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The Environmental Justice Index: Measuring Cumulative Impacts of Environmental Burdens on Health

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Editor's Note: As part of our continued effort to highlight innovative approaches to improve the health and environment of communities, the *Journal* is pleased to publish regular columns from the Agency for Toxic Substances and Disease Registry (ATSDR) at the Centers for Disease Control and Prevention (CDC). ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. The purpose of this column is to inform readers of ATSDR's activities and initiatives to better understand the relationship between exposure to hazardous substances in the environment, its impact on human health, and how to protect public health.

The findings and conclusions of this column are those of the author(s) and do not necessarily reflect the views of CDC or ATSDR.

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Introduction

The environmental justice movement has increased awareness that contamination of land, air, and water has disparate impacts on communities in the U.S. and that ending environmental injustice can only be accomplished with the diminution of race, gender, and class inequities (Bullard, 2001; Perez et al., 2015). To this end, the focus of scientific research on justice-centered environmental activism has increased in recent years, as has the development of tools aimed at helping reduce environmental injustices (Lee, 2020).

In response to calls for state and federal tools that address the cumulative impacts of environmental injustice on health (Callahan et al., 2021; Lee, 2020), the Geospatial Research,

Analysis, and Services Program (GRASP) at the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry (CDC/ATSDR) partnered with the National Environmental Public Health Tracking Program within CDC and the Office of Environmental Justice within the U.S. Department of Health and Human Services to develop the Environmental Justice Index (EJI). The index was publicly released in August 2022.

Development of the Environmental Justice Index

The EJI is the first place-based, nationwide index designed to help public health officials, community-based organizations, and researchers identify and support communi-

ties facing cumulative impacts on their health from environmental and social burdens. The EJI is calculated at the census tract level, a geographic unit that is useful for analyzing community-level data for policy and planning (Krieger, 2006). The census tract level is also a standard unit used for tools that map national cumulative impacts.

Indicators of the Environmental Justice Index

Potential indicators for the EJI were identified based on the results of a thorough literature review, including a scoping review of current environmental justice literature and tools. Potential indicators were then evaluated to ensure that the data:

1. Come from a trusted, reliable, and stable national data source;
2. Accurately measure what they intend to;
3. Are at or can be easily aggregated to the census tract level; and
4. Are regularly updated for inclusion in future iterations of the EJI (ATSDR, 2023).

Following the application of these criteria, we identified 36 indicators, grouped into 10 domains and 3 overarching modules: the Social Vulnerability Module, Environmental Burden Module, and Health Vulnerability Module (Figure 1).

FIGURE 1

Indicators of the Environmental Justice Index

	Module	Domain	Indicator	Data Source
Overall Environmental Justice Rank	Social Vulnerability	Racial/Ethnic Minority Status	Minority Status	U.S. Census Bureau American Community Survey (ACS)
		Socioeconomic Status	Poverty No High School Diploma Unemployment Housing Tenure Housing Burdened Lower-Income Households Lack of Health Insurance Lack of Broadband Internet Access	
		Household Characteristics	≥65 Years ≤17 Years Individual With a Disability Speaks English “Less Than Well”	
		Housing Type	Group Quarters Mobile Homes	
	Environmental Burden	Air Pollution	Ozone Particulate Matter 2.5 (PM _{2.5}) Diesel Particulate Matter Air Toxics Cancer Risk	U.S. Environmental Protection Agency (U.S. EPA) Air Quality System and National Air Toxics Assessment
		Potentially Hazardous and Toxic Sites	National Priority List Sites Toxic Release Inventory Sites Treatment, Storage, and Disposal Sites Risk Management Plan Sites Coal Mines Lead Mines	U.S. EPA Facility Registry Service U.S. Mine Safety and Health Administration Mine Data Retrieval System
		Built Environment	Lack of Recreational Parks Houses Built Pre-1980 Lack of Walkability	TomTom MultiNet Enterprise Dataset U.S. Census Bureau ACS U.S. EPA National Walkability Index
		Transportation Infrastructure	High-Volume Roads Railways Airports	TomTom MultiNet Enterprise Dataset
		Water Pollution	Impaired Surface Water	U.S. EPA Watershed Index Online
	Health Vulnerability	Preexisting Chronic Disease Burden	Asthma * Cancer * High Blood Pressure * Diabetes * Poor Mental Health *	Centers for Disease Control and Prevention Population Level Analysis and Community Estimates (PLACES)

* Health vulnerability measures are marked with asterisks because they are calculated differently than other indicators. While most indicators can have a range of values, the health vulnerability indicators represent only whether a given census tract experiences a high estimated prevalence of disease or not.

Environmental Justice Index Model

Each indicator in the EJI is ranked from highest to lowest vulnerability across all census tracts in the nation for which data are avail-

able, producing a percentile rank score for each indicator for each census tract. Module scores are calculated a bit differently, depending on the module. For example, scores for the Social Vulnerability and Environmental

Burden Modules are calculated by summing the percentile rank scores for constituent indicators and then assigning each tract a percentile rank score for that module based on the scores of all constituent indicators.

