

PAPA Progress

Public Health and Air Pollution in Asia

HEI



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PAPA Progress is a periodic publication of the Health Effects Institute 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 is supported in part by funds from the US Agency for International Development and the William and Flora Hewlett Foundation.

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THIS ISSUE

**Key Results from First Four PAPA Time-Series Studies
Major New Study Using PAPA Methods to Begin in China
HEI Assesses Air Pollution, Poverty, and Health in Ho Chi Minh City
HEI Science Informs Bangkok Air Quality Conference
Expanded and Updated HEI Asia Literature Review
PAPA Pranaam (प्रणाम)**

Key Results from First Four PAPA Time-Series Studies Published in *EHP*

Environmental Health Perspectives (EHP) recently published key results from Asia's first ever coordinated time-series studies of ambient air pollution in Bangkok, Hong Kong, Shanghai, and Wuhan (*EHP* vol. 116, no. 9, 2008). Results suggest that the effect of small particles from combustion and other sources (also known as PM_{10} or particulate matter $\leq 10\mu m$ in aerodynamic diameter) on daily mortality remains consistent even at the high levels seen in Asia (concentrations over $100 \mu g / m^3$). The articles in this issue of *EHP* have been reprinted as *HEI Communication 13*.

The results of the first four HEI-funded studies of the PAPA program, along with an accompanying editorial outlining their importance for policymakers and other stakeholders, were published in the September 2008 issue of *EHP*. This issue includes a combined analysis of data from Bangkok, Hong Kong, Shanghai, and Wuhan, as well as individual results for the four cities. The influence of weather and social class were also explored as regionally relevant factors that modify the health impact of environmental exposure to air pollution.

The combined analysis (Wong et al. (2008)) in *EHP* presents the estimated risk of premature death associated with increasing levels of particulate pollution (i.e. concentration-response relationship) in all four cities. Individual and combined risk estimates for exposure to PM_{10} , nitrogen dioxide, sulfur dioxide, and ozone are also provided and compared to estimates from studies conducted in Western industrial nations. Consistent with previous research, these results suggest that short-term exposures to polluted air impact daily mortality rates in major cities in developing Asia, and that neither genetic factors nor longer-term exposure to high pollutant concentrations appear to substantially modify the observed relationship.

These studies are the first coordinated, multi-city analyses of the short-term effects of air pollution on daily mortality in Asia, a region experiencing rapid development. They provide enhanced epidemiologic evidence of the effects of short-term exposure by:

- expanding the base of high-quality studies of daily mortality in Asian cities;
- examining whether observed risks are similar to, greater than, or smaller than those in other regions;

- evaluating whether the appropriate health outcomes (e.g., infant mortality) are addressed;
- exploring factors that could explain observed differences within and across regions; and
- increasing confidence in the strength of the results by using a common protocol for study design and data analysis in the four studies.

Similarities in the results observed in these studies and results in similar studies conducted in the developed world increase confidence in the ability of Asian nations to rely on this literature in regional decision making. These articles, as well as the combined analysis and accompanying editorial, have been reprinted as *HEI Communication 13*. Detailed studies for each of the individual sites, Bangkok, Hong Kong, Shanghai and Wuhan, and related HEI commentaries will be published by HEI this spring.

To download *Communication 13*, or get more information about the PAPA time-series studies, visit www.healtheffects.org. The *EHP* publication (*EHP* vol. 116, no. 9, 2008) can also be accessed at <http://www.ehponline.org/>.

Major New Study Using PAPA Methods to Begin in China

The PAPA Protocol for Coordinated Time-Series Studies will be used in a new study of mainland China. Other opportunities for the expansion of the PAPA protocol are currently being explored in Malaysia, Indonesia, Thailand, Sri Lanka, Pakistan, and India.

Dr. Haidong Kan, principal investigator of the PAPA time-series study in Shanghai, along with Dr. Bingheng Chen, member of HEI's International Scientific Oversight Committee, have received funding from the China Ministry of Environmental Protection to conduct a new coordinated, multi-city, time-series study of nine cities in Eastern mainland China: Fuzhou, Guilin, Guanzhou, Hangzhou, Taiyuan, Tianjin, Shanghai, Shenyang, and Xi'an.

