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Integrating Environmental Justice and the Precautionary Principle in Research and Policy Making: The Case of Ambient Air Toxics Exposures and Health Risks among Schoolchildren in Los Angeles

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ABSTRACT: Two policy frameworks, environmental justice and the precautionary principle, have begun to transform traditional approaches to environmental policy making and community organizing related to public health. Despite having several important overlapping policy goals, little effort has been made to purposefully integrate these two frameworks. This article discusses preliminary research on environmental inequality in ambient air toxics exposures and associated health risks among schoolchildren in the Los Angeles Unified School District. Results indicate that children of color, namely, Latinos and African Americans, bear the highest burden of estimated cancer and noncancer health risks associated with ambient air toxics exposures while they are in school. The implications of these study results for controversial policy decisions related to school siting and construction in urban districts are discussed within the context of environmental justice and the precautionary principle.

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> Environmental justice embraces the principle that all people and communities are entitled to equal protection of environmental and public health laws and regulations.
>
> —Bullard (1996)

> When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.
>
> —Raffensperger and Tickner (1999)

> Hazards are produced by business operations, to be sure, but they are defined and evaluated socially—in the mass media, in the experts' debate, in the jungle of interpretations and jurisdictions, in courts or with strategic-intellectual dodges, in a milieu of contexts.
>
> —Beck (1992)

The emergence of two policy frameworks during the past two decades—environmental justice and the precautionary principle—has begun to transform traditional approaches to environmental policy making, research, and community organizing related to public health. Yet despite the burgeoning literature on both of these frameworks, and the fact that they share some important tenets, environmental justice and the precautionary principle have not always been well integrated at either the theoretical or the policy levels. In this article, we examine the foundations of environmental justice and the precautionary principle and propose ways in which these concepts could be better integrated to reshape environmental health policy making to protect public health, particularly for vulnerable populations, such as poor communities of color. We attempt to elucidate the implications of environmental justice and the precautionary principle for policy making by discussing some results from our research on environmental inequality in ambient air toxics exposures and associated health risks among schoolchildren in Southern California. We conclude by suggesting possible future paths of inquiry for research and policy making.

Race in America *(2002, Norton). His interests in environmental justice research and policy have resulted in grants from the California Endowment and the California Wellness Foundation and publications in* Social Science Quarterly, Economic Development Quarterly, Urban Affairs Review, *and the* Journal of Urban Affairs.

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ENVIRONMENTAL JUSTICE AND THE FRAMEWORK FOR PRECAUTION

The principle of environmental justice emerged out of a vibrant social movement that has challenged biases within environmental policy making and regulation along with exclusionary land use and economic development decision making that create disparities in the prevalence of hazardous pollution among the poor and communities of color (Morello-Frosch 2002). Environmental justice advocates contend that despite seemingly neutral and uniform regulations, legislation, and performance standards, formal and informal dynamics may affect the daily operations of regulatory activities in unexpected ways that produce and perpetuate discriminatory outcomes. Indeed, situations where there is leeway for bureaucratic discretion in the implementation of environmental policies can lead to regional and community differences in the extent of regulatory enforcement efforts. The fact that working-class and minority interests are poorly represented within regulatory circles can perpetuate these discriminatory outcomes (Gelobter 1992; Lavelle and Coyle 1992).

With its emphasis on public health, social inequality, and environmental degradation, environmental justice provides a framework for public policy debates about the impact of discrimination on the environmental health of diverse communities in the United States. The issue of environmental justice also raises the challenging question of whether disparities in exposures to environmental hazards may play an important, yet poorly understood, role in the complex and persistent patterns of disparate health status among the poor and people of color in the United States (Ecob and Smith 1999; Haan, Kaplan, and Camacho 1987; Haan 1985; Hahn et al. 1996; Kawachi and Marmot 1998; Krieger et al. 1993; Kubzansky et al. 1998; Lazarus 1993; Navarro 1990; Robinson 1984, 1987; Syme and Berkman 1976; U.S. Department of Health and Human Services 1990).

The movement has also catalyzed a surge of academic inquiry into whether and how discrimination creates disparities in the distributions of environmental hazards among diverse communities. Research on environmental inequality varies widely, ranging from anecdotal and descriptive studies to rigorous statistical modeling that quantifies the extent to which race and/or class explain disparities in environmental hazards among diverse communities (Boer et al. 1997; Bowen et al. 1995; Bullard 1983; Burke 1993; Commission for Racial Justice 1987; Hersh 1995; Kraft and Scheberle 1995; Lavelle and Coyle 1992; Mohai and Bryant 1992; Pastor, Sadd, and Hipp 2001; Pollock and Vittas 1995; Pulido, Sidawi, and Vos 1996; Sadd et al. 1999; Wernette and Nieves 1991; Zimmerman 1993). Much, although not all, of the evidence points to a pattern of disproportionate exposures to toxics and associated health risks among communities of color and the poor, with racial disparities often persisting across economic strata.

