

## EDITION 6, SUMMER 2010

PAPA Progress is a periodic publication of the Health Effects Institute (HEI) that describes recent accomplishments and current and future activities of the Public Health and Air Pollution in Asia (PAPA) program.

The PAPA Program was initiated by the Health Effects Institute to support the Clean Air Initiative for Asian Cities (CAI-Asia), a partnership of the Asian Development Bank and the World Bank to inform regional decisions about improving air quality in Asia in three major ways:

- Periodically assessing and reviewing science on the effects of exposure to air pollution in Asia;
- Initiating new research in several representative Asian cities; and,
- Developing the scientific and technical capacities of a network of Asian investigators.

The PAPA Program has been supported in part by funds from the US Agency for International Development, the William and Flora Hewlett Foundation, and the Asian Development Bank.

### Members of HEI's PAPA Team:

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## New Studies of Air Pollution and Birth Outcomes in Taiwan and Wuhan, China

*HEI is funding new studies intended to fill knowledge gaps in the regional and global scientific evidence on the relationship between air pollution and birth outcomes.*

Adverse pregnancy outcomes from a variety of causes are of concern worldwide, particularly in Asia, where the burden of disease from these outcomes is the largest. However, the extent to which prenatal exposure to air pollution may affect the health of infants and young children remains unclear, leaving an important gap in the epidemiologic literature on the health effects of air pollution. To date, the majority of studies in this area have been conducted in developed countries, and because most of the Asian studies focus on qualitative measures of exposure, such as proximity to industrial sources of pollution, their results cannot be directly compared with the larger global evidence. To help address this knowledge gap, and with supplemental funding from the William and Flora Hewlett Foundation, HEI's Board of Directors recently approved two studies that will investigate the relationship between ambient air pollution and adverse pregnancy outcomes in Asia.

Zhengmin Qian of the Geisinger Center for Health Research in Danville, Pennsylvania, and his colleagues will evaluate whether air pollutants at levels typically found in the developing countries of Asia are related to increased rates of preterm birth, low birth weight, and intrauterine growth retardation in neonates born in Wuhan, China, in 2009 through 2012. The proposed research, which will be conducted in two phases, will focus on particulate matter  $\leq 2.5$  and  $\leq 10 \mu\text{g}/\text{m}^3$  in aerodynamic diameter (PM<sub>2.5</sub> and PM<sub>10</sub>, respectively), sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>) and carbon monoxide (CO). The first phase will be a cohort study of more than 120,000 women and their infants and will rely on existing data on ambient air pollution, deliveries, and first prenatal care visits. The second phase will look at a subset of cases and controls from the cohort and incorporate data on the influence of additional factors: family income, indoor pollution sources, parental smoking, alcohol consumption, and time-activity patterns. The investigators will assess whether associations between individual pollutants and outcomes are confounded by copollutants and whether they are modified by socioeconomic status and indoor sources of pollution.

In a second study, Yungling Leo Lee of the National Taiwan University and colleagues will assess the effects of air pollution in Taiwan on adverse pregnancy outcomes, including low birth weight, preterm delivery, and specific birth defects. The investigators will conduct a case-control study, using data from the Taiwanese Birth Registry on births from 2001 to 2007. Daily data on SO<sub>2</sub>, nitrogen oxides (NO<sub>2</sub> and NO), O<sub>3</sub>, CO, PM<sub>2.5</sub>, and PM<sub>10</sub> at specific locations and meteorologic data from the Taiwan

Environmental Protection Agency will be integrated with information on the mother's location of residence to estimate monthly average exposure concentrations during the pregnancy. An assessment will also be carried out for whether socioeconomic status modifies the effects of air pollution.

The two studies are part of HEI's PAPA program. They are intended to inform regional decisions on air quality while contributing to the global body of scientific evidence on this issue.

For additional information about these studies, contact Sumi Mehta (+1-617-488-2306; [smehta@healtheffects.org](mailto:smehta@healtheffects.org)).

