Neighborhood-Level Determinants of Life Expectancy in Oakland, CA
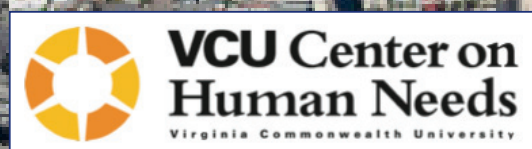
TECHNICAL REPORT
Center on Human Needs
Virginia Commonwealth University
Richmond, Virginia

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VCU Center on Human Needs
Virginia Commonwealth University

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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.

From: *A Conceptual Model for Taking Action on the Social Determinants of Health.*
Geneva: World Health Organization, 2010 (reprinted with permission)
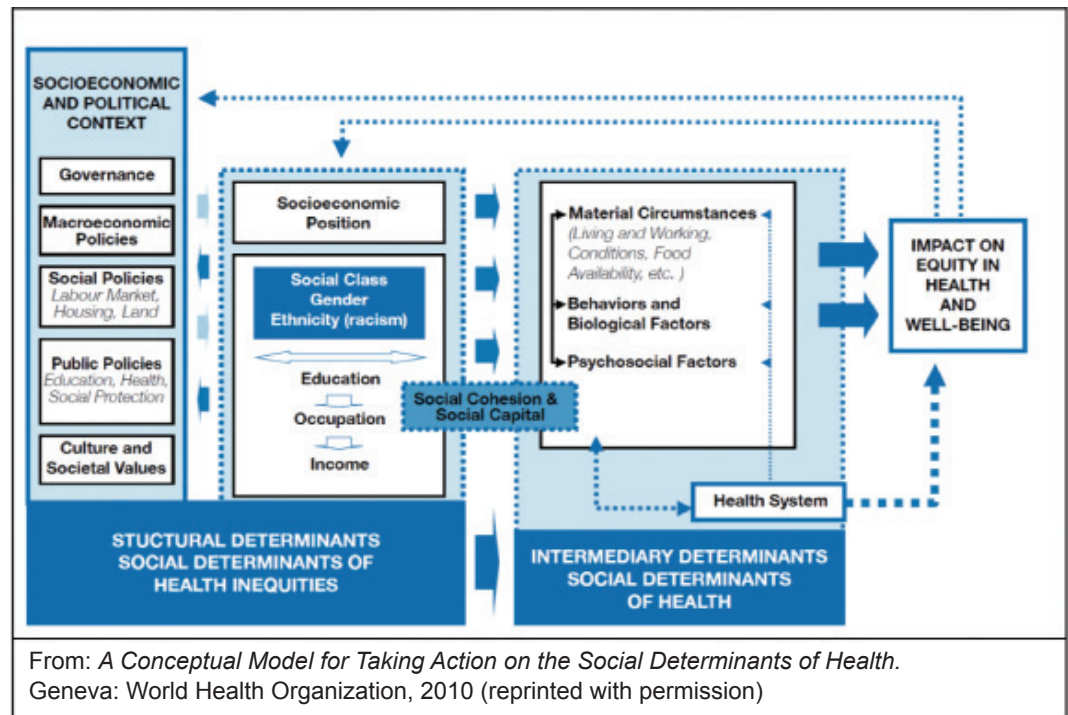
In the language of social epidemiology, "downstream" determinants of health—ranging from unhealthy behaviors to living and working conditions—are the byproduct of "upstream" structural determinants (Figure 1) such as socioeconomic position, race-ethnicity, occupation, and social cohesion. These socioeconomic 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 CHN and VANGHR were contracted by HPI to develop technical reports on which the eight CHERs were based. What follows is the technical report for Alameda County, California. The focus of the report and the research questions it addresses were guided by extensive input from the Place Matters team in Alameda County. 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/

Introduction

The health of Alameda County 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.[3,7–12] Place matters in health because characteristics of the areas in which people live affect health choices, behaviors, environmental risks, and access to medical care.[13–18] 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.

Countywide statistics oversimplify important geographic differences that exist between different neighborhoods and communities within Alameda County and that contribute to large differences in the health of residents. Geographic disparities in health status within Alameda County reflect, in part, geographic patterns in the population and living conditions. The health challenges faced by individuals and households are influenced by the neighborhood.[19,20] Regardless of one's education, income, or motivation to make healthy choices, risks may be introduced by increased crime, air pollution, the absence of places to exercise or obtain nutritious food, poor schools, a scarcity of good jobs, and stress related to these community challenges.[18,21–28] 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.[29–32]

This report will focus on the characteristics of Alameda County and its communities that may affect health outcomes for residents, including public safety, socioeconomic opportunity, the built environment, and educational conditions. Life expectancy will be explored as well as the interrelations between these various community characteristics. Particular attention will be paid to the characteristics and health outcomes of the City of Oakland, the largest city in Alameda County.

Part I of this report provides background information about Alameda County and the City of Oakland, including population data, health outcomes, socioeconomic conditions, and community characteristics. Part II examines the relationship between socioeconomic status, educational factors, public safety, the built environment, and health outcomes. Part III presents conclusions about community-level factors related to life expectancy in Alameda County. Appendix A (available on the CHN website) presents detail about the data and methods that were used in preparing this report.

I. Background: Population, Community Characteristics, and Health in Alameda County

Population

Alameda County is located in the San Francisco Bay Area of California. It includes 14 cities; the four largest are Oakland, Fremont, Hayward, and Berkeley. Oakland's population of 409,151 made up over one fourth of the total Alameda County population (1,491,482) in 2009. The overall population density in Oakland was 7,134.9 persons per square mile in 2009, which is over three and half times the population density of Alameda County (Map 1).
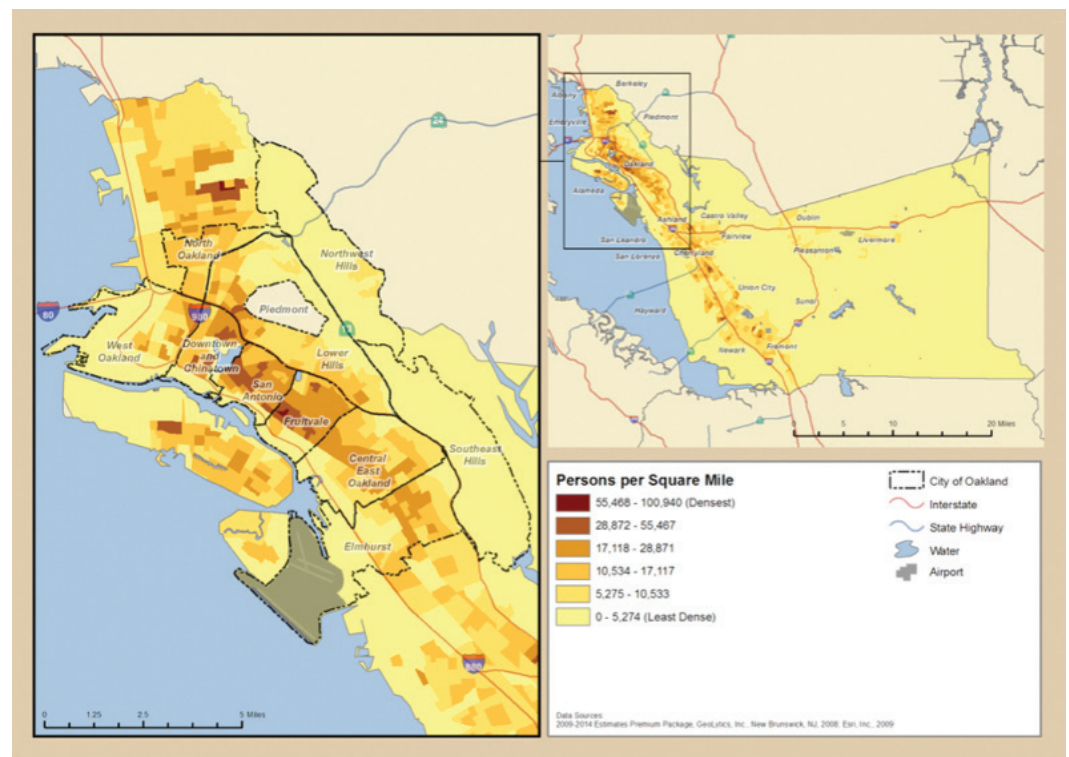
Table 1:
Demographic Characteristics
of the City of Oakland,
Alameda County, the State
of California, and the United
States

