# Pollution, Poverty, and Potentially Preventable Childhood Morbidity in Central California

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**Objective** To measure ecological relationships between neighborhood pollution burden, poverty, race/ethnicity, and pediatric preventable disease hospitalization rates.

**Study design** Preventable disease hospitalization rates were obtained from the 2012 California Office of Statewide Health Planning and Development database, for 8 Central Valley counties. US Census Data was used to incorporate zip code level factors including racial diversity and poverty rates. The pollution burden score was calculated by the California Office of Environmental Health Hazard Assessment using 11 indicators. Poisson-based negative binomial regression was used for final analysis. Stratification of sample by age, race/ethnicity, and insurance coverage was also incorporated.

**Results** Children experiencing potentially preventable hospitalizations are disproportionately low income and under the age of 4 years. With every unit increase in pollution burden, preventable disease hospitalizations rates increase between 21% and 32%, depending on racial and age subgroups. Although living in a poor neighborhood was not associated with potentially avoidable hospitalizations, children enrolled in Medi-Cal who live in neighborhoods with lower pollution burden and lower levels of poverty, face 32% lower risk for ambulatory care sensitive condition hospitalization. Children living in primary care shortage areas are at increased risk of preventable hospitalizations. Preventable disease hospitalizations increase for all subgroups, except white/non-Hispanic children, as neighborhoods became more racially diverse.

**Conclusions** Understanding the geographic distribution of disease and impact of individual and community level factors is essential to expanding access to care and preventive resources to improve the health of children in California's most polluted and underserved region. *(J Pediatr 2016;168:198-204).*

A mbulatory care sensitive conditions (ACSCs) are diagnoses for which timely and effective outpatient, or ambulatory, treatment can help reduce the likelihood of hospitalizations through prevention and/or management of a health condition.[1] Examples of ACSC diagnoses in pediatric hospitalizations include asthma, pneumonia, and conditions for which immunizations are available.[2] Prior research highlights the effects of insurance status and access to primary care as key determinants of ACSCs.[3-5]

Inequalities in ACSC hospitalizations point toward the larger issue of social inequalities in health. Understanding the characteristics of communities disproportionately shouldering ACSC hospitalizations is an important step in identifying associated causes. Research demonstrates an overall pattern suggesting that the clustering of social, economic, and environmental health risks in low income and racially segregated neighborhoods limits opportunities for people in these communities to live healthy lives.[6,7] The combined ecological/neighborhood exposures are also known as "multiple risk exposure" and "cumulative risk" and appear to be particularly detrimental for children.[8] A prominent theory is that the burden of cumulative exposure over the life course increases the vulnerability of individuals, usually members of traditionally excluded racial/ethnic groups in lower socioeconomic communities, and increases the likelihood that elevated environmental exposures will impair their health.[9]