### Workshop on Expanded Use of PAPA Methods to Be Held at Joint ISES – ISEE Conference

*Chit-Ming Wong, principal investigator of the PAPA time-series study in Hong Kong, and his team seek to encourage new coordinated, time series studies at the joint ISES-ISEE conference to be held in Korea in August.*

HEI's multi-city studies of short-term effects of air pollution on mortality in Bangkok, Hong Kong, Shanghai, and Wuhan were published in the September 2008 issue of [Environmental Health Perspectives](#). These studies are the first coordinated and combined analyses of air pollution and daily mortality in Asia; they were designed and conducted by local investigators and officials in concert with international experts on air pollution and public health.

Investigators developed a common, state-of-the-art time-series protocol, allowing for comparison of the results within Asia and between Asia and other regions (such as North America and Europe) that have a larger body of evidence. The common protocol also facilitated a combined analysis of the data across the studied locations. With only four cities, however, it was not possible to develop a precise estimation of combined effects, or of the shape of the concentration–response function.

Members of the PAPA Hong Kong team are exploring possibilities for expanding this approach to other cities and other health outcomes such as hospital admissions. A half-day workshop will be held with potential collaborators on August 28 prior to the 2010 Joint Conference of International Society of Exposure Science and International Society for Environmental Epidemiology (ISES-ISEE 2010) in Korea.

Strengths and limitations of the existing protocol will be discussed, as well as replication in other cities across

Asia and opportunities for scaling up the protocol (for example, including hospital admissions data or addressing sensitive subpopulations). Chit-Ming Wong of the Hong Kong team will present an overview of the PAPA common protocol, and participants will be invited to share descriptive information on their prospective cities. Researchers from Colombo, Dhaka, Jakarta, Kuala Lumpur, Seoul, Singapore, and Taipei have already expressed interest in participating in the meeting.

For more information about the workshop or the PAPA Protocol for Coordinated Time-Series Studies, contact Chit-Ming Wong ([hmrwcm@hkucc.hku.hk](mailto:hmrwcm@hkucc.hku.hk)) or Sumi Mehta (+1-617-488-2306; [smehta@healtheffects.org](mailto:smehta@healtheffects.org)).

### HEI to Publish Review of Asian Literature on Air Pollution and Health

*HEI has prepared a comprehensive, updated review of the health effects of air pollution in East, South, and Southeast Asia, to be released at the Better Air Quality conference (BAQ 2010) in November.*

In November, HEI will publish a review tentatively titled *Outdoor Air Pollution and Health in the Developing Countries of Asia: A Comprehensive Review*. This benchmark publication for policy makers, stakeholders, and scientists will assess the latest science on air pollution and health from rapidly developing countries in East, South, and Southeast Asia. The findings will be released at BAQ 2010 in Singapore.

The review begins with a broad **overview of status and trends** in air pollution sources, emissions, concentrations, and exposure, as well as factors related to urban development, population health, and public policy. This is followed by an expanded assessment of the Asian literature on the health effects of outdoor air pollution, now comprising more than 400 studies identified through 2007 as part of HEI's Public Health and Air Pollution — Science Access on the Net ([PAPA-SAN](#)).

A **meta-analysis of Asian time-series studies** summarizes results from 82 reports published through August 2007, which is three times as many studies as were available for HEI's earlier review, published in 2004. These results, which now include estimates from the recently completed coordinated multi-city PAPA project, provide the basis for a unique regional estimate of the magnitude of the effects of exposure on daily mortality and hospital admissions and allow more definitive comparisons of Asian evidence with results from other regions.

The review also presents results of the first-ever **critical review of Asian studies of selected chronic effects** of long-term exposure to air pollution. Included are studies of chronic respiratory disease outcomes, lung cancer, and adverse reproductive outcomes.

The review also identifies important knowledge gaps. For instance, the effects of air pollution in major population centers in South and Southeast Asia still have not been quantified, and there is little knowledge about the components of air pollution mixtures from diverse sources in rapidly growing urban areas or about their health effects. To date, there are no cohort studies of the effects of long-term exposure to air pollution on mortality from cardiovascular and respiratory disease in Asian populations.

The need for high-quality research on the health effects of air pollution will only grow as attention increasingly focuses on issues of regional importance, such as climate change and trans-boundary air pollution. This HEI Special Report, and continued funding of a targeted program of research in Asia under the PAPA program, is intended to improve understanding of the problems posed by air pollution in Asia and to help build the capacity of Asian scientists to conduct scientific research towards solutions.

