

Community Risk Factors for Mortality and Exposure to Environmental Hazards in the San Joaquin Valley

TECHNICAL REPORT
Center on Human Needs
Virginia Commonwealth University
Richmond, Virginia

February 2012



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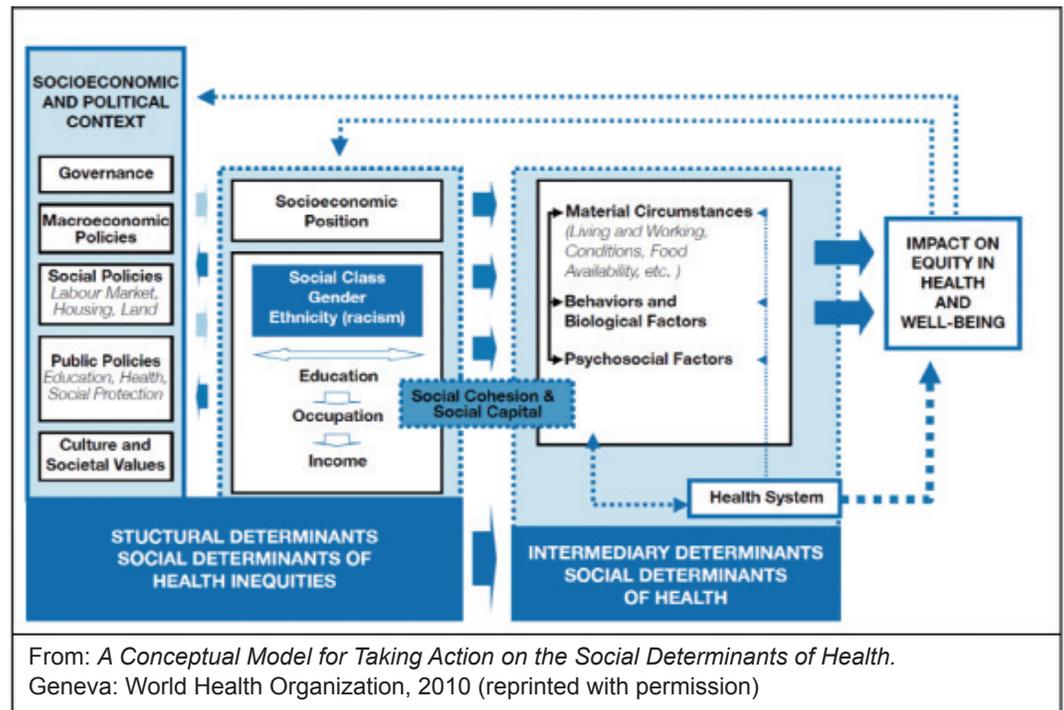
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Preface

Health is influenced by more than health care, and the same is true for health disparities.¹ Inequities in health exist for reasons that transcend access to health care or adequate health insurance coverage. Health is also heavily influenced by health behaviors (such as tobacco use), modifiable risk factors (such as obesity), and environmental conditions. These conditions are only partly a matter of personal choice. Adopting a healthier diet requires access to supermarkets or farmers' markets that sell fresh produce. Regular physical activity requires a conducive built environment and access to safe parks, pedestrian routes, and green space for residents to walk, bicycle, or play. Tobacco and alcohol use is influenced by enticing advertising and marketing practices. Exposure to environmental pollutants from unhealthy housing or from nearby factories and smokestacks are not choices made by residents but by society.

Figure 1:
World Health Organization
Conceptual Model for Social
Determinants of Health



In the language of social epidemiology, “downstream” determinants of health—ranging from unhealthy behaviors to living and working conditions—are the byproduct of “upstream” structural determinants (Figure 1) such as socioeconomic position, race-ethnicity, occupation, and social cohesion. These socioeconomic circumstances are themselves the result of upstream policies that create opportunities for education and employment, income and savings, social equality, and environmental stewardship. Macroeconomic policies create commercial incentives for industries to either promote unhealthy products or more healthful alternatives.²

Health also varies sharply by geography—across communities and neighborhoods—because unhealthful downstream conditions are often concentrated in disadvantaged areas. Areas populated by the poor or communities of color typically experience greater exposure to unhealthy conditions and material deprivation, a vicious cycle that is itself shaped by upstream factors. These upstream influences include historical antecedents, such as racial or ethnic discrimination and recurring cycles of poverty that inhibit economic growth and social mobility over generations, but also modern-day decisions about where to position highways and supermarkets and how much resource to invest in public transportation, housing, local development, crime prevention, public schools, job training, and social services. The recognition that “place matters” to health and the need to understand how unwise social policies foment health inequity comes at the recommendation of prestigious commissions sponsored by the World Health Organization,³ MacArthur Foundation,⁴ and Robert Wood Johnson Foundation.⁵

About the Place Matters Project

The Place Matters technical reports were produced by the Virginia Commonwealth University (VCU) Center on Human Needs (CHN) in collaboration with the Joint Center for Political and Economic Studies/Health Policy Institute (HPI) and the Virginia Network for Geospatial Health Research (VANGHR). All maps and geospatial analyses were produced by VANGHR.

The production of the Place Matters technical reports was funded by HPI under a subaward from a parent grant from the National Institutes of Health (grant 5RC2MD004795-02). The goal of the project was to prepare and disseminate a series of locally tailored Community Health Equity reports (CHERs) to assess population health inequities and related social and economic conditions for the following eight communities:

- Alameda County, California
- Baltimore, Maryland
- Bernalillo County, New Mexico
- Orleans Parish, Louisiana
- Cook County, Illinois
- San Joaquin Valley, California
- Boston, Massachusetts
- South Delta, Mississippi

The VCU Center on Human Needs and VANGHR were contracted by HPI to develop technical reports on which the eight CHERs were based. What follows is the technical report for the San Joaquin Valley, California. The focus of the report and the research questions it addresses were guided by extensive input from the Place Matters team in the San Joaquin Valley. See the Methods Appendix on the CHN website for more details on analytic methods.

The project was approved by the VCU Institutional Review Board.

For more information about the Place Matters technical reports or collaborating organizations visit the websites listed below:

Center on Human Needs: www.humanneeds.vcu.edu

Health Policy Institute: www.jointcenter.org/institutes/health-policy

Place Matters Initiative: www.jointcenter.org/hpi/pages/place-matters

Virginia Network for Geospatial Health Research: vnghr.org/

Acknowledgements: The authors thank the following individuals for their assistance with developing this report and the research on which it is based: Marlene Benjamin, Ph.D. (San Joaquin Valley Place Matters Team); Melanie Briones, M.P.H. (San Joaquin Valley Place Matters Team); John Capitman, Ph. D. (San Joaquin Valley Place Matters Team); Armando Cortez (San Joaquin Valley Place Matters Team); Rexford Dwamena, M.P.H. (VANGHR); Felicia Eaves (HPI); Beth Manghi (VANGHR); Andrea Robles, M.A., M.S., Ph.D. (George Mason University); Stephen Sedlock, M.A., G.I.S.P. (VANGHR); Brian Smedley, Ph.D. (HPI); Kenneth Studer, Ph.D. (VANGHR); I-Shian Suen, Ph.D. (VCU Urban and Regional Planning Program); Leroy Thacker, Ph.D. (VCU Department of Biostatistics); and Michael Wenger (HPI).

Introduction

The health of San Joaquin Valley residents is related to many factors.⁶ As is true elsewhere, disease rates vary dramatically by age, gender, race, and ethnicity as well as with the prevalence of risky health-related behaviors.^{3, 7-13} Place matters in health because characteristics of the areas in which people live affect health choices, behaviors, environmental exposures, and access to medical care.¹⁴⁻¹⁹ Local conditions that may affect health include levels of stress and environmental toxins, the social and economic characteristics of individuals and families (such as education and income), and the characteristics of the communities in which people live. This report will focus on the characteristics of San Joaquin Valley and its communities that may affect health outcomes for residents, including access to care, exposure to environmental hazards, and socioeconomic disadvantage. Health outcomes that will be explored include years of potential life lost (YPLL) and asthma hospitalization.

Regional averages oversimplify important geographic differences that exist between different neighborhoods and communities within the San Joaquin Valley and that contribute to large differences in the health of residents. Geographic disparities in health status within San Joaquin Valley reflect, in part, geographic patterns in the population and living conditions. The health challenges faced by individuals and households are influenced by community conditions.^{20, 21} Regardless of one's education, income, or motivation to make healthy choices, risks may be introduced by increased crime, air pollution, the absence of nutritious food or places to exercise, poor schools, a scarcity of good jobs, and stress related to these community challenges.^{19, 22-30}

Historical patterns contribute to long-term trends of placing vulnerable populations in stressed areas. This in turn reinforces cycles of hardship that entrench patterns of socioeconomic disadvantage.³¹⁻³⁵

This report investigates the relationship between social conditions, environmental factors, and health outcomes, such as premature mortality and asthma hospitalization, in the context of the unique demographic characteristics of the area. The San Joaquin Valley has a sizeable immigrant population with high poverty and low educational attainment, but who also exhibit some favorable health outcomes not generally associated with these socioeconomic characteristics. This situation is known as the Hispanic Paradox,⁶⁰ and we will examine how this immigrant demographic has affected the health outcomes of the San Joaquin Valley and suggest longer-term health implications for a community in which social determinants of health remain at problematic levels.

Part I of this report provides background information about San Joaquin Valley, including population data and community characteristics, such as poverty and educational attainment, and health outcomes. Part II examines the relationship between poverty, educational attainment, race/ethnicity, and health outcomes. Part III presents data on air quality and respiratory health in San Joaquin Valley. Part IV presents conclusions about social determinants of premature mortality and environmental justice in the San Joaquin Valley. Appendix A on the CHN website presents details about the data and methods that were used in preparing this report.



I. Population and Community Characteristics in the San Joaquin Valley

Population

The San Joaquin Valley is located in the Central Valley of California. The San Joaquin Valley is home to San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern Counties and had a combined population of 3,880,304 as of 2009.^{33,36} The overall population density in the San Joaquin Valley is 248.8 people per square mile, but it ranges by county and ZIP code from 71.7 per square mile in Madera County to 487.4 in San Joaquin County. The San Joaquin Valley is home to several urban areas, including the cities of Stockton, Modesto, Fresno, and Bakersfield, which are surrounded by rural farming areas (Map 1).

The San Joaquin Valley has a much larger concentration of Hispanics than does the rest of the nation (48.5 and 15.8%, respectively), making the White population the minority^{36,37} (Table 1 and Figure 2). In 2009, an estimated 21.4% of the population was foreign born, slightly lower than the percentage in California but much higher than the national average.

Table 1:
Demographic Characteristics
of San Joaquin Valley,
California, and United States

	San Joaquin	California	United States
Population (2009)_(a)	3,880,304	36,961,664	307,006,556
Population density (2009)_(b)	248.8	239.5	86.7
Race/ethnicity (%) (2009)_(a)			
White	38.2	41.5	64.9
Black	4.5	5.8	12.1
Hispanic	48.5	37.0	15.8
Asian	5.7	12.3	4.4
Other	3.1	3.3	0.7
Foreign born (2009)_(a)	21.4	26.9	12.5

(a) Source: U.S. Census Bureau, 2009 American Community Survey
(b) Source: 2009 Geolytics Projections
Note: "Other" includes American Indian and Alaskan Native, Native Hawaiian and Other Pacific Islander, and those who identified themselves as some other race or two or more races. Racial groups include the non-Hispanic population only; Hispanic can include any racial group.

