

Workshop Summary: Connecting social and environmental factors to measure and track environmental health disparities

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Abstract

On May 24–25, 2005 in Ann Arbor, Michigan, the US Environmental Protection Agency, the National Institute of Environmental Health Sciences, and the University of Michigan sponsored a technical workshop on the topic of connecting social and environmental factors to measure and track environmental health disparities. The workshop was designed to develop a transdisciplinary scientific foundation for exploring the conceptual issues, data needs, and policy applications associated with social and environmental factors used to measure and track racial, ethnic, and class disparities in environmental health. Papers, presentations, and discussions focused on the use of multilevel analysis to study environmental health disparities, the development of an organizing framework for evaluating health disparities, the development of indicators, and the generation of community-based participatory approaches for indicator development and use. Group exercises were conducted to identify preliminary lists of priority health outcomes and potential indicators and to discuss policy implications and next steps. Three critical issues that stem from the workshop were: (a) stronger funding support is needed for community-based participatory research in environmental health disparities, (b) race/ethnicity and socioeconomic position need to be included in environmental health surveillance and research, and (c) models to elucidate the interrelations between social, physical, and built environments should continue to be developed and empirically tested.

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1. Rationale

The federal Healthy People 2010 initiative has made the elimination of health disparities a top national priority (US Department of Health and Human Services, 2000). To reach this goal, we must understand the causes of racial/ethnic and class disparities in the United States. Social disparities in health are defined as the inequities in morbidity and mortality in social groups, particularly among racial/ethnic groups and socioeconomic groups (Carter-Pokras and Baquet, 2002). Current research suggests that health disparities may be produced by both environmental (e.g., physical, chemical, and biological agents to which individuals are exposed in a multitude of settings, including home, school, community, and workplace) and social factors (e.g., individual- and community-level characteristics such as socioeconomic status, education, psychosocial stress, coping resources and support systems, residential factors, cultural traditions, and institutional, structural, and political processes such as racism and classism) (Institute of Medicine, 1999). A growing number of environmental justice advocates, scientists, and regulators view the “environment” holistically by considering the effects that socioeconomic and other social factors have on exposure to environmental hazards and resulting health outcomes. To reduce racial/ethnic and socioeconomic health disparities, it is likely that interventions will have to address social and environmental factors together.

A wide range of activities from various sectors of US society (e.g., by scientists and communities, federal, state, and local governments, nongovernmental organizations) have attempted to address inequality in exposures to environmental hazards and resulting health outcomes, including federally funded research programs on environmental hazards, initiatives to increase citizen involvement in environmental decisions, and community-based efforts to address local concerns about environmental hazards (Institute of Medicine, 1999). However, it is difficult to evaluate the success of these efforts, especially with regard to eliminating the disparities between racial/ethnic and socioeconomic groups, because tools to understand and assess disparities and to evaluate impacts have not been fully developed. The development of indicators to track disparities and potential risk factors may be one mechanism that helps to integrate interdisciplinary theories into concrete measures, evaluate the effectiveness of current regulatory and policy initiatives, and identify areas that need further research or policy intervention.

Researchers in the fields of environmental health science, epidemiology, public health, health education, sociology, and psychology have advanced their methods and technologies to improve the assessment of environmental exposures and the measurement of social processes that shape health disparities (Goldman and Coussens, 2004; National Institutes of Health, 2001; Shonkoff

and Phillips, 2000). However, to date there have been few transdisciplinary initiatives to bridge these diverse traditions.

We convened a diverse group of researchers and public health practitioners for a workshop (described below). We sought to initiate such transdisciplinary theoretical and methodological discussions on the question of 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 environment. The workshop was designed to (a) develop a scientific foundation to explore the conceptual issues, data needs, and policy applications with regard to health disparities; (b) explore potential indicators that may be used to track disparities and their correlates; and (c) examine and refine a framework that might be helpful in exploring environmental health disparities. The specific questions that workshop participants explored are listed in Table 1. This meeting report summarizes the workshop’s activities and discussions.

