively coupled plasma mass spectrometer (ICP-MS). Concentrations of Mn and As in lakewater ranged from 40-382 and 0.68-8.79 µg/L whereas the USEPA Human Health Water Quality Criteria (Mn) and WHO (As) guidelines for drinking water are 50 and 10 µg/L, respectively. Concentrations of some metals (Al, Cr, Mn, and Fe) in water were found to be higher in the area where water flowed into the lake from a small river than in other areas. The highest metal concentrations were found in the period of the dry season (May 2005). Among different sampling sites, the patterns of metal accumulations were different. Estimated fishery product consumption from the lake was calculated and the results indicated that the concentrations of metals in these products were lower than the recommended average daily dietary intake. Therefore, the consumption of fish and pond snail from this water resource may not pose a risk of metal toxicity. However, monitoring of the levels of Mn and As in lakewater should be carried out routinely so that appropriate prevention of contamination from these toxic metals can be implemented.

Source: Journal of Environmental Science and Health, Part A, Vol. 42, January 2007.

AIR POLLUTION, SMOKING, AND PLASMA HOMOCYSTEINE

(Continued from page 4)

independently associated with increased tHcy levels in patients with coronary artery disease, ischemic stroke, and diabetes as well as in the general population. Several mechanisms have been suggested to account for the smoking-related increase in tHcy, including changes in plasma thiol redox status, possibly because of a higher formation of reactive oxygen species; inactivation of the enzymes of homocysteine remethylation, such as methionine synthase; reduced intake of nutrients and vitamins; and lower levels of plasma folate, vitamin B12, and plasma pyridoxal 5-phosphate.

Oxidative stress and endothelial dysfunction, which are enhanced in subjects with hyperhomocysteinemia, have been associated with both cigarette smoking and exposure to air particles. It has been suggested that noncompensated oxidative stress may contribute to the increase in plasma homocysteine concentrations by subtracting from the synthesis of homocysteine methyl group donors that are used to compensate cell oxidative damage. It is possible that the inflammatory status induced by cigarette smoking produces an increased demand for methyl group donors that may be exacerbated by air particle exposure. Thus, smoking may amplify the effects of PM_{10} on homocysteine metabolisms and produce the association that was observed among smokers.

In this study the estimates for the association of PM_{10} levels with increased tHcy among smokers indicate that an interquartile range (IQR) difference in PM_{10} average concentration in the preceding 24 hr is associated with a 6.3% increase in fasting tHcy and a 4.9% increase in PML tHcy. The clinical significance of the PM_{10}-related increases in tHcy in this study is uncertain and should also be interpreted in the light of the results of recent large multicenter clinical trials on homocysteine-lowering treatment that failed to demonstrate a reduction in major cardiovascular events in high-risk subjects with previous acute myocardial infarction or preexisting cardiovascular disease or diabetes. These results may suggest that differences in tHcy such as those observed in the study may represent indicators of increased cardiovascular risk, rather than causal determinants of cardiovascular disease.

The study demonstrated no consistent association of air pollution levels with fasting and PML tHcy when all subjects were considered. However, increased tHcy levels were found in association with higher concentrations of ambient PM_{10} among smokers, suggesting that cigarette smoking and air pollution may interact in increasing plasma tHcy levels in healthy subjects.

Source: Environmental Health Perspectives, Vol. 115, February 2007.

Health Risks from Urban Air Pollution

A recent study has claimed that air pollution in major cities may be more damaging to health than the radiation exposure suffered by survivors of the Chernobyl disaster. The study suggests that the high levels of urban pollution as measured in many of the world's major cities are responsible for a greater reduction in life expectancy than the radiation exposure of the emergency relief workers who were sent into the 19 mile exclusion zone around the Chernobyl site immediately after the accident in 1986, an accident that caused 30 deaths from acute radiation and is estimated to have caused up to 16,000 deaths as the radioactive contamination spread over most of Europe.

However, the new study of health risks from urban air follows a recent report in UK from the Royal Commission on Environmental Pollution stating that air pollution was responsible for 24,000 premature deaths in Britain every year.

Populations still living unofficially in the abandoned lands around Chernobyl may actually have a lower health risk from radiation than they would have if they were exposed to air pollution in a major city, such as nearby Kiev.

The study found that health risks associated with urban air pollution and passive smoking appear more severe than the doses of radiation received by the Chernobyl group. Pollution in central London increases mortality due to heart and lung disease by 2.8% compared with Inverness, Britain's least polluted city, while living with a smoker increases mortality by 1.7%.

The author of the report stated that one reason for comparing everyday risks with those of radiation contamination was the way in which contaminated Chernobyl refugees felt rejected by society. Our understandable fear of radiation needs to be placed in the context of other risks we encounter in our daily lives if we are to properly understand, and respond to, the potential impacts of any future radiation incidents.

Source: BMC Public Health, Vol. 7, April 2007.

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