Map 1:
Population Density by
Census Tract, San Joaquin
Valley, 2009

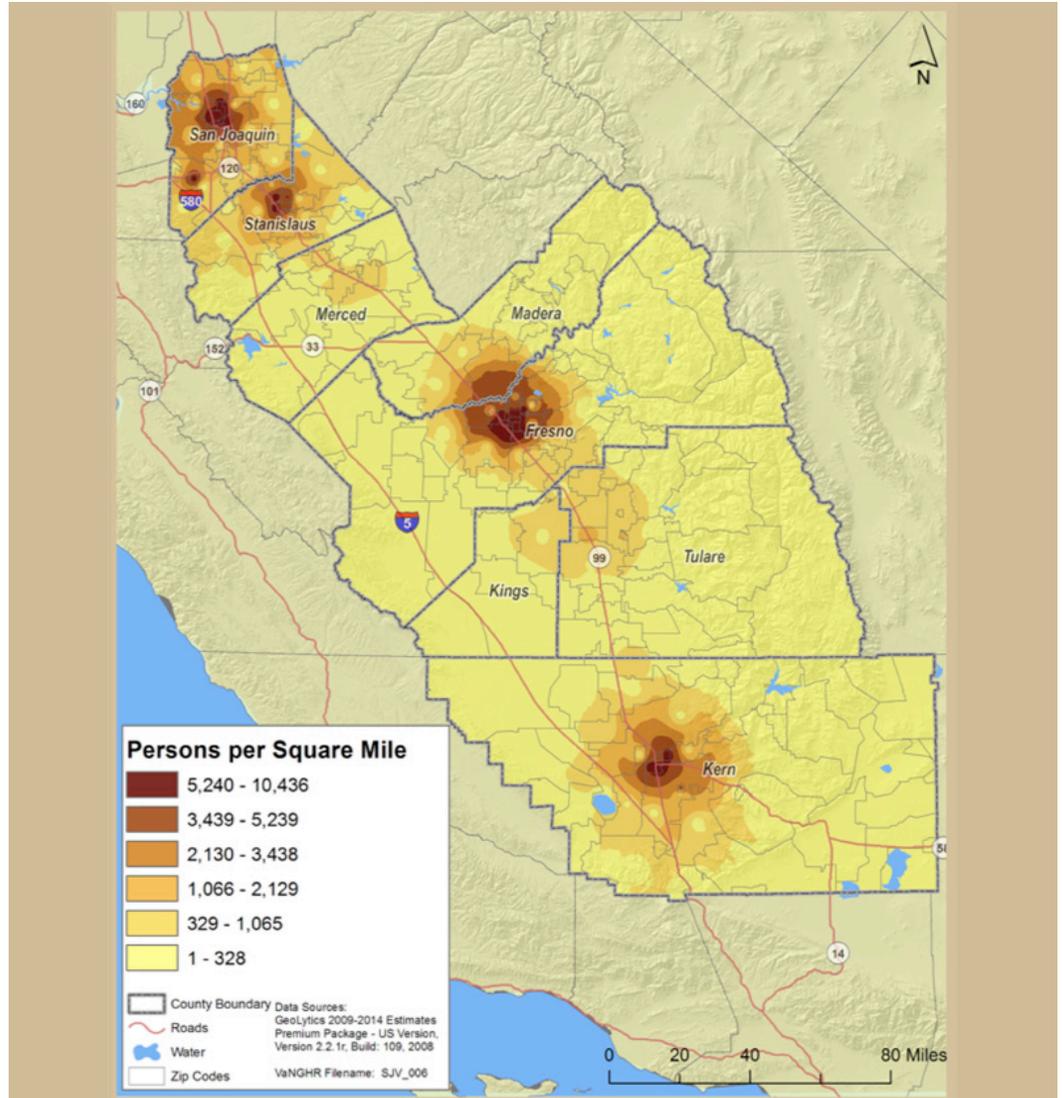
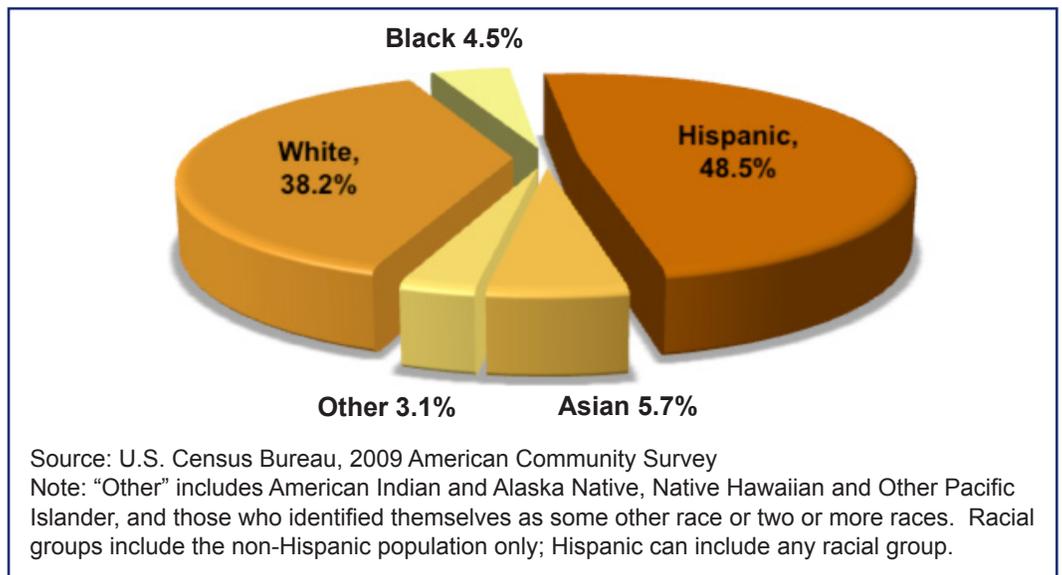
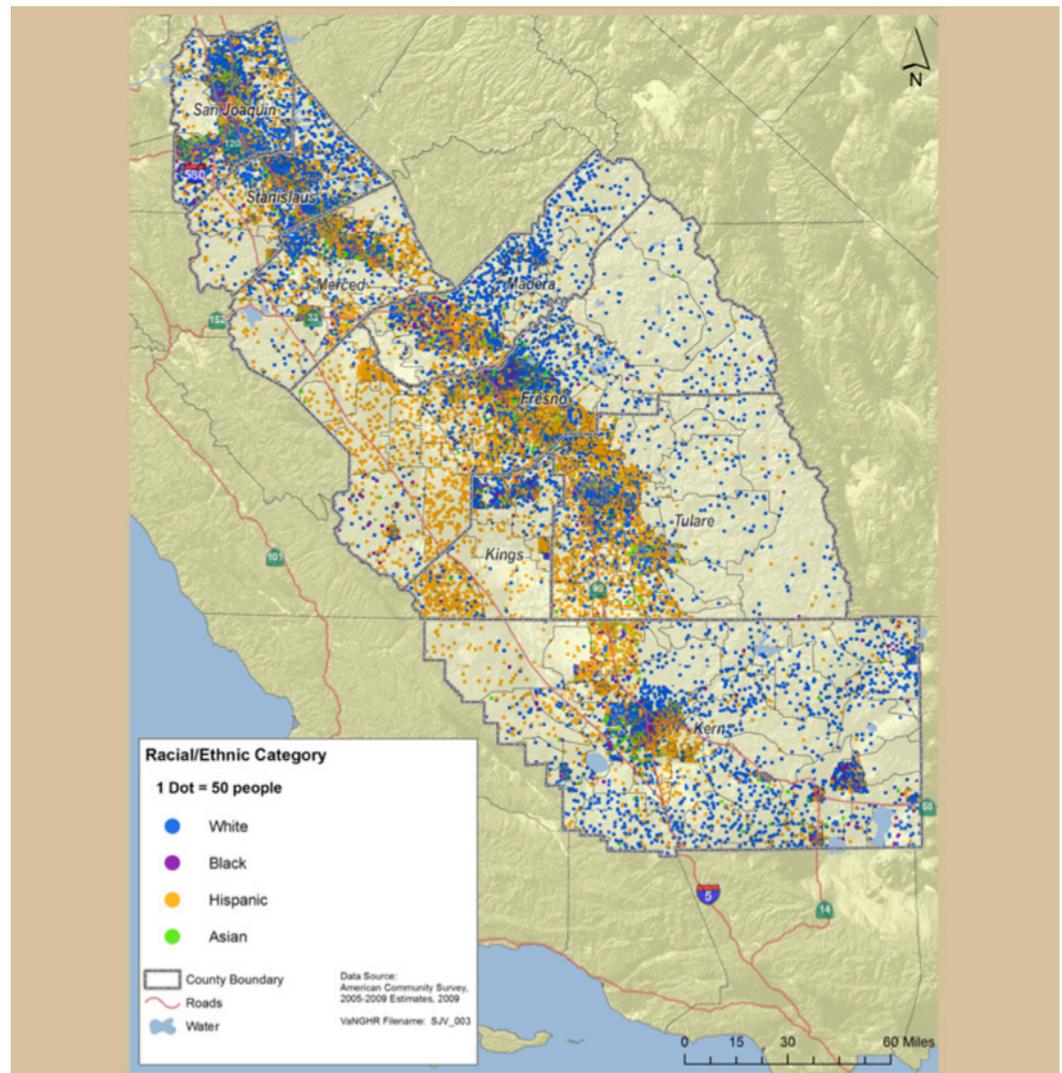


Figure 2.
Race/Ethnicity
in San Joaquin Valley, CA



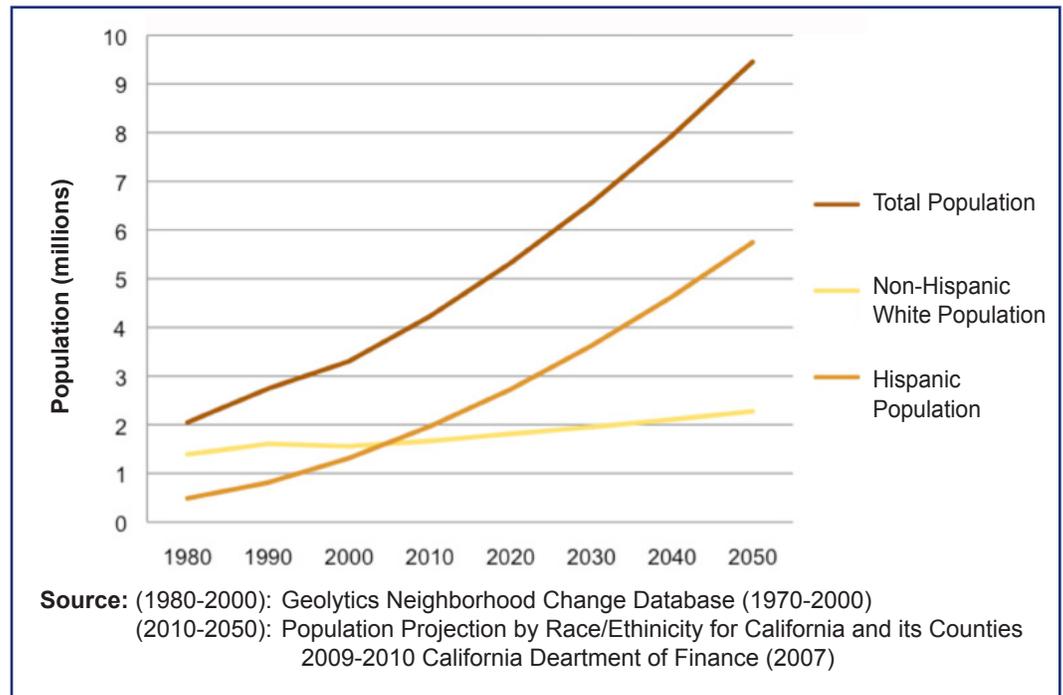
The extent to which an area is racially segregated may affect population health outcomes.^{19, 38, 39} Racial and ethnic groups are concentrated differently across the San Joaquin Valley.⁴⁰ Although at the county level racial and ethnic distributions between counties show few significant differences, smaller geographies reveal several areas of more pronounced racial or ethnic segregation. For example, several census tracts in the western portions of Kern, Fresno, and Tulare counties are more than 90% Hispanic. The western portion of Madera and southern and western regions of Kern also show a reverse pattern of ethnic segregation; in many areas, more than 80% of the population consists of non-Hispanic Whites. Notably, there is a relatively small population in the foothills, mountains, and high desert areas that is primarily White. The majority of the Asian population resides in San Joaquin County, where Asians account for 13.5% of the county population and, in a number of census tracts, more than one third of the population. The Black population is concentrated in Fresno, Kern, and San Joaquin counties. In the urban areas of Stockton, Modesto, Bakersfield, and Fresno, Hispanic residents are concentrated in the south, whereas the White populations occupy the northern parts of the cities. The racial and ethnic distribution of San Joaquin Valley residents is displayed in Map 2.