California's San Joaquin Valley (SJV) is an important region, responsible for a substantial portion of the nation's agricultural production. Its residents suffer from high rates of poverty and cumulative exposure to environmental hazards, as indicated in the **Figure**. Recent studies in the SJV demonstrated that residents of its 8 counties experience worse overall health and shorter life expectancies than other California regions. The variability of life expectancy by zip code is among the highest in the nation. In zip codes with the lowest life expectancy, people can
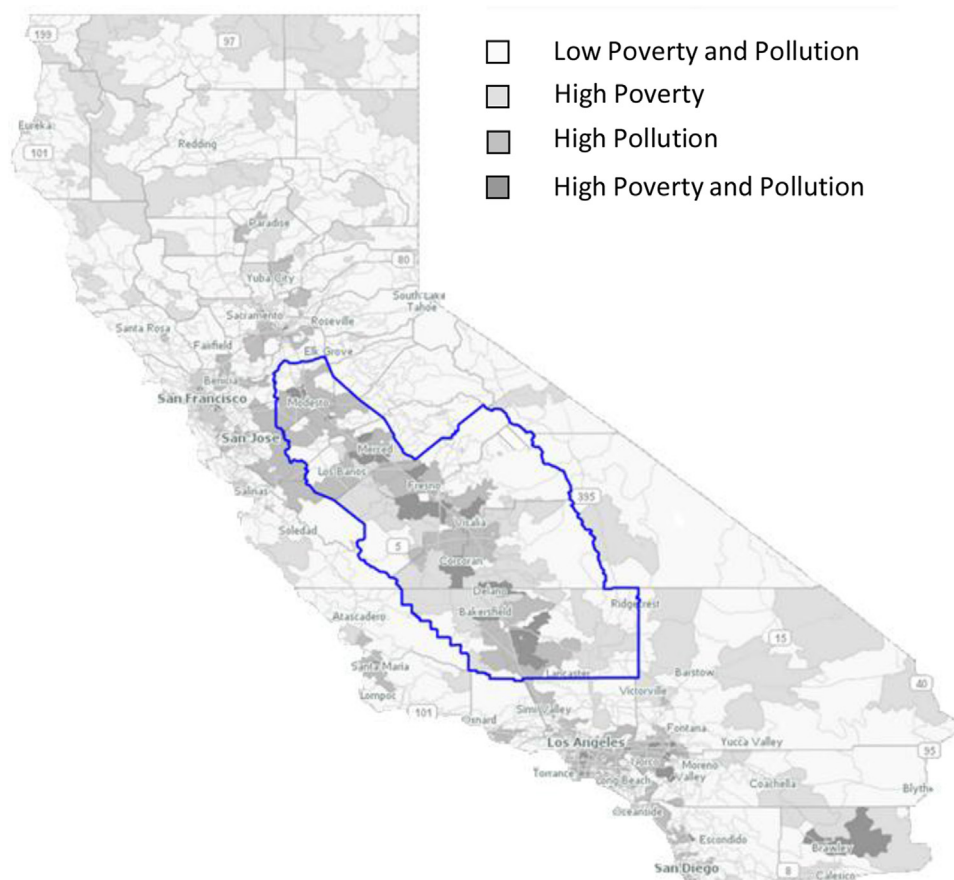
| | |
|---|---|
| ACSC | Ambulatory care sensitive condition |
| CES | CalEnviroScreen |
| FPL | Federal poverty line |
| ICD-9 | *International Classification of Diseases, Ninth Revision* |
| SJV | San Joaquin Valley |

**Figure.** Top quintile of poverty and pollution in California's SJV. Pollution Burden Score, California Office of Environmental Health Hazard Assessment (OEHHA) CalEnviroScreen version 1.0 and Individuals Living in Poverty, American Community Survey, 2012.

expect to live approximately 69 years or less, and people can expect to live to 90 years or more in zip codes with the highest life expectancy. Many of the zip codes with low life expectancy have been highlighted in recent reports describing how historic redlining policies and current development models have concentrated African American, and more recently Latino and Asian immigrant families in relatively diverse urban core and rural slum neighborhoods.[5,10]

This study seeks to analyze ACSC events in the context of race, poverty, pollution, and neighborhood composition, a cumulative approach not previously explored with ACSC diagnoses.

## Methods

This is a retrospective analysis of ACSC hospitalizations. Inpatient healthcare facilities licensed by the state of California are required to submit data to the California Office of Statewide Planning and Development semi-annually regarding all patient hospitalizations.[11] The data are de-identified and made publicly available within 2 years of admission. Each ACSC hospitalization record includes

information on the patient's race/ethnicity, age, sex, county, and zip code of residence, expected source of payment, hospital charges, and facility type. There may be repeat preventable disease hospitalizations for the same individual, but unfortunately, the de-identification process did not allow for preventable disease hospitalizations to be grouped by patient. A primary *International Classification of Diseases, Ninth Revision* (ICD-9) diagnosis and up to 24 additional diagnoses are also included. For this analysis, 2012 California Office of Statewide Planning and Development patient discharge data were used from admissions of individuals residing within the 8 SJV counties: San Joaquin; Stanislaus; Merced; Madera; Fresno; Kings; Tulare; and Kern.

### Measures

ACSC hospitalizations in the SJV were assessed using ICD-9 codes classified as prevention quality indicators by the Agency for Healthcare Research and Quality. The Agency for Healthcare Research and Quality prevention quality indicators consist of ACSCs for which appropriate outpatient care can prevent the need for hospitalizations or for which early intervention can prevent complications or more severe disease. These

measures were adapted for use in a pediatric population in a study evaluating hospital charges for preventable pediatric hospitalizations.[2] The ICD-9 designations outlined in Lu et al[2] were used to classify preventable pediatric hospitalizations for this study. For the analysis, preventable disease hospitalizations were aggregated at the zip code level by disease.

