and related surgery), and provider reimbursement rates for patients who receive public assistance are relatively low compared with private rates.[11–13] Thus, those without private insurance may have less opportunity to utilize health care services because public programs may not cover these "elective" procedures, or the costs of care may be too high for many families who no longer have insurance.

Within the context of evidence-based care, our findings underscore the dearth of health outcomes like health-related QoL and emotional well-being among youths with cleft. To date, it is unresolved whether the surgical needs among youths representing people of color or people lacking private insurance receive the recommended or optimal care. Given the importance of facial attractiveness in our culture,[14] one might hypothesize that denial of recommended services aimed to improve facial appearance may be associated with reduced QoL and emotional well-being. Yet such patient-oriented outcomes are not routinely collected. Additionally, it is unknown whether elective secondary treatment actually improves OHRQoL. In this evidence-based care era, we are advocating that these issues be addressed systematically using longitudinal research designs. Such research could inform health policy regarding access to care for elective procedures (e.g., secondary lip or nose revisions for children with CLP, orthognathic surgery) and health outcomes. To establish cleft care standards, especially for individuals with reduced access to care, these public policy health issues are crucial. In short, until these issues are fully explored, health policy remains lacking critical evidence regarding access and quality of care.

In summary, this report reveals OHRQoL differences associated with specific demographic characteristics and identifies a possible connection between these differences and disparities in health care utilization and access to care. It also suggests the importance of longitudinal investigation of patient-oriented outcomes to measure treatment effectiveness of secondary cleft treatment among youths. ■

About the Authors

Hillary L. Broder and Lacey Sischo are with the Department of Cariology and Comprehensive Care, New York University College of Dentistry, New York, NY. Maureen Wilson-Genderson is with the Department of Social and Behavioral Health, Virginia Commonwealth University School of Medicine, Richmond.

Correspondence should be sent to Hillary L. Broder, PhD MEd, NYU College of Dentistry, Cariology and Comprehensive Care, 380 Second Avenue, Suite 301, New York, NY 10010-5615 (e-mail: hillary.broder@nyu.edu). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

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Contributors

H. L. Broder designed the study and assisted in article preparation and data analysis. M. Wilson-Genderson conducted the statistical analysis and contributed to article preparation. L. Sischo aided in article preparation.

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Human Participant Protection

Institutional review board approval was received from each site for this study.

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Mapping Cumulative Environmental Effects, Social Vulnerability, and Health in the San Joaquin Valley, California

Ganlin Huang, PhD, and Jonathan London, PhD

To understand the social distribution of environmental hazards, methods to assess cumulative effects and their health implications are needed. We developed a cumulative environmental hazard index integrating environmental data on pollution sites, air quality, and pesticide use; a social vulnerability index to measure residents' resources to prevent or mitigate health effects; and a health index. We found that communities in California's San Joaquin Valley with high social vulnerability face more environmental burdens and have worse health conditions. (*Am J Public Health*. 2012;102:830–832. doi:10.2105/AJPH.2011.300466)

Environmental hazards are not distributed randomly. Many low-income communities[1] and communities of color[2] face a higher concentration and magnitude of environmental hazards with significant potential health effects. These hazards, across multiple media, tend to cluster with one another, creating

TABLE 1—Cumulative Environmental Hazards Index, Social Vulnerability Index, and Health Index: San Joaquin Valley, CA

Data Set	Source	Years
Cumulative Environmental Hazards Index		
Toxic release inventory sites	US Environmental Protection Agency	2006
Refineries	California Air Resources Board	2006
Hazardous waste treatment, storage, and disposal facilities	California Department of Toxic Substance Control	2006
Chrome platters	California Department of Toxic Substance Control	2006
Total amount of agricultural pesticide application per 1 $mile^2$	California Department of Pesticide Regulation	2007
National-scale air toxic assessment	US Environmental Protection Agency	2005
Social Vulnerability Index		
Sensitivity of receptors		
Percentage of people aged < 5 or > 60 y	American Community Survey	2005–2009
Locations of health care facilities	Cal-Atlas (http://atlas.ca.gov/download.html)	2010
Availability of social and economic resources		
Percentage of linguistically isolated households	American Community Survey	2005–2009
Percentage of population in poverty	American Community Survey	2005–2009
Percentage of people of color	American Community Survey	2005–2009
Percentage of people aged > 25 y without a high-school diploma	American Community Survey	2005–2009
Health Index		
Low birth weight rate	California Department of Public Health	1999–2007
Years of potential life lost before age 65 y	California Department of Public Health	1999–2007
Asthma hospitalization rate ages 0–19 y	California Office of Statewide Health Planning and Development	1999–2007

a cumulative effect. Communities with multiple environmental hazards tend to have fewer social, political, and economic resources to mitigate the potential health effects and to advocate on their own behalf.[3–5] This has been described as the "double jeopardy" of environmental injustice and a systemic driver of health disparities.[4,6] Environmental justice advocates argue that new policy approaches are needed to address the sociospatial bias that disproportionately puts their communities at risk.[7–9]

We developed a cumulative environmental health effects analysis methodology that combines measures of environmental hazards, social vulnerability, and health conditions to understand the environmental injustices in California's San Joaquin Valley.