Map 2:
Racial and Ethnic
Distribution, San Joaquin
Valley, 2005–2009



Migration trends and migrant characteristics also play an important role in the social context of the San Joaquin Valley. High rates of immigration, both domestic and international, have had a notable influence on the area’s population and are projected to continue over the next several decades.⁴¹ The San Joaquin Valley is a rapidly growing area; between 1980 and 2003, the population increased by 75%, or 1.5 million people,⁴² and population growth percentage projections place five of the area’s eight counties into the top 10 fastest growing in California over the 2000–2050 period (Figure 3).⁴¹ A significant portion of this increase is due to the migration of lower-skilled workers from other areas of California and internationally, who are drawn by the seasonal agricultural work opportunities in the San Joaquin Valley—one of the most agriculturally productive areas in the United States.⁴²

Figure 3.
Historical and Projected
Population Change in the San
Joaquin Valley, 1980 - 2050



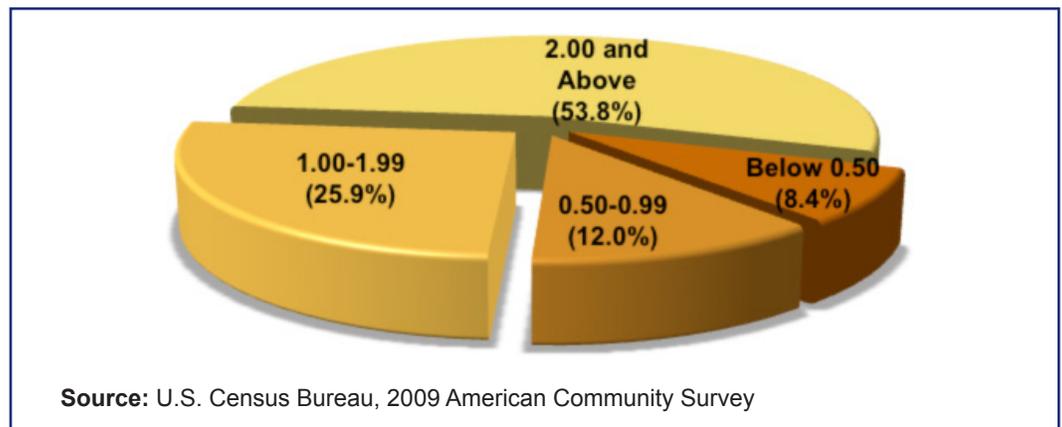
Although a natural increase in population still explains the bulk of the San Joaquin Valley’s population growth, the increase from migration is substantial and results in significant impacts. The majority of migrants come from other counties in California, and the net domestic migration rate has increased steadily since the mid-1990s to a peak of over 20 per 1,000 residents in 2000. The net migration rate from other countries has remained relatively stable since 1990 at about 6 per 1,000 residents. The majority of foreign-born residents immigrate from Latin America (56% in San Joaquin County and 88% in Madera County) and Asia (7% in San Joaquin County and 37% in Madera County), with 5% or less immigrating from Europe, Africa, North America, Australia or New Zealand.⁴³ Within the area, differences in migration trends exist as well; the southern part of the San Joaquin Valley tends to receive more international migrants, and both the international and domestic migrants to this area have higher rates of poverty and lower rates of education than do those in the northern valley.⁴⁴ Although it is beyond the scope of this report, it should be noted that the influx of undocumented workers to the San Joaquin Valley and their treatment and economic vulnerability raise significant issues related to poverty and education.

Socioeconomic Characteristics

Poverty

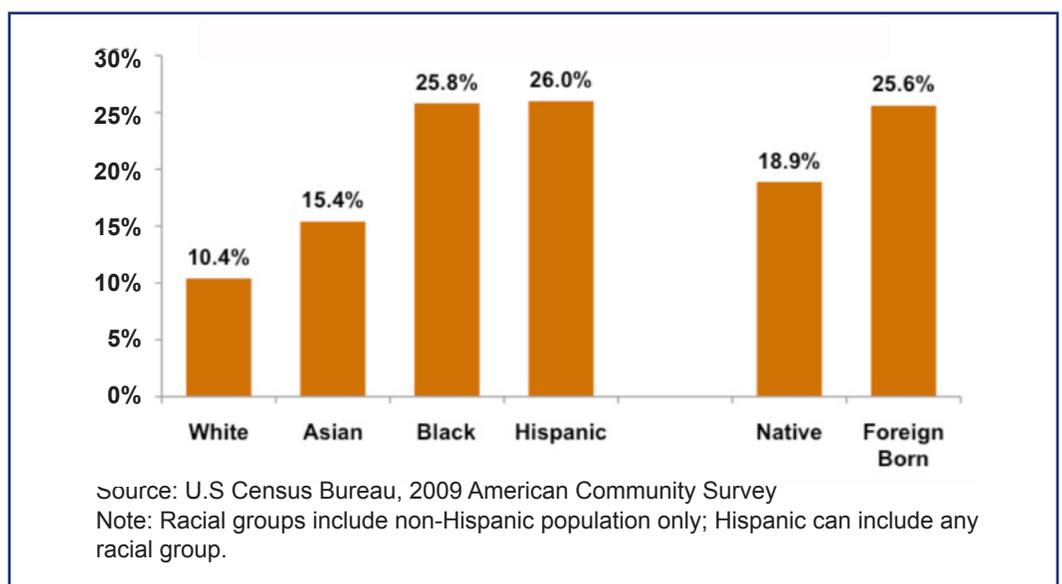
As is true elsewhere in the United States, socioeconomic conditions in the San Joaquin Valley exert an important, and often unrecognized, influence on health status. Nationally, families living below the federal poverty level are 3.6 times more likely to report fair or poor health than are those with incomes of at least twice the poverty level.⁴⁵ Experiencing poverty during childhood influences a child’s cognitive, emotional, behavioral, and physical development. Childhood poverty also decreases a child’s likelihood of completing high school.^{46, 47}

Figure 4:
Income-to-Poverty Ratio,
San Joaquin Valley



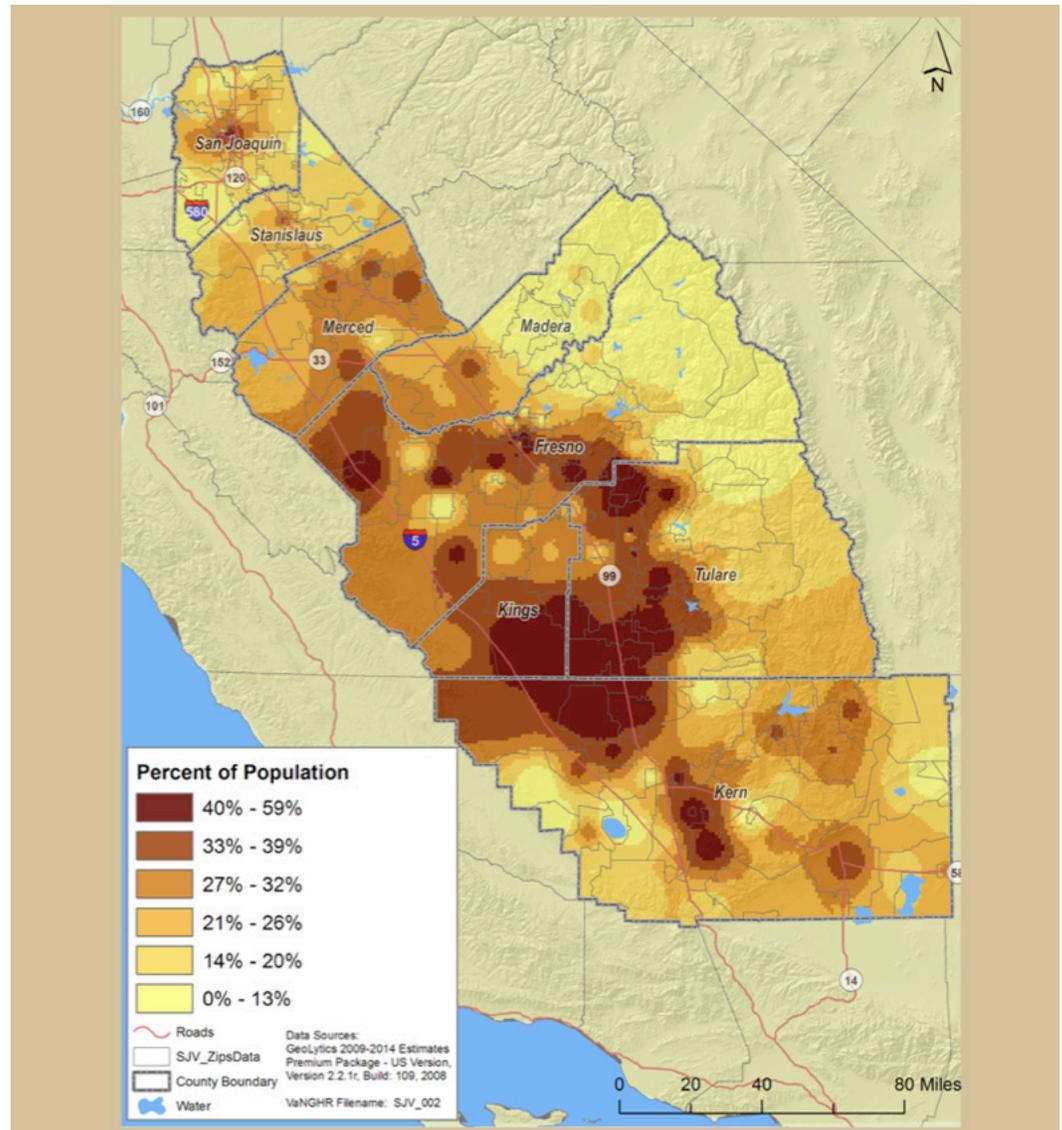
In 2009, more than one fifth (20.4%) of households in San Joaquin Valley had incomes below the federal poverty level, significantly more than the rate for both California and the nation (14.2 and 14.4%, respectively). The income-to-poverty ratio expresses household income as a percentage of the federal poverty level. As shown in Figure 4, 8.4% of households in the San Joaquin Valley lived in severe poverty, with incomes less than

Figure 5:
Poverty by Race,
Ethnicity and Nativity in
San Joaquin Valley, 2009



Map 3:
Households below 150%
of the Federal Poverty
Threshold, by ZIP Code,
San Joaquin Valley, 2009

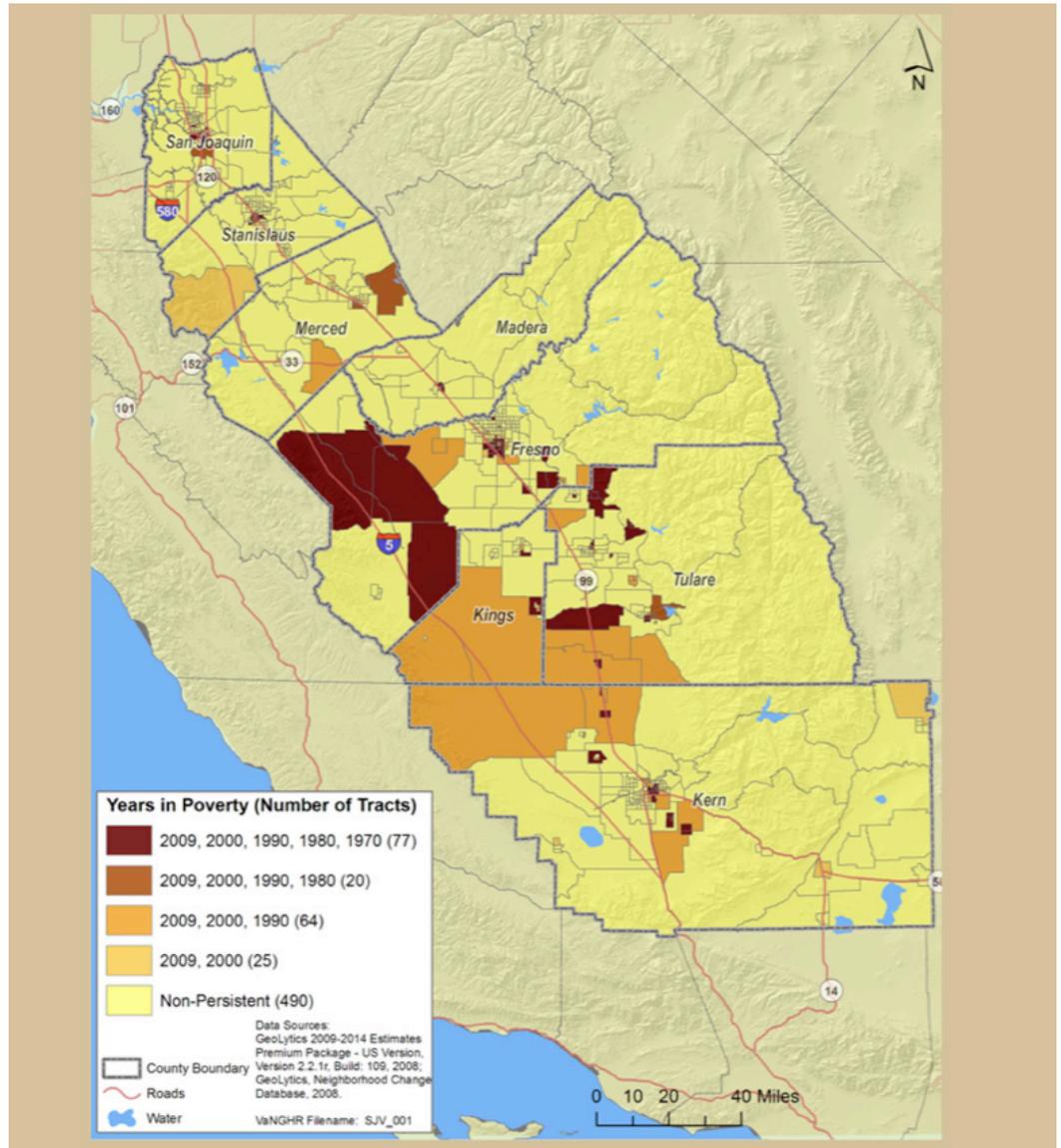
half the federal poverty level (or an income-to-poverty ratio of 0.5), and almost half of households (46.3%) were either poor or near poor, with incomes less than twice the poverty threshold. For a family of four in 2009, this would equal an annual income below \$43,908. As shown in Figure 5, over one quarter of all Black, Hispanic, and foreign-born residents of San Joaquin Valley had incomes below the federal poverty level in 2009.