	City of Oakland	Alameda County	California	United States
Population (2009)ₐ	409,151	1,491,482	36,961,664	307,006,556
Population density (persons per square mile) (2009)b	7,134.9	2,029.1	239.5	86.7
Race/ethnicity (%) (2009)ₐ				
White	27.1	36.1	41.5	64.9
African American	27.4	12.3	5.8	12.1
Latino	25.5	21.9	37.0	15.8
Asian	15.1	25.1	12.3	4.4
Other	5.0	4.5	3.3	2.8

(a) Source: U.S. Census Bureau, 2009 American Community Survey.
(b) Source: 2009 Geolytics Projection.
Note: "Other" includes American Indian and Alaska 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-Latino population only; Latino can include any racial group.

The City of Oakland and Alameda County are very diverse both racially and ethnically. In 2009, Oakland's population was almost equally divided between White (27.1%), African American (27.4%), and Latino (25.5%) residents, and it also had a large percentage of Asian residents (15.1%). Alameda County had a greater percentage of White (36.1%) and Asian (25.1%) residents, with 21.9% Latino and 12.3% African American residents (Table 1 and Figure 2).

Source: U.S. Census Bureau, 2009 American Community Survey.
Note: "Other" includes American Indian and Alaska 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.
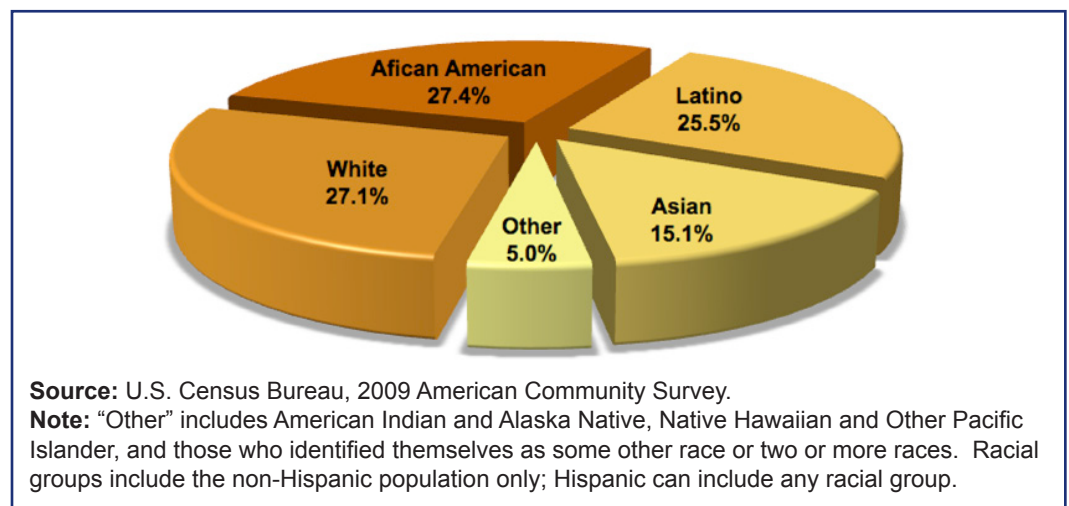
In many cities and towns in America, people of color and disadvantaged populations have historically been relegated to isolated and segregated communities that perpetuate cycles of hardship by means of limited housing and employment opportunities and lack of access to financial capital.

In part because of racial segregation, racial and ethnic groups are concentrated differently across Alameda County. The Index of Dissimilarity[33] is a measure of residential segregation that identifies the percentage of the population that would have to relocate to completely integrate the community. The higher the value, the more segregated the area. Between 2005 and 2009, the Index of Dissimilarity for the Oakland metropolitan area between White and African American populations was 63.8%, compared with 62.3% in California.[34] The Oakland metropolitan area ranked 32nd in Black-White segregation among the top 100 largest metropolitan areas based on 2005–2009 American Community Survey data. Milwaukee, Detroit, the New York metropolitan area, Chicago, and Cleveland held the top five spots.[34] The Index of Dissimilarity for the Oakland metropolitan area between White and Latino populations was 49.9%, compared with 54.9% in California.[34] The Oakland metropolitan area ranked 33rd in Latino-White segregation.

The Index of Dissimilarity is less useful for comparisons at smaller geographic levels. For this purpose, the diversity index is more useful. It is a measure of the likelihood that two people randomly chosen from an area will be of a different race or ethnicity. The higher the value, the less segregated the area. Although the diversity index for Alameda as a whole is 77.0%, the value ranges from 15.3% in Berkeley to 89.1% in Hayward.

The extent to which an area is racially segregated may affect population health outcomes.[20,35,36] Racial and ethnic groups are concentrated differently across Alameda County and Oakland.[37] Within Oakland, some areas in Elmhurst are more than 70% Latino. In census tracts in Lower Hills and North Oakland, non-Latino Whites constitute more than 80% of the population. The majority of the Asian population resides in southwestern Alameda County. The African American population is concentrated in West Oakland and areas in Central East Oakland and Elmhurst. Map 2 displays the racial and ethnic distribution of Alameda County residents.