The California Environmental Protection Agency identified and grouped key indicators of exposure and effects of air and water pollution to produce the CalEnviroScreen (CES) score. Pollution burden and deprivation (population characteristics) are the 2 indices that create the cumulative impact score from the CES 1.0. Initially, a model with the CES total score (pollution burden X deprivation) as the predictor was compared with a model with the pollution burden score and other demographic predictors, serving as proxy measures for the deprivation score. The comparison showed that more variance in preventable pediatric hospital admission was accounted for with the proxy model; therefore, only the pollution burden score from the CES was used in subsequent analysis. The proxy measures provide the advantage of identifying unique pathways that stem from neighborhood context contributing to pediatric admissions.

The pollution burden score was calculated using estimates for 11 such indicators, including: ozone concentrations; particulate matter up to 2.5 micrometers; diesel emissions; pesticide use; toxic releases from facilities; traffic density; cleanup sites; groundwater threats; hazardous waste; impaired water bodies; and solid waste sites and facilities.[12] Cronbach alpha yielded a score of .74, suggesting a fair degree of internal consistency. This variable is continuous in the analysis.

Additional measures for age distribution and poverty rates were estimated from 2010 US Census Data. Count estimates were obtained from the US Census to control for the population at risk within each zip code. This method adjusts the scale of the model and allows for coefficients to be interpreted as rate ratios. Areas of low poverty were identified by examining the distribution of individuals living below 125% of the federal poverty line (FPL) throughout California. Forty percent of zip codes in California are composed of less than 14% of individuals living below poverty. This standard was used to identify areas of low poverty within the SJV. In the SJV, 20% of zip codes are composed of less than 14% of residents living below poverty. Low poverty is a dichotomous measure in the analysis indicating that either a zip code has more or less than 14% of residents living below FPL. Age distribution is a continuous measure, indicating the proportion of residents under the age of 15 years.

The Simpson diversity index was used to measure the probability of racial/ethnic diversity within a zip code. Population estimates from the 2010 Census were used to identify subgroups (Hispanic, white, African American, Asian, Native Hawaiian, American Indian, and other). Essentially, this continuous measure predicates how likely an individual is to encounter someone of a different race from themselves in

**Table I.** Ecological determinants of pediatric ACSC hospitalizations for age, insurance, and race/ethnicity subpopulations*

| Variables | All preventable | | Under 1 | | Private | | Medi-Cal/other payer | | White/non-Hispanic | | African American | | Hispanic/other race | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RR | 95% CI | RR | 95% CI | RR | 95% CI | RR | 95% CI | RR | 95% CI | RR | 95% CI | RR | 95% CI |
| (Intercept) | 3.63 | (1.77, 7.44) | 1.06 | (0.46, 2.45) | 0.62 | (0.24, 1.63) | 2.62 | (1.21, 5.66) | 5.55 | (1.92, 16.01) | 0.02 | (0.00, 0.19) | 3.66 | (1.78, 7.53) |
| Pollution burden score | 1.26** | (1.15, 1.39) | 1.32†† | (1.18, 1.47) | 1.21†† | (1.08, 1.36) | 1.28†† | (1.15, 1.41) | 1.26†† | (1.12, 1.41) | 1.26†† | (1.05, 1.50) | 1.27†† | (1.15, 1.40) |
| Low poverty† | 3.53 | (0.60, 20.76) | 2.22 | (0.28, 17.27) | 8.63 | (0.96, 77.42) | 2.45 | (0.36, 16.52) | 1.77 | (0.30, 10.34) | 5.38 | (0.16, 181.22) | 3.18 | (0.27, 37.1) |
| Simpson diversity index | 1.02†† | (1.01, 1.03) | 1.01†† | (1.01, 1.02) | 1.03†† | (1.02, 1.04) | 1.02†† | (1.01, 1.03) | 1.00 | (0.98, 1.01) | 1.07†† | (1.04, 1.09) | 1.01†† | (1.00, 1.02) |
| PCSA‡ | 1.24** | (1.02, 1.50) | 1.37†† | (1.10, 1.70) | 0.83 | (0.65, 1.05) | 1.41†† | (1.14, 1.73) | 0.80 | (0.62, 1.03) | 1.24 | (0.84, 1.83) | 1.43†† | (1.16, 1.74) |
| Pollution by low poverty scale§ | 0.73 | (0.53, 1.00) | 0.75 | (0.52, 1.09) | 0.73 | (0.49, 1.09) | 0.68†† | (0.48, 0.96) | 0.89 | (0.65, 1.23) | 0.57 | (0.30, 1.09) | 0.69 | (0.45, 1.06) |
| | 1935 | | 852 | | 2871 | | 2309 | | 686 | | 308 | | 1403 | |
| Likelihood ratio χ²‖ | 90.9†† | | 83.3†† | | 50.2†† | | 141.1†† | | 19.2†† | | 60.0†† | | 86.2†† | |