2. Workshop preparation and structure

This invitational workshop was held on the campus of the University of Michigan in Ann Arbor on May 24–25, 2005. It was sponsored by the US EPA’s Office of Children’s Health Protection, Office of Research and Development, National Health and Environmental Effects Research Laboratory, and Office of Environmental Justice; the National Institute of Environmental Health Sciences; and the University of Michigan’s Department of Health Behavior and Health Education and its Center for Research on Ethnicity, Culture and Health at the University of Michigan School of Public Health.

This transdisciplinary workshop was coordinated by an eight-member planning committee (Appendix). The organizers commissioned three papers (Morello-Frosch and Lopez, 2005; Payne-Sturges and Gee, 2005; Soobader et al., 2005) that, along with other relevant studies, were mailed to all participants in advance of the workshop to give participants a point of departure for discussion. The commissioned papers examined the relationship between racial residential segregation and exposure to air pollutants, the selection of indicators for environmental health disparities, and the methodologies for examining environmental health disparities.

The workshop was organized around the stress-exposure disease (SED) framework (Fig. 1) that suggests that health disparities are produced in part by differential exposure to historically situated physical and chemical hazards, community stressors, disadvantages in economic and political power, and differential community resources (Gee and Payne-Sturges, 2004). These differential exposures may result in part from historical and current social policies that promote disparities in economic opportunities

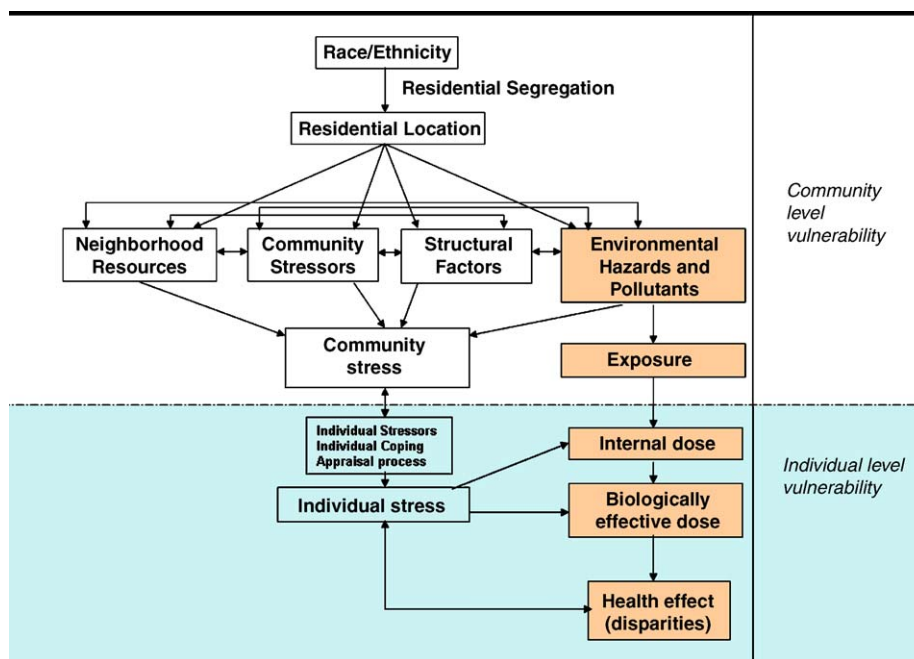


Fig. 1. Stress-exposure disease framework for environmental health disparities. Reproduced with permission from Environmental Health Perspectives (Gee, G. C. and D. C. Payne-Sturges (2004)).

and residential segregation. The SED framework also suggests that social stressors are vulnerability conditions that may amplify the potentially detrimental effects of environmental exposures.

Mirroring the transdisciplinary framework, the 35 participants at the workshop represented a diverse set of backgrounds, including social epidemiologists, health educators, social scientists, environmental health scientists, environmental justice advocates, occupational health scientists, environmental health risk scientists, policy experts, public health practitioners, and biostatisticians. These participants worked in universities, community organizations, and state and federal agencies.