Social science researchers examining environmental inequalities have generally limited their inquiries to evaluating differences in the location of pollution sources between population groups, while placing less emphasis on evaluating the distribution of exposures or, more important, potential health risks. Activists have pushed environmental health researchers and regulatory authorities in particular to move beyond chemical-by-chemical or facility-by-facility analysis toward a cumulative exposure approach that accounts for the exposure realities of diverse populations and that better elucidates how race and class discrimination can increase community susceptibility to environmental pollutants (Morello-Frosch, Pastor, and Sadd 2001).

Nevertheless, causally linking the presence of environmental pollution with potentially adverse health effects is an ongoing challenge in the environmental health field, particularly in situations where populations are chronically exposed to complex chemical mixtures (Institute of Medicine 1999). Environmental organizations, including environmental justice activists, have powerfully argued that in the never-ending quest for better data and unequivocal proof of cause and effect, some researchers and regulators have lost sight of a basic public health principle—namely, the importance of disease prevention (Bullard 1994; Lee 2002). As a result, activist organizing and models of community-based participatory research have encouraged some academics and regulators to integrate and operationalize the precautionary principle into their work (Brown and Mikkelsen 1997, 134-38). Practically, this means that in the face of uncertain but suggestive evidence of adverse environmental or human health effects, regulatory action is needed to prevent future harm. Known as the precautionary principle, this perspective seeks to mobilize environmental and public health policy making that otherwise can be paralyzed when implementation is too dependent on scientific certainty.

The essence of the precautionary principle promotes planning, alternatives assessment, and anticipatory action with the aim of promoting disease prevention and avoiding environmental health and ecological calamities due to industrial production and other potentially harmful activities. Instead of presuming that specific chemicals or production processes are safe until data and research prove they are hazardous, the precautionary principle favors a more cautious regulatory and policy approach that prioritizes the protection of human and environmental health. In short, "the absence of evidence of harm is not the same thing as evidence of the absence of harm" (Kriebel et al. 2001, 873). Equally important, the precautionary principle also seeks to shift the burden of hazard assessment, monitoring, and data generation activities onto those who propose to undertake potentially harmful activities or chemical production (Kreibel and Tickner 2001; Steingraber 2000). The notion of precaution has been used to justify the development and implementation of innovative policies at the international, national, and local levels to address a range of environmental problems, including acid rain, water pollution, global warming, exposure to electromagnetic fields, and children's exposure to pesticides (Foster, Vecchia, and Repacholi 2000; Raffensperger and Tickner 1999, 3; World Health Organization 2002; Calver 2000).

Recently, children's health advocates have put forth recommendations for implementing the precautionary principle to protect children from the adverse effects of environmental hazard exposures (Tickner and Hoppin 2000; Schettler et al. 1999). Indeed, scientific evidence indicates that children are more susceptible to the effects of environmental pollution than adults because of fundamental differences in their physiology, metabolism, and absorption and exposure patterns (Crom 1994; Guzelian, Henry, and Olin 1992; Kaplan and Morris 2000; National Research Council 1993; Parkinson 1996; Schettler et al. 1999). Certain childhood diseases (e.g., respiratory illnesses such as asthma) are significant health issues (Leikauf et al. 1995; Mannino, Homa, and Pertowski 1998), and air pollution could be aggravating these problems (Burg and Gist 1998; Leikauf et al. 1995; Ware et al. 1993). Anecdotal, epidemiologic, and exposure studies suggest potential short- and long-term health effects among children from outdoor and indoor air pollutants (Gilliland et al. 1999; Guo et al. 1999; Jedrychowski and Flak 1998; Ritz et al. 2002; Schettler et al. 2001; Van Vliet et al. 1997), potentially hazardous facilities (Ginns and Gatrell 1996; Gomzi and Saric 1997), and pesticides (Landrigan et al. 1999; Northwest Coalition for Alternatives to Pesticides 2000; U.S. General Accounting Office 1999). Partly because of this research, Executive Order 13045, issued in 1997, directs federal agencies to consider the particular vulnerability of children to environmental health risks (White House 1997). Consistent with the concerns of environmental justice, there is increasing evidence that children of color bear the burden of exposures to environmental hazards and their potentially adverse health effects (Clark et al. 1999; Gold et al. 1993; Schwartz et al. 1990; Sexton and Adgate 1999).