*PCSA*, primary care shortage area; *RR*, rate ratio.
*Poverty and PCSAs are the only dichotomous variable; all other covariates are entered as continuous.
†Low poverty is dichotomous, 0 = 15% or more below FPL and 1 = 14% or less below FPL.
‡PCSA is dichotomous, 1 = a PCSA; 0 = all other areas.
§Model scale to adjust for population at risk.
‖Likelihood ratio χ² compares the fitted model against the intercept-only model.
**P < .05.
††P < .01.

their community.[13] Higher values on the index indicate greater diversity. In the SJV, neighborhoods with relatively fewer whites and Latinos and relatively more African Americans and Asian Americans have higher scores on this index (Table I). Estimates from the 2010 Census were used to identify subgroups (Hispanic, white, African American, Asian, Native Hawaiian, American Indian, and other).

The measure assessing primary care shortage was adopted from the California Healthcare Workforce Policy Commission and was originally designed to determine high-need areas in California to target with workforce recruitment and retention support through the Song-Brown program for family practice, family nurse practitioner-physician assistant, and mental health-physician assistant programs. Approximately 47% of Californians live in a primary care shortage area.[14]

### Data Analyses

In order to accommodate the discrete nature of the dependent variable, a Poisson-based negative binomial model was used. White test of heteroskedasticity demonstrated that an ordinary least squares model was a poor fit for these data (P value of ≤.001) because of a violation of the assumption of homogeneity of error variance. A Poisson model was then tested. Although the Poisson model was more appropriate than ordinary least squares, a significant amount of over-dispersion was unaccounted for by fixed Poisson parameters. The negative binomial model was a significantly better fit (log likelihood ratio P value of ≤.05) than the basic Poisson.

The final model was used to analyze the effect of neighborhood-level factors on ACSC hospitalizations. Tests for interaction were conducted, and the interaction between

pollution burden and poverty was significant in the overall model and for those children with Medi-Cal benefits. The sample was divided into age categories (under 1, 1-5, and 5-14 years), race categories (white/non-Hispanic, Hispanic/other, and African American), and insurance coverage (private and Medi-Cal/other payer) to understand the individual level boundary conditions of the final ecological model. Individuals who identified as Hispanic or "other" were grouped together as the rates of preventable disease hospitalizations were similar in these populations, as well as other demographic factors including poverty rates and insurance coverage. Preliminary analysis demonstrated that events are too rare when investigating the additional stratification by both age and race categories (ie, under 1 year and white/non-Hispanic).

### Results

The Figure depicts the distribution of poverty and pollution burden in California. Areas of high poverty are zip codes with greater than 40% of individuals living at 125% or below FPL. High pollution burden indicates zip codes where pollution levels are in the top 20% of California pollution on the cumulative environmental burden measure. High pollution and high poverty highlight zip codes where both of these circumstances exist. As indicated in the map, both high pollution and high poverty/high pollution zip codes are concentrated in the SJV.