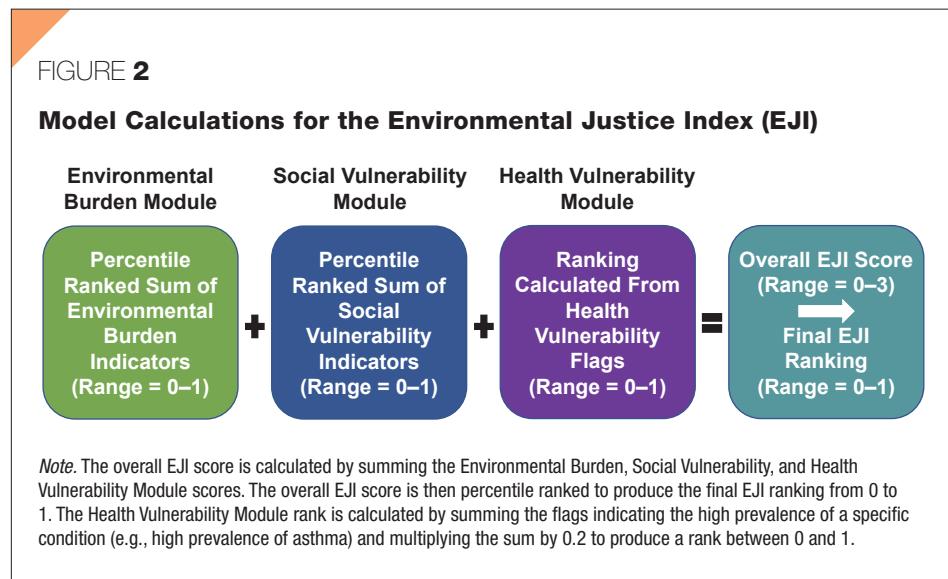
On the other hand, Health Vulnerability Module scores are calculated by first determining if the indicator estimate for a tract ranks in the top one third nationwide (>66.66%). If so, the tract is assigned a flag score of 1, otherwise, it receives a flag score of 0. The Health Vulnerability Module score is then calculated by summing the number of flags and multiplying this sum by 0.2 to produce a module score between 0 and 1, which ensures that all modules are weighted equally in the overall EJI. The overall EJI score is then calculated by summing the ranked scores of these three modules to determine an overall percentile ranking for each census tract (Figure 2).

The EJI model is based on the Environmental Justice Screening Method (EJSM; Sadd et al., 2011). The EJI differs, however, from other EJSM-derived tools—such as CalEnviroScreen (California Office of Environmental Health Hazard Assessment, 2021)—as the EJI uses an additive rather than multiplicative model. The EJI also differs from CalEnviroScreen and similar tools in that it does not give a heavier weight to pollution exposures than to other environmental justice factors. These decisions were intended to facilitate easy adaptation and interpretation of the EJI by a wide range of users with varying technical expertise and health literacy.

Using the Environmental Justice Index

The overall EJI rank is a useful tool for identifying and prioritizing communities experiencing high cumulative impacts of environmental burdens on health and health equity. Once highly burdened census tracts are identified, the module, domain, and indicator scores that drive high EJI ranks can be used to inform actions that are targeted to their specific social, environmental, and health burdens.

For example, during an environmental assessment for a new program in Manhattan, New York, census tracts along the Cross Bronx Expressway were identified as already experiencing high cumulative impacts from environmental burdens and thus were prioritized for mitigative actions based on their overall EJI rank. By taking a closer look into the module, domain, and indicator ranks provided in the EJI, it was clear that air pollution indicators (specifically diesel particulate matter and air toxics cancer risk) in the Environmental Burden Module and the high preva-



lence of chronic health conditions (including asthma and diabetes) in the Health Vulnerability Module were driving cumulative impacts in this area. As a result, recommendations for focused health protective mitigation measures, including the installation of air filtration systems and funding low- and zero-emission public transportation, were made to sponsoring agencies (Office of the Assistant Secretary for Health, 2022).

Limitations of the Environmental Justice Index

The EJI is intended as a high-level mapping and screening tool that characterizes cumulative impacts and patterns of environmental injustice across the U.S. and is a useful starting point for investigating issues of distributive and procedural justice and their effects on health and well-being. The EJI is not, however, intended for labeling highly impacted communities as “environmental justice communities,” nor is it intended to characterize all environmental justice issues that a community might experience. Additionally, as environmental injustice occurs locally, high-level tools, such as the EJI, cannot fully represent all the social, environmental, or health issues that a community might face, as the data representing these issues (e.g., pesticide use, low birthweight) might be limited or too coarse to be applied at a neighborhood scale. Given that the environmental indicators included in the EJI do not represent detailed measures of risk or exposure assessment, the EJI is not intended as a

representation of risk or exposure for a given community or as a tool to discern whether individuals are at risk of exposure.

While the full EJI ranking is useful for the identification, prioritization, and characterization of cumulative impacts in an area, it is not designed for use in secondary analysis where disease is the outcome of interest. To make the EJI more useful in this context, the EJI Social–Environmental Ranking was created using only the Environmental Burden and Social Vulnerability Modules of the EJI. Health outcome prevalence estimations from the Health Vulnerability Module were not included in its construction, making it appropriate for studying associations with health outcomes. The EJI Social–Environmental Ranking can be found in the EJI database at <https://eji.cdc.gov>.

Conclusion

The EJI adds to a growing body of literature and tools as the first national, place-based tool that looks at the cumulative impacts of environmental burdens on health. By using a cumulative impacts framework and relative rank methodology, the EJI allows users to identify communities experiencing high cumulative impacts from environmental burdens, so that those communities can be prioritized for mitigative action. This framework also allows users to further investigate indicators that could be driving high cumulative impacts in a community so that mitigative action can be tailored to meet the needs of individual communities. Lastly, this framework allows users

to adapt the EJl to their own needs, such as by removing Health Vulnerability Module indicators for use in studying health outcomes or by adding local indicators when appropriate. ❁

Acknowledgements: The authors thank Meekie Shin and Mitra Kashani from the National Environmental Public Health Tracking Program within CDC for their attention to detail and review of this column.

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