ENVIRONMENTAL JUSTICE AND CHILDREN'S EXPOSURE TO AMBIENT AIR TOXICS IN LOS ANGELES

While children's health may certainly be affected by environmental hazards in their homes and neighborhoods, they spend much of their day in schools—and these schools may or may not be located in the communities where they live, particularly given magnet programs and cross-town busing in major urban areas. We sought to examine the issue of children's environmental health through the lens of environmental justice with a preliminary analysis of estimated outdoor air toxics exposures and associated health risks among schoolchildren in the Los Angeles Unified School District (M. Pastor, J. L. Sadd, and R. Morello-Frosch 2002). The Los Angeles Unified School District is the second largest school district in the country, spanning 704 square miles and enrolling more than 700,000 students. Given suggestive evidence of a link between childhood respiratory problems associated with air pollution and diminished academic performance (Bener et al. 1994; Diette et al. 2000; Fowler, Davenport, and Garg 1992; Perera et al. 1999), we have also conducted a preliminary assessment of the potential relationship between estimated respiratory risks associated with air toxics and overall school academic performance (M. Pastor, J. Sadd, and R. A. Morello-Frosch 2002).

Method and data sources

All school locations were geocoded to host census tracts and linked to a set of environmental hazard indicators, including tract-level estimates of lifetime individual cancer risk and a respiratory hazard index, both associated with ambient exposures to air toxics from mobile and stationary emission sources. Estimated cancer risk and respiratory hazard indices were derived by combining modeled estimates of ambient air toxics concentrations with corresponding toxicity data information from the U.S. Environmental Protection Agency and the California Environmental Protection Agency. The methodology for calculating these cancer and noncancer risk estimates is discussed extensively elsewhere (Caldwell et al. 1998; Morello-Frosch, Pastor, and Sadd 2001; Morello-Frosch et al. 2000). Exposure data were derived from a modeling analysis undertaken by the U.S. Environmental Protection Agency's Cumulative Exposure Project, which estimated long-term average concentrations for 1990 of 148 air toxics for every census tract in the contiguous United States (U.S. Environmental Protection Agency 1998). Emissions data used in the model take into account large stationary sources (such as Toxic Release Inventory facilities), small area service industries and fabricators (such as dry cleaners, auto body paint shops, and furniture manufacturers), and mobile sources (such as cars, trucks, and air craft). The modeling algorithm takes into account meteorological data and simulation of atmospheric processes (Rosenbaum et al. 1999; Rosenbaum, Ligocki, and Wei 1999).

Cancer risk estimates were derived using inhalation unit risk estimates, which are a measure of carcinogenic potency for each pollutant (U.S. Environmental Protection Agency 1986). Cancer risks for each pollutant in each census tract were derived with the following formula:

$$R_{ij} = C_{ij} \times IUR_j,$$

where R_{ij} is the estimate of individual lifetime cancer risk from pollutant j in census tract i, C_{ij} is the concentration of hazardous air pollutant j in micrograms per cubic meter ($\mu g/m^3$) in census tract i, and IUR is the inhalation unit risk estimate, or cancer potency, for pollutant j in $(\mu g/m^3)^{-1}$. The cancer risks of different air toxics were assumed to be additive and were summed together in each census tract to estimate a total individual lifetime cancer risk in each tract.

For respiratory health risks, pollutant concentration estimates were divided by their corresponding reference concentration for chronic respiratory effects to derive a hazard ratio (Dourson and Stara 1983). Respiratory hazard ratios for each pollutant in each census tract were calculated using the following formula:

$$HR_{ij} = C_{ij}/RfC_j,$$

where HR_{ij} is the hazard ratio for pollutant j in tract i, C_{ij} is the concentration in $\mu g/m^3$ of pollutant j in census tract i, and RfC_j is the reference concentration for pollutant j in $\mu g/m^3$. An indicator of total respiratory hazard was calculated by summing the hazard ratios for each pollutant to derive a total chronic respiratory hazard index:

$$HI_i = \Sigma_j HR_{ij},$$

where HI_i is the sum of the hazard ratios for all pollutants (j) in census tract i. This measure assumes that multiple subthreshold exposures may result in an adverse health effect.

School-level information came from the October 1999 California Basic Educational Data System, an annual data collection program administered by the California Department of Education Demographic Research Unit that includes basic school information as well as data on 1997-1998 enrollment and ethnic makeup of the student population by school (M. Pastor, J. L. Sadd, and R. Morello-Frosch 2002).