Table II summarizes the general study population of children under 15 years as well as those who were admitted to a hospital in 2012 for an ACSC in the SJV. The mean rate of preventable hospitalizations in the SJV for children under 15 is 68/10 000. These preventable disease hospitalizations

**Table II.** Demographic characteristics for population and ACSC hospitalizations, children under 15 years of age*

| | SJV | | ACSC hospitalizations | | | | | | | |
| | | | Total | | White/non-Hispanic | | Hispanic and other | | African American | |
| | N | % | N | % | N | % | N | % | N | % |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sex** | | | | | | | | | | |
| Male | 47 400 | 50 | 3646 | 55† | 973 | 54 | 2371 | 55 | 302 | 57 |
| Female | 47 200 | 49 | 2906 | 44† | 814 | 45 | 1873 | 44 | 219 | 42 |
| **Age group (y)** | | | | | | | | | | |
| <1 | 132 000 | 13 | 1543 | 23† | 372 | 20 | 1075 | 25 | 96 | 18 |
| 1-4 | 202 000 | 21 | 2706 | 41† | 772 | 43 | 1768 | 41 | 166 | 31 |
| 5-9 | 291 000 | 30 | 1516 | 23† | 413 | 23 | 944 | 22 | 159 | 30 |
| 10-14 | 321 000 | 33 | 787 | 12† | 230 | 12 | 457 | 10 | 100 | 19 |
| **Payer** | | | | | | | | | | |
| Medi-Cal | 543 000 | 57 | 4414 | 67† | 842 | 47 | 3175 | 74 | 396 | 76 |
| Private coverage | 332 000 | 35 | 1726 | 26† | 807 | 45 | 873 | 20 | 72 | 13 |
| Other government | 63 000 | 6 | 351 | 5 | 117 | 6 | 190 | 4 | 44 | 8 |
| Self-pay | 9000 | <1 | 61 | <1 | 21 | 1 | 31 | <1 | 9 | 1 |
| **Race/ethnicity** | | | | | | | | | | |
| White/non-Hispanic | 212 000 | 22 | 1787 | 27† | | | | | | |
| Hispanic and other | 684 000 | 72 | 4244 | 64† | | | | | | |
| African American | 51 000 | 5 | 521 | 8† | | | | | | |
| Rate‡ | | | 68 | | 78 | | 62 | | 127 | |
| Total | 980 053 | | 6552 | | 1787 | | 4244 | | 521 | |

*Population estimates for the SJV derived from the California Health Interview Survey.
†Z test comparing population to ACSC hospitalizations, P < .01.
‡Rate of preventable hospitalizations per 10 000.

are then stratified by race/ethnicity. The majority of children experiencing ACSC hospitalizations were between 0 and 4 years of age, Hispanic/other, and relied on Medi-Cal to cover healthcare costs. Table II illustrates the uneven distribution of Medi-Cal and private coverage by race/ethnicity. Medi-Cal recipients make up 74% of Hispanic/other preventable disease hospitalizations, 76% for African Americans, and 47% of white/non-Hispanic ACSC hospitalizations. Furthermore, the rates of ACSC hospitalizations differ substantially by race/ethnicity. Children who identify as Hispanic/other experience a rate of 62/10 000, and white children experience rates of 78/10 000. African American children experience nearly twice the rate of preventable disease hospitalizations, 127/10 000. Table II also compares children with ACSC hospitalizations to all children, ages 0-14 years, in the SJV. Z tests were conducted to determine if the sample's proportion of subgroups differed substantially from the SJV population and indeed, findings indicate that all racial, age, and insurance subgroups vary significantly from the overall population. Those with ACSC admissions were significantly younger (64% were under the age of 4 years compared with 34% in the SJV), African American (8% compared with 5% in the SJV), and/or using Medi-Cal (67% compared with 57% in the SJV).

Table III provides the averages, SDs, and correlations for the independent and dependent variables used in the final model. The unit of measure and range is indicated for each variable. All population subgroups are positively correlated with pollution burden, indicating children are more likely to reside in highly polluted areas. Higher pollution burden is correlated with higher ACSC hospitalizations but poverty is not. There is not substantial direct correlation between subgroups and poverty, suggesting that population subgroups are dispersed throughout the SJV, and not necessarily concentrated in low-income communities. The exception is that "white" is negatively correlated with this variable, indicating that children in white families are less likely to reside in high poverty zip codes.

### Impacts of Race, Poverty, and Pollution on Pediatric ACSC Hospitalizations

The analysis of all ACSC hospitalizations, stratified by age, race/ethnicity, and insurance, controlling for pollution burden, poverty, racial/ethnic diversity, primary care shortage areas, and the interaction between pollution burden and poverty are listed in Table I. Pollution burden has a significant effect on ACSC hospitalization rates, with a 26% increase in relative risk for ACSC hospitalizations for every 10% increase in the pollution burden measure ($P$ value of <.001). With slight variation in increased risk, pollution burden remains significantly associated, with an increase in relative risk for ACSC hospitalizations, across all age and race/ethnicity categories.