The first day of the workshop featured several presentations. Woodruff discussed the development and use of indicators to track children's environmental health (Kyle et al., 2005). Gee summarized the SED framework (Gee and Payne-Sturges, 2004) that was used to help organize the workshop. Morello-Frosch and Lopez presented analyses linking residential segregation and exposure to environmental toxicants. Soobader and colleagues discussed the use of multilevel analysis in assessing environmental health concerns. Crowder reviewed criteria for choosing valid and reliable indicators. Payne-Sturges presented sample indicators that might be used to track environmental health disparities. Slides from these presentations will be available online at a future date.

The discussions after the presentations focused on sharpening definitions about "the environment" and on health disparities. One key point that came up was the need to better understand the scales from which to best examine health disparities and potential correlates of

Table 1
Workshop questions

1. *Theoretical Frameworks*—How do existing theoretical or conceptual frameworks integrate social and environmental conditions to address disparities in environmental health?
2. *Current Knowledge*—What is the current state of scientific knowledge on the connections/interactions between social factors, environmental conditions/exposures, and health?
3. *Factor Identification*—What are the key social and environmental factors to evaluate in considering environmentally produced health disparities?
4. *Data and Methodology Needs*—What data and methods are needed to assess the impact of social and environmental factors on health at the national and local levels?
5. *Policy Applications*—How can we develop indicators and methods that could guide regulations and policies at regulatory agencies and that serve as useful tools for public health practitioners and communities in their efforts to develop policies and programs that reduce health disparities?

these disparities. For example, should air toxics be best modeled at the regional or local level? Should neighborhood poverty be modeled at the block group or census tract level? Another point emphasized was that the environment does indeed consist of multiple dimensions (e.g., social, built, physical) but that these multiple dimensions are not always recognized in extant research and policies.

The first day of the workshop also featured breakout sessions in which groups of 10–12 participants collaborated to create lists of priority environmental health outcomes,

Table 2
Leading health outcomes related to environmental health disparities identified by the workshop's four breakout groups

Group 1	Group 2	Group 3	Group 4
All-causes mortality	Adverse reproductive outcomes (low birth weight, malformations)	Adult cancer	Alzheimer's
Birth defects	Asthma	Asthma	Asthma
Cancers	Breast cancer	Cardiovascular disease	Birth defects
Cardiovascular	Cardiovascular	Childhood cancer	Cancer
Diabetes	Depression	Chronic respiratory disease	Diabetes
Functional disability	Diabetes	Depression	Heart disease
Lead poisoning	Injuries	Developmental outcomes	Lead poisoning
Mental health	Lung cancer	Neurological disease	Low birth weight/infant mortality
Multiple chemical sensitivity	Neurological (blood lead, ADHD)	Obesity	Neurodevelopmental outcomes
Neurological outcomes	Obesity	Occupational illness	Obesity
Obesity	Other respiratory	Transportation injuries	Quality of life
Quality of life			Respiratory diseases
Respiratory (lung function, asthma)			

These lists of outcomes were generated with lively debate on such topics as the definition of "health outcome," the relative importance of various outcomes, the process of identifying outcomes, and other questions that were not resolved during the workshop. The intent is to resolve these issues as the group moves forward in its work on measuring and tracking environmental health disparities.

related upstream¹ physical and social environmental factors, indicators, and data sources to inform the proposed indicators (see Tables 2 and 3).

On the second day, the preplanned morning session was revised to address issues that had emerged during discussions from the first day. These issues included broadening the discussion to better integrate the concerns of some participants who felt that their perspectives needed to be more proactively incorporated into the workshop agenda, more concrete discussion of the roles of race and racism in driving and shaping environmental health disparities, and following up with a deeper review and refinement of the SED framework presented. Participants responded positively to the agenda revisions and noted that the organizers' flexibility and willingness to respond to newly emerging ideas was key in making the workshop a success. This flexibility is a good "lesson learned" for workshops that seek to grapple challenging topics.

The SED framework was well received and generated considerable discussion by workshop participants. Among the challenges identified for refining the framework were to depict a life course perspective and to more fully encapsulate the ideas of community participation. There

was also interest in supporting studies that might test the propositions raised by the framework.