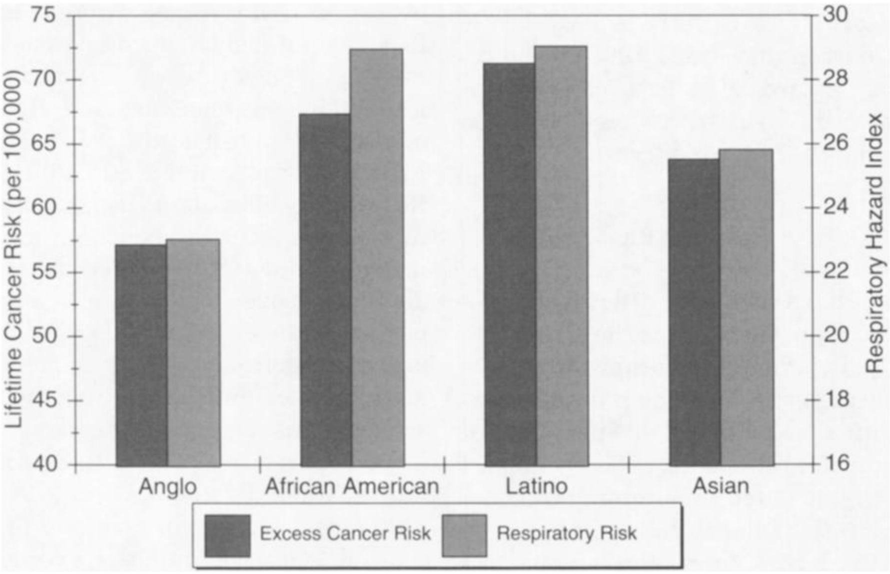
Results

Estimated lifetime cancer risks associated with outdoor air toxics exposures in Los Angeles were found to be ubiquitously high, often exceeding the Clean Air Act goal of one in 1 million by between one and three orders of magnitude (Morello-Frosch, Pastor, and Sadd 2001).[1] Respiratory hazards, although not as high, exceeded health benchmarks in many locations (Morello-Frosch et al. 2000). Moreover, on average, a major portion of the estimated health risks are coming from pollutants generated from mobile and small area source emissions as compared to large point sources (Morello-Frosch, Pastor, and Sadd 2001).

Figure 1 shows the average lifetime cancer risk and the average chronic respiratory hazard index by schoolchildren of different racial and ethnic groups. The graph indicates that Latino and African American students bear the greatest burden of lifetime cancer risks associated with ambient air toxics, but Asian schoolchildren also face higher risks than Anglos. A similar pattern emerges for estimates of respiratory hazard (M. Pastor, J. L. Sadd, and R. Morello-Frosch 2002).

We then examined the relationship between school demographics and cancer and noncancer health risks associated with air toxics using multivariate regression (see Table 1). Estimated respiratory and cancer risks were modeled as a function of the proportion of students of color within each school as well as location-specific (or tract-level) characteristics, including percentage of

FIGURE 1
CANCER AND RESPIRATORY RISKS FOR SCHOOLCHILDREN, BY RACE—LOS ANGELES UNIFIED SCHOOL DISTRICT



land devoted to industrial use, population density, median household income, and the proportion of home ownership. Although this is not an explicitly causal model, these regressions provide an assessment of the relationship between school demographics and estimated health risks after controlling for other key factors, which may indicate whether there are issues of environmental inequality among Los Angeles schoolchildren. Regression results show that after controlling for key covariates, the proportion of students of color at a school site continues to be a statistically significant factor for increased estimated cancer and respiratory risks associated with ambient air toxics exposures (M. Pastor, J. L. Sadd, and R. Morello-Frosch 2002).

To assess whether environmental hazards and estimated respiratory risks may affect student school performance, we assessed the relationship between school educational outcomes and estimated respiratory risk. To do this, we utilized California's Academic Performance Index, a summary score of school performance based on the Stanford 9 achievement test given as part of the state's mandated testing program (M. Pastor, J. Sadd, and R. A. Morello-Frosch 2002). It is important to note that we do not have measures of individual student performance but rather a score for the entire school that helps in ranking a particular school in question against other schools.[2] Such school-level studies are increasingly common because of

TABLE 1

RELATIONSHIPS OF SCHOOL DEMOGRAPHICS TO ESTIMATED HEALTH RISKS ASSOCIATED WITH AMBIENT AIR TOXICS—LOS ANGELES UNIFIED SCHOOL DISTRICT

	Ordinary Least Squares Regression			
	Cancer Risk		Respiratory Risk	
Demographic	Coefficient	*T*-Score	Coefficient	*T*-Score
Percentage of land devoted to industrial land use	0.121	2.701***	0.039	1.402*
Population density per square mile	0.086	8.169***	0.033	5.005***
Median household income	–0.033	–1.080	–0.011	–0.565
Rate of home ownership	–0.168	–3.407***	–0.067	–2.173**
Minority students as percentage of school site	0.117	2.111**	0.078	2.274**
F value/log likelihood	96.8***		41.2***	
Adjusted or Nagelkerke R^2	.456		.260	
n	572		572	

*Significant at the .20 level. **Significant at the .05 level. ***Significant at the .01 level.

the way in which states and school districts have focused on schools as the unit of accountability, which requires an emphasis on aggregate performance (Bickel and Howley 2000; Fowler and Herbert 1991).