Although all models, including subpopulation models, represent a significant increase over a null model, as indicated by the omnibus test listed for each model, the African American model is less reliable because of the relatively smaller and more geographically concentrated population. In this model, over 38% of zip codes had no African American residents and were subsequently dropped, and an additional 24% of zip codes have fewer than 100 African American residents between the ages of 0-15 years. As a result, although descriptive analyses indicate increased risk for this group, findings from the African American negative binomial model should be interpreted with extreme caution.

After controlling for the other indicated measures, low poverty is not substantially associated with a decrease in ACSC hospitalization rates. However, the interactive effects of poverty and pollution burden are significant overall and for those children covered by Medi-Cal, with children in low poverty and low pollution neighborhoods experiencing reduced risk for ACSC hospitalization.

The Simpson diversity index is associated with an increase in ACSC hospitalizations for all categories except white/non-Hispanic. This measure is continuous indicating that for every 10% increase in the diversity of a community, the relative risk for ACSC hospitalizations increases by 2%. The shortage of primary care access was also accounted for in the model, and was significantly associated with increased rates of preventable disease hospitalization in the overall model, for children under 1 year, children receiving Medi-Cal benefits, and children who identify as Hispanic/other.

**Table III.** Mean, SD, and Pearson correlation with pollution burden and poverty by variables in model*

| Variables | Mean | SD | r with pollution burden | r with poverty |
|---|---|---|---|---|
| Preventable hospitalizations (count per zip code) | 34.02 | 36.84 | .57[†] | .06 |
| Pollution burden (score ranges 1.1-7.8) | 5.05 | 1.44 | - | .04 |
| Low poverty[‡] | 0.18 | 0.38 | −.22[†] | −.64[†] |
| Simpson diversity index (score ranges 0-77)[§] | 53.24 | 16.05 | .58[†] | −.02 |
| PCSA[¶] | 0.29 | 0.45 | .19[†] | .28[†] |
| Population at risk (count per zip code) | | | | |
| Under 1 y | 333 | 344 | .56[†] | .14[†] |
| 1-4 y | 1703 | 1719 | .61[†] | −.02 |
| 5-14 y | 3292 | 3346 | .62[†] | −.08 |
| Under 15 y | 4999 | 5019 | .63[†] | −.06 |
| Hispanic/other | 3138 | 3533 | .58[†] | .12 |
| White | 1162 | 1446 | .44[†] | −39[†] |
| African American | 232 | 436 | .37[†] | −.02 |

*N = 191 zip codes. Poverty is continuous, proportion at or below 125% FPL.
[†]Pearson r, $P < .01$.
[‡]Low poverty is dichotomous, 0 = 15% or more below FPL and 1 = 14% or less below FPL.
[§]Simpson diversity index, or S, is the probability that 2 randomly selected people from the zip code will be of different races/ethnicities. $S = 1 - \Sigma(N_k - N)^2$ where $N_k$ is the population count in group $k$, and N is the total population in the area.
[¶]PCSA is dichotomous, 1 = a PCSA; 0 = all other areas.

### Discussion

In California's SJV, children who are under 4, African American, and low income disproportionately experience pediatric

ACSC hospitalizations. Further, cumulative environmental burden—neighborhood level relative exposure and effects from air and water pollution—is a strong and independent predictor of ACSC hospitalizations for children 15 years of age and younger in the SJV. In a region such as the SJV with high pollution and high poverty throughout, it is not the case that exposure to pollution, and associated ACSC hospitalization risk is concentrated in neighborhoods in primarily low income, racially diverse communities. Nonetheless, overall and for individuals with public reimbursement, the combination of lower poverty and less pollution burden is protective for ACSC hospitalization, in models that also control for an indicator of primary care shortage. Although several possible pathways linking cumulative pollution exposure to health outcomes have been advanced,[8] the specific biological and health services mechanisms underlying this relationship across population groups is not known.

