HEI update
HEALTH EFFECTS INSTITUTE

The conference will be held in Boston's Seaport District.

New HEI Accountability Studies Underway Soon

For almost two decades, HEI has played a leadership role in accountability research to assess whether actions to improve air quality have been effective in improving public health. The Institute is now embarking on a third wave of studies, solicited in December 2018 under request for applications (RFA) 18-1, "Assessing Improved Air Quality and Health from National, Regional, and Local Air Quality Actions."

Studies Apply Novel Approaches to Improve Exposure Assessment

There are many challenges in conducting epidemiological studies of long-term exposure to air pollutants given that concentrations vary so widely over space and time. One difficulty is how to accurately determine the exposures of individuals to air pollution. Another is how to quantify the influence of errors in measuring exposure on health-risk estimates.

Tackling such challenges are five new studies funded under HEI request for applications 19-1, "Applying Novel Approaches to Improve Long-Term Exposure Assessment of Outdoor Air Pollution for Health Studies":

Sign Up Now for HEI's 2020 Annual Conference

Join us in Boston, our home city, on April 5–7 when we host the 2020 HEI Annual Conference marking four decades of high-quality, impartial science. Each spring this event highlights the latest research on air pollution and health and brings together investigators, institute sponsors, and policymakers for dialogue and information sharing. Our upcoming program at the Boston Renaissance Waterfront Hotel — in the heart of Boston's innovative Seaport District — includes the following sessions:

The Big Deal About Big Data, Causal Inference, and Accountability Research

Accountability research, or evaluating the effectiveness of interventions to improve air quality and public health, remains a topic of high interest. Although there have been some successes, showing effectiveness — particularly at increasingly lower air pollution levels — is challenging. This session will take stock of recent progress across the globe, including novel statistical approaches and big data; discuss the importance of accountability evidence for the causality debate; and explore what approaches are needed for future research.

Brain Health and Air Pollution

Globally, neurological disorders represent the second leading cause of death. While increasing evidence has emerged reporting an association between air pollution exposure and brain health throughout the life course, important research gaps remain. This session provides an overview of the relationship between air pollution and neurological effects in childhood and adolescence, and neurodegenerative disease in adulthood, as well as the physiological impacts on the brain that have been observed using recent neuroimaging techniques.

Inequalities of Air Pollution Exposures and Associated Health Effects in the U.S.

A growing body of research has examined inequitable distribution of air pollution exposure across racial and socioeconomic groups in the United States.

Also in This Issue

These four new studies are summarized below.

National School Bus Retrofit Lottery Program

Sara Adar of the University of Michigan will study the National Clean Diesel Rebate Program, a lottery program that allocates available funding to school districts across the United States to replace or retrofit old-technology diesel-powered school buses. Adar and colleagues will compare student health and educational performance in districts with and without such funding.

The investigators plan to analyze student attendance rates and emergency department visits for respiratory causes in the school-aged Medicaid population, as well as standardized test scores for math and English among children in grades 3 through 8. Approximately 400 districts with 1.5 million students that received funding will be compared with about 2,700 districts that were not selected in the lottery since the program began in 2012.

This would be the first study to assess the effectiveness of this national rebate program on the health or educational attainment of students and potentially add evidence on the health benefits of clean-air technologies used in school buses.

Curbing Transportation Emissions in Texas

A second accountability study in the United States will be led by **Perry Hystad** of Oregon State University. His team plans to assess effects of emission-control measures on birth outcomes associated with traffic-related air pollution in Texas. Hystad and colleagues will evaluate air quality changes associated with national motor vehicle emissions regulations, as well as a diverse array of local congestion reduction programs implemented in Texas over the past 25 years.

The investigators plan to use a combination of economics and epidemiology approaches to analyze existing data from a population-based cohort of 7.6 million births in Texas from 1996–2016. Texas provides an interesting test case, because during that period, about 1.7 million pregnant mothers lived within 500 meters of a Texas highway or expressway, while NO_2 concentrations (a marker of traffic-related air pollution) were reduced by more than 50%.

Evaluating Air Quality Policies in China

Two of the new accountability studies are looking at air quality actions in China. In the first China-based study, **Patrick Kinney** of Boston University and Chinese colleagues plan to evaluate the major national regulatory policies the country implemented from 2008–2018. They will focus on regulations in particular regions that target specific sources, such as coal combustion, and how they have reduced ambient concentrations of fine particles (and their components). They plan to analyze trends in mortality using data from two nationwide cohorts of Chinese adults maintained by the China Center for Disease Control, employing two complementary approaches: chemical transport models and empirical source apportionment analyses.