The map in Figure 2 shows the geographic pattern when we compare the estimated cumulative respiratory hazard ratio, split into thirds, to quartiles of school performance; the visual correlation between higher risk estimates and lower scores is striking. Figure 3 helps to contextualize this map by showing the average school Academic Performance Index score for schools, ranked by lowest respiratory hazard to highest respiratory hazard associated with ambient air toxics, with the risk groups each reflecting one-third of all schools. As can be seen, the differences are substantial as schools located in tracts with the highest estimated respiratory hazard have a performance differential of about 20 percent compared to schools located in tracts with the lowest risk level. This 20 percent differential is sizable, roughly matching the average difference between the bottom third and middle third of schools in terms of academic performance.

These preliminary results, showing a correlation between estimated respiratory risks and Academic Performance Index scores, are likely to be influenced by other demographic characteristics that affect student academic performance. A stepwise regression approach found that increasing estimated respiratory risks has a negative and statistically significant impact on overall school performance on the Academic Performance Index, even when controlling for the other factors that should explain such indicators of academic achievement. Key factors that were entered into the model included the percentage of children receiving free school lunches (see Krueger 1999;

FIGURE 2

PUBLIC SCHOOL ACADEMIC PERFORMANCE INDEX (API) AND ESTIMATED CUMULATIVE RESPIRATORY RISK FROM AMBIENT AIR TOXICS EXPOSURE—LOS ANGELES UNIFIED SCHOOL DISTRICT

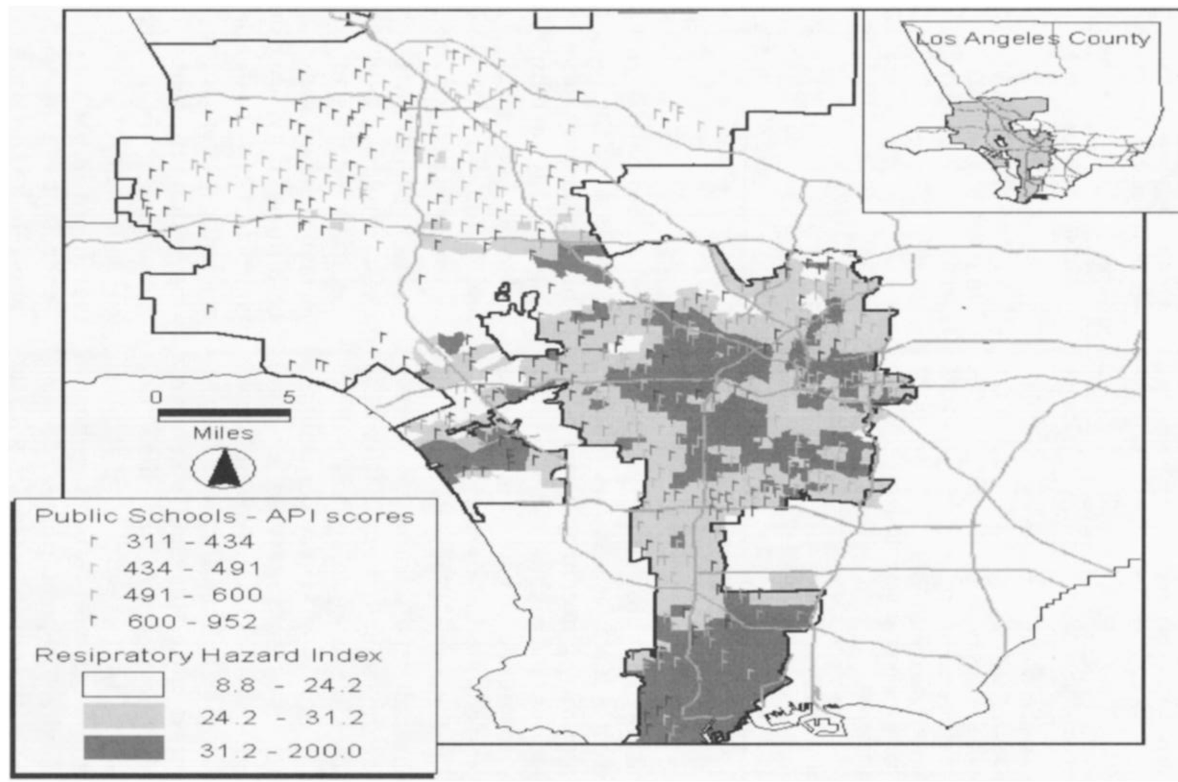
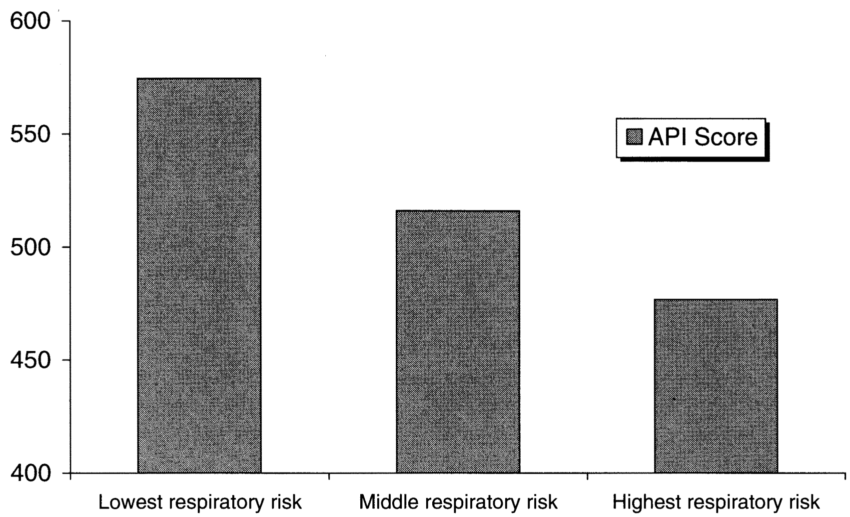