The China Air Pollution and Health Effects Study (CAPES) plans to build on the methods developed for the PAPA coordinated analysis used to assess daily air pollution levels

in relation to mortality and morbidity. As mortality registry data has only recently become available in many Chinese cities, CAPES will involve the



Nine Cities in the CAPES Study

analysis of data from 2005 through 2008, with some exceptions. (In Shanghai, the data for daily mortality with regard to air pollution will be analyzed for 2001 through 2008.)

The PAPA “protocol”, a common approach developed in March 2006 to enable time-series analyses across multiple cities, has been used in PAPA studies in Bangkok, Hong Kong, Shanghai, and Wuhan (see *HEI Communication 13*). The goal of the coordinated analysis for these studies and future studies, as stated in the PAPA protocol, is to assess daily air pollution levels in relation to mortality and morbidity data. The use of this common protocol further enables the comparison of results across Asian cities and provides definitive, locally derived estimates to assist policy makers in rapidly developing cities of Asia.

Dr. Chit-Ming Wong, principal investigator of the PAPA time-series study in Hong Kong, is currently leading efforts to explore other opportunities to use the PAPA protocol in other Asian cities. Some of the potential countries include Malaysia, Indonesia, Thailand, Sri Lanka, Pakistan, and India.

For additional information about the PAPA Protocol for Coordinated Time-Series Studies, contact Tiffany North (+1-617-488-2309; tnorth@healtheffects.org.)

HEI Assesses Air Pollution, Poverty, and Health in Ho Chi Minh City

In cooperation with an initiative of the Asian Development Bank, an interdisciplinary team of local and international experts is conducting a unique program to assess the complex interactions among air pollution, poverty, and health in Ho Chi Minh City (HCMC), Viet Nam.

The PAPA program is committed to exploring various ways to understand the relationship among air pollution, poverty, and health in



Traffic in Ho Chi Minh City

Asian cities. With extensive numbers of the world's poor living in highly polluted areas of Asia's cities, increased effects of air pollution on the health of these populations

have significant public health impacts and highly relevant policy implications.

An interdisciplinary team of local and international experts, in cooperation with an initiative of the Asian Development Bank, is conducting a unique program to assess the health effects of air pollution in HCMC. The project is led by a team from the HCMC Department of Health (DOH) and HCMC Environmental Protection Agency (HEPA) along with scientists from the PAPA program. As Nao Ikemoto, an environment specialist at the Asian Development Bank, notes, "We expect that this project will help guide Viet Nam policy makers at the local HCMC and national level as they make decisions about mass transportation and other measures designed to improve air quality."

The HCMC project has two complementary components—a hospital-based study and a household-based study.

- The hospital study estimates the effect of short-term exposure to air pollution on hospital admissions for acute lower respiratory infections in young children (< 5 years of age) and compares the magnitude of the effect of air pollution on children in various socioeconomic groups.
- The household study assesses determinants of personal exposure for the poor and non-poor and explores whether the use of ambient monitors are adequate for assessing differences in exposure among people of varying socioeconomic status.

This study is the first-ever collaborative investi-

gation of air pollution and health in Viet Nam and also the first to focus on the association between air pollution and a major childhood illness. As such, the project involves applied training in many epidemiologic methods and exposure-assessment techniques for assessing population-level and individual air pollution exposures. "The project has extended HEPA's technical capacity to include measurement of personal exposures to particulate matter and nitrogen oxides [alongside] current fixed monitoring sites" said Nguyen Dinh Tuan, director of HEPA. Furthermore, the formal cooperation between the DOH and HEPA in implementing the study has led to a consensus between the departments that further collaborative research on the health effects of air pollution in HCMC is necessary.

Policy relevance and awareness-raising are important components of the study. Because one



Personal Exposure Monitoring in Ho Chi Minh City

long-term goal of the study is to enable similar studies in other Asian cities, opportunities to involve and inform interested stakeholders from other countries in the region are encouraged and welcomed. "The levels of both air pollution and the extent of poverty in HCMC are somewhat lower than those typically found in many Asian cities," says Dr. Truong Giang, vice director of the DOH. With a focus on developing methods through applied research, work undertaken in HCMC can be expected to serve as a model to guide future studies in other Asian cities.

Initial briefings of regional decision makers about the study were held in Vietnam in spring 2008, at the Asian Development Bank's annual Poverty Environment Program meeting in June 2008, and at the largest conference of Asian air pollution stakeholders—the Clean Air Initiative's Better Air Quality Conference—in November 2008 in Bangkok; final results will be presented this fall. Draft final reports for the

hospital and household components of the study are currently in preparation and will be submitted to the HEI Review Committee later this year.

