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Editorial

# We cannot do it alone: Building a multi-systems approach for assessing and eliminating environmental health disparities

## 1. Introduction: Connecting environmental justice to health disparities

There is growing interest by communities, scientists and policy makers in the connections between environmental justice and racial/ethnic health disparities. Several researchers (e.g., Bullard and Wright, 1993; Lee, 2002; Shepard, 2002) have speculated that the totality of environmental conditions—be it from chemical exposures, the dearth of healthy food products, or the unavailability of gainful employment—affects health, creating disparities in both favorable and adverse health outcomes between segments of the population (e.g., racial, ethnic, or income differences). Because health disparities refer to population differences, explanations and solutions are more likely found at the population level than at the individual level. This represents an "upstream" view that seeks to uncover the fundamental, or root causes, of these group differences (Link and Phelan, 1995).

Elucidating the fundamental mechanisms by which exposures to physical environmental hazards interact with social environmental stressors to lead to health disparities requires a multi-systems approach. Such an approach must be community based and would benefit from an interdisciplinary perspective; multiple stakeholder input; and strong cooperation and collaboration between agencies at the federal, state, and local levels.

We believe that bringing together different approaches in partnership is necessary to reduce or eliminate health disparities in the United States. This approach allows for realistic consideration of the nexus between health disparities and environmental justice, leads to more targeted risk management and disease intervention/prevention actions, and guides the best use of public dollars in ensuring the health of our citizens.

On May 24–25, 2005 a workshop was held at the University of Michigan in Ann Arbor on *Connecting Social and Environmental Factors to Measure and Track Environmental Health Disparities*. The workshop's aim was to begin building the foundation and a movement for a multi-systems approach to address environmental health disparities. For the purposes of this workshop, environmental health disparities were defined as racial/ethnic and socioeconomic inequities in illness and exposures that are at least partially mediated by factors associated with the physical, social, and built environments.

The workshop was sponsored by EPA's Office of Children's Health Protection, Office of Research and Development, and Office of Environmental Justice; the National Institute of Environmental Health Sciences; and the University of Michigan School of Public Health's Department of Health Behavior and Health Education, and its Center for Research on Ethnicity, Culture and Health. Thirty-five individuals participated in the workshop, representing diverse backgrounds including social epidemiology, environmental health, environmental justice, occupational health, environmental health risk assessment, public policy, public health practice, and biostatistics. As part of the workshop, three technical papers were commissioned and presented on indicators and analytical methods for assessing environmental health disparities that integrate social and traditional environmental health science approaches.

Systems analysis has long informed the study of the ecosystem, but this line of thinking not been fully integrated in the environmental health arena. Further, a systems analysis approach requires describing the inputs and outputs of the system and the study of processes as integrated systems rather than as isolated parts. For environmental health disparities, we suggest that a multi-systems approach is required in which traditionally separated scientific disciplines such as environmental health sciences and social sciences are unified by quantitative and qualitative models. Recently, the need for bridging these disciplines has been featured in several scientific articles (see Gee and Payne-Sturges, 2004; O'Neill et al., 2003; Schulz and Northridge, 2004) that provided the foundation for the workshop.

The purpose of this editorial is to provide some perspective for the accompanying articles that describe the structure and outcome of the workshop (Payne-Sturges et al., this issue), approaches for developing indicators (Payne-Sturges and Gee, this issue), multi-level analysis methods for the study of environmental health disparities (Soobader et al., this issue) and the impact of racial

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residential segregation, an important social process that has been linked to health disparities, on exposures to environmental contaminants (Morello-Frosch and Lopez, this issue). The articles presented herein speak to a systems approach. In particular, they recognize that upstream social factors, including residential segregation, social attitudes, and other ''root causes'' of differential exposure to environmental hazards, may contribute to adverse health outcomes. We conclude the editorial with a discussion of the significance of this workshop and implications for future work.

## 2. Indicators are needed to assess progress

The workshop was envisioned as an opportunity to build steps toward identifying the various social and environmental factors, and their interactions, that lead to health disparities. Payne-Sturges and Gee strongly argue for a broader view of environmental health, including both social and physical environmental contributors. They propose a traditional public health approach: developing and validating health indicators or measures to assess environmental health disparities. Health indicators are basic tools used by public health practitioners to characterize community health and assess trends in risk factors, mortality, and morbidity (Thacker and Berkelman, 1988; Thacker et al., 1996). Health indicators have been incorporated into national health and environmental planning activities such as the Department of Health and Human Services' Healthy People 2010, CDC's National Environmental Public Health Tracking Network, and EPA's Report on the Environment. To track progress toward the elimination of health disparities and, further, to understand and address the causes of these disparities, additional tools specific to environmental health disparities are required.