In the second study, "How Do Household Energy Interventions Work?" **Sam Harper** and **Jill Baumgartner**, both at McGill University in Canada, and their colleagues will focus on a coal ban and heat pump subsidy program in the Beijing region. They are building on an existing panel study that is following about 966 people who live in 50 villages around Beijing. Half the villages are subject to the policy, the other half are not.

The investigators will collect air quality measurements in all villages during the heating seasons and collect personal exposure monitoring data from approximately half of the study participants. They plan to compare data on respiratory symptoms and cardiovascular biomarkers in people in the villages where the policies are in place with those living in control villages. They are interested in evaluating changes in the chemical composition of fine particles from different pollution sources and analyzing their contribution to the health outcomes, with a focus on household coal burning. HEI

HEI remains open to time-sensitive applications for accountability research that take advantage of new regulations or interventions going into effect in the near future. Contact Annemoon van Erp or Hanna Boogaard at HEI for more information.

Questions remain about which population groups are inequitably exposed and likely to benefit from air quality improvements. This session will provide an overview of social determinants of health and exposure in the United States, air pollution inequality research to date, and applications in epidemiological research and policy decisions.

Particle Components and Associated Health Effects: Then and Now

Evidence on the health effects of particulate matter has led regulatory agencies to establish mass-based ambient air quality standards for $PM_{2.5}$. However, interest remains high in whether some chemical components or physical characteristics of the PM mixture are of greater public health concern. This session will present the state of the science related to $PM_{2.5}$ components and other attributes and discuss whether regulations based on any of these would be more protective of public health than the current PM-mass-based approach.

Understanding Ultrafine Particles and Health: How Can We Make Progress?

The contribution of ultrafine particle (UFP) exposure to health effects of the air pollutant mixture is an unresolved issue in air pollution research. Recent reviews of the UFP literature continue to identify many of the same challenges in measurement, exposure assessment, and health assessment that were previously identified by HEI's 2013 review. This session will summarize those challenges, discuss areas of progress, and identify issues that need to be resolved by targeted research.

Conference program updates, registration forms, and hotel information are available at *www.healtheffects.org/annual-conference*. HEI

Strategies for Enhanced Exposure Assessment

Three studies will focus on combining novel methods for measuring air pollution and diverse exposure assessment approaches to improve exposure assignment in well-established cohorts.

Scott Weichenthal of McGill University and colleagues will evaluate health impacts of long-term exposures to traffic-related air pollution using exposure estimates from fixed-site and mobile measurement campaigns, as well as deep learning models, in Toronto and Montreal, Canada. They will compare exposure estimates generated by these models to present-day and historical measurements, and to each other. They plan to estimate concentration–response relationships for nonaccidental and cause-specific mortality in the Canadian Census Health and Environment Cohort (CanCHEC), and evaluate how the magnitudes and shapes of those relationships are influenced by different exposure models.

Gerard Hoek of Utrecht University and colleagues will prepare maps of modeled annual average air pollution across the Netherlands, validate the maps using new measurements from over 100 sites, and evaluate the performance of several exposure models. For example, they plan to use measurements from low-cost sensors, mobile monitoring, and a national network of air pollution monitors. The investigators will conduct cross-comparisons to evaluate how different exposure assessment methods compare in their ability to predict long-term pollutant concentrations, with a particular focus on spatial variability of pollutants. Furthermore, they will apply the various models to three cohorts in the Netherlands to evaluate how they influence health effect estimates in epidemiological studies.

Kees de Hoogh of the Swiss Tropical and Public Health Institute and colleagues plan to improve our understanding of the

contribution of individual mobility in air pollution exposure estimates. They will use location tracking on a mobile phone application for 2,000 individuals in the Netherlands and Switzerland. These data, together with available data on air pollutant concentrations, will then be used to estimate long-term hourly exposure estimates. Subsequently, these exposure estimates will be compared against exposures estimated using home addresses. The team will then apply their findings to three major cohorts: the Study on Air Pollution and Lung Disease in Adults (SAPALDIA) in Switzerland, participants in the European Prospective Investigation into Cancer and Nutrition Netherlands (EPIC-NL), and the Swiss National Cohort. They plan to evaluate whether the accuracy of health effects estimates for respiratory diseases can be improved using the enhanced exposure estimates they will develop. Through this study, the researchers aim to generate a conceptual framework and novel methods for exposure assessment taking human mobility into account, and produce open-source software for conducting such analyses.

Quantifying Influence of Exposure Error

Two studies will test the added value of incrementally more complex statistical modeling approaches to improving exposure assessment and apply their findings to estimating health effects in epidemiological studies.