For additional information about the literature review, contact Aaron Cohen (+1-617-488-2325; [acohen@healtheffects.org](mailto:acohen@healtheffects.org)).

## Systematic Search of the Asian Literature Yields Over 100 New Studies!

As part of its commitment to identify the latest science, the PAPA program actively reviews the epidemiologic literature on the health effects of air pollution in Asia. A systematic search was recently conducted in PubMed, Web of Science, and EMBASE to identify relevant new studies.

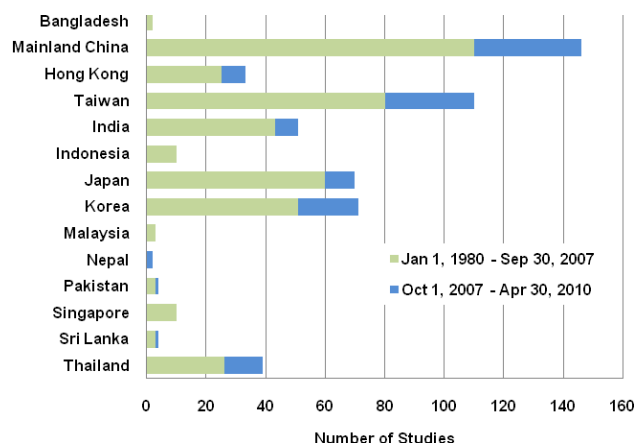
[PAPA-SAN](#) (Public Health and Air Pollution — Science Access on the Net) is a signature product of the PAPA program created to help facilitate research on the effects of air pollution in Asia and provide a resource for informed decision-making about population health and air pollution. The online version of PAPA-SAN currently includes peer-reviewed reports published since 1980 and identified through September 2007. For each report, the Web site provides key data, a brief summary of findings, and (when available) a live link to the abstract. Results are presented according to country or region, study design, type of pollutant, and health outcome.

Over 500 studies on the health effects of air pollution in Asia have now been identified by the PAPA program

through systematic searches of the epidemiologic literature. Over 100 relevant studies published between October 1, 2007 and April 30, 2010 were found in a new search of this literature. As before, the majority of studies estimated effects of exposure to particulate matter and/or gaseous pollutants, with a few new studies on volatile organic compounds (8) and traffic exposure (13). Most of the studies looked at short-term effects of exposure using such measures as daily mortality (44) and/or hospital admissions, visits, and discharges (34). Some studies also explored effects on birth outcomes (7), cardiovascular outcomes (18), and biomarkers of exposure (10).

The bulk of studies were conducted in China and Japan (nearly 80%), with fewer studies identified from South Asia (12). Two global assessments of the health effects of air pollution focused on intercontinental sources of pollution within East Asia and South Asia. In this new search, no studies were identified for Bangladesh, Cambodia, Indonesia, Laos, Malaysia, Mongolia, or Singapore — all of which remain underrepresented in the literature on air pollution and health effects.

Studies Identified by Location in Searches of the Literature  
Jan. 1, 1980–Apr. 30, 2010



The results from the latest search are being compiled for addition to the PAPA-SAN Web site. We expect that PAPA-SAN will continue to be a unique resource for scientists, policy makers, international lending organizations, and other stakeholders seeking access to the latest air pollution research from across the region.

For access to PAPA-SAN, visit [www.healtheffects.org/Asia/papasan-home.htm](http://www.healtheffects.org/Asia/papasan-home.htm). For additional information about the most recent search, contact Tiffany North (+1-617-488-2309; [tnorth@healtheffects.org](mailto:tnorth@healtheffects.org)).

## PAPA Results Inform Beijing Workshop on Air Quality Standards, Climate

*The latest HEI research in China and Asia was presented in Beijing at a workshop organized by the U.S. Environmental Protection Agency (EPA) with the Chinese Ministry of Environmental Protection (MEP) as part of a series on Regional Air Quality Management (RAQM).*

In May 2010, at the invitation of the EPA and the China Energy Foundation, HEI President Daniel Greenbaum presented the latest PAPA results at a three-day workshop in Beijing on “PM<sub>2.5</sub> and Ozone Air Quality Standards Development and Implementation and Co-benefits of Integrating Air Quality Management and Climate Change.”