FIGURE 3
ACADEMIC PERFORMANCE INDEX (API) SCORE, BY RESPIRATORY HAZARD RANKING



Orfield 1997), the percentage of teachers with emergency credentials (an indicator of teaching quality), average class size and school size, whether schools were on year-round schedules, the percentage of students who are just learning English,[3] a measure of student mobility (the number of students who are new to a school that year), and parents' educational attainment level with all variables also coming from the state's Academic Performance Index database (M. Pastor, J. Sadd, and R. A. Morello-Frosch 2002).

Thus, this cross-sectional study indicates that minority students, particularly African Americans and Latinos, are more likely to bear the burden of attending school in locations where estimated cancer and respiratory risks from air toxics tend to be highest. Moreover, after controlling for demographic covariates, it appears as if indicators of respiratory risk associated with air toxics are associated with diminished school performance.

IMPLICATIONS OF RESULTS FOR POLICY MAKING

Preliminary results from our analysis indicate that there may be serious environmental justice concerns for minority students attending public schools in Los Angeles. While all Los Angeles schoolchildren face problematic outdoor air toxics exposures and associated health risks, minority (especially African American and Latino) youth seem to bear the largest share of the burden. Moreover, these estimated respiratory hazards associated with air toxics appear to negatively affect indices of school performance. While the causal chain and biological mechanisms are not clearly specified, the association, even after controlling for other important covariates, is problematic given the existing tendency of predominantly minority and poor schools to underperform academically.

While our results cannot be meaningfully generalized beyond Los Angeles, our study offers some useful policy lessons and has implications for future research on the intersection of environmental justice and children's health. First, our study results reinforce the need to take a more holistic approach to environmental health and justice research. As more comprehensive data become available, future studies need to move away from locational and pollutant-by-pollutant analysis and toward a cumulative exposure approach that gets at the ultimate question of what disparities in exposures mean for potential inequities in health risks. Due to a paucity of comprehensive epidemiological data to answer this question, we are often left with the tools of risk assessment, which even within an equity analysis framework remains controversial among the public and policy makers alike (Kuehn 1996; Latin 1988). However, we sought to use risk assessment comparatively to assess the distribution of health risks associated with ambient air toxics exposures among schoolchildren in Los Angeles. Although the analysis focused on one exposure media, air pollution, it characterized potential health risks from cumulative exposures to multiple chemicals from multiple sources (e.g., mobile and stationary sources). Results here show that with a paucity of good epidemiological data, risk assessment can provide crucial information for communities and policy makers who are grappling with potentially high-stakes environmental equity issues related to school siting decisions.

Moreover, with student enrollments spiraling and mounting pressure to ease severe overcrowding in Los Angeles schools, the district is faced with the Herculean task of building more than eighty new schools during the next five years (Trotter 2002). This scenario, which is occurring in urban districts across the country, raises challenges for balancing the need to enhance educational opportunities for students in the district, most of whom are students of color, with the need to address legitimate environmental health concerns about siting new facilities. The difficulties of resolving this conflict came to light during a recent controversy in 1999 over construction of the Belmont Learning Complex, a state-of-the-art school designed to relieve overcrowding in a largely Latino immigrant section of the city. Unfortunately, the school was sited in a former oil field with active methane gas leaks and soil contaminated with carcinogenic compounds (Anderson 2000).