Nationwide in 2009, 22% of households had incomes below 150% of the federal poverty threshold.³⁷ In the San Joaquin Valley, 49% of ZIP codes (115) had the same or a greater percentage of households with incomes below 150% of the federal poverty threshold. The comparable percentage for the state of California was 31% of ZIP codes. Areas of concentrated poverty in San Joaquin Valley, where at least 40% of the population in a ZIP code had an income below 150% of the federal poverty level, are in southeast Kings County, southwest Tulare County, northwest Kern County, and areas of Fresno County (Map 3).

A persistent lack of economic resources during childhood may have consequences on cognitive, emotional, behavioral, and physical development.^{46,47} It may also diminish the likelihood of high school completion, thus perpetuating disadvantage and the multigenerational cycle of living in conditions that adversely affect health. “Persistent poverty,” in which at least 20% of the population was poor (incomes less than 100% of the federal poverty threshold) for at least two decennial census periods, has been a pervasive influence in urban areas of each county in the valley. Persistent rural poverty is also a significant problem, experienced primarily in areas with many low-wage farm workers and their families. The darkly shaded census tracts on Map 4 identify areas of San Joaquin Valley with persistent poverty for four or more decades.

Map 4:
 Persistent Poverty by
 Census Tract, San Joaquin
 Valley, 1970-2009



Economic risks specific to the San Joaquin Valley exist because of the nature of its economy and the large migrant population. As a large agricultural area, the majority of jobs in the San Joaquin Valley are low-paying and seasonal. Outside of farming jobs, there are few opportunities for low-skilled workers because of the lack of a diversified economy in heavily agricultural areas.⁴² Although the area has high unemployment and low wages, the consistently large number of migrants over the past two decades is explained in part by low housing prices and year-round agricultural work.^{44, 48}

Since the 1990s, there has been a steady and continuing increase in resident-based labor as opposed to migrant labor. This is largely because of the San Joaquin Valley’s extended growing season, which allows farm workers to find work throughout the year and causes many migrants to become permanent residents. Some of these residents eventually move out of farm labor into other area industries, opening up jobs for the next wave of new migrants; however, low wages limit the economic growth of these farm worker communities, and job alternatives are limited.⁴²

This lack of opportunity as well as lower rates of education and lack of preparation for skilled labor among migrants can lead to widespread and entrenched rural poverty, which affect both new and permanent resident communities. As discussed in this report, persistent poverty increases vulnerability to a wide range of health risks through a variety of channels.

Education

Education is a pathway to higher income and net worth, which also have strong influences on health status and access to health care. National statistics indicate that adults (age 25 years and older) who lack a high school education or equivalent are three times more likely to die before age 65 as are those with a college education.⁴⁹ They are also more likely to engage in unhealthy behaviors such as cigarette smoking.⁵⁰

At almost 30%, the San Joaquin Valley has a much higher percentage of the population without a completed high school education than does the state of California or the nation (19.4% and 14.7%, respectively) (Table 2).^{40,51} The percentage of adults in San Joaquin

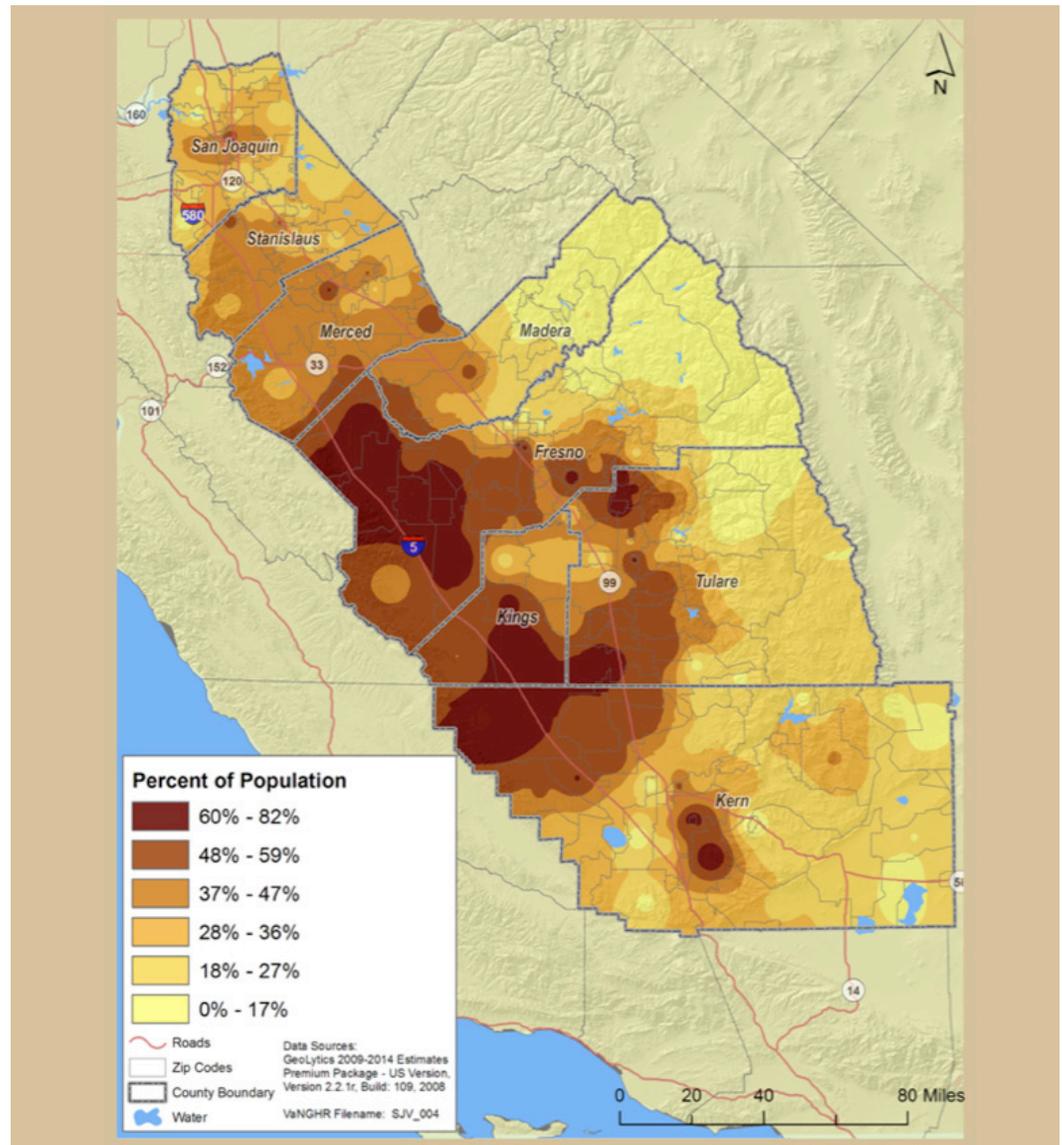
Table 2:
Socioeconomic
Characteristics of
San Joaquin Valley,
State of California and
United States

	San Joaquin (%)	California (%)	United States (%)
Educational attainment^(a)			
Less than high school	29.2	19.4	14.7
High school only	24.5	20.9	28.5
Some college	24.1	29.8	28.9
Bachelor’s degree or higher	14.8	29.9	27.9
Poverty Rate^(b)			
Below 0.50 of poverty rate	8.4	6.0	6.3
0.50-0.99 of poverty rate	12.0	8.2	8.1
1.00-1.99 of poverty rate	25.9	19.5	18.4
2.00 and above of poverty rate	53.8	66.3	67.3

(a) Source: U.S. Census Bureau 2009, American Community Survey
(b) Source: 2009 Geolytics Projection

Valley who lack a high school education varies greatly by location. Among the valley's ZIP codes, the percentage of adults without a high school education ranges from less than 5% to more than 80%. As shown in Map 5, Kings County, southeast Tulare County, northwest Kern County, and areas of western Fresno County have the largest populations lacking a high school education. Conversely, southwestern San Joaquin County and the eastern portions of Madera, Fresno, Tulare, and Kern counties have the smallest population with less than a high school education.

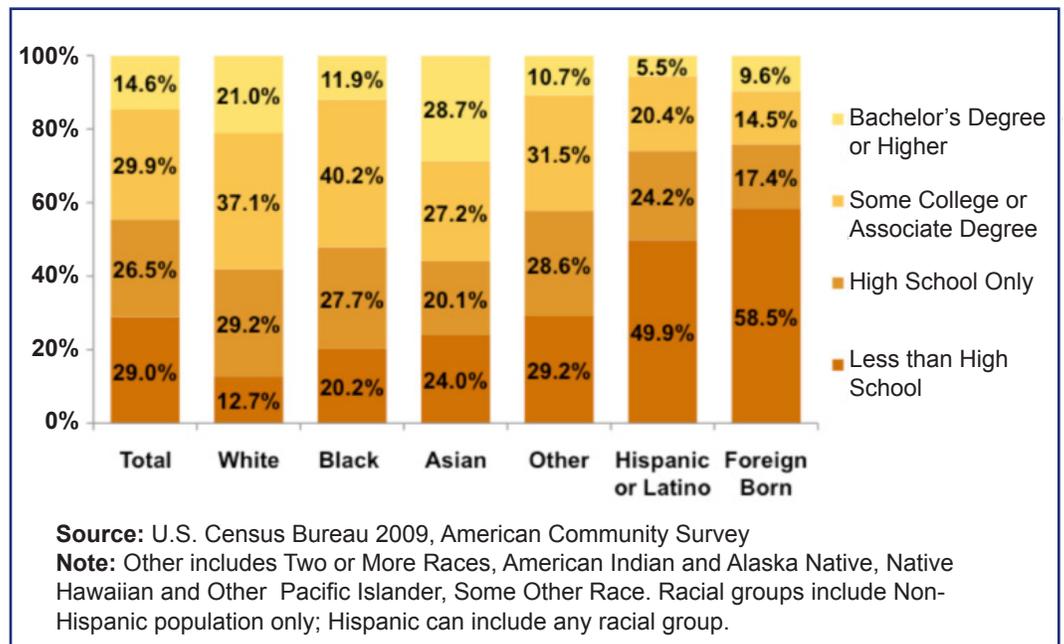
Map 5:
Adults with Less than a
High School Education,
San Joaquin Valley, 2009



Race and ethnicity are strongly correlated with educational attainment. Compared with Whites in 2009, Hispanic residents of San Joaquin Valley age 25 years and older were more than four times as likely to lack a high school education (Figure 6).⁴⁰ Migrant status is also strongly correlated with lower educational attainment. Between 1995 and 2000, well over half of all international migrants had less than a high school education. Additionally, because migrants into the San Joaquin Valley are far less likely to have a college education as compared with migrants leaving the area, and because the area offers limited access to universities, the San Joaquin Valley experiences a large net loss of college-educated and college-bound individuals.⁴⁴

As discussed previously, this trend toward lower levels of education may have significant health-related repercussions.

Figure 6:
Educational Attainment in
San Joaquin Valley, 2009



Health Outcomes

The health outcome statistics available for San Joaquin Valley generally compare favorably with those for California and the United States (Table 3). For the years 1999–2007, the average life expectancy of newborns in San Joaquin Valley was 79.2 years, compared with 80.0 years in California and 78.0 years nationwide. Rates for all-cause mortality and low-birth weight babies in the region tend to be lower among Hispanics than among non-Hispanics, mirroring the Hispanic health advantage observed statewide and nationally.