The meeting was organized by the EPA and the MEP as part of a series of RAQM meetings in which Greenbaum and HEI Vice President Robert O’Keefe have participated to help China further develop its air quality standards and enhance its air quality management system.

To help inform those decisions, Greenbaum presented the latest HEI research in China and Asia — most notably the PAPA studies in Shanghai, Wuhan, and Hong Kong — and described how those data might be used to estimate the relationship between health effects at different levels of pollution and health effects and how to analyze the results to set new ambient air quality standards.

The meeting also focused on the nexus of air quality and climate and on potential “win-win” actions that address climate and conventional air pollutants. HEI’s worldwide work on improved technologies for diesel engines offered an example of how cleaner technologies could simultaneously benefit health and limit the effects of short-lived pollutants, such as black carbon, on climate.

## Capitol Hill Forum on Climate Change, Air Quality, and Health

*Findings from the PAPA program were featured in two forums of the Woodrow Wilson International Center for Scholars in Washington, D.C.*

Findings from HEI’s PAPA program were featured in two forums held in Washington, D.C. in May 2009, and organized by the congressionally chartered Woodrow Wilson International Center for Scholars. The two seminars, developed in partnership with HEI, focused on the global relevance of local air pollution problems in China and, in particular, the complex intersection of climate change, air quality, and human health concerns.

At the first seminar, work on these challenging issues was presented by a panel of experts, including HEI Vice President Robert O’Keefe, before a group of congressional staff members gathered in the U.S. House of Representatives’ Rayburn Building. Drawing on the PAPA program and other research, O’Keefe discussed the linkage between strategies to improve air quality and steps to mitigate climate change. He and others on the panel outlined possible opportunities to simultaneously reduce local air pollution levels and global warming effects.

O’Keefe stressed that the potential local health and other benefits of carefully integrated actions could provide important incentives for greenhouse gas reductions in developing countries. He also noted that achieving such benefits, however, and understanding the complex tradeoffs that can also be involved, requires continued close attention.

This panel presentation was hosted by the Wilson Center’s Scholars on the Hill program, which is dedicated to educating members of Congress, their aides, and other Capitol Hill staff about current issues related to international trade and security, sustainable development, and globalization.

HEI’s work in China was featured in a separate session on the same day, this one hosted by the Wilson Center’s China Environment Forum, which invites specialists from government, academia, the business community, and others interested in China to explore the implications of environmental conditions for the country’s development and global relations.

The session included HEI’s overview of the latest science on the health burden caused by air pollution in China; a presentation by Junfeng (Jim) Zhang of the University of Southern California, the principal investigator of an innovative HEI study to understand the health impacts associated with measures taken to reduce air pollution during the 2008 Beijing Olympic Games; and a presentation by Denise Mauzerall of Princeton University of her work on the interconnection among air pollution, climate change, and health in a Sino–U.S. context.

Interest in high-quality science investigating the effects of air pollution on health in China is burgeoning, given the country’s air quality challenges and the global implications of the choices China will make to meet its future energy and transportation needs. International scientific cooperation has been an important factor in building local capacity for environmental health research in China.

## HEI Traffic Literature Review, Beijing Olympics Study Featured in India

*HEI's latest review of the health impacts of exposure to traffic-related air pollution and preliminary results from its study of air pollution-mitigation measures taken during the Beijing Olympic Games were presented at two key meetings in India in May.*

In Chandigarh, a city in northern India, industry representatives and state and federal transport officials gathered in May for the annual Society for Automobile Fitness and Environment (SAFE) convention. Participants discussed a range of transport, traffic safety, and other vehicle stewardship issues. HEI President Daniel Greenbaum opened the technical meeting with an overview of HEI-sponsored studies and other work on issues such as emissions, noise, and stress.

The talk drew heavily from HEI's newly released study of the health effects associated with exposure to traffic-related air pollutants. The review, recently featured in the [New York Times](#), assessed more than 700 studies of exposure and toxicologic and epidemiologic studies of traffic-related pollution and human health. Among its key findings were the identification of a 300- to 500-meter zone of contribution for primary exposure to many traffic-related air pollutants, a potential for a large percentage of residents to be exposed, and a causal association between exacerbations of asthma in children and exposure to traffic-related air pollution.