Map 2:
Racial/Ethnic Distribution, Alameda County (2005–2009).
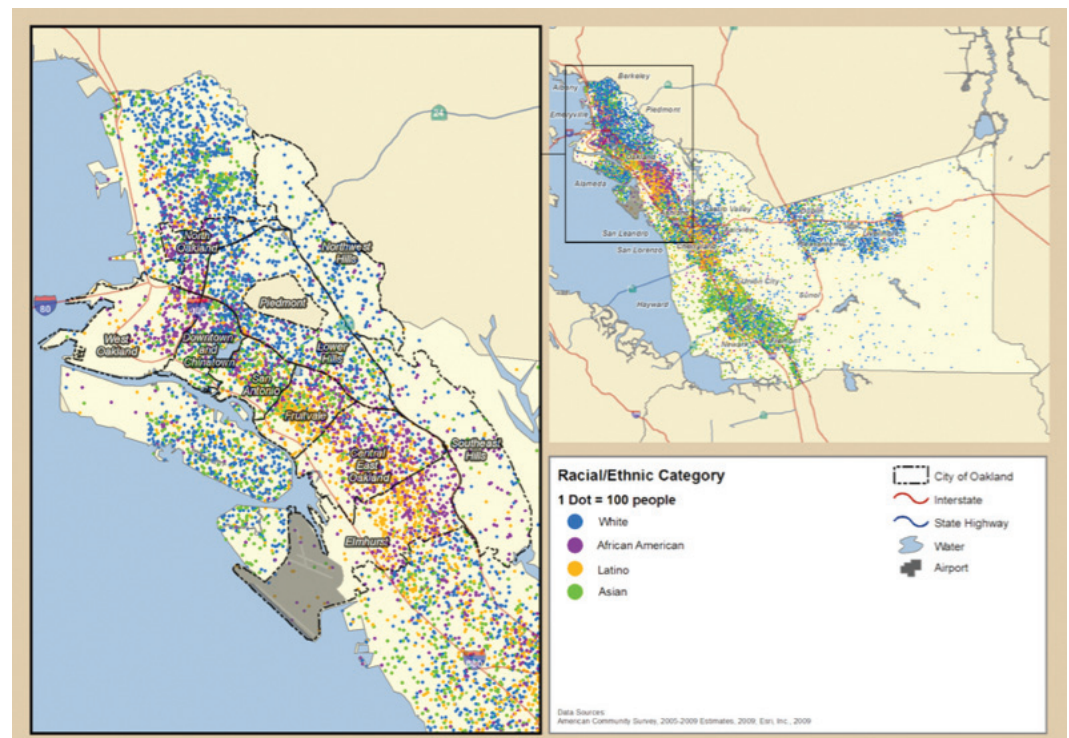
Socioeconomic Characteristics

As is true of other communities, socioeconomic conditions in Alameda County exert an important, and often unrecognized, influence on health status. Nationally, families with incomes below the federal poverty level (FPL) are 3.6 times more likely to report fair or poor health than are those with incomes of at least twice the poverty level.[38]

In 2009, 17.2% of households in Oakland had incomes below the FPL—well greater than the national average. The income-to-poverty ratio expresses household income as a percentage of the FPL. As shown in Figure 3, 8.3% of households in Oakland earned less than half the FPL, and almost 40% earned less than twice the poverty threshold. For a family of four, that was less than $44,100 in 2009.

Source: U.S. Census Bureau, 2009 American Community Survey.
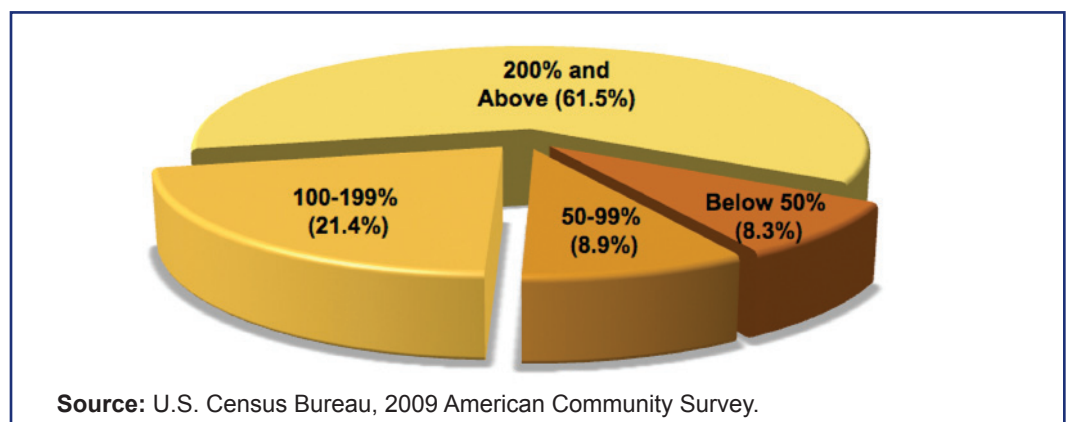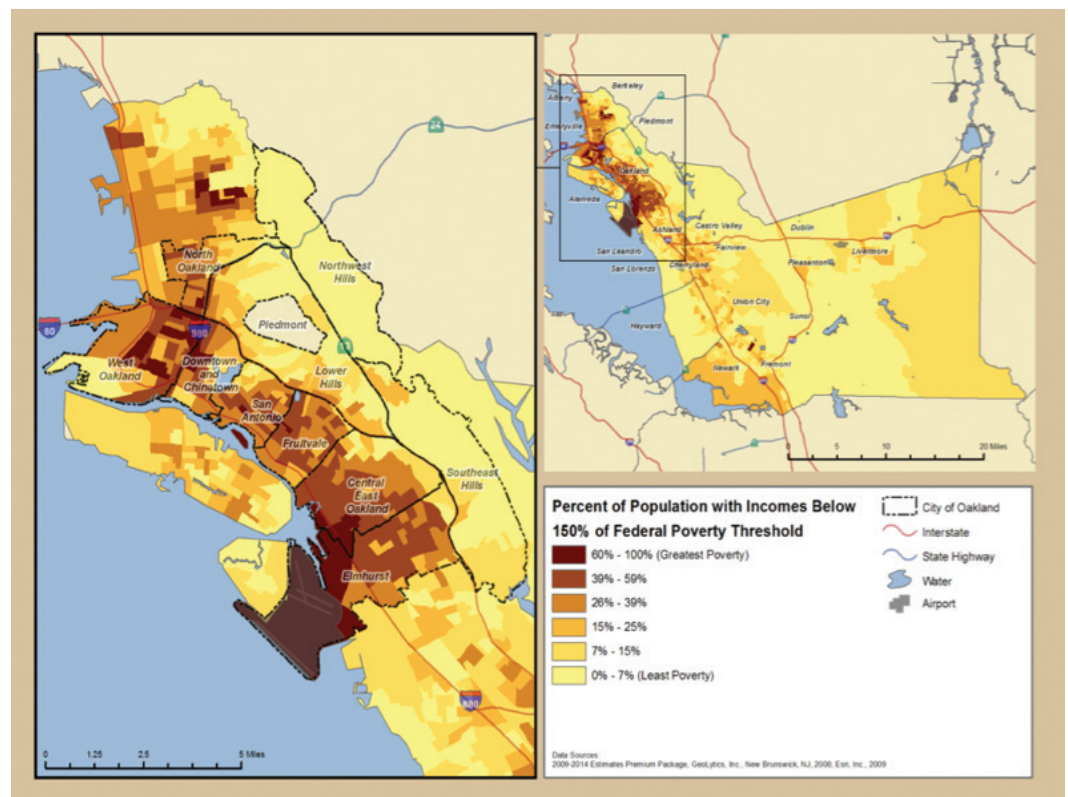
According to the U.S. Census Bureau, 22.0% of households in the United States reported an income below 150% of the FPL in 2009.[37] In Alameda County, 18.0% of the population had incomes less than 150% of the FPL, yet 35.7% of Alameda census tracts—representing 109 tracts—met or exceeded this level of poverty. In Oakland, 67.9% of the census tracts and 70.9% of block groups met or exceeded the county's average poverty rate. Poverty levels were highest in West Oakland, Downtown, and Chinatown (Map 3).