Table 3:
Health Characteristics of
the San Joaquin Valley,
California, and United States

	San Joaquin	California	United States
Life Expectancy (years)	79.2^(a)	80.0^(b)	78.0^(b)
All-cause mortality rate* (2007)^(c)	732.9-871.7	675.0	759.5
Non-Hispanic	782.5-955.2	702.8	776.3
Hispanic	528.5-645.8	537.9	546.1
Asthma (%)			
Childhood	10.6-24.0^(d)	15.4^(d)	10.9^(e)
Adult	11.9-21.9^(d)	13.0^(d)	13.1^(e)
Low-birthweight rate (%) (2008)^(f)	7.0	6.8	8.2
Non-Hispanic	7.8	7.5	8.6
Hispanic	6.5	6.1	7.0

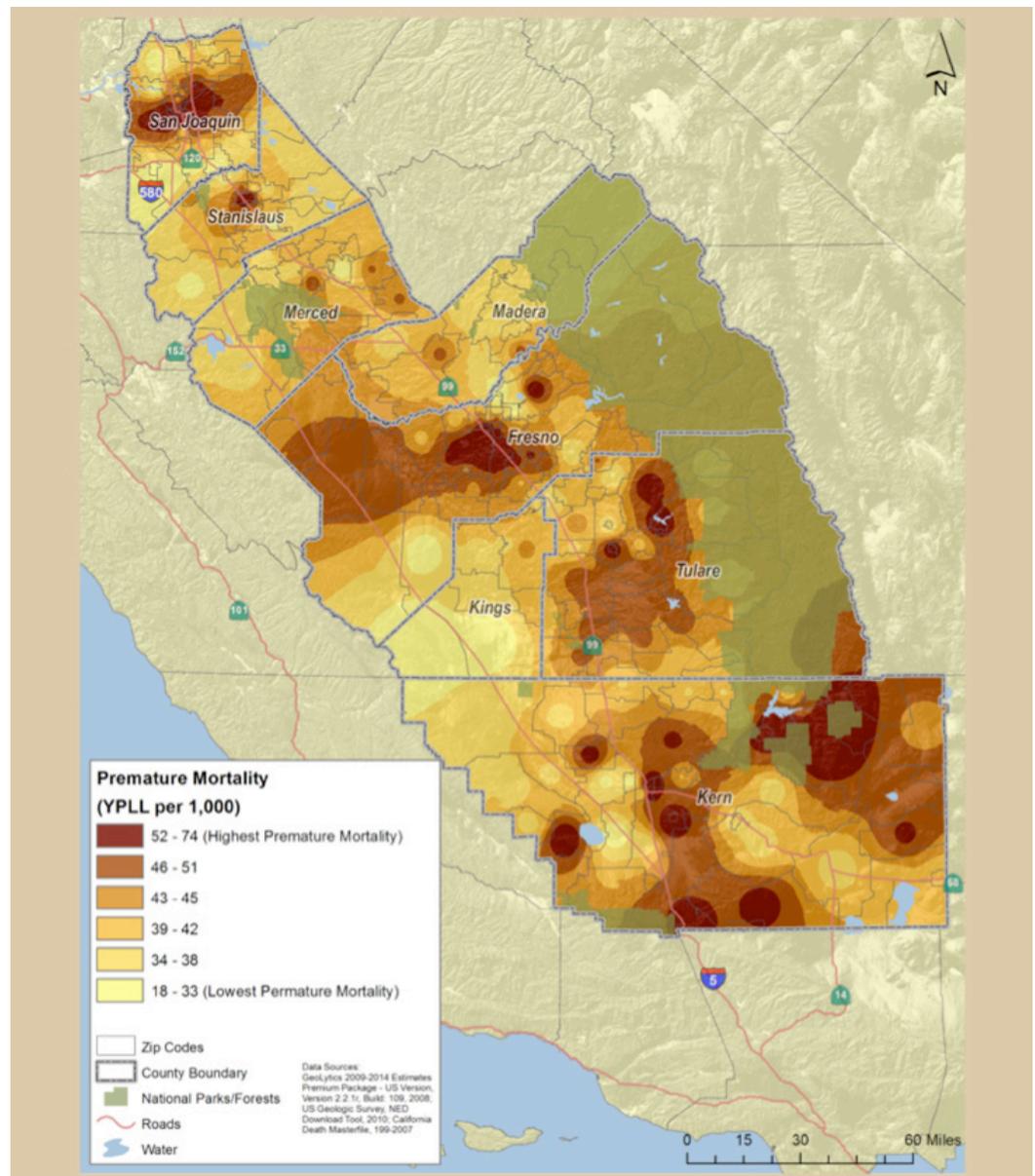
(a)Source: Calculations performed by VCU Center on Human Needs from data provided by California Death Masterfile 1999-2007 and 2009 Geolytics Premium Estimates
(b)Source: Calculations performed by American Human Development Index from data provided by the Centers for Disease Control and Prevention's National Vital Statistics Survey and the US Census Bureau
(c)Source: Data from the Centers for Disease Control and Prevention, CDC Wonder, adjusted to the 2000 Census Population
(d)Source: California Health Interview Survey, 2007
(e)Source: National Health Interview Survey, 2007
(f)Source: The Centers for Disease Control and Prevention National Vital Statistics System 2008
 *Mortality statistics are per 100,000 population

In summary, the San Joaquin Valley comprises a large geographic region with a number of urban centers surrounded by rural areas, farmland, and national parks. It is an area that has a much larger Hispanic population than elsewhere in the United States, and many residents are immigrants or migrant laborers. More than one fifth of households in the Valley have incomes below the federal poverty threshold. As a large agricultural area, the majority of jobs in the San Joaquin Valley are low-paying. About 30% of the region's adult population and almost 60% of foreign-born residents lack a high school education. These characteristics are important because of the geographic clustering of risk factors, such as poverty and low educational attainment, and because of the relationship between socioeconomic and community risk factors and health outcomes. The next section will examine these relationships.

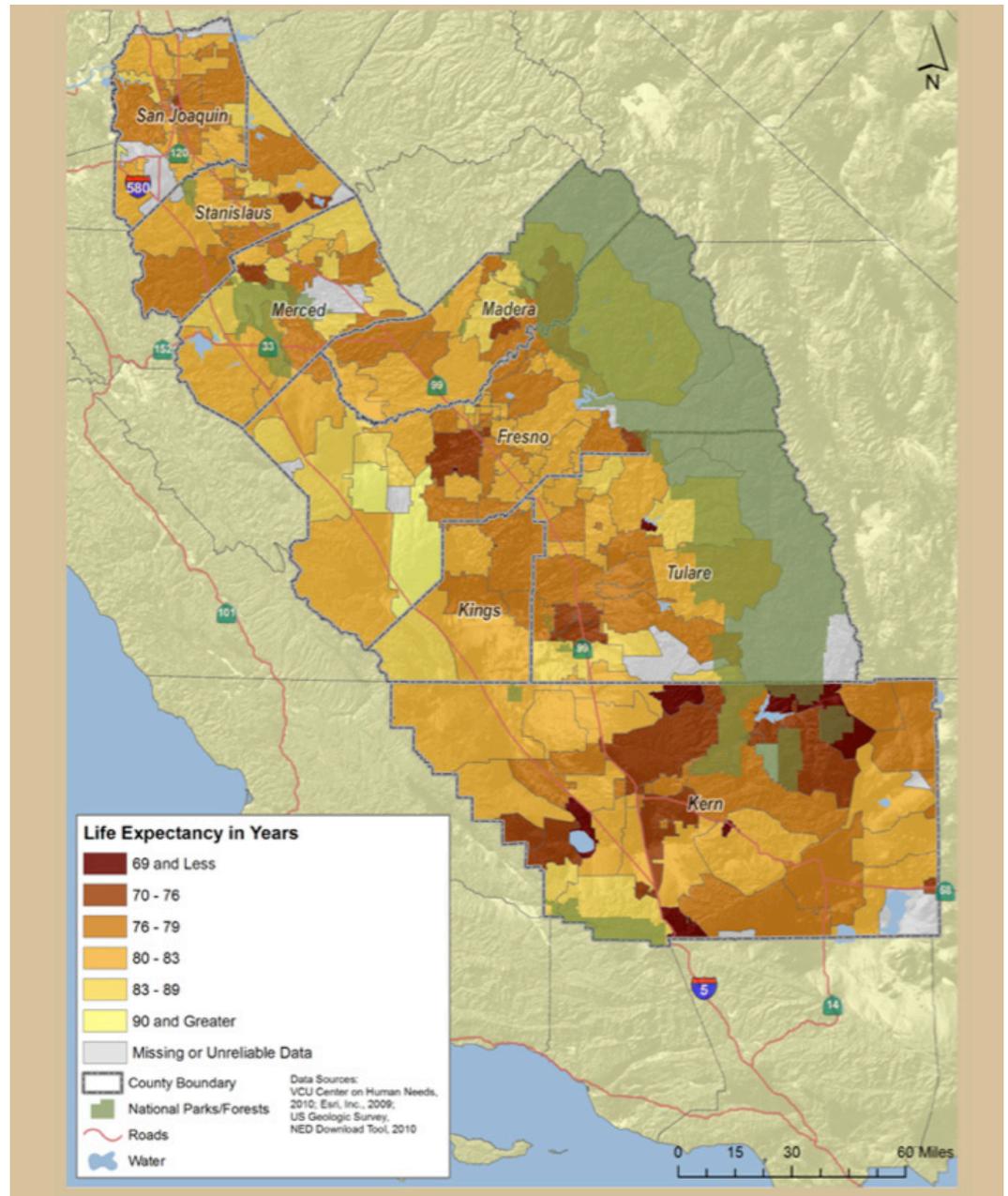
II. Social Determinants of Mortality

Premature mortality (YPLL before the age of 65 as calculated by the San Joaquin Valley Place Matters Team) serves as an important group-level indicator of inequality. In the San Joaquin Valley, the communities with the highest levels of premature mortality and lowest life expectancy are in San Joaquin County, central Stanislaus, western and central Fresno, north central Tulare, as well as central and eastern portions of Kern County (Map 6-7).

Map 6:
Premature Mortality
by ZIP Code,
San Joaquin
1999–2007



Map 7:
Life Expectancy
by ZIP Code,
San Joaquin Valley,
2009



It is widely known that social factors that coexist in places with concentrations of disadvantaged populations are part of a complex web of interrelated factors that are only beginning to be understood. The health disparities associated with these economic, educational, and social factors are complex, multifactorial relationships that cannot be reduced to a single etiology or mitigated by a single policy solution. In the San Joaquin Valley, the highest rates of premature death are found in areas with significantly higher poverty, lower educational attainment, and a higher concentration of Hispanic residents and recent immigrants. These areas are also home to the lowest median incomes (Table 4).

Table 4:
Characteristics of Lowest
and Highest Premature
Mortality Regions of the
San Joaquin Valley

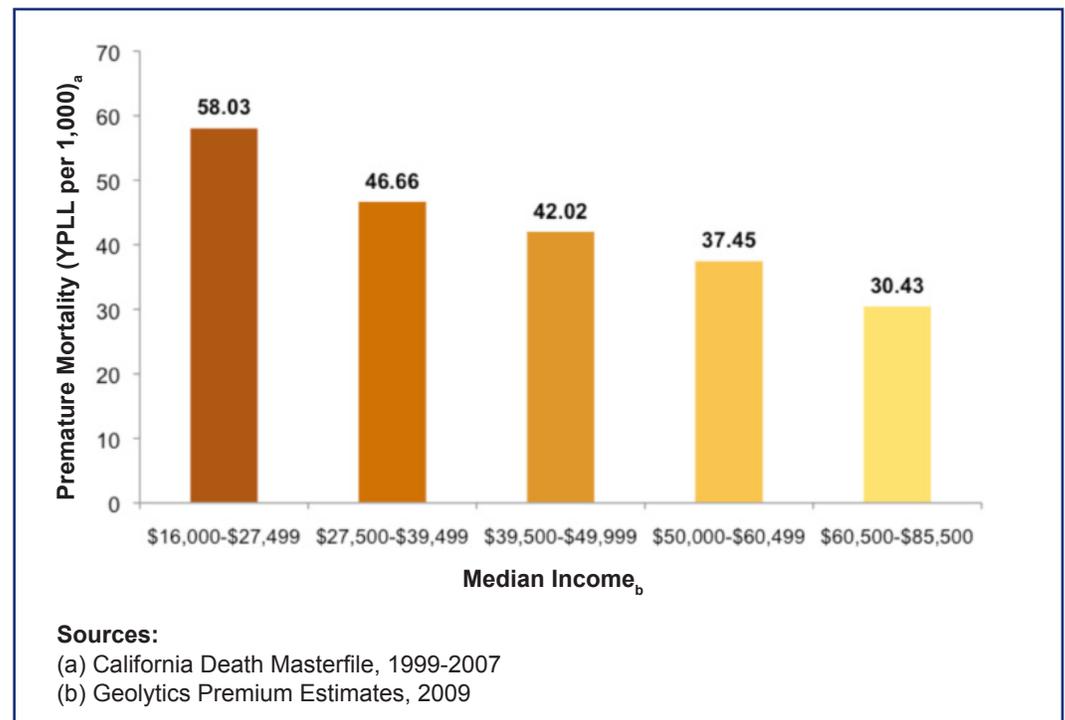
	Lowest Premature Mortality	Highest Premature Mortality
Premature mortality (YPLL per 1,000) ^(a)	26.6	57.8
Median household income ^(b)	60,729	36,806
Below 150% of the federal poverty level (%) ^(b)	18.6	38.4
Less than a high school diploma (%) ^(b)	24.2	42.0
Births to immigrant mothers ^(c)	31.6	37.0
Hispanic (%) ^(b)	35.8	49.1

(a)Source: California Death Masterfile, 1999-2007
(b)Source: Geolytics Premium Estimates, 2009
(c)Source: California Death Masterfile, 1999-2007

Income

Although individual-level factors have received the greatest attention as determinants of premature mortality, there is increasing awareness of and evidence for the important role of social factors that operate at a larger group level.⁵²⁻⁵⁷ In the 2011 Centers for Disease Control and Prevention *Health Disparities and Inequalities Report*, which consolidates the most recent national data available on health disparities, key factors examined in relation to premature mortality/YPLL include income, race/ethnicity, and educational attainment.⁵⁸ A review of the literature shows significant research investigating the relationship between these factors and premature mortality at a variety of levels, including individual, neighborhood (as represented by census tract), county, and state.^{56, 57, 59-63}