The interaction between neighborhood poverty and pollution was found significant overall for the majority of children receiving Medi-Cal. The risk of experiencing an ACSC hospitalization is higher for residents of both high pollution and high poverty areas. This is consistent with prior findings that cumulative economic and social stressors for residents of over-burdened urban or rural slum neighborhoods can exacerbate pollution-related risk for adverse health outcome.[8] Although white children demonstrate a similar response to neighborhood pollution burden as children from other racial subgroups, neighborhood poverty, diversity, and access to primary care are not predictive of ACSC hospitalizations, indicating perhaps the presence of additional preventive resources or less vulnerability for white children.

In general, beyond pollution burden and its interactions with poverty, the effects of living in neighborhoods with high diversity increases the relative risk of preventable disease hospitalizations for all children except white/non-Hispanic. Children in the more diverse communities appear to be exposed to additional health stressors or barriers to preventive care, as suggested by previous research.[15] In the SJV zip codes with relatively higher diversity are often the products of historic segregation and continuing disinvestment, leaving few social programs and crumbling infrastructure to address the substantial health issues residents are facing.[16]

The purpose of this study was to measure the effects of pollution burden and poverty on neighborhoods' healthcare burden. In previous research, pollution was typically measured at an individual level and limited to 1 source such as traffic-related air pollution. Utilizing the CES tool allows for an analysis of aggregate pollution exposures, a more realistic depiction of what children are facing in communities. In addition, much of the previous research has relied heavily on projections, both for illness and pollution burden on a region.[17,18] Although the CES was initially designed to identify communities facing greater environmental injustice, analyzing the effect of high pollution burden and its relationship with poverty and race/ethnicity on actual preventable hospitalizations at the neighborhood level helps clarify sources of ill

health for children. Although our effort to examine the individual level boundary conditions of the ecological relationship between pollution burden and neighborhood composition were informative, the relatively small size and geographic concentration of African American children in the region limited the reliability of this subpopulation model.

Though evaluating principal ICD-9 codes has been used extensively to estimate burden of disease, it remains an imperfect process. ICD-9 codes are reported by a physician for billing purposes, and there may be discrepancy between practitioners in terms of what is considered the most pressing health condition to report initially. Furthermore, although ACSC conditions are often used to analyze preventable hospitalizations, it is possible that some children are more likely to develop and be hospitalized for these conditions based on pre-existing comorbidities. These comorbidities are not included in the analysis.

The possibility of multiple admissions for the same patient exists, with no way to perform a cluster analysis given that all identifiers have been removed for privacy purposes. For this reason, our analysis may overestimate actual figures. For example, previous research suggests that pediatric asthma cases experience a 15% readmission rate.[19] This may be one reason that preventable disease hospitalization rates are so high in the SJV compared with California; children in the SJV may be more likely to have repeat preventable disease hospitalizations because of poorer overall health status or access to preventative care. However, each hospitalization, even repeat events, disrupts the family and community and given that they are categorized as preventable, warrant evaluation.

For the purposes of this study, potentially preventable hospitalizations were chosen as a dependent variable given that the physical, financial, and emotional burden of disease at the stage in which hospitalization is required is hugely impactful on individuals, families, and communities. Furthermore, our inclusion of environmental factors provides evidence that ACSC conditions vary across neighborhoods because of differential exposure to pollution and availability of resources to manage resulting ill health.

Compared with California, the SJV experiences over twice the rate of potentially preventable hospitalizations for many preventable conditions and has communities with nearly twice the rate of families living at or below 125% of FPL (Fresno County: 28.2% vs California: 16.9%).[11,20] Children in the SJV live in areas with high exposures to pollution and poverty with fewer resources to address the health ramifications that result.

Several pathways likely contribute to the effects of pollution burden, poverty, and racial diversity on poor health, and need to be further explored in the context of cumulative pollution exposure. These may include access to high quality healthcare, limited social and economic capital, lack of social support, and cumulative risk of exposure over the life course. To better understand the complexity of composition, context, and collective effects of neighborhoods on health and illness, researchers should continue to develop improved measures representing the effects of environmental,

behavioral, and predisposing factors. Further research exploring individual level factors, in the context of neighborhood level factors, for each subgroup would also help researchers and public health professionals understand the unique context and risk each sub-group face. Specifically, future research should also investigate regions with higher proportions of African American residents to further explore the intersection of poverty and pollution on ACSC hospitalizations and other health indicators in this group. Understanding the impact of community level factors is essential to expanding access to care and allocating preventive resources to improve the health of children in California's most underserved region. ∎

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