C O N F E R E N C E   R E P O R T

Environmental Epidemiology – What's at Stake: Open Issues and Methodologies

A Report from the 26th Annual International Society for Environmental Epidemiology (ISEE) Conference

At the end of last August, the University of Washington (UW) in Seattle welcomed over 1,100 attendees at the 26th Annual ISEE Conference - "From Local to Global: Advancing Science for Policy in Environmental Health".

The Conference started in the late afternoon of Sunday August 24th, after an entire day of workshops covering a broad range of topics. What followed was an exciting 4-day series of oral contributed and poster sessions. Here is an attempt to summarize the rich body of knowledge emerged during those days.

CONSEQUENTIAL ENVIRONMENTAL EPIDEMIOLOGY

The Conference opened with a plenary session held by Prof. Howard Frumkin (Dean of the UW School of Public Health) on what he referred to as "Consequential Environmental Epidemiology", synthetically explained as what epidemiologists should care about to produce an appreciable impact on the society they live in. According to his thought, epidemiologists should:
- Focus on important environmental risk factors and relevant health outcomes, identified on the basis of good-quality scientific literature, such as, for example, the Global Burden of Disease (GBD) study (12, 16);
- Recognize that intervention studies are needed to verify the effectiveness and efficiency of policy actions (e.g. those aimed at controlling environmental exposures);
- Be aware that, most of the times, they have the capabilities to answer questions policy makers ask;
- Not only improve their expertise in exposure/outcome statistical modelling, but also learn to communicate results to a multifaceted audience.

It is interesting to notice that Frumkin's talk opened the Conference: as a matter of fact, the attention to underline the public health impact of epidemiological studies characterized many presentations during the whole week.

ENVIRONMENTAL JUSTICE

Right after Frumkin's presentation, Dr. Kenneth Olden (Director of EPA's National Center for Environmental Assessment) gave a talk on environmental justice, another topic that dominated the scene during the days after. The starting point was represented by Murray's work on the "Eight-Americas" (15) that highlighted a huge gap between the highest and lowest life expectancies for race-county combination categories in the US population and assessed that the observed disparities could not be explained by single stressors alone (e.g. race, income, healthcare access and utilization). As thoroughly described in his recently published commentary (18), Dr. Olden firstly recognized that most studies on the relation between neighborhood context and health have focused on single stressors and that the cumulative effect of multiple stressors has not been widely investigated due to the lack of integrated tools «to quantify effects of such exposures and link them to health outcomes». He then speculated that «the accumulated extent and character of epigenetic markers resulting from exposure to a broad spectrum of environmental risk factors may be a predictive biomarker of susceptibility to chronic illnesses». Thus, recent advances in epigenetic technologies could offer the opportunity of identifying neighborhood-specific epigenetic patterns and, as a consequence, allow to examine the relationship between health disparities and environmental justice.

BUILT ENVIRONMENT

Strictly related to the environmental justice issues, another topic of interest was represented by the so called "built environment" (BE), two words summarizing many characteristics of the places people live in (e.g. walkability, bikeability, urbanization, and so on). BE has been associated with many health or health-related outcomes, such as physical activity, obesity, and cardiovascular health (5, 17, 20). Attention has been given, at first, to the finding that BE characteristics might be important predictors of environmental exposures, such as ultra-fine particle concentrations (25). Secondly, also the potential for interaction between BE and key environmental attributes, such as traffic-related air pollution, has been underlined (13). Lastly, it has been suggested that BE characteristics might be considered as proxy of exposure to environmental pollutants, especially in situations where access to environmental data might be difficult (8).

EXPOSURE ASSESSMENT

A very broad topic for discussion was represented by exposure assessment. Most of the studies claiming to rely on powerful exposure modelling proposed integrated approaches, where nearly all sources of environmental exposure data were gathered and blended into a single model providing, eventually, personal exposure predictions for all study participants. The best example of such an attempt of "integration" was probably represented by the Multi-Ethnic Study of Atherosclerosis and Air Pollution (MESA Air), that has been extensively cited throughout the various presentations (7). Briefly, the study included more than 7,000 participants enrolled from nine locations across the US (4). Personal exposure predictions for each participant were obtained by integrating a consistent number of data sources in different exposure models: geospatial data, outdoor and indoor pollutant measurements, personal pollution samplings, reported housing characteristics and time-location information treated by means of deterministic, spatiotemporal, and infiltration models.

Great relevance has also been given to mobility information, for its potential to bias the exposure assessment process. Here is a brief list of the techniques researchers proposed to face this issue:

- GPS-equipped devices assigned to study participants to track their movements throughout the day with subsequent linkage of GPS-retrieved information to space-time air pollution mapping (19);
- Assessment of mobility through questionnaires (7) or by means of information retrieved from large governmental databases (14, 23);

- Mobile-phone tracking in support of modelling traffic-related air pollution (3, 10, 11).

Personal exposure monitoring also received great visibility during the Conference. Researchers proposed various techniques. Understandably, the common denominator to the multifaceted range of field experiences presented was the attempt to provide low-cost, precise, sensitive, easy to use, and possibly wearable devices. Some examples:

- Ultra-fine particle sensors (22);
- Low-cost microfluidic assays to measure reactive oxygen species and metals (Fe, Ni, Cu, Cr, Pb, Cd) in particulate matter (21, 24);
- Low-weight, low-burden personal air samplers featuring ultrasonic micropumps (24);
- Personal sensors for NO and NO_2 (6);
- Re-purposing of a low-cost, portable and lightweight particle counter (1).

HEALTH IMPACT ASSESSMENT

Although formally confined to the last session of the last day, debates on the health impact assessment of environmental pollutants permeated most talks during the Conference. Its specific session, however, offered the opportunity to deepen the knowledge of the GBD attributable to ambient air pollution. Aaron Cohen from the Health Effect Institute presented results from the completed GBD 2010 study, recalling that ambient particulate matter exposure contributed, in 2010, to 3.2 million deaths and 74 million Disability-Adjusted Life Years (DALYs) worldwide, while ozone contributed to an additional 150,000 deaths (2, 9). He also pointed out that the GBD study update on ambient air pollution will extend the methods and datasets used in GBD 2010 to estimate deaths and DALYs attributable to $PM_{2.5}$ and ozone for 1990-2013 for 188 countries in 21 global regions. For this purpose, exposure to ambient $PM_{2.5}$ is currently being estimated at a 10 x 10km resolution by combining satellite-based measurements, estimates from a chemical transport model and measured air pollution levels.

CONCLUSIONS

It is certainly not easy to draw conclusions after a 4-day series of presentations covering an immense range of diverse topics. However, we wish to propose a brief list of considerations as representative of what appeared as the most relevant thoughts:

- When designing a study, in addition to clearly-stated and rigorous methodological criteria, epidemiologists

should also care about the potential impact their findings might have from a public health perspective and learn to communicate them;

- Novel analytic tools might provide a good opportunity to deepen our knowledge of health disparities related to environmental justice;

- Exposure modelling needs to rely on a broad amount of data from diverse sources in order to guarantee realistic predictions of personal exposure to environmental pollutants;

- Health impact assessment studies are becoming increasingly important in providing robust scientific evidence to the processes of policy and decision making.

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