In the wake of the Belmont controversy, some have forcefully argued that building schools in densely populated urban areas may require the use of brownfield land and that slowing down construction or failing to quickly identify sites will have a negative impact on the educational opportunities and futures of minority schoolchildren (Blume 2000;

Hernandez 1999; Metropolitan Forum Project 1999). Yet preliminary data from our study showing demographic disparities in health risks associated with air toxics exposures among schoolchildren should encourage precaution on the part of critics who argue against strict and potentially costly environmental standards for siting new schools. Indeed, both environmental justice concerns and the precautionary principle would promote the notion that any future construction plans should take into account the disparities in environmental hazard distributions among minority schoolchildren in the district, particularly given the overall poorer health status of these populations (U.S. Environmental Protection Agency 1992). These environmental inequalities have implications for public policy in terms of future zoning, siting decisions, and general school-based intervention strategies aimed at improving the health status and educational opportunities of minority students. At a minimum, this situation of environmental inequity should not be further aggravated by future expansion plans.

One lesson learned from the Belmont controversy and our preliminary study results is that environmental health concerns must always be part of the equation when deciding how to site new school facilities. Standards for acquiring and cleaning up brownfields for school construction should be clarified and take into account the particular vulnerability of children to environmental hazards. A positive outgrowth of the Belmont controversy is a new requirement that potential sites for school construction must pass an environmental review by California's Department of Toxic Substances Control. This development is a key step in the right direction in terms of proceeding with precaution to ensure that children's environmental health concerns are adequately addressed. However, it also raises a polemical social justice issue for urban districts that face unique challenges in finding suitable sites for school construction but are also pressured to expedite the siting and construction process to ensure that they receive adequate and timely state funding to support new projects. Until recently, California's system for allocating state funds to support massive school construction initiatives such as those desperately needed in Los Angeles functioned on a first-come, first-served basis. This seemingly neutral and fair policy had the unintended effect of placing urban school districts at a severe financial disadvantage and created a strong disincentive to integrate the precautionary principle and environmental justice concerns when weighing the merits and pitfalls of potentially new sites for future schools. Currently, the funding allocation system is being overhauled to accommodate urban districts facing unique and difficult challenges, both in acquiring suitable property and redeveloping industrial land to build new schools. Further efforts to address the overwhelming challenges faced by the Los Angeles Unified School District in accommodating the space needs of its rapidly expanding student body will require leadership and collaboration between impacted communities, the school district, city and state officials, and even the private sector to ensure that the environmental health and educational needs of children of color are effectively addressed.

CONCLUSION: THE PROMISE OF PRECAUTION AND ENVIRONMENTAL JUSTICE FOR POLICY MAKING

The issue of children's environmental health has been used as the quintessential example for making the case to support environmental justice and the precautionary principle in environmental regulation and policy making (Bullard 1994; Tickner and Hoppin 2000). The persistent and tragic problem of childhood lead poisoning highlights the need to better integrate both of these frameworks to better protect children's environmental health. Indeed, historical failures in policy making to exercise precaution and to decisively act to eliminate lead from paint and gasoline has created a situation in which currently 1 million U.S. children continue to exceed the benchmark for blood lead level exposure that affects development (Schettler et al. 2001). This failure to enact precaution has had a disparate impact on urban children of color, who tend to have the highest average blood lead levels, and their attendant neurological and developmental effects.

Our study results on the environmental justice implications of air toxics exposure among Los Angeles schoolchildren provide some preliminary and suggestive data to justify the development of policy strategies in the district that uphold both environmental justice and the precautionary principle. Creating a process to assess the environmental hazards of new construction sites, coupled with changing the statewide school bond funding allocation system to address the needs of urban districts serving predominantly minority students, demonstrates how these two principles can be effectively integrated in the policy-making arena. In addition, the Los Angeles Unified School District's recent integrated pest management policy to decrease pesticide use in the schools further demonstrates how community organizing can effectively create significant local policy shifts that protect children, particularly children of color (Prussel and Tepperman 2001).