Persistence of concentrated poverty across several decades may have additional health and social consequences, particularly for the children living in those areas. A persistent lack of economic resources during childhood has consequences on cognitive, emotional, behavioral, and physical development.[39,40] Persistent poverty may also diminish the likelihood of high school completion,[39,40] thus perpetuating disadvantage and the multi-generational cycle of living in conditions that adversely affect health. Persistent poverty, in which at least 20% of the population have incomes under 100% of the FPL for at least two census periods, has been a pervasive influence in Oakland. Out of 45 census tracts that meet the criteria for persistent poverty in Alameda, all but four (91.1%) are in Oakland. Within Oakland, West Oakland fares the worst, with 11 out of 14 (78.5%) census tracts in persistent poverty (Map 4).
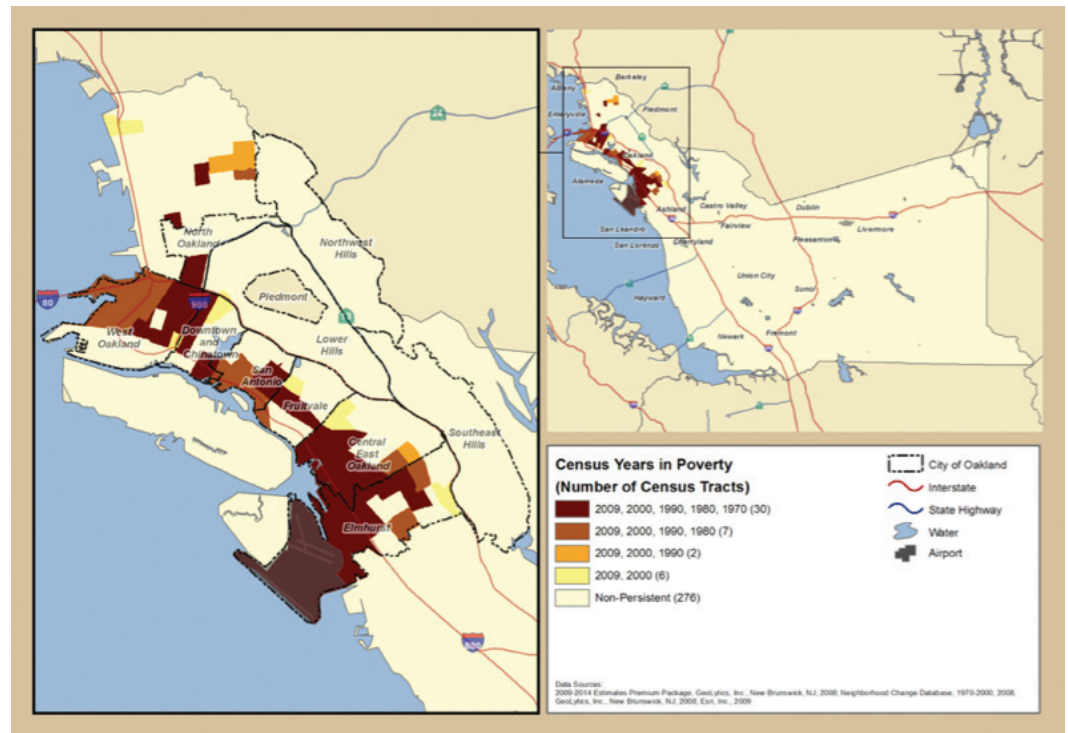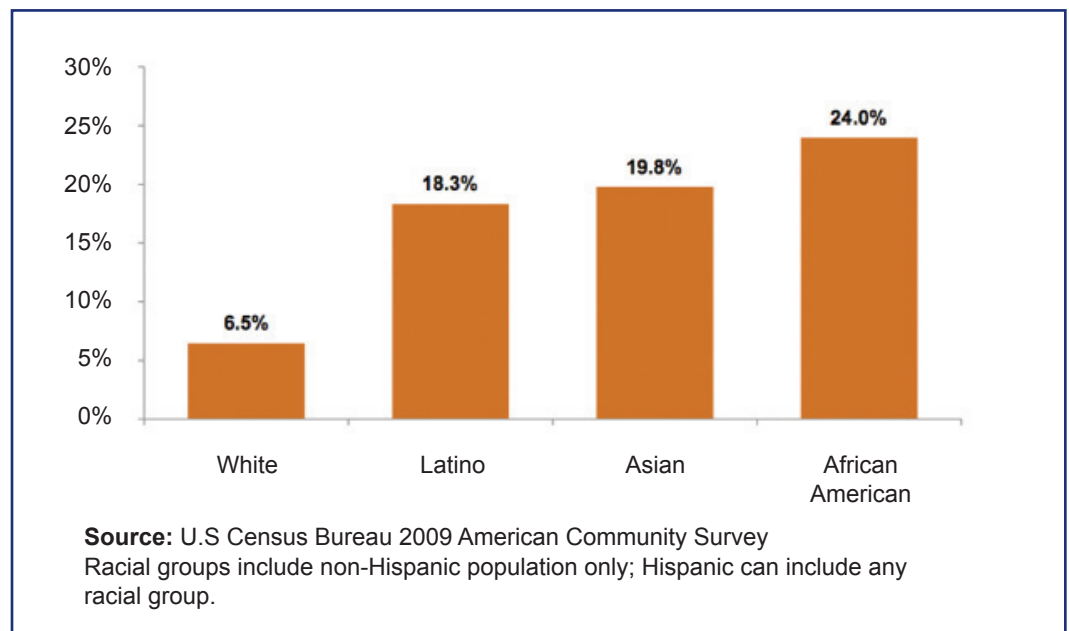
Note: The category of "Persistent Poverty" includes census tracts with a poverty rate of at least 20% for at least two consecutive census periods, looking retrospectively from 2009. This concept is based on the U.S. Department of Agriculture's research on counties with persistent poverty.

Insufficient income to meet basic needs intensifies material hardship. A lack of financial resources exposes individuals to further risks from the environment in which they live. Lower percentages of community-level, owner-occupied housing are associated with adverse outcomes in crime and education.[41–44] Because of a lack of access to financial capital, impoverished families are more likely to rent rather than own property and to live in less desirable areas. In 2009, only 41.5% of housing units in Oakland were owner-occupied, compared with 54.7% in Alameda County, 57.6% in California, and 60.7% nationally.[45]

The demographic characteristics of a community can be associated with poverty. Poverty rates are generally higher among racial and ethnic minorities than among White populations. In Oakland, White residents are least likely to live below the poverty level (6.5%), whereas almost one out of every four African American residents lives in poverty (24.0%) (Figure 4).