For additional information about the Ho Chi Minh City Study, contact Sumi Mehta (+1-617-488-2306; smehta@healtheffects.org.)

HEI Science Informs Better Air Quality (BAQ) Conference in Bangkok

Members of the HEI-PAPA program presented a broad range of new science on the health effects of air pollution at BAQ 2008. BAQ is hosted biennially by the Clean Air Initiative for Asian Cities (CAI-Asia) in efforts to bring together a growing number of policymakers and stakeholders to discuss how to improve air quality management in Asian cities.

The PAPA program served as a major source of independent information on the health effects of air pollution in Asian cities at the November 2008 BAQ conference in Bangkok, Thailand.

The BAQ conference, which is hosted biennially by the CAI-Asia, is the largest air quality



BAQ 2008 Plenary Speakers

management event in Asia. With a theme of "Air Quality and Climate Change: Scaling-up Win-Win Solutions for Asia," the meeting attracted over 900 participants from more than 43 countries, including representatives from governments, non-governmental organizations, the private sector, academia, and intergovernmental agencies.

HEI scientists and HEI-funded Asian investigators made active contributions to the BAQ meeting by chairing and speaking in numerous technical sessions, including:

- An opening plenary presentation highlighting key preliminary results from HEI's upcoming Special Report, *Outdoor Air Pollution and Health in the Developing Countries of Asia: A*

Review and Research Needs Assessment.

- A comprehensive session on the Asian literature review, addressing trends in air quality sources, emissions and exposures across Asia—including the latest evidence on the health effects of air pollution in Asian cities, policy implications, and research needs.
- A session featuring an overview of both Dr. Junfeng (Jim) Zhang's study on molecular and physiological responses to ambient pollution during and after the Beijing Olympics and the investigation of air pollution, poverty, and health in Ho Chi Minh City.
- A workshop titled "Quantifying the Health Effects of Air Pollution in Asia," where PAPA-funded investigators highlighted key scientific contributions of their studies and discussed opportunities for expanding the PAPA coordinated analysis.
- An informative session on integrated assessments of health impacts and climate risks of air pollution that included talks on ambient air quality standards in Europe and Asia, estimated health impacts in urban cities in 2000 and 2030, and the revised ambient air quality standards in India.

To download conference presentations and access more information about BAQ 2008, visit www.baq2008.org/program.

Coming Soon! Expanded and Updated HEI Asia Literature Review

HEI has prepared a comprehensive and updated review of the health effects of air pollution in Asia that focuses on the rapidly developing countries of East, South, and Southeast Asia.

Later this year, HEI will publish *Outdoor Air Pollution and Health in the Developing Countries of Asia: a Review and Research Needs Assessment*, a comprehensive review of the health effects of air pollution in Asia with a focus on rapidly developing countries in East, South, and Southeast Asia.

This new review, a key resource for policy makers, scientists, and stakeholders, significantly extends HEI's initial review, published in 2004—Special Report 15, *Health*

Effects of Outdoor Air Pollution in Developing Countries of Asia: a Literature Review. Special Report 15 provides the first-ever review of the evidence from the peer-reviewed Asian literature on the health effects of air pollution, a literature that comprised over 100 studies in 9 countries at the time of investigation.



Figure 1: Studies on Health Effects of Air Pollution in Asia (1982-2008)

On the basis of gaps in understanding identified in the 2004 assessment, the PAPA program initiated and has recently completed a coordinated set of studies of air pollution and daily mortality in selected Asian cities. Since 2004, the published literature has increased fourfold and includes the results of the new HEI studies (Figure 1).

The new review will provide an expanded assessment of the Asian literature on the health effects of outdoor air pollution. It begins with a broad overview of status and trends in air pollution sources, emissions, and concentrations and exposures, as well as factors related to urban development, population health, and public policy that set the context for the health effects of air pollution. Local examples are highlighted throughout to illustrate the underlying diversity among countries.