Payne-Sturges and Gee discuss two tools: (1) a set of proposed measures of environmental health status of minority and low income populations, and (2) a conceptual framework to understand how disparities may arise. Based on a conceptual framework that views health disparities as partially driven by differential access to resources and exposures to hazards, Payne-Sturges and Gee grouped indicators into four categories: social processes (e.g. residential segregation, neighborhood deprivation), environmental contaminants/exposures (e.g. ambient air pollution), bodyburdens of environmental contaminants (e.g. blood mercury levels, urinary pesticide metabolites), and health outcomes (e.g. adverse birth outcomes, asthma, diabetes). These proposed indicators can facilitate the tracking of environmental health status in disadvantaged populations, aid in assessing the contribution of the environment to health disparities, inform discussion among policy makers and the public on how to improve data and research on environment and minority health, and, subsequently, be applied to determine the public health impact of decisions/actions based on such data.

Future work might extend their taxonomy to include indicators associated with health behaviors, genetics, health care, and the built environment. The ultimate selection of indicators will require partnerships with community-based environment and health organizations; federal agencies that maintain data sets; public health practitioners; and academic researchers in the fields of environmental, public health, and social sciences. Their framework presents a system for understanding the connections between race/ethnicity, environmental conditions and health disparities, which can aid in identifying opportunities for prevention and environmental contributors to health disparities.

## 3. Multi-level approach to studying environmental health disparities

The term ''multi-level'' typically refers to the concept of lower-level units contained within higher-level units: e.g., individuals nested within groups, nested within neighborhoods or industrial facilities, nested within communities. Individuals within groups, groups within local contexts, and local contexts within macro contexts may share similar characteristics. Recent development in methodology (e.g., hierarchical linear modeling) and greater availability of individual and ecological data have prompted new discussions on this topic. These discussions are not about whether ecological data are good proxies of individual data, but rather speak to the deeper issue of whether ecological factors are important in their own right and whether some have no individual-level analogues. For example, a growing number of multi-level analyses have found that the social and economic characteristics of residential areas are associated with a broad range of health outcome independent of individual indicators of socioeconomic status (Diez-Roux, 1998, 2000; Diez-Roux et al., 1997).

Soobader et al. (submitted for publication) systematically examine several units of analysis and provide recommendations for their use in developing environmental health indicators that incorporate both social factors (e.g. neighborhood deprivation, community resources, psychosocial stress) and physical environmental risk factors (e.g. exposure to environmental contaminants). Lead poisoning is used as an example to demonstrate how multi-level analysis can be applied to understand contextual differences in individual lead levels between contexts, after taking into account individual characteristics. Multi-level analyses can help in understanding the various levels through which social disparities in environmental health are produced and perpetuated, setting the stage for targeted interventions and policy decisions.

## 4. Unequal exposures

In many instances, members of ethnic groups live segregated from one another in the United States. It has

been suggested that this residential segregation may contribute to disparities in health and environmental exposure for minority ethnic groups (Acevedo-Garcia et al., 2003; Alaniz, 1998; Hart et al., 1998; Haynatzka et al., 2002; Laveist, 1989, 1993; Lopez, 2002; Luke et al., 2000; Polednak, 1991, 1996a, 1996b). The published public health and social sciences literature on segregation and its related health impacts has been growing. Adequate data, however, are not available in most instances to examine the relationships among the environmental, racial, ethnic, and other socioeconomic determinants of adverse health outcomes. Within environmental health sciences, scientists have examined segregation only with regard to modeled air exposures showing increasing cancer risk due to ambient levels of toxic air pollutants associated with increasing degree of residential segregation (Lopez, 2002).

Morello-Frosch and Lopez (submitted for publication) examine the association between segregation and other environmental exposures, such as pesticides, criteria air pollutants, lead poisoning, or housing quality. Racial residential segregation is also discussed within a regional equity context. Morello-Frosch and Lopez point to the historical and contemporary segmentation of housing markets; the spatial mismatch of labor markets; and the decentralization of metropolitan governance, which contributes to unequal access to economic opportunities and the fragmentation of local control over land use and zoning decisions in ways that affect community environmental health.

The observations of connections between segregation and exposures to environmental contaminants raise important policy and science questions. Environmental health research, incorporating new models of exposure and better reflecting the patterns of environmental exposure, should include segregation as an environmental health risk factor. Good risk management decisions should be based on a careful analysis of the weight of scientific evidence that support conclusions about a problem's potential risks to human health and the environment. Environmental health policy makers need to pay attention to the role of social inequality, such as residential segregation, because it may affect the options that communities have to address environmental and health problems through, for example, the effects of poverty on the likelihood of having health insurance, or the impact of language limitations on effective engagement with public officials. Therefore, it is necessary to incorporate these broad but significant indicators of community socioeconomic vulnerability and other individual-level factors into a comprehensive understanding of patterns of environmental health disparities.