METHODS

We developed a cumulative environmental hazard index that integrated 6 data sets:

1. toxic release inventory sites;
2. refineries;
3. hazardous waste treatment, storage, and disposal facilities;
4. chrome platters;
5. pesticide applications for agricultural use; and
6. national-scale air toxic assessment.

These variables represent a significant portion of the overall environmental hazards in the region and have been validated in other environmental justice studies.[3,8]

We used census block groups as the unit of analysis. The cumulative environmental hazard index is a relative measure of environmental hazards in and around each block group and scores between 0 and 1. A higher value indicates that more environmental hazards are found within or around the block group.

The first 4 data sets—toxic release inventory sites; refineries; hazardous waste treatment, storage, and disposal facilities; and chrome platters—describe point source pollution (Table 1). The percent area of each block group that falls within the 1-mile buffer was calculated and incorporated into the cumulative environmental hazard index along with indicators describing pesticide applications and air toxic risks.

Pesticide density was described as the total amount of active ingredient per square mile of agricultural pesticide applications. We calculated the mean value of pesticide density for each block group. We used the national-scale air toxic assessment to estimate the risk of different kinds of cancer and other serious health effects from inhaling air toxics. This analysis was based on census tracts: we assigned the total risk of cancer of a tract to all the block groups contained within it.

Finally, we normalized the data by dividing each data set by its maximum value. The cumulative environmental hazard index was then calculated as the mean value of the 3 data sets (point source, pesticides, air toxic health risks).

Social Vulnerability Index

We developed a social vulnerability index that included 6 data sets (Table 1):

1. age,
2. locations of health care facilities,

3. linguistic isolation,
4. poverty rate,
5. race/ethnicity, and
6. education.

Census block groups were used as the unit of analysis. The social vulnerability index measures both the sensitivity of the receptors and the social and economic resources available to prevent or mitigate effects.

The social vulnerability index was calculated as the mean value of the 6 data sets resulting in a relative measure with values between 0 and 1: the higher the value, the more vulnerable the residents of a block group are to the effects of environmental hazards.

Health Index

A health index was constructed from data on low-birth-weight rate, years of potential life lost before age 65 years, and asthma hospitalization rate for ages 0 to 19 years. These factors have been shown to be correlated with a range of environmental hazards.[3,5,8] These health data were reported by zip code and provided by Central Valley Health Policy Institute, California State University, Fresno. We converted data to block groups in ArcGIS 9.3 (ESRI, Redlands, CA).

We normalized low birth weight rate, years of potential life lost before age 65 years, and asthma hospitalization rate for ages 0 to 19 years by dividing each data set by its maximum value. For each zip code, the maximum value of the 3 health indicators was assigned as the value on the health index. In this way, the health index was designed to reflect high value (i.e., more health problems) from any indicator.

Finally, we conducted a correlation analysis among the cumulative environmental hazard index, social vulnerability index, and health index in SPSS version 19 (IBM, Somers, NY).

RESULTS

Our results showed that the cumulative environmental hazard index was correlated (via Pearson product moment correlation) with the social vulnerability index and health index at the 99% confidence level, with coefficients of 0.296 and 0.092, respectively. These results align with those of earlier studies that showed a correlation of race, ethnicity, and socioeconomic status with the presence of disproportionate environmental hazards.[3,5,7,9] Populations confronting higher concentrations of environmental hazards and greater health challenges also tend to be the very populations that are most sensitive and vulnerable to these environmental and health conditions.

DISCUSSION

We used indices that combined multiple indicators to construct a cumulative measure of the environmental, social, and health conditions. This attention to cumulative influences and conditions, and not only single-issue or single-media analyses, allows for a more holistic understanding of the lived experiences of the most vulnerable populations and hopefully collaborative partnerships between environmental justice advocates and public environmental and health agencies. ■

About the Authors

Ganlin Huang is with the Center for Regional Change, University of California, Davis. Jonathan London is with the Department of Human and Community Development and Center for Regional Change, University of California, Davis.

Correspondence should be sent to Ganlin Huang, PhD, Center for Regional Change, UC Davis, Mapping Lab, 152 Hunt Hall, One Shields Ave, Davis, CA 95616 (e-mail: ganlinhuang@hotmail.com). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

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Contributors

G. Huang originated the study, completed the analysis, and led the writing and revisions of the brief. J. London supervised the study and contributed to the study design and analysis. Both authors edited and approved the brief.

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Note. The analysis was completed by the authors and does not necessarily reflect the opinions of the San Joaquin Valley Cumulative Health Impact Project.

Human Participant Protection

No protocol approval was necessary because we used only health data (low-birth-weight rate, years of potential life lost before age 65 years, and asthma hospitalization rate for ages 0–19 years) aggregated at the zip code level.

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