The review describes the remarkable growth of the current Asian literature on the health effects of air pollution: enumerating and classifying the more than 400 studies identified through 2007 in the PAPA-Science Alert Network (PAPA-SAN), HEI's web-based survey of the Asian literature on public health and air

pollution. The heart of the review consists of two critical, quantitative reviews, or meta-analyses, of Asian epidemiologic studies:

- **An updated analysis of 82 Asian time-series studies.** These studies estimate the effect of short-term exposure to air pollution on daily mortality and hospital admissions for cardiovascular and respiratory disease. Substantially more studies are included in the updated analysis than were in HEI's 2004 analysis, extending the scope and the overall confidence in the results.
- **A first-ever comprehensive meta-analysis of Asian studies of long-term exposure to air pollution and chronic respiratory disease, lung cancer, and adverse reproductive outcomes.** Studies of long-term effects are especially important to policy makers in assessing the full public health implications and cost of air pollution's impact on populations.

These analyses provide quantitative numeric and graphic summaries by country, health outcome, air pollutant, and other features. The review concludes with a critical evaluation of Asian health-effects studies in the context of the worldwide literature, identifies gaps in knowledge, and recommends approaches to address them.

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

PAPA Pranaam

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 is committed to developing the scientific and technical capacities of our collaborators. This effort includes providing active guidance—from the PAPA program's International Scientific Oversight Committee—organizing workshops involving leading international researchers, and providing technical assistance in epidemiologic methods

and state-of-the-art statistical techniques.

The PAPA program is extremely grateful to Dr. Bart Ostro for his leadership and commitment to developing the technical capacity of our Asian colleagues throughout the research process. Dr. Ostro, a senior co-investigator on the PAPA Bangkok study on air pollution and mortality, played a key role throughout the entire project, guiding the development of the PAPA coordinated analysis protocol, providing training in PAPA time-series workshops, and providing technical assistance.

Uma Rajarathnam, the principal investigator of the PAPA Delhi Study, noted that “Dr. Ostro proved to be an excellent resource” and that she had previously used Dr. Ostro’s research publications as important reference materials, particularly his earlier publication of a dose response curve for particulate matter. For Dr. Rajarathnam, Dr. Ostro’s comprehensive workshops on time-series analysis and related software packages during the course of the PAPA project in Delhi enabled her investigative team to thoroughly assess the short-term effects of air pollution exposure on mortality.

Ostro has devoted nearly his entire career to air pollution research and regulation and is currently the Chief of the Air Pollution Epidemiology Unit in the Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency. His primary responsibilities are to formulate the Agency’s recommendations for state ambient air quality standards and to investigate the health effects of criteria air pollutants.



Dr. Bart Ostro

His studies have extended scientific knowledge about the health effects of air pollution and have played a prominent role in the development of local, national, and international air quality standards. He co-authored the regulatory impact analysis of the U.S. Environmental Protection Agency that formed the basis for the ban of lead in gasoline in the United States. His model for estimating the health and economic effects of air pollution control, developed for the World Bank and the World Health Organization, has been used extensively throughout the developing world.

As a result of his work, he has been honored with Special Achievement Awards from the U.S. EPA and the California Air Resources Board and with a Rockefeller Foundation Fellowship. In 2005, he was given the American Lung Association of California’s Clean Air Award, presented to the individual who “has made the most significant contribution to the cause of cleaner air in California.”

Dr. Nuntavarn Vichit-Vadakan, the principal investigator of the PAPA Bangkok study, applauded Ostro’s personal style as well as his technical expertise: “He not only provided significant technical inputs, but he extended his time and effort in getting to know us as people. We started the project as individual researchers but came out as friends and that is truly the best achievement for PAPA.”

Dr. Frank Speizer, Chair of PAPA’s International Scientific Oversight Committee, recognized Ostro’s unique contribution to the success of the project: “Dr. Ostro’s willingness to engage fully and provide active, on-the-ground leadership was indispensable to the success of the project.” The PAPA program and HEI thank Dr. Ostro for his invaluable contributions to our field.

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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.



CAI-Asia demonstrates and promotes innovative ways to improve the air quality of Asian cities by promoting private–public partnerships and shared expertise. The program’s goals include (1) sharing technical knowledge and institutional experiences on air quality management; (2) improving policy and regulatory frameworks at regional levels; (3) piloting projects to encourage innovation; and (4) assisting cities in implementing integrated air quality strategies in cost-effective ways. CAI partners and participants foster actions to improve air quality in cities by bringing together a range of crosscutting expertise in urban development, transport, energy reform, environmental management, and environmental health. www.cleanairnet.org/caiasia