Figure 7:
Premature Mortality
by Median Income in
San Joaquin Valley

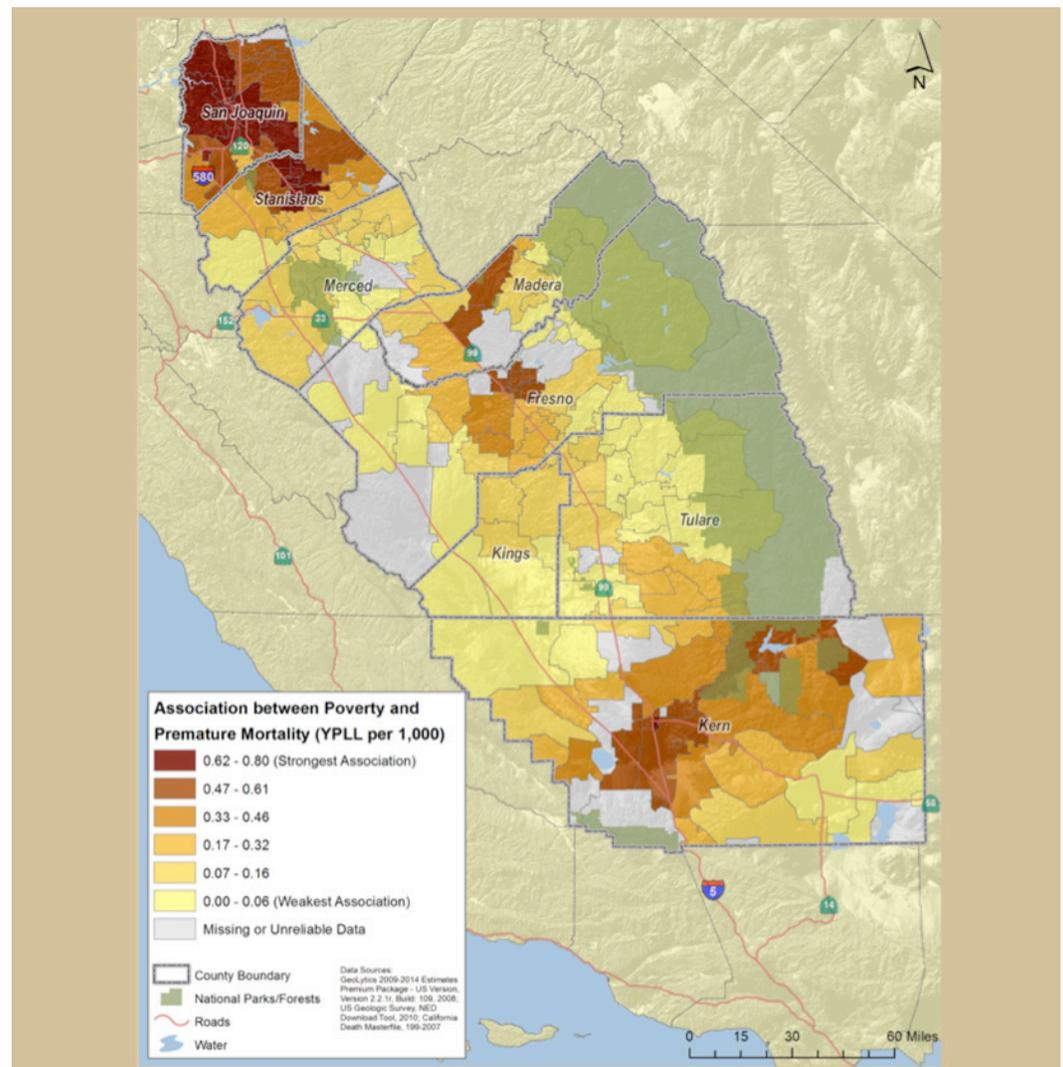


Neighborhood-level effects have been observed, particularly with regard to income,^{54, 57, 63, 64} indicating that poverty rates or income inequality in a given geographic area correlate with premature mortality or similar mortality indicators. In San Joaquin Valley, there is a moderate statistical correlation between median income and premature mortality ($r = -0.33, P < 0.0001$). As shown in Figure 7, ZIP code areas with lower median incomes suffer substantially more premature deaths than those with higher incomes; the rate for the lowest earning ZIP codes is nearly twice that of the highest income group (58 per 10,000 deaths versus 30 per 10,000).

Poverty

Poverty rates at the ZIP code level show a moderately strong correlation with premature mortality in San Joaquin County ($r = 0.41, P < 0.0001$). To examine the geographic relationship between poverty rates and premature mortality, we performed a geographically weighted regression (shown in Map 8). ZIP codes in which poverty is a strong predictor of premature mortality (shown in the darkest colors on Map 8) are in San Joaquin, central Stanislaus, and regions of Madera, Fresno, and Kern counties.

Map 8:
Poverty (2009) as a
Predictor for Premature
Mortality (1999–2007),
San Joaquin Valley



Educational Attainment

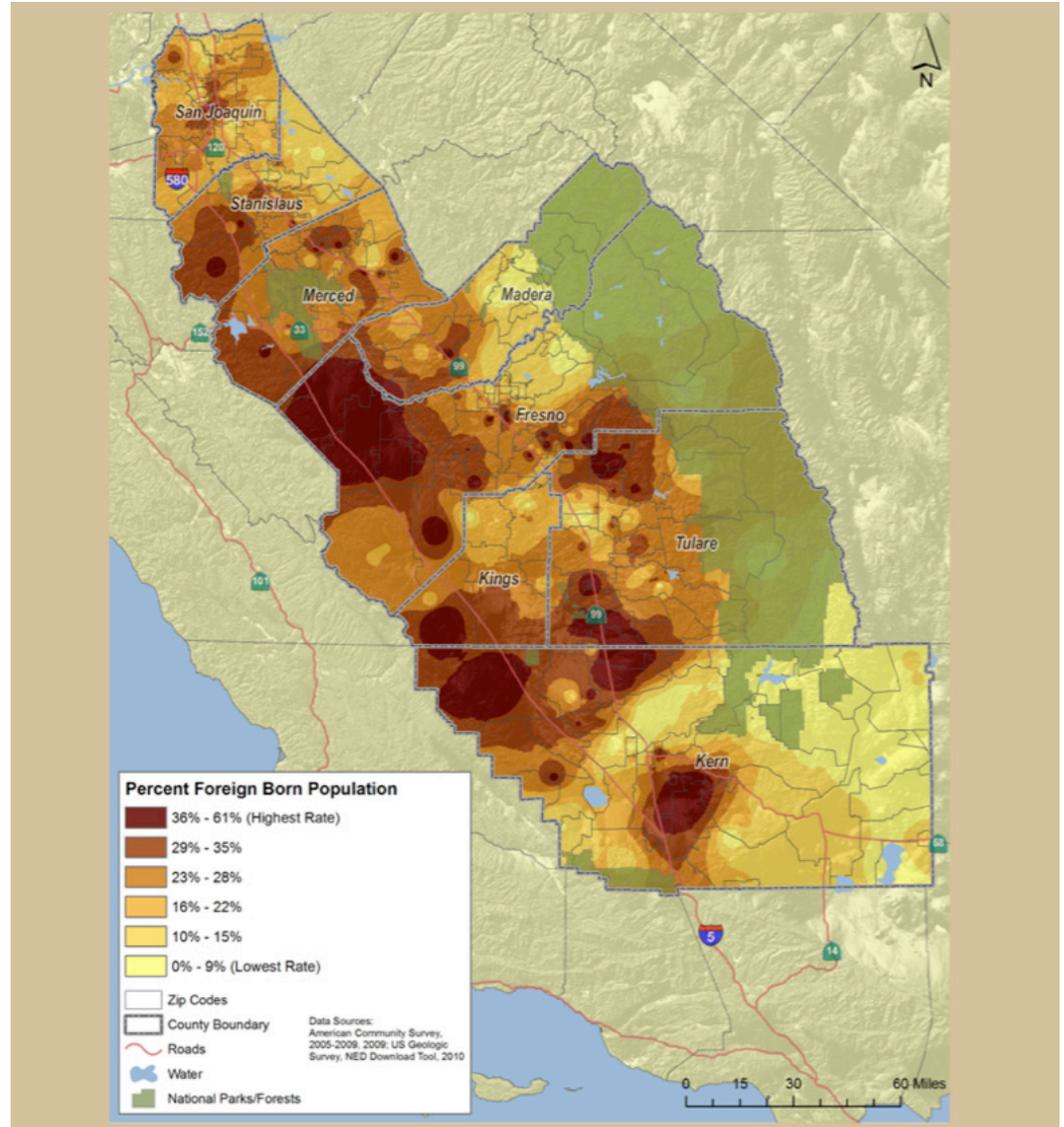
Like income and poverty, educational attainment^{55, 65-68} has been found to be significantly related to premature mortality at the individual and group levels. In the San Joaquin Valley, ZIP codes where a higher percentage of the population lacks a high school diploma have higher rates of premature mortality ($r = 0.42$, $P < 0.0001$). Map 5 shows concentrations of the population without a completed high school education. An apparent overlap—communities with both low levels of educational attainment and high premature mortality values—is observed in the following areas: central San Joaquin, western and central Fresno, north central Tulare, and central Kern County. In these areas, the educational attainment of the population may influence the premature mortality rates of its residents. Areas of high premature mortality but high educational attainment may be influenced by other predictive factors, such as a large proportion of retirees or the rural nature of the area.

Ethnicity

Although premature mortality is markedly higher in areas with high poverty and low educational attainment, the relationship between premature mortality and ethnicity in the San Joaquin Valley is inconsistent. As seen in Map 9, both Kings County and western Kern County have high percentages of foreign-born residents, ranging from 29 to 61% (in particular, at the western intersection of Kings and Kern counties), and these correspond with areas that have relatively low premature mortality rates (Map 6).

It is well documented that despite lower socioeconomic status and educational attainment levels, the general health and mortality outcomes of Hispanic populations in the United States, particularly Mexican Americans, are similar to or better than those of non-Hispanic White populations when they first come to the United States.⁶⁹⁻⁷⁴ However, second- and subsequent-generation Hispanic Americans tend to have poorer health and mortality outcomes as compared with recent immigrants.⁷⁴⁻⁷⁷ Among the factors that may account for this trend are socioeconomic and educational disadvantages to which immigrant workers are subjected, whether they are documented or undocumented, environmental factors related to where they live, and their lack of political power to address these conditions. If this trend continues, it may portend increasingly significant health and mortality issues in the San Joaquin Valley.

Map 9:
 Percent Foreign-Born
 Population by Census Tract,
 San Joaquin Valley,
 2005–2009



We performed a multivariate regression analysis to examine the simultaneous contribution of socioeconomic and demographic factors on premature mortality. The model confirmed that poverty is the strongest determinant of premature mortality: Poverty alone accounted for 33% of the variation in premature mortality across geographic areas in the San Joaquin Valley. The model also exhibited evidence of the Hispanic Paradox: Holding levels of poverty constant, premature mortality tended to decrease in geographic areas with higher concentrations of Hispanic residents (see Appendix A for more details on the regression methods and findings).

In summary, premature mortality (measured as YPLL) is geographically clustered in the region, so that premature mortality is higher in the areas of San Joaquin County, central Stanislaus, western and central Fresno, north central Tulare, and central and eastern portions of Kern County. Data on premature mortality were only available at the ZIP code level, and thus individual-level analyses of socioeconomic characteristics and health outcomes were not possible. Nonetheless, our analyses showed that areas with lower median incomes and higher poverty rates had significantly higher risk of premature deaths. A geographic regression analysis of poverty and premature mortality showed that poverty was a strong predictor of premature mortality in central Stanislaus County and regions of Fresno and Kern counties. Findings on the relationship between ethnicity and premature mortality showed evidence of the Hispanic Paradox: Despite lower average socioeconomic status and educational attainment levels, the general health and mortality outcomes of Hispanic populations are similar to or better than those of non-Hispanic White populations. However, as these migrant populations acculturate in the coming decades, this advantage may diminish over time, with magnified health impact given population projections.