Klea Katsouyanni of King's College London will lead a team to investigate the consequences of measurement error on estimates of health

effects of long-term exposure to outdoor air pollution in London by developing increasingly sophisticated exposure models. They plan to compare exposure models that account for mobility, are based on exposure estimates at the residential address, and are based on concentrations measured at the nearest air pollution monitor. The air pollution surfaces will include outputs from several types of air pollution models (a chemical transport model, land-use regression, and machine learning) and combinations of these models. Finally, exposures will be applied to the London segment of the UK Biobank study to evaluate associations with asthma, chronic obstructive pulmonary disease, myocardial infarction, stroke incidence, and mortality.

Lianne Sheppard of the University of Washington and colleagues will compare and contrast scientific and logistical benefits of different approaches to air pollution exposure assessment. The investigators will leverage large air pollution datasets obtained from low-cost sensors, mobile monitoring, and passive

samplers. They will apply the exposure assessment approaches to determine associations with cognitive decline and dementia incidence in an ongoing cohort study, Adult Changes in Thought Air Pollution (ACT-AP). In particular, the investigators plan to use statistical techniques to assess the bias and precision of health effect estimates. They also plan to compare the value of specific information by including increased time and costs spent on more sophisticated exposure assessment activities. They hope this will guide future studies in efficient selection of exposure assessment methods. ⊞

Contact Allison Patton or Pallavi Pant at HEI for more information.

Two Rosenblith Awardees Selected for 2019

In October 2019, HEI's Research Committee selected two applicants from a field of highly qualified candidates to receive the Institute's 2019 Walter A. Rosenblith New Investigator Award. The recipients are Tanya Alderete, assistant professor of epidemiology at the University of Colorado, and Megan Herting, assistant professor of epidemiology at the University of Southern California in Los Angeles (USC).

Alderete was awarded for her project "Air pollutants and the gut microbiota and metabolome during early life: Implications for childhood obesity." She proposes to study whether prenatal and/or early-life exposure to air pollutants affects the infant gut microbiota and fecal metabolome, thereby altering infant growth trajectories in the first two years of life. She plans to study this in an ongoing longitudinal cohort of Hispanic mother–infant pairs in California with existing validated clinical assessments of infant growth trajectories. She will also use gut microbial profiling and high-resolution fecal metabolomics profiles to understand the mechanisms underlying the obesogenic effects of air pollutants in early life.

Tanya Alderete.

Alderete received a B.A. in biology from the University of Pennsylvania and a Ph.D in integrative biology of disease from USC, where she went on to pursue postdoctoral training in environmental epidemiology. In 2018, Alderete became an assistant professor in the Department of Integrative Physiology at the University of Colorado, Boulder, as well as an adjunct assistant professor in the Environmental Health Sciences Center at USC's Keck School of Medicine. Her mentors for this project are Jeremy Sarnat at Emory University in Atlanta, Georgia, and Kenneth Wright at the University of Colorado, Boulder.

Herting received a Rosenblith award for her project "Air pollution exposure and prefrontal connectivity in early adolescence." She proposes to elucidate how fine-particle exposure affects the development of prefrontal connections and emotional behaviors during the transition from childhood to adolescence and whether this, in turn, contributes to greater risk for neuropsychiatric disorders. Using a novel hybrid spatiotemporal-exposure model, she will estimate annual average exposure to ambient fine particles of boys and girls across the United States who are participating in the Adolescent Brain Cognitive Development cohort. She will then relate the fine-particle exposures to structural connectivity of the prefrontal cortex at ages 9 to 10 years, and to impairments in neuropsychiatric outcomes after 1 year of follow-up at ages 10 to 11 years.

Megan Herting.
ANDREW ZAW, USC

Herting has a B.S. in psychology from the University of Illinois, Urbana, and a Ph.D in behavioral neuroscience from Oregon Health & Science University. In 2016, she was appointed an assistant professor in the Department of Preventive Medicine at the USC Keck School of Medicine, and a faculty member in the USC Neuroscience Graduate Program. Herting is also director of USC's Herting Neuroimaging Laboratory. She has recruited three mentors at the university for this project, Jiu-Chiuan Chen (a 2008 Rosenblith awardee), Rob McConnell, and Kiros Berhane.

The Rosenblith Award provides funding for up to three years at a total budget of $500,000. Eligible candidates should be at the assistant professor or equivalent level and within two to seven years of their highest degree. HEI has issued the Request for Applications for the 2020 award (RFA 19-2). To apply, see our Funding page. HEI

HEI in the News

Op-Ed Cites HEI Model for Transparency

Granger Morgan of Carnegie Mellon University mentioned HEI in a *USA Today* opinion column (November 25, 2019) about the U.S. Environmental Protection Agency's (EPA) proposed "transparency" rule. The rule would mean that, when making policy decisions on air and water pollutants, EPA could consider only studies for which all the underlying health data are made public. In many cases, confidentiality agreements with study participants prevent sharing of such data.