In Delhi, initial and final results from HEI's work on the Beijing and Atlanta Olympic Games, respectively, were presented at a large workshop organized by the Centre for Science and the Environment (CSE). The workshop addressed the adequacy of air pollution-mitigation measures planned in preparation for the 2010 Commonwealth Games, which will be held in Delhi in October. The meeting drew leaders from environmental agencies, nongovernmental organizations, and academia.

Greenbaum and HEI Vice President Robert O'Keefe opened the workshop with presentations of HEI's studies of air pollution and daily mortality in Delhi (led by principal investigator Uma Rajarathnam) and Chennai (principal investigator Kalpana Balakrishnan).<sup>1</sup> This was followed by a comprehensive overview of mitigation measures taken in China ahead of the 2008 Games and a companion study of health effects by principal investigator Junfeng (Jim) Zhang from the University of Southern California and his team of

<sup>1</sup> Uma Rajarathnam is the principal investigator of *Time-Series Study on Air Pollution and Mortality in Delhi*. Kalpana Balakrishnan is the principal investigator of *Short-term Effects of Air Pollution on Mortality: Results from a Time-Series Analysis in Chennai, India*.

collaborators.

The presentations sparked active discussions of potential effects of pollution prior to and during the Games on the health of athletes and on local residents. Participants also compared the merits of pollution-reduction measures that can be taken leading up to the Games, and in some cases retained permanently. (See press coverage by the [Hindustan Times](#).)

## HEI Receives Hewlett Foundation Grant

*The William and Flora Hewlett Foundation has provided new funds to HEI. This supplemental funding will be a key source of support for policy-relevant science on air pollution in Latin America and Asia.*

HEI is pleased to announce that it has received a new grant of \$500,000 from the William and Flora Hewlett Foundation. The funding, to be provided over two years, supports science on the health effects of air pollution in the developing countries of Asia and Latin America.

"This grant is a gratifying signal of the foundation's continuing support for our important work in parts of the world where pollution remains high and large portions of the population are exposed, even as new challenges posed by the intersection of air pollution, health, and climate are emerging," said HEI Vice President Robert O'Keefe.

The Hewlett grant will help HEI leverage funds from other sources to support its Public Health and Air Pollution in Asia (PAPA) program and related international activities (in Latin America and other locations), which includes:

- increasing the institute's ability to identify new research opportunities and investigator teams to inform decisions in the United States and Europe;
- providing high-quality, independent science to inform policy decisions by stakeholders in developing countries; and
- carrying out research in a manner that promotes capacity building, policy relevance, and the use of advanced techniques by local investigators.

The supplemental funding will be instrumental in supporting HEI's continuing effort to provide quality science to inform international air quality decisions.

*For complete information about PAPA, PAPA-SAN, and HEI's international activities, visit [www.healtheffects.org/international.htm](http://www.healtheffects.org/international.htm). For information about HEI funding and the PAPA program, contact Bob O'Keefe (+1-617-488-2334; [rokeefe@healtheffects.org](mailto:rokeefe@healtheffects.org)).*

## PAPA Pranaam to Kalpana Balakrishnan for New M.P.H. Program in India

*Pranaam (प्रणाम) is a Hindi word meaning "salutation." In this and upcoming issues of PAPA Progress, we will highlight key individuals who have made important contributions to the PAPA program.*

The PAPA program congratulates Kalpana Balakrishnan, professor at Sri Ramachandra University (SRU), on her instrumental role in launching a Master of Public Health (M.P.H.) program in Occupational and Environmental Health (OEH) in Chennai, India. Balakrishnan (shown to the left) is best known within the HEI community as principal investigator for the PAPA time-series study in Chennai.



Kalpana Balakrishnan and HEI Vice President Robert O'Keefe at the 2008 HEI Annual Conference

The two-year, four-semester program at SRU is the first of its kind in India; the degree will be offered through the Department of Environmental Health Engineering of SRU in collaboration with the School of Public Health at the University of California at Berkeley (UC Berkeley). The newly created program, which emerged from collaboration between the universities, with Balakrishnan contributing leadership and guidance, aims to help build capacity for research and training in OEH in India.