I. Environmental Justice and Respiratory Health

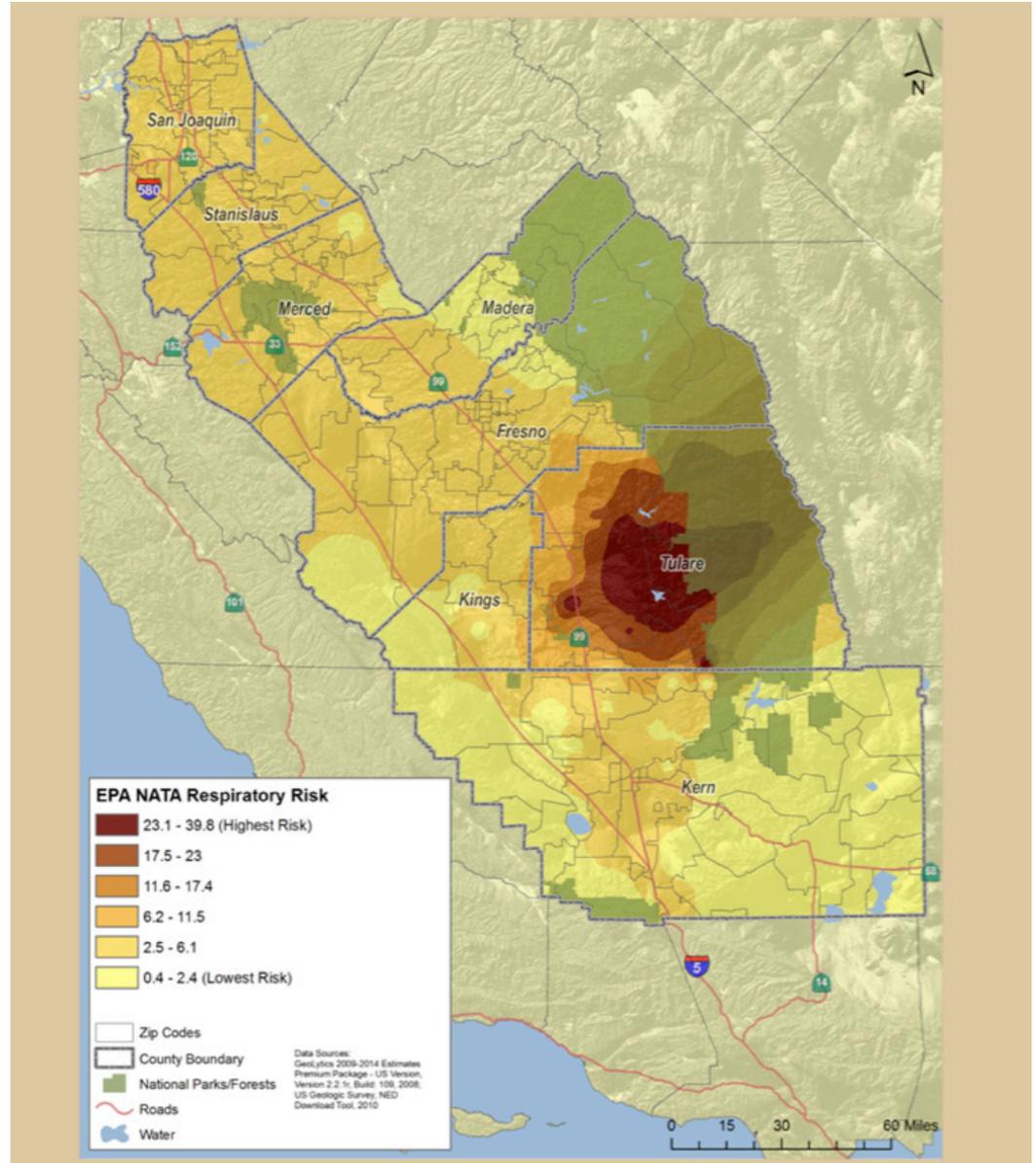
Geographic Distribution of Respiratory Risk

Environmental hazards are an important influence on community health. Within the San Joaquin Valley, air quality poses a particularly persistent hazard. The valley's counties consistently rank in the top 25 most polluted locations in the United States,⁷⁸⁻⁸³ and they frequently exceed the federal ambient air quality standards for ozone and fine particulate levels by a significant amount.⁸⁴

Poor air quality poses serious health risks and can lead to a variety of respiratory and cardiovascular conditions and symptoms. A recent study found that ozone levels above the federal standard in the San Joaquin Valley caused 460 premature deaths per year and that the total yearly economic cost of health complications and lost productivity due to unhealthful levels of ozone and particulate matter was greater than \$3 billion.⁸⁵ Although poor air quality poses potential risks throughout the valley, respiratory risk is heavily concentrated in Tulare County (Map 10).

Throughout the country, studies document proximity to hazardous sites and heightened exposure to pollution in neighborhoods with larger populations of people of color and the poor.⁸⁶⁻⁹¹ Some longitudinal studies suggest that toxic facilities are deliberately sited in minority communities,⁹² possibly because such neighborhoods are socially isolated and hold limited political power to resist undesirable land use decisions by governments and corporations.⁹³

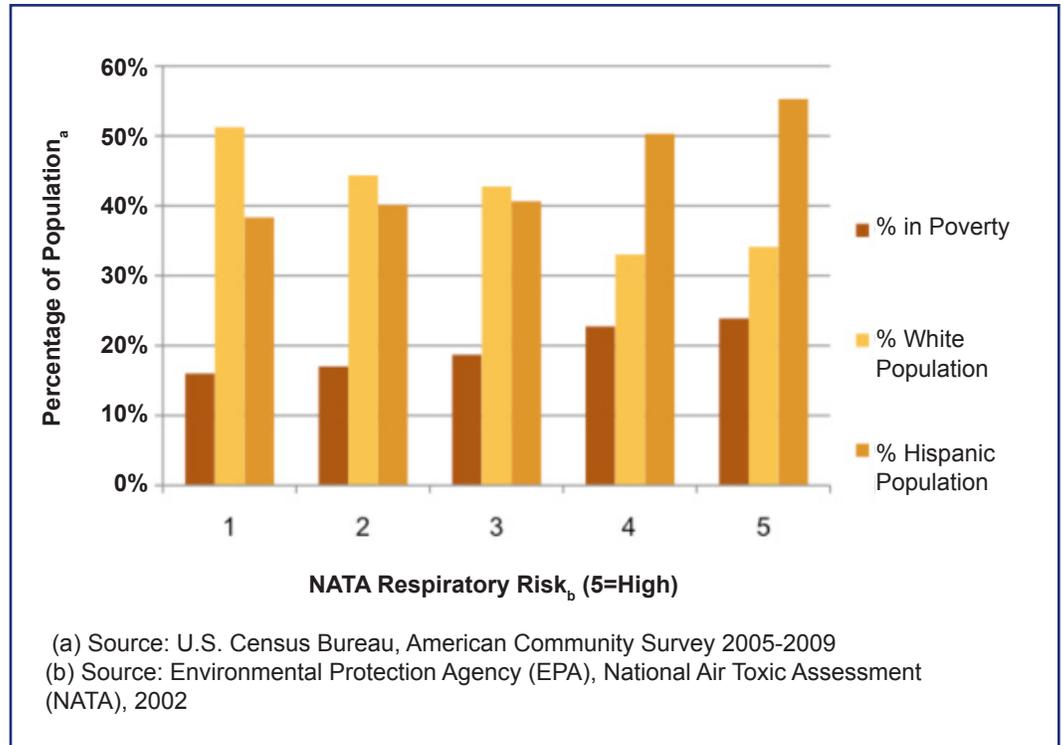
Map 10:
National Air Toxic
Assessment (NATA)
Respiratory Risk,
San Joaquin Valley,
2002



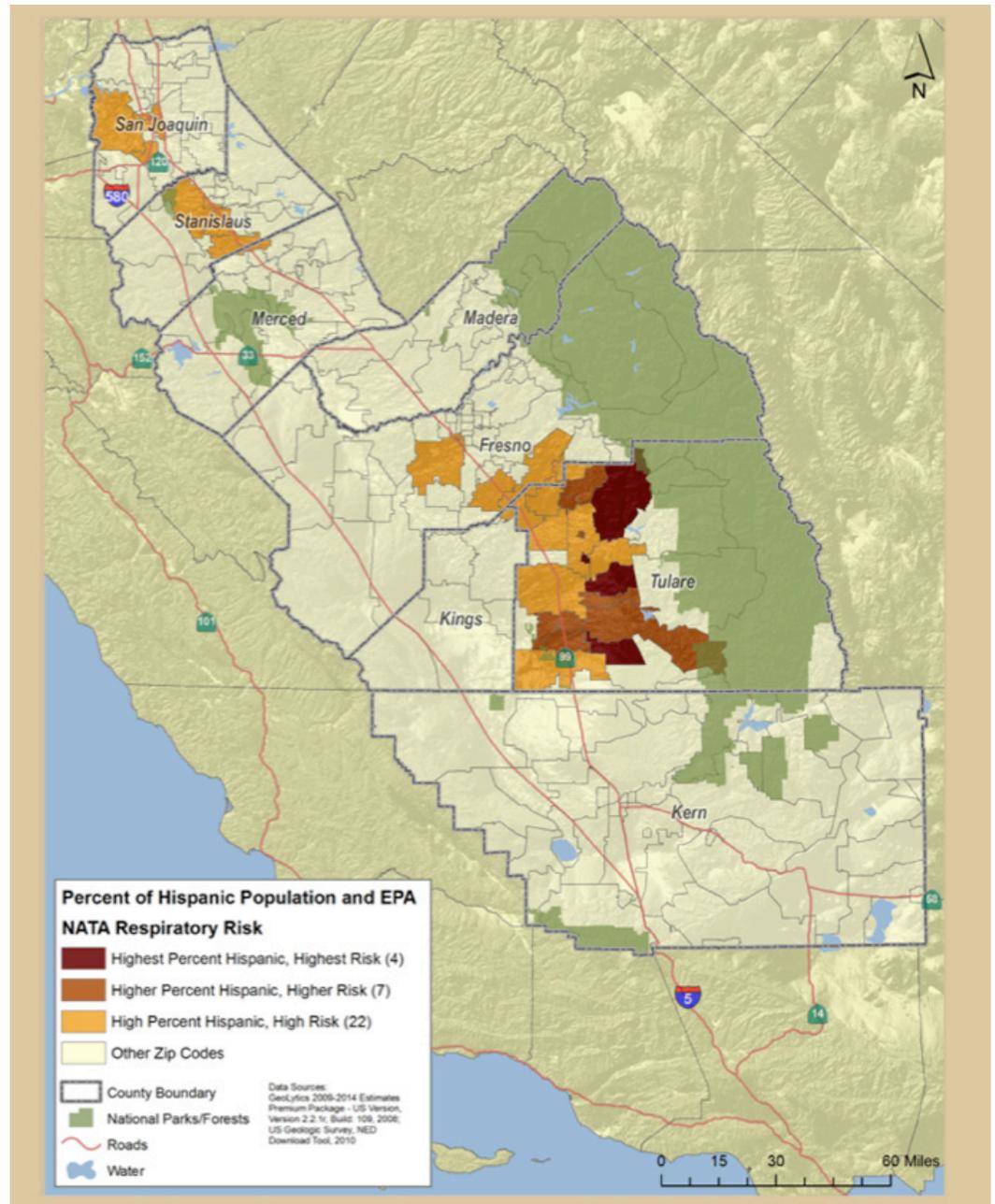
Note: Data in Map 10 refer to the noncancer hazard index (HI), representing the sum of hazard quotients for substances that affect the same target organ system (respiratory). Aggregate exposures below an HI of 1.0 derived by using target organ-specific hazard quotients likely will not result in adverse noncancer health effects over a lifetime of exposure and would ordinarily be considered acceptable. Results are presented for multiple sources of pollution (major, area, on-road mobile, non-road mobile, and background), with total risk representing the sum of all substances that affect the respiratory system.

The same appears to be true in the San Joaquin Valley, where census tracts with the highest levels of National-Scale Air Toxics Assessment (NATA) respiratory risk are disproportionately populated by poor ($r = 0.17$, $P < 0.0001$) and Hispanic residents ($r = 0.21$, $P < 0.0001$). Shown in Map 11 are areas of the San Joaquin Valley with a high level of respiratory risk and a large proportion of Hispanic residents, particularly in Tulare County. Areas with the highest risk according to NATA data have significantly fewer Whites and a greater percentage of low-income residents (Figure 8).