Morgan pointed to independent second looks at major health study findings "in which groups like the nonprofit Health Effects Institute have gotten protected access to these sensitive data so they could check the analysis. These independent studies have confirmed the results." Morgan linked readers to HEI's Special Report, *Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality.*

The HEI reanalysis was mentioned in another discussion of the proposed EPA rule in the online edition of *The New Yorker* (November 15, 2019).

School Transportation News

"U.S. EPA's Cleaner Trucks Initiative Launches Next Chapter for Advanced Diesel Technology" (January 6, 2020)

While commenting on a new Environmental Protection Agency diesel truck proposal, this industry publication noted the diesel exhaust test results in HEI's *Advanced Collaborative Emissions Study (ACES)*, which showed the effectiveness of diesel particulate filters and of selective catalytic reduction systems in reducing diesel engine emissions.

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HEI's *State of Global Air* was widely cited. Two examples:

The Telegraph (UK)

"India Government Ordered to Pay Residents Compensation for Enduring Toxic Smog" (November 28, 2019)

India Times

"Summers, Winters, Monsoon & Pollution. From October To February, 'Pollution' Is Now Delhi's New Season" (November 15, 2019). HEI

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To sign up for e-mail delivery of *Update,* go to "Newsletter Sign-up" at the bottom of our home page, *www.healtheffects.org.*

Search is On for Next Review Committee Chair

HEI is working to fill an important role: chair of the HEI Review Committee, who plays a key role in ensuring the quality of HEI's science.

James Merchant, professor and founding dean emeritus at the College of Public Health, University of Iowa, has chaired HEI's Review Committee for the past five and a half years. Last year, he informed HEI that he would like to step down at the end of his current term in June 2020. The HEI Board, grateful for his leadership, has begun the search for his successor.

HEI is seeking candidates with a broad perspective on the Institute's mission and the Review Committee's work, along with an understanding of the importance of a balanced interpretation and thoughtful communication of research results. "For decades, the Environmental Protection Agency and other governmental bodies, as well as our private sector sponsors, have trusted the integrity of HEI's reviews and commentaries. The Review Committee chair has a vital role in maintaining that trust," said Dan Greenbaum, HEI president.

Although many past Review Committee chairs have been physicians, this is not a requirement. The Committee, under its chair's leadership, does have an important responsibility in interpreting diverse studies in terms of human health and placing them in a broader scientific context. But an outstanding health scientist — whether or not involved with air pollution health issues — or an environmental scientist from another discipline could also ably serve as chair. Experience as a journal editor is a plus, given the nature of the Committee's work.

HEI has consistently attracted eminent scientists to serve as chairs of the Review Committee. Merchant's predecessors include Homer Boushey (professor of medicine, University of California, San Francisco), Daniel Tosteson (dean emeritus of Harvard Medical School), Arthur Upton (former director of the National Cancer Institute), and Robert I. Levy (former director of the National Heart, Lung, and Blood Institute), and HEI hopes to attract a similarly distinguished scientist for this role.

Nominations should be sent as soon as possible to HEI Director of Science Rashid Shaikh. HEI

Communicating the Science

Helping to Inform EU Air Quality Policies …

In mid-January, HEI participated in a joint meeting in Brussels, Belgium, to inform air quality decisions in the European Union. The two-day event was co-organized by HEI, the World Health Organization, the International Society for Environmental Epidemiology, and the European Respiratory Society to present recent science on air quality and health and discuss potential implications for policy. Afterward the participants presented a briefing on the latest evidence to members of the European Parliament. View the meeting agenda and slide presentations at *www.healtheffects.org/meetings*. HEI

"What's Next for the Green Deal?" panelists, from left: Bojan Lalić, diplomatic counselor for environment, Croatia; Christer Ågren, Air Pollution and Climate Secretariat, Sweden; Nathalie Roebbel, World Health Organization; Thomas Henrichs, European Commission Directorate-General for Environment; and Francesco Forastiere, King's College London.   PHOTO BY ROBERTA SADAUSKAITE

… and Cohosting a Workshop in India

In early December, three Indian research institutes and HEI jointly hosted a workshop aiming to develop a broad strategy for advancing the science on air pollution and health effects in India. The two-and-a-half-day event, held at the All India Institute of Medical Sciences (AIIMS) in New Delhi, brought together leading experts in air pollution and health sciences from across India and from North America, Europe, and China.