Representatives from community-based organizations then gave presentations on the use of indicators of environmental health disparities at the local level. These organizations used indicators to assess baseline information, monitor trends, advocate for policy change, and measure the progress of their programs.

Donele Wilkins, executive director of Detroiters Working for Environmental Justice in Detroit, Michigan, discussed how the University of Michigan's Community Action Against Asthma project documented peaks in exposure to airborne particulate matter and elemental carbon in predominantly Latino and African American neighborhoods. These peaks were found near the Ambassador Bridge between Detroit and Windsor, Ontario, and appeared to be related to the idling of diesel trucks delayed at the border for security reasons after September 11, 2001. The group presented its findings to the city council, educating officials about the health risks and the need to address them. Ms. Wilkins also commented that communities are often concerned about many environmental issues for which data do not exist or are unavailable at the local level. She emphasized that community groups require both local and national data, that more research should examine cumulative exposures and cumulative impacts, and that the results of research should be accessible to the lay public.

Azibuike Akaba, community technical assistance coordinator for the Coalition for West Oakland Revitalization in Oakland, California, explained that having local data helps raise awareness among residents about issues in their community and are a way of democratizing access to information. He said that indicators amplify the community's voice in policy debates and provide benchmarks

¹The notion of "upstream" promotes primary prevention (e.g., moving upstream), which emphasizes disease prevention or health promotion in populations. In an environmental health context, this implies strategies aimed at preventing human exposure to toxics through pollution prevention and toxics use reduction. "Upstream" also emphasizes focusing on the root causes of health disparities, including systems of socioeconomic advantage and power. Secondary prevention aims to provide screening, early detection of possible disease, and prompt intervention for people at risk of disease. Tertiary prevention (downstream) minimizes the impact of disease in people who are already quite sick.

Table 3
Upstream social and environmental factors identified for selected health outcomes

Health outcome	Upstream factors
Obesity	<ul style="list-style-type: none"> ● Poverty ● Access to transportation ● Access to affordable/nutritious food ● Food security policy ● Crime rate/safety ● Access to exercise facilities ● School funding ● Electronic media
Cardiovascular effects	<ul style="list-style-type: none"> ● Obesity ● Smoking ● Particulate AP ● Smoking regulations ● Poverty ● Segregation ● Zoning regulations ● Grocery store access ● Industry regulation <ul style="list-style-type: none"> ○ Waste handling ○ Industry siting ○ Occupational health guidelines ● World trade ● Larger market forces ● Farming practices ● Government subsidies ● Agrochemical production, application, distribution ● Water quality/quantity ● Climatological factors/weather ● Antibiotic disposal/resistance, subtherapeutic use ● Unregulated pharmaceuticals/personal care products
Asthma	<ul style="list-style-type: none"> ● Segregation ● Poverty ● Health insurance ● Proximity to major roadways ● Housing/indoor air quality ● Air pollution ● Low birth weight ● Safety concerns/crime ● Crowding/population density ● Municipal services ● Availability of health providers ● Residential ETS ● Smoking regulations
Neurodevelopmental effects	<ul style="list-style-type: none"> ● Substandard housing ● Nutrition ● Lack of access to healthcare ● Pesticide drift ● Prenatal care ● Lack of information ● Cultural practices ● Take-home exposure (parents' occupations) ● Maternal health status ● Pesticide exposure/toxin exposure
Neurological effects	<ul style="list-style-type: none"> ● Access to healthcare (diagnosis, hypertensives)

Table 3 (continued)