Figure 8:
NATA Respiratory
Risk by Race/Ethnicity
and Poverty in
San Joaquin Valley



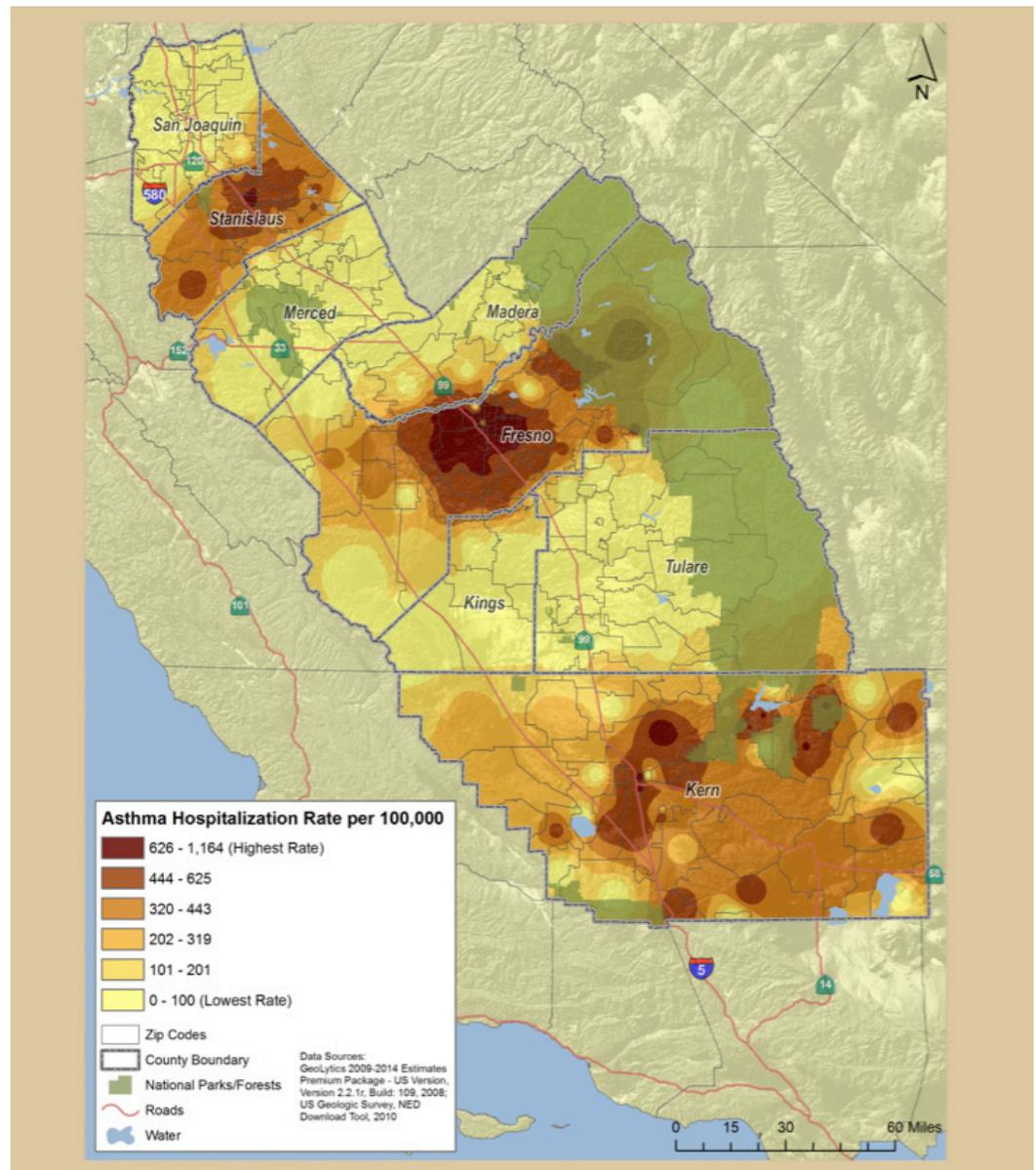
Map 11:
 Elevated Respiratory Risk
 (2002) and High Percentage
 Hispanic Population
 by ZIP Code (2009), San
 Joaquin Valley



Asthma Hospitalizations

Striking geographic disparities in asthma hospitalization rates exist in the San Joaquin Valley (Map 12). Areas of central Fresno, central and northeastern Kern, and Stanislaus have substantially higher rates of asthma hospitalization when compared with the remainder of the San Joaquin Valley.

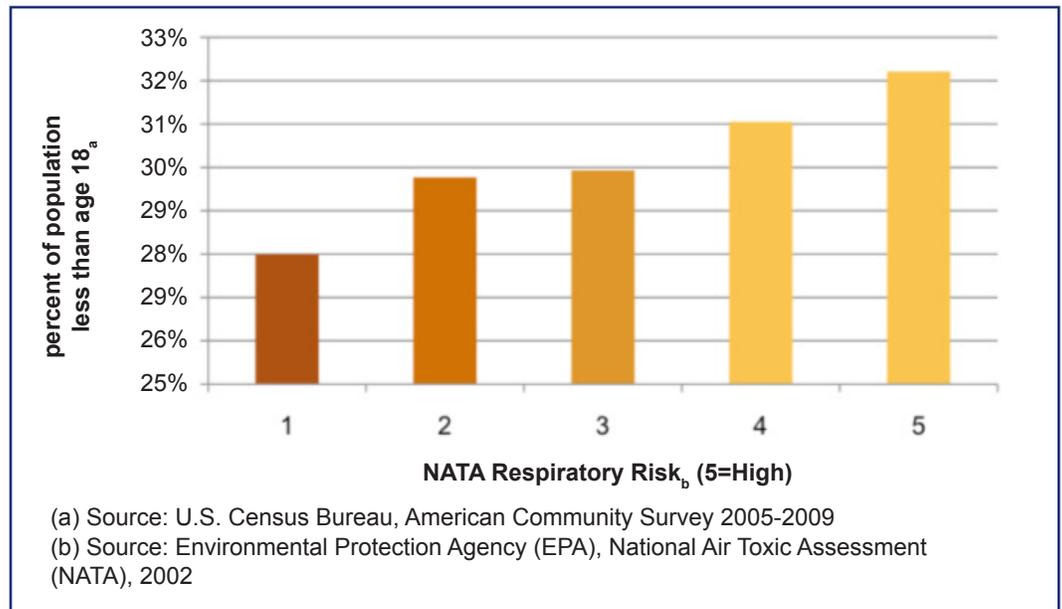
Map 12:
Asthma Hospitalization
Rates by ZIP Code,
San Joaquin Valley,
2000–2007



Note: Asthma hospitalization rates are age adjusted to the 2000 U.S. Census Population

Strong evidence in the medical literature links poor air quality with a higher incidence of asthma symptoms.⁹⁴⁻⁹⁷ This association has been observed in the San Joaquin Valley specifically, for both adults and children.⁹⁸ Children are particularly vulnerable to asthma, and in the San Joaquin Valley, the prevalence of asthma has reached epidemic levels: One in six children is diagnosed with the condition before the age of 18.^{99,100} According to a recent impact study, reducing ozone and particulate matter levels in the Valley to the federal limit would avert 23,300 asthma attacks, and 16,310 days of upper respiratory symptoms in asthmatic children every year,⁸⁵ resulting in huge savings financially and in terms of human suffering. In the San Joaquin Valley, the areas with the highest Environmental Protection Agency (EPA) respiratory risk have a higher percentage of the population under the age of 18 (Figure 9).

Figure 9:
NATA Respiratory Risk by
Population Under 18, San
Joaquin Valley



Nearly half of the children diagnosed with asthma in the San Joaquin Valley are low-income, defined as a family income below 200% of the federal poverty limit.¹⁰¹ Not only do those with low income have higher prevalence rates, they also experience more frequent symptoms and miss more days of school and work than do wealthier people with asthma.

Relationships between race and ethnicity and asthma prevalence and asthma-related symptoms exist but are complex and difficult to determine through examination of statistics alone.^{102, 103} Of the 278,000 adults with active asthma in the San Joaquin Valley in 2007, 29.7% were Hispanic, 7.1% were American Indian/Alaskan Native, 5.7% were Asian, 4.0% were African American and 53.0% were white.¹⁰⁴ Our data indicate that ZIP codes with greater percentages of African American residents had significantly higher asthma hospitalization rates among children ($r = 0.22$, $p < .008$), adults ($r = 0.25$, $p < .002$) and seniors ($r = 0.30$, $p < .0002$).

Furthermore, substantial literature links the incidence of asthma symptoms with exposure

to poor air quality,⁹⁴⁻⁹⁷ which is a critical problem throughout the San Joaquin Valley. However, air quality varies from area to area within the San Joaquin Valley's eight counties, and recent research indicates that asthma-diagnosed individuals in locations with high ozone and particulate matter concentration experience more frequent asthma symptoms and are more likely to visit the emergency room or be hospitalized.⁹⁸ This indicates that geographic disparities in asthma symptom incidence may exist as well. According to the 2001 California Health Interview Survey, 52.8% of children diagnosed with asthma living in rural settings experienced symptoms once a month or more as compared with only 42.5% of children living in urban settings.⁹⁹

However, limitations of the data available for examining the relationship between asthma rates and air quality make it challenging to demonstrate significant findings in this study. Data limitations included lack of asthma incidence data and lack of air quality measures related to ozone and particulate matter.

From the available data, we cannot document a significant statistical or geographic relationship between NATA respiratory risk and asthma hospitalization rates. Although Maps 10 and 11 pinpoint Tulare County as the area of highest NATA respiratory risk, in Map 12 this area is observed to have some of the lowest rates of asthma hospitalization. It is important to note, however, that NATA data do not measure concentrations of all particulate matter. Particulate matter is one of the biggest sources of pollution in agricultural areas in general and the San Joaquin Valley in particular and has been linked to asthma, increased incidence of other respiratory problems, and increased hospitalizations. According to Pastor and colleagues (2006), NATA risk represents only one category of air pollutant, one which tends to concentrate more easily than do more ubiquitous air pollutants, such as particulates. These authors note that this limitation of NATA data may explain why areas such as the intensively farmed San Joaquin Valley of California, acknowledged to be among the areas in the United States with high particulate air pollutants, does not appear to have high respiratory hazard ratios based solely on NATA data. When criteria air pollutants are analyzed, San Bernardino, Riverside, Kern, Fresno, and Tulare are among the top six California counties most exposed to environmental risk.¹⁰⁵

Other research has found that low-income residents in California exhibit increased vulnerability to asthma. According to a report based on the 2007 California Health Interview Survey, 8.7% of California residents with incomes below 200% of the poverty level have asthma, compared with 7.8% of those with incomes above 400% of the poverty level. In the San Joaquin Valley, the survey did not find a statistically significant difference between income groups. However, nearly half of the children diagnosed with asthma in the San Joaquin Valley are low-income, defined as a family income below 200% of the federal poverty limit.¹⁰¹ Not only do those with low income have higher prevalence rates, they also experience more frequent symptoms and miss more days of school and work than do wealthier people with asthma. Low-income California residents diagnosed with asthma have higher rates of emergency department visits and hospitalizations and are much more likely to be uninsured and lack access to care.¹⁰¹

In summary, our findings concur with previously cited studies, which document that proximity to hazardous sites and heightened exposure to pollution disproportionately affect neighborhoods with larger populations of people of color and the poor. Because of the limited sources of environmental hazard data available for this analysis and access to health outcome data only at the ZIP code area or larger, we were unable to find statistical associations between the EPA environmental hazard density data and health outcomes to present here (see Appendix A for more details). Previous studies have documented the high asthma prevalence rate in the San Joaquin Valley and the relationship between asthma and poor air quality.^{94, 96-98, 103, 106}

IV. Conclusions

Premature Mortality

The analyses presented here have shown that social factors are strongly linked with premature mortality in the San Joaquin Valley. Both income and educational attainment are strongly correlated with premature mortality ($r = 0.41$ and 0.42 , respectively). As the income and educational attainment of an area decreases, premature mortality generally increases. Poverty is a particularly strong predictor of premature mortality at the aggregated ZIP code level.

Socioeconomic conditions of distress are distributed throughout the San Joaquin Valley. Poverty is particularly concentrated in the western and northwestern portions of the region, but it exists in every county. Similarly, low educational attainment is concentrated in western San Joaquin Valley but is prevalent across the region. Despite the relatively favorable mortality rates associated with recent Hispanic immigrants, the well-established relationship between poverty, education, and health combined with the limited economic and educational opportunities available to immigrants in the San Joaquin Valley likely will result in worsening health outcomes in succeeding generations.

Environmental Justice and Respiratory Risk

High poverty and low educational attainment rates make migrant workers and their families particularly vulnerable to asthma. Recent research indicates that those with asthma face significant barriers to care: They are more likely to lack a usual source of care, report a delay in medical care, and report no visit to the physician in the past year. They are also less likely to report asthma symptoms and emergency department visits, but this may reflect under-utilization due to a variety of barriers, such as cost, language, and fear of repercussions with immigration officials. Perhaps as a result of these barriers, migrant families are less likely to report that a child in their family has ever been diagnosed with asthma. For immigrant families with children, poverty and language barriers were both associated with greater limitations in function and poorer perceived health.¹⁰²

We found that geographic areas with the highest levels of NATA respiratory risk were disproportionately populated with poor and Hispanic residents. In communities with the highest NATA environmental exposure, 55% of the population is Hispanic, and 24% live below the poverty level. By comparison, in communities with the lowest risk, 38% of the population is Hispanic and 16% live below the poverty line. Additionally, areas with higher respiratory risk had a significantly higher percentage of the population under the age of 18—the population that is particularly vulnerable to respiratory illness. These findings are consistent with literature that suggests that vulnerable populations are disproportionately exposed to environmental hazards. Further research is needed to document the respiratory health burden experienced by residents of the San Joaquin Valley, particularly children.

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