HEI staff members Dan Greenbaum, Katherine Walker, and Pallavi Pant shared insights from HEI-funded research and moderated various sessions.

On the first two days, researchers outlined potential near- and long-term opportunities for policy-relevant research. Participants noted that there is a rapidly growing Indian evidence base on the health effects of exposure to air pollution, but underlined the need for more studies. In particular, the group observed that most of the ongoing studies focus on short-term exposure and are not designed to assess effects of long-term exposure, which are typically associated with a larger health and economic burden. The group identified several sources of data for air quality and health outcomes that scientists could leverage to conduct studies in the near future and outlined potential research projects for further consideration.

On the third day, workshop participants presented key recommendations from the technical discussions to a range of stakeholder groups, including national government agencies, civil society groups, and funding organizations.

Throughout the workshop, participants emphasized the need for ongoing dialogue and communications to facilitate collaborative research and capacity-building efforts. To address this, the group decided to establish a national network, Collaborative on Air Pollution and Health Effects Research (CAPHER-India). Its goals would be to build partnerships among research institutions in order to develop and implement studies, develop capacity in the country for conducting high-quality research, and in the long run, support translation of science into policy.

Cohosting the workshop with HEI were AIIMS; the India Institute of Technology (also located in New Delhi); and the Sri Ramachandra Institute for Higher Education and Research (Chennai). The workshop was supported by foundations interested in supporting enhanced science on air pollution in India. HEI

A follow-up session to formally release the workshop report and launch CAPHER was held on March 2 at the Indian Public Health Association Conference 2020. For information contact Pallavi Pant at HEI.
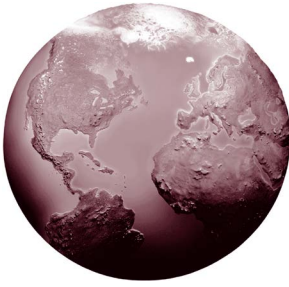
Health Effects Institute

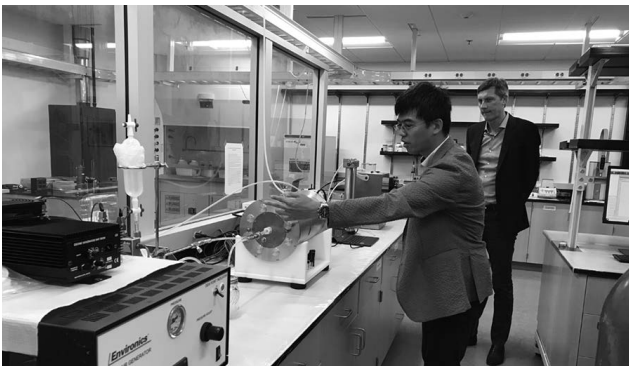75 Federal Street, Suite 1400
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PHOTO BY ANNEMOON VAN ERP

Progress Check

A delegation from HEI recently toured the laboratory of HEI investigator Manabu Shiraiwa at the University of California, Irvine. Shiraiwa is using a Potential Aerosol Mass reactor to produce secondary organic aerosols in his HEI study, "Formation of Reactive Oxygen Species by Organic Aerosols and Transition Metals in Epithelial Lining Fluid," which was funded under the 2018 Walter A. Rosenblith New Investigator Award. Observing him (right) is Ivan Rusyn of the Research Committee. HEI

New Annual Report Now Available

The HEI Annual Report for 2019, *A Window to Trusted Science,* describes how the Institute provides high-quality, impartial, and relevant science informing public policy on air quality and public health, and continues its longstanding commitment to transparency. The report highlights HEI's latest achievements and initiatives, including:

- New and forthcoming Accountability studies examining whether air quality regulations succeeded at improving public health;
- Publication of the first results of HEI's studies on low levels of exposure;
- Innovative research HEI is funding to study traffic-related pollution;
- Our targeted Global Health Science initiatives; and
- The strides HEI-Energy is making to study the potential population exposures from unconventional oil and natural gas development operations.
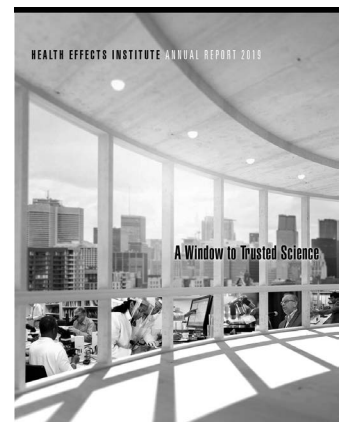
View the report at *www.healtheffects.org/about/annual-report*. HEI