Health outcome	Upstream factors
	<ul style="list-style-type: none"> ● Pesticide exposure/toxin exposure ● Fish consumption/traditional lifestyle ● Early life viral infections ● Head injury ● Health behaviors ● Neighborhood characteristics
Birth outcomes	<ul style="list-style-type: none"> ● Stress ● Access to transportation ● Medicare/Medicaid ● Preconceptual health of parents ● Environmental exposures ● Prenatal health ● Neonatal health ● Poverty ● Public health infrastructure ● Structure of health insurance ● Discrimination ● Occupational exposures ● Stratification of health care facilities ● Maternal age ● Maternal education ● Birth space ● Family and non-family violence ● Family size ● Housing conditions <ul style="list-style-type: none"> ○ Density ○ Structure ● Food security ● Access to food (quality) ● STDs/STIs
Diabetes	<ul style="list-style-type: none"> ● Access to greenspace, recreation centers ● Access to healthy food ● Targeted marketing, TV ● Health care access ● Race-based segregation ● SES ● Voter turnout ● Political "juice" index ● Land use, zoning, industrial, residential ● Regional integration and governance ● Collective efficacy ● Access to preventive care and relevant culturally appropriate info ● Exposure to endocrine disruptors ● Exposure to stress ● Built environment ● Neighborhood quality
Quality of life	<ul style="list-style-type: none"> ● Exclusion of certain groups in political process, political process to be responsive to the needs/concerns of "minority" groups ● Economic side of equation the draining of resources ● Cultural cohesiveness that can empower ● Segregation and spatial mismatch ● Jobs ● Transportation ● Policing, services ● Community weathering from so many simultaneous stressors

against which to measure change efforts. In one example, Mr. Akaba described how his organization was able to engage the community in the process of collecting data for an environmental indicators project that culminated in a series of practical recommendations for reducing truck traffic through residential neighborhoods.

Bhavna Shamasunder from the Environmental Health and Justice Program at Urban Habitat in Oakland, California, said that the most useful local data (1) are based on individual and community experiences, (2) reflect the problem and community-defined goals, (3) are supported by a trainer/organizer, and (4) are echoed or strengthened by state and/or national data. For example, communities affected by inequitable access to transportation can use specific analyses of transportation subsidies. This type of information can be obtained by a community technical advisor (TA) who can analyze and interpret the data in a way that can be directly applied to a campaign for more equitable funding. Even better, the TA can train community residents to find the data by themselves the next time they need it, building the community's research capacity.

To close the workshop, Bunyan Bryant, a pioneer social scientist and advocate in the environmental justice movement, led a discussion on the policy implications of the issues that had been discussed at the workshop. Workshop participants pointed to the need to develop policies to address cumulative risks,² including assessing social stressors and multiple pollutants. Risk assessment could be expanded to consider the effects of psychosocial stressors in assessing costs and benefits. Some participants highlighted the use of the precautionary principle in the development of new policies (although this principle was not universally endorsed by all participants). Some participants highlighted the need to reinvigorate the environmental and environmental justice movements. Others said that we need to find more creative and effective ways to translate existing research into policy and regulatory change. One potential way to achieve some of these concerns could be to bolster grant support to community-based participatory collaboratives and demonstration projects that link policy initiatives with environmental health disparities.

In a closing exercise, participants were asked to recommend their highest-priority next steps for moving forward on the issue of environmental health disparities. The exercise revealed several recurring themes: develop a set of indicators that can be used to assess environmental health disparities, improve our understanding of the relationships between health outcomes and the underlying factors behind environmental health disparities, improve

the availability and quality of data, engage communities in participatory research projects, and enhance the political influence and power of communities, minority racial/ethnic groups, and those with low socioeconomic status/position.

3. Discussion

The workshop featured candid and spirited discussions among participants from a wide range of disciplines. Several themes that will be useful in assessing ways to measure and track environmental health disparities emerged. First, it was recognized that much environmental exposure data are collected and reported without reference to race, ethnicity, social class, gender, and other social characteristics. Without information on these characteristics, it is not possible to gauge whether disparities do exist and what the trends and their potential drivers may be. The monitoring of these disparities is already a goal of many federal and state agencies that have adopted Healthy People 2010. Therefore, to achieve these goals and to allow scientific investigation, tracking efforts must include indicators of race/ethnicity, socioeconomic position, and gender.