Purposeful strategies for integrating environmental justice and the precautionary principle are key if we are to effectively protect vulnerable populations and eliminate persistent race- and class-based disparities in environmental hazard exposures and health outcomes. Although it is important to acknowledge the unique histories of community organizing and policy advocacy that underlie these two distinct policy principles, environmental justice and the precautionary principle have some important overlapping goals, which are delineated in Table 2. These include (1) *Public health and disease prevention for environmental justice,* i.e., protecting communities of color from the environmental health effects of institutional and social discrimination. For the precautionary principle, this goal implies a commitment to preventing harm to human health or ecosystems in the face of inadequate scientific tools and incomplete, but suggestive, data. *(2) Shifting the burden of proof:* environmental justice advocates reject the notion that claims of environmental inequality must demonstrate a pattern of discriminatory intent and disparate impact, a requirement that creates formidable barriers to communities seeking remedies or policy action to address disparities in environmental hazard exposures. Similarly, the precautionary principle proposes that chemicals should not be considered innocent until proven guilty but rather that proponents of a proposed new activity rather than the public must bear responsibility for demonstrating that a new product or chemical is safe. *(3) Procedural justice and democratic decision making:* here environmental justice and the precautionary principle offer divergent yet complementary objectives for ensuring public participation in decisions that affect community environmental health. Environmental justice proposes a political economy perspective that asserts the need to enhance community capacity to shape environmental policy making and regulatory enforcement and to influence regional and economic development activities in systematic ways that benefit (or at least do not harm) its residents. The precautionary principle emphasizes procedural justice by promoting the concept of alternatives assessment, which entails a democratic, open, and transparent process to examine viable alternatives to potentially harmful activities. This process can be applied to government, through requirements of the National Environmental Protection Act, for example, which requires an environmental impact statement that describes the adverse and beneficial consequences of federally funded projects and their alternatives. Alternatives assessment is also the key element of the Massachusetts Toxic Use Reduction Act, which requires industries using a threshold quantity of certain chemicals to periodically undergo a process to identify alternatives to reduce chemical use. Both of these approaches to alternatives assessment allow for a certain level of public disclosure, comment, and input.

The integration of environmental justice and the precautionary principle offers possibilities for new and innovative approaches to addressing issues of children's environmental health. Community participation is key for developing long-term regulatory, enforcement, and economic development initiatives that are sustainable and that protect the health of diverse and vulnerable communities. Moreover, decision making about regulatory action in the face of inadequate scientific tools and uncertain data must be transparent and democratic, particularly given that polemical questions of whether and how to regulate hazards often transcend the realm of science, data, and risk assessment and become political, socioeconomic, and moral judgment calls. The challenge for advocates, scientists, and policy makers alike is to keep in mind that environmental policy making is generally carried out in a milieu where the

TABLE 2
A FRAMEWORK FOR INTEGRATING THE PRECAUTIONARY PRINCIPLE AND ENVIRONMENTAL JUSTICE

Environmental Justice Principle	Principle of Integration	Precautionary Principle
Protect communities of color and the poor against environmental inequality and the disparate impact of toxics	Public health and disease prevention	Prioritize prevention of harm and public health in the face of uncertain science and incomplete data
Eliminate the discriminatory intent standard in favor of a disparate impact standard to trigger regulatory action or remediation for environmental harm against communities of color	Shifting the burden of proof	Uphold the principle of reverse onus, which requires that proponents of a potentially harmful activity, rather than the public, bear responsibility for showing that a new product or chemical is safe
Democratize environmental, regulatory, social, and economic policy making, which requires community decision-making power in a. Environmental regulation activities, e.g., facility siting, sanctioning activities, and pollution monitoring strategies; b. Regional and economic development policy, e.g., industrial and housing development, zoning and land use, transportation planning, job creation and labor markets, and community revitalization	Procedural justice and democratic decision making on issues affecting community environmental health	Democratize environmental regulation and industrial production decisions Employ principle of least harmful alternative: Require implementing an open, democratic, and informed process of evaluating viable alternatives to a potentially hazardous activity Assess must examine adverse as well as beneficial effects of proposed activity Fully disclose who is affected by proposed activity All of which can be a requirement for government agencies (e.g., National Environmental Policy Act) or industry (e.g., Massachusetts Toxic Use Reduction Act)

distinction between the scientific and sociopolitical realms is often unclear. Integrating some of the overarching goals of environmental justice and the precautionary principle offers a new path and framework to create concrete policy tools that promote public health, disease prevention, and a safer future for everyone.

Notes

1. In 1990, Congress established a health-based goal for the Clean Air Act: to reduce lifetime cancer risks from major sources of hazardous air pollutants to one in 1 million. The act required that over time, U.S. Environmental Protection Agency regulations for major sources should "provide an ample margin of safety to protect public health" (Clean Air Act Amendments 1990).

2. For a general review of the quality of such educational indicators, see Koretz (1997).

3. English proficiency affects the overall Academic Performance Index scores, which are not adjusted for this variable. The underlying exams used to calculate the Academic Performance Index are administered in English due to the passage in California of a 1998 statewide initiative that limits bilingual instruction and testing.

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