Figure 4:
Poverty by
Race-Ethnicity in
Oakland, CA

Source: U.S Census Bureau 2009 American Community Survey
Racial groups include non-Hispanic population only; Hispanic can include any racial group.

Education

Education is a pathway to higher income and net worth, which also have strong influences on health status and access to health care. In 2009, American adults with less than a high school diploma as their highest educational attainment had less than half the earnings ($18,432 versus $47,510)[37] and were three times more likely to die before age 65 as were those with at least a Bachelor's degree.[46] They were also more likely to engage in unhealthy behaviors such as cigarette smoking.[47]

Residents of impoverished communities are more likely to have low educational attainment. In Oakland, two out of five adults living in poverty have less than a high school diploma. Race and ethnicity are also strong predictors of educational attainment. Compared with non-Latino Whites in the same time period, African American adults in Oakland were more than three times as likely to lack a high school education (Figure 5).[37] Latino residents fare even worse, with more than half of adults lacking a high school education.

Figure 5:
Educational Attainment in
Oakland, California

Source: U.S. Census Bureau 2009 American Community Survey
Notes: Other includes Two or More Races, American Inidan and Alaska Native, Native Hawaiian and Other Pacific Islander, Some Other Race. Racial groups include non-Hispanic population only; Hispanic can can include any racial group.
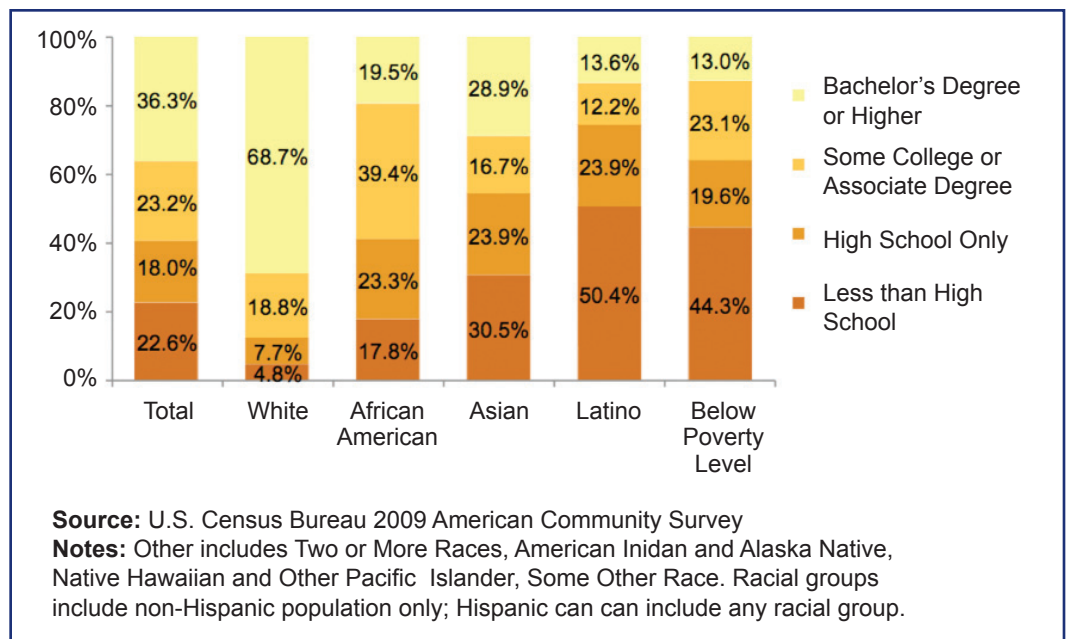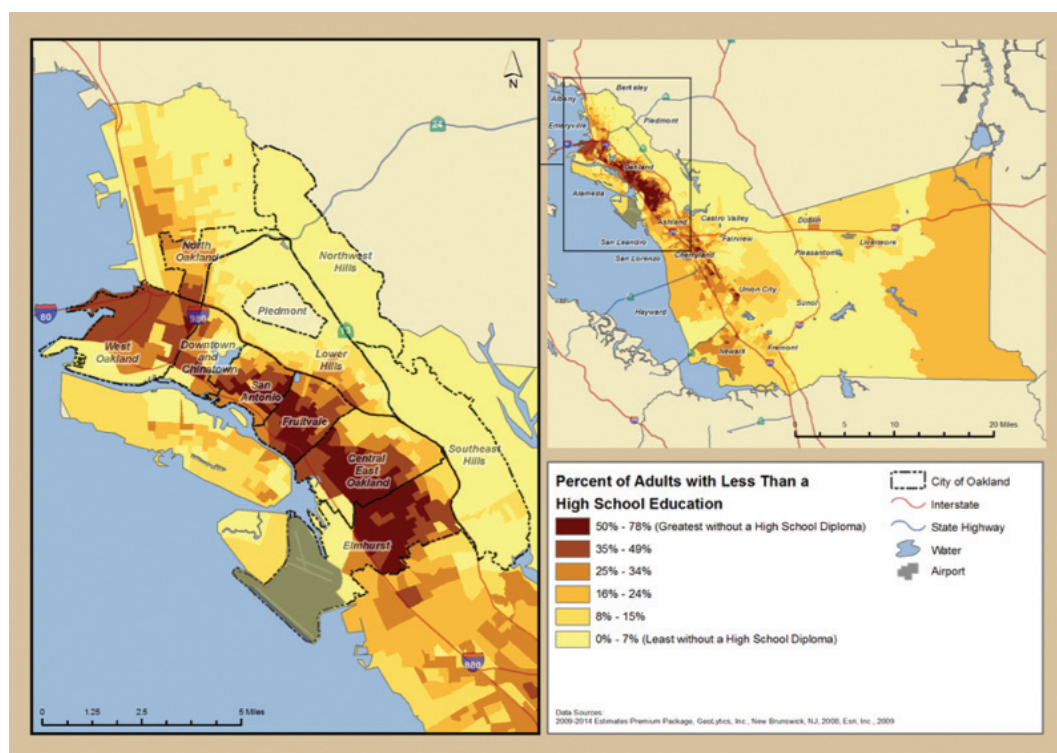
Table 2:
Socioeconomic
Characteristics of the City of
Oakland, Alameda County,
the State of California,
and the United States

	City of Oakland	Alameda County	California	United States
Educational attainment (%)				
Less than high school	22.6	14.8	19.4	14.7
High school only	18.0	20.0	20.9	28.5
Some college	23.2	25.0	29.8	28.9
Bachelor's degree or higher	36.3	40.2	29.9	27.9
Poverty Rate (%)				
Below 50% of poverty rate	8.3	5.0	6.0	6.3
50–99% of poverty rate	8.9	5.7	8.2	8.1
100–199% of poverty rate	21.4	14.9	19.5	18.4
200% and above of poverty rate	61.5	74.4	66.3	67.3

Source: U.S. Census Bureau, 2009 American Community Survey.