Second, environmental health tracking is related to and can inform environmental health risk assessment. Both health tracking and risk assessment must find ways to incorporate the complexity of information that is not easily quantifiable using traditional techniques. For example, how can we measure and track community empowerment and civic engagement? How can we incorporate empowerment into an assessment of environmental risk? If it is true that psychosocial stressors and pre-existing disease make one more susceptible to the toxic impacts of environmental hazard exposures, how can we track stressors and comorbidities? Traditional risk assessment comes with its own set of assumptions and limitations, including a focus on a single environmental pollutant, a single pathway, and a single health endpoint (National Environmental Justice Advisory Council, 2004; Slovic, 1997, 2000; US Environmental Protection Agency, 2003). Future work must include a multi-stressor and cumulative risk approach that can incorporate psychosocial "pollutants" (e.g., racial discrimination, poverty) and potential interactions or confounding between social and environmental exposures.

Third, to assess what these factors, stressors, and resources are, scientists and policymakers must include community participants from the initial stages of the discussion. Community-based participatory research (CBPR) is one approach for including community participants in scientifically validated methodologies for including community participants (Israel et al., 1998). True participation requires that research projects, policies, and regulations be jointly developed by all stakeholders. A CBPR approach may be especially advantageous in elucidating cumulative risks. This is because communities often think in terms of cumulative and competing risks, whereas scientists are more apt to investigate a single risk.

²Cumulative risk: the combined risks from aggregate exposures to multiple agents or stressors. Aggregate exposure refers to the combined exposure of an individual (or defined population) to a specific agent or stressor via relevant routes, pathways, and sources (US Environmental Protection Agency, 2003).

This was reflected also in the exercise showing that many health outcomes identified by participants were not diseases but related to quality of life. Thus, communities may play important roles in generating new theories from which to elucidate cumulative risk and in identifying potential risks that may be overlooked by scientists who are not familiar with a particular setting or local context.

Not including all stakeholders in the tracking, research, and intervention processes runs the risk of producing short-term gains at the expense of creating long-term problems. For example, one intervention claimed success when it changed the diet of a Native American community to avoid the consumption of environmentally contaminated fish. However, this short-term success led to longer-term problems when the dietary changes led to an epidemic of diabetes and obesity within the community (Arquette et al., 2002).

Fourth, tracking efforts at the national level are clearly not enough. While a national perspective is important, many policies (e.g., zoning regulations) and practices that determine health disparities are situated at the local level (Maantay, 2001). Accordingly, tracking efforts at the local level must be supported alongside national-level efforts. The types of indicators tracked at the local level may differ from those at the national level. For example, at the national level, one could produce fairly reliable mortality estimates, but these estimates become less reliable as the population size decreases. On the other hand, individual communities may wish to track hazards that are endemic to their community but not discussed at the national level. For example, a local community may be concerned about hog waste, a problem seldom recognized as a national issue. Thus, balancing local and national tracking efforts will require further research. Future discussions, at minimum, should include considerations of (a) scientific validity, (b) feasibility, and (c) community, regulatory, and policy needs and priorities.

Overall, participants were enthusiastic about the meeting and expressed strong interest in convening additional workshops to explore theoretical frameworks and the state of the science that links multiple dimensions of the environment. Several of the sponsors recalled the groundbreaking conference on Race and the Incidence of Environmental Hazards, which took place at the University of Michigan in 1990 and was coorganized by Bunyan Bryant. Several participants also observed that the social environment was not considered a factor in environmental health disparities 15 years ago. Today, researchers have come to understand that cultural, social, and economic influences coalesce in complex ways, set the stage for differential exposures and responses, and must be measured and addressed as part of an environmental health surveillance system.

The workshop was envisioned as a first step toward developing a process to better characterize the state of environmental health disparities. The workshop provided a basis from which to begin by allowing for diverse participants to voice their concerns and share knowledge.

Next steps include the testing of propositions raised in the SED framework and the establishment of a base of indicators from which to track environmental health disparities. Research could assess the validity of the hypotheses raised in the SED and, in doing so, inform the decision making of citizens, communities, and public officials.

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Appendix. Workshop organizing committee

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