## 5. Political science optics

The workshop on *Connecting Social and Environmental Factors to Measure and Track Environmental Health Disparities* is timely and significant from both scientific and policy perspectives. Environmental and public health data gaps in ethnic and racial minority and impoverished communities are often translated into a perceived lack of scientific evidence to validate claims of disproportionate environmental health impacts. Environmental justice advocates have always pushed environmental scientists and policy makers to also consider the social context in which environmental exposures/hazards occur in a community, which is to consider the cumulative impacts of multiple stressors of poverty, racism, linguistic isolation, psychosocial stress, air pollution, and exposure to other environmental hazards (e.g. poor housing quality) and life style factors (e.g. poor nutrition, etc.).

This workshop was unique in that it brought together traditional environmental health scientists and social scientists, who usually do not directly interact with each other, to share knowledge and data and scientific research methodologies that can be applied to examine "the environment" in more holistic terms. Attendees struggled with language, definitions, and nomenclature for social and biological processes that affect health. But the healthy and open discussions may lead to more interdisciplinary research. This interdisciplinary dialogue is critical as EPA is currently interested in further developing existing cumulative risk assessment guidelines to incorporate other, non-pollutant factors influencing population vulnerability such as psychosocial stress, poor access to quality health care, and health disparities (US Environmental Protection Agency, 2003). Additionally, EPA is gearing up to revise existing guidelines on conducting environmental exposure assessments, and intends to flesh out approaches that exposure assessors can use to examine the contribution of racial, ethnic, and income disparities to exposures to environmental contaminants.

The mission of the National Institute of Environmental Health Sciences (NIEHS) is to reduce the burden of environmentally associated diseases by defining how environmental exposures affect public health, how individuals differ in their susceptibility to these exposures, and how these susceptibilities change with age. NIEHS has been at the forefront in pushing research scientists who are working in communities to adopt principles of community-based research and for funding community-academic partnerships to address environmental justice issues. NIEHS also has funded the Health Disparities Research Program to foster multidisciplinary research that will elucidate underlying mechanisms by which the interaction of physical exposures and the social environment leads to health disparities.

Much remains to be learned about environmental health within the context of environmental justice. Multiple and complex environmental stressors make identification of the causation or the etiology of adverse health outcomes difficult. Thus, it is critically important to continue NIEHS support of community-based research in order to help researchers understand the mechanisms by which social inequalities and environmental exposures affect community health and to inform population-based interventions.

The challenge is moving from research to action, and developing policies not just at EPA but at all levels of government. Then we need an interdisciplinary cross-agencies approach to evaluate those policy actions to assess success.

Finally, the workshop is timely given discussions both outside and within EPA on how to consider environmental justice more explicitly in policy decisions, and in rule making in particular. The US Government Accountability Office recently released a report in which it identified the need for scientific methods and guidance to enhance EPA's ability to analyze potential environmental justice impacts (US Government Accountability Office, 2005). In addition there has been great urging from members of Congress for EPA to reinvigorate its leadership role in addressing environmental justice. But environmental justice cannot be considered solely an EPA responsibility, just as health disparities cannot be seen solely as a Department of Health and Human Services problem. To be successful, it requires a multi-stakeholder multi-systems approach that recognizes (not denies) and attends to social inequalities, develops language and methodologies that cross social and environmental health science disciplines to define our common interests in promoting health, and that engages in community partnerships in framing the issues and how tools can be applied to assess progress. This workshop begins to build the foundation and tools to address such concerns.

A primary goal of the workshop was to develop a scientific foundation to explore conceptual issues, data needs, and policy applications with regard to the social and environmental factors used to measure and track racial, ethnic, and class disparities in environmental health.

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Devon Payne-Sturges, William Sanders

*U.S. EPA Office of Children's Health Protection, 1200 Pennsylvania Ave., NW, MC 1007A, Washington, DC 20460, USA*

*E-mail address:* payne-sturges.devon@epa.gov (D. Payne Sturges)

Harold Zenick
*U.S. EPA Office of Research and Development, National Health and Environmental Effects Research Laboratory, 1200 Pennsylvania Ave., NW, MC 1007A, Washington, DC 20460, USA*

Charles Wells
*National Institute of Environmental Health Sciences, 1200 Pennsylvania Ave., NW, MC 1007A, Washington, DC 20460, USA*