Overall, educational attainment in Alameda County exceeds that of California and the nation. However, in Oakland the percentage of the population without a high school diploma is higher than the average for the county, state, or nation. Within Oakland, more than one out of every five adults lacks a high school diploma (Table 2).[37,48] The block groups in Oakland exhibiting the highest level of educational distress—with more than half of adults lacking a completed high school education—are in Central East Oakland, Elmhurst, San Antonio, and Fruitvale (Map 5).

Map 5:
Adults with Less
than a High School
Education by Block Group,
Alameda County (2009).

Health Outcomes

Alameda County has longer life expectancy at birth (80.5 years) than do California (80.0 years) and the United States (78.0 years) (Table 3). However, the all-cause mortality rate and the low birth weight rate for Alameda County were both somewhat higher than the rates in California.

Rates for all-cause mortality and low birth weight babies in the region tend to be lower among Latinos than among non-Latinos. The highest rates for both all-cause mortality and low birth weight are observed among African Americans, who also have elevated rates at the state and national levels.

Table 3:
Health Characteristics of Alameda County, State of California, and United States

	Alameda	California	United States
Life expectancy (years)	80.5[a]	80.0[b]	78.0[b]
All-cause mortality rate* (1999–2007)[c]	732.3	675.0	759.5
Non-Latino	749.4	702.8	776.3
Latino	577.3	537.9	546.1
White	761.0	790.4	815.9
African American	1092.5	1061.1	1068.5
Asian	462.8	482.2	458.6
Low birth weight rate (%) (2008)[d]	7.1	6.8	8.2
Non-Latino	7.9	7.5	8.6
Latino	5.3	6.1	7.0
White (%)	6.8	6.4	7.2
African American (%)	11.3	12.1	13.7
Asian (%)	7.3	7.7	8.2

(a) Calculations performed by the Alameda County Health Department from data provided by California Death Masterfile 2002–2008.
(b) 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) Data from the Centers for Disease Control and Prevention, CDC Wonder, adjusted to the 2000 Census Population.
(d) The Centers for Disease Control and Prevention National Vital Statistics System 2008.
*Mortality statistics are per 100,000 population.
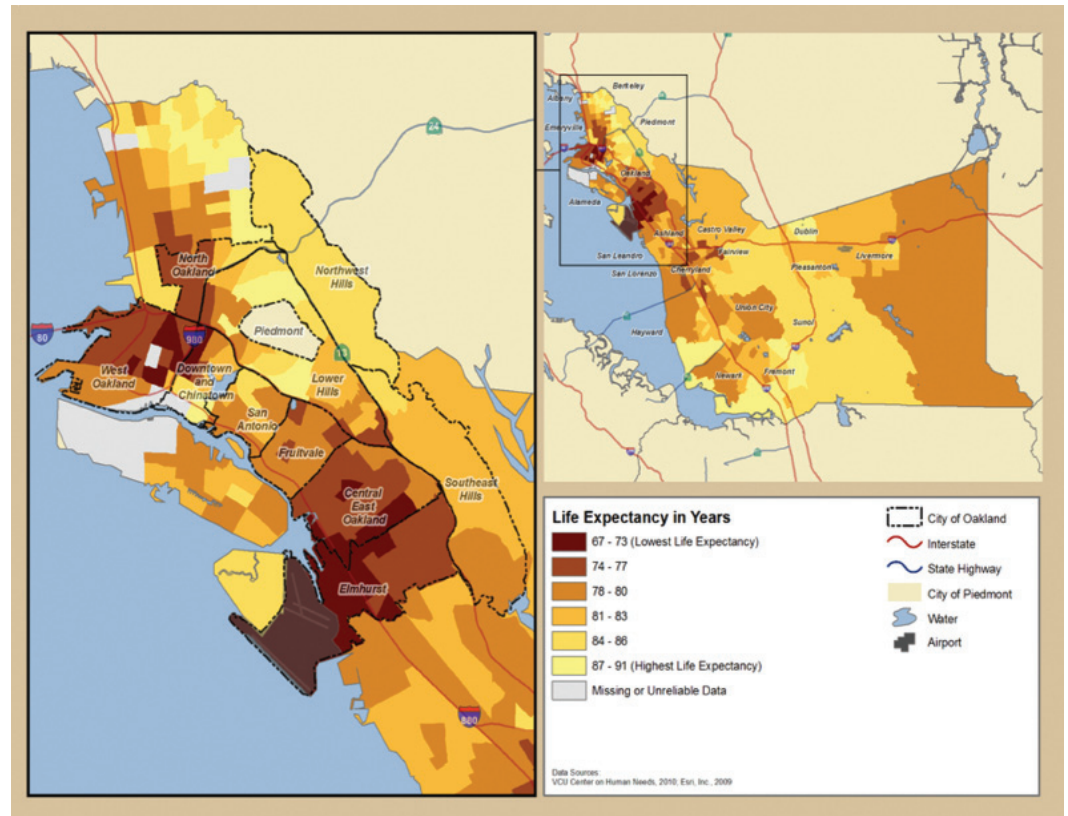
Given the geographic variation in socioeconomic and environmental factors that affect health in Alameda County, it follows that health outcomes—including life expectancy—vary sharply by neighborhood as well (Map 6). Life expectancy varies by as much as 24 years between census tracts in Alameda County. The tract with the highest life expectancy (91 years) is in the Lower Hills. The tract with the lowest life expectancy (67 years) is in West Oakland. The life expectancy in West Oakland is similar to the life expectancy of countries such as Turkmenistan, Kazakhstan, and North Korea.[49] This is consistent with the findings of the Alameda County Health Department, which documented disparities in health outcomes, including life expectancy.[50]

II. Neighborhood Characteristics and Health Outcomes

This section explores health opportunities associated with neighborhood characteristics that represent different domains of community life: economics, education, public safety, and the built environment. For economics, education, and public safety, we constructed multivariate indices that provide summary values for each census tract. For education and economics, high index values indicate high opportunity, whereas low values indicate lower opportunity. For public safety, high index values represent areas with higher crime. For the built environment, we also explored the use of multivariate indices, but because these were not reliable, we present data on individual measures of these domains.

Although we will explore each of these domains separately, it is important to note that they are deeply interrelated. To better understand how these individual variables interact to shape a community environment that affects how long a person can expect to live, we combined the indices together in order to examine the relationship between multiple community-level risks and life expectancy simultaneously.