SRU's M.P.H. program is of critical importance, given the small number of Indian professionals and researchers with advanced training in OEH and in light of India's complex public health challenges. As a rapidly developing country with more than 1.1 billion people (one-sixth of the world's population), India needs highly trained professionals who can assist academic institutions, government, and industry in protecting public and environmental health.

According to Balakrishnan, the program will train its students in the recognition, prevention, and management of OEH risks. It will focus on building their research and analytical skills through laboratory- and field-based methods, preparing them to design and conduct sophisticated, multidisciplinary research studies.

In addition, Balakrishnan and other SRU faculty members will continue to collaborate extensively in the areas of air pollution epidemiology, exposure assessment, and occupational medicine, with further

expansion in industrial hygiene and safety. Already, SRU has formed more than 50 national and international partnerships for the development of a broad research and academic program designed to fill critical gaps in this discipline.

Several experts in OEH, including collaborators on this initiative, have commented favorably on the program. At its launch, Kirk R. Smith, professor of global environmental health, UC Berkeley, spoke of the program's potential to greatly enlarge the number of professionals in India who are involved in improving lives and contributing to better OEH outcomes, while also advancing the fields of occupational and environmental health.

Balakrishnan is head of the Department of Environmental Health Engineering at SRU and a recognized international expert in environmental health. She completed a doctoral degree in biophysics at Johns Hopkins University and post-doctoral training in environmental health engineering. Her fields of specialization include occupational and environmental health risk assessment, exposure assessment, industrial hygiene, and industrial toxicology. She serves in multiple technical capacities for such respected organizations as the World Health Organization, the World Bank, the Indian Council for Medical Research, and the Tamil Nadu State Pollution Control Board.

## Announcement of Upcoming Meetings

**Joint ISES-ISEE Conference (August 28–September 1, 2010):** The conference of the International Society of Exposure Science and International Society for Environmental Epidemiology (ISES-ISEE 2010) will be held in Seoul, South Korea, from August 28 to September 1 at the COEX Convention Center. The theme "Technology, Environmental Sustainability, and Health" reflects a broad range of interrelated focus areas including environmental health issues, development of exposure techniques, and new epidemiologic approaches. The conference will include plenary sessions with leading international speakers and several hundred oral presentations, posters, and thematic symposia in the fields of environment and health. ISES-ISEE 2010 is organized by the Korean Society of Environmental Health and Toxicology and the National Institute of Environmental Research, Korea. For more information about ISES-ISEE 2010, visit [www.isesisee2010.org](http://www.isesisee2010.org).

**Better Air Quality Conference (November 9–11, 2010):** The Better Air Quality conference (BAQ 2010), "Air Quality in a Changing Climate" will be held from

November 9 to 11 at the Suntec Singapore International Convention & Exhibition Centre. The theme reflects three key developments: the growing relevance of climate change for air quality management; the rapid urbanization in Asia, which requires a total shift in city planning; and the changing role of development agencies. BAQ is the largest regional gathering of policy makers and stakeholders

on air quality in Asia, covering transport, energy, industry, and climate change, with a particular emphasis on government policies and regulatory measures. BAQ 2010 is organized by the Clean Air Initiative for Asian Cities (CAI-ASIA) in partnership with the National Environmental Agency of Singapore and the Asian Development Bank, among others. For more information about BAQ 2010, visit [www.baq2010.org](http://www.baq2010.org).

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The Health Effects Institute (HEI) is an independent nonprofit research institute established in 1980 to provide scientists, public and private decision makers, and the public with high-quality, impartial, and relevant scientific information on the health effects of air pollution. Over the years, HEI has funded a comprehensive body of new research, scientific reviews, and reanalyses that were designed to be directly relevant to decisions made in the US and in key international regulatory forums. HEI has sponsored research in the Americas, Asia, and Europe.



The Clean Air Initiative for Asian Cities (CAI-Asia) promotes better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors. It was established in 2001 by ADB, the World Bank and USAID as part of a global initiative that also includes Latin America and Sub-Saharan Africa.  
[www.cleanairinitiative.org](http://www.cleanairinitiative.org)