Map 7:
Economic Opportunity Index by Block Group, Alameda County (2009).
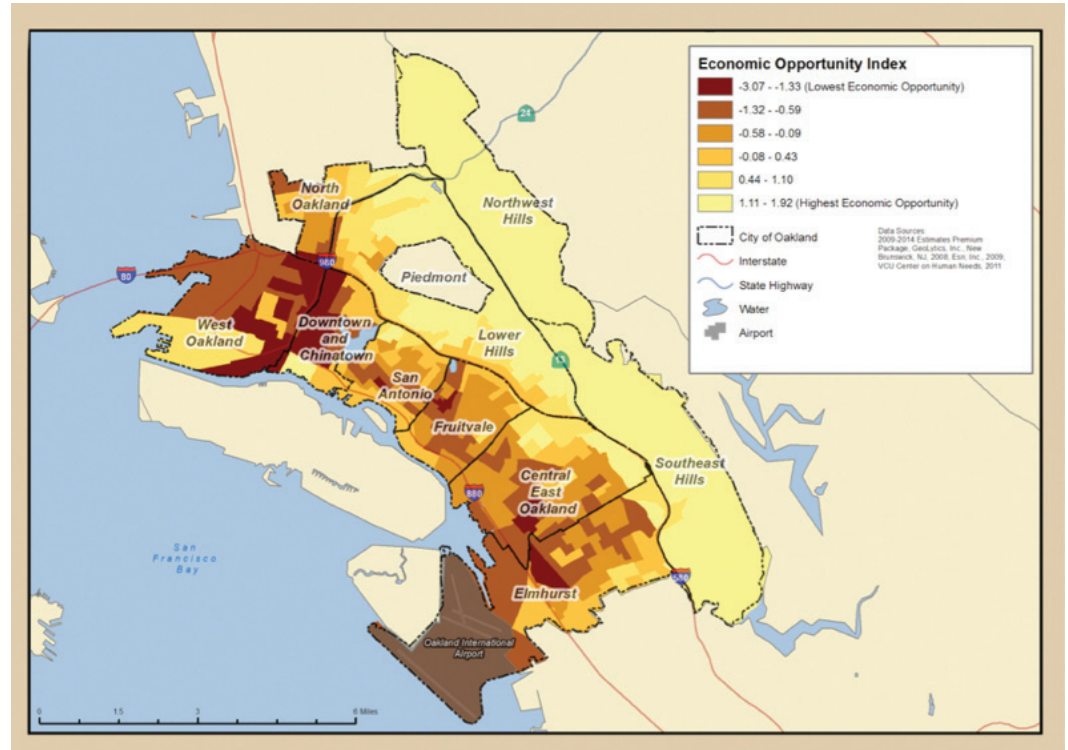
Note: The economic opportunity index is a composite index based on the following indicators: percent employed, percentage of owner-occupied houses, percentage of households with an automobile, and percentage of population with incomes above 150% of the FPL. Higher scores represent higher levels of economic opportunity.

Life Expectancy and Economic Conditions

Individual and community-level economic resources are known to be important to health.[13,17,51–54] Income, race, educational attainment, and health behaviors are some of the strongest predictors of a long life[55] across a variety of geographic levels, including neighborhood (census tract), county, state, and nation. To examine the relationship between economic opportunity and health in Oakland, we created an index to represent economic opportunity based on rates of employment, home ownership, automobile ownership, and poverty from 2009 Geolytics data (see Appendix A for more details on methods). The lowest scores on the economic opportunity index, representing extreme economic disadvantage, can be found in West Oakland, Elmhurst, Downtown, and Chinatown (Map 7). The higher rates of foreclosure can be found in West Oakland, Downtown, Chinatown, Central East Oakland, and Elmhurst (Map 8).
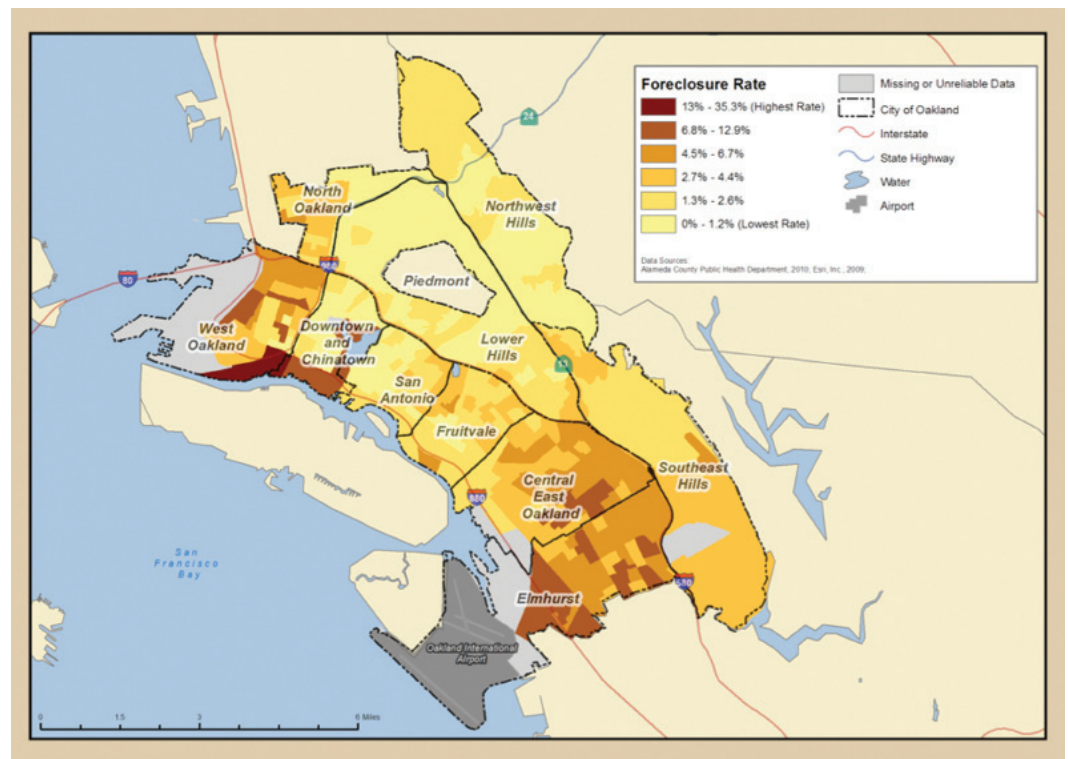
Strong neighborhood-level effects of economic factors on health have been observed, particularly with regard to income, [17,53,56,57] indicating that economic opportunities in a given geographic area correlate with mortality indicators. In Oakland, we found a moderately strong correlation between the economic opportunity index and life expectancy ($r = 0.59$, $P < 0.0001$) at the census-tract level, indicating that as economic opportunity increases, life expectancy tends to increase.

Source (a): Alameda County Vital Statistics, 2002-2008
Source (b): Geolytic Projections, 2009
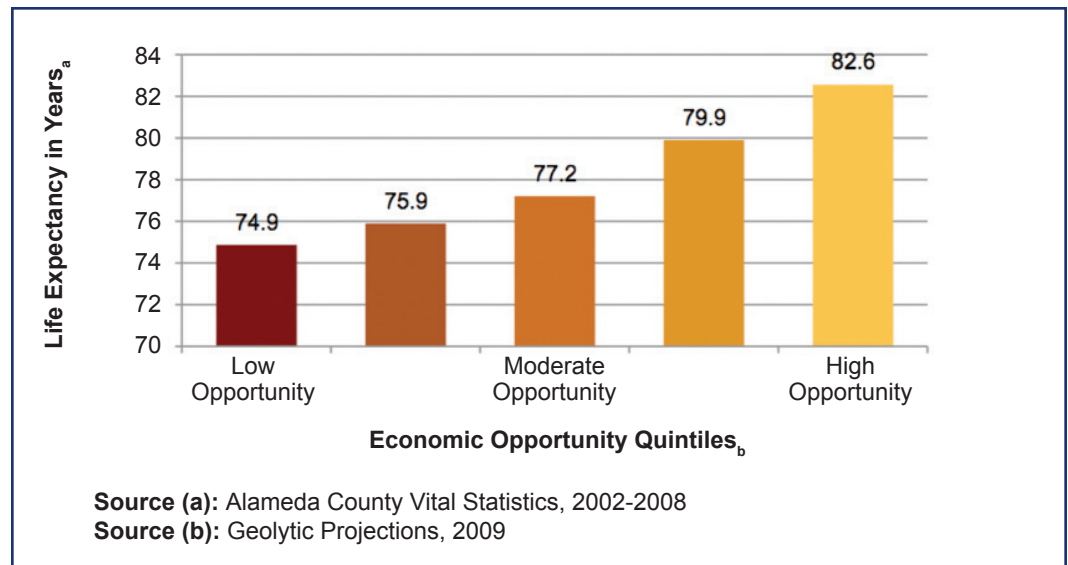
In Figure 6, Alameda County census tracts are divided into quintiles (five groups) from the highest economic opportunity to the lowest. Life expectancy in census tracts in the highest economic opportunity quintile averaged 7.7 years longer than life expectancy in census tracts in the lowest economic opportunity quintile. West Oakland, Downtown, and Chinatown contain census tracts with the lowest economic opportunity and the lowest life expectancy (Map 9).

Map 9:
Co-occurrence of Low
Economic Opportunity and
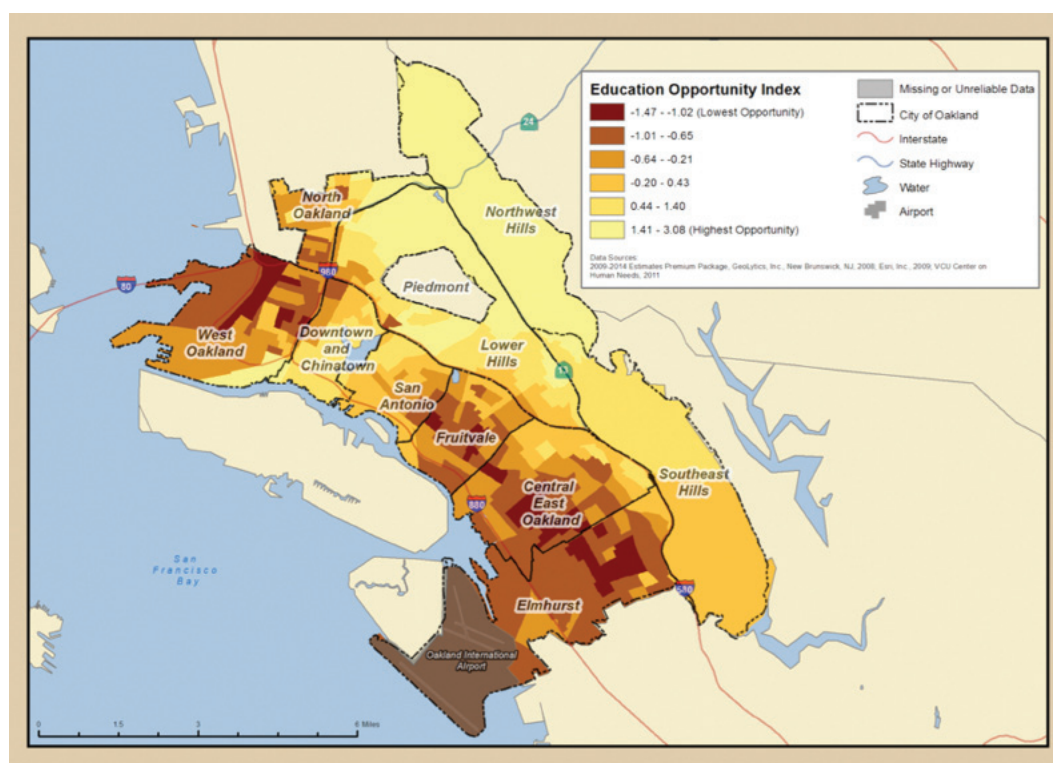Low Life Expectancy by
Census Tract, Oakland
(2002–2009).
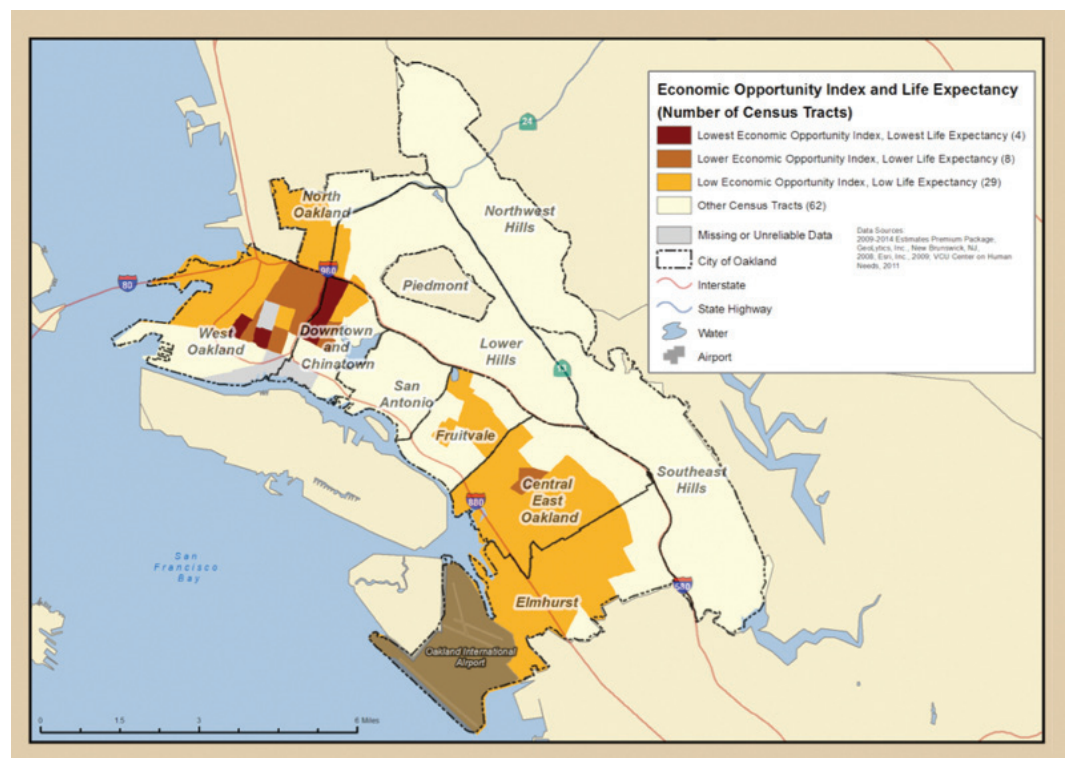
Note: *Lowest* economic opportunity = –3.07 to –1.65; *lower* economic opportunity = –3.07 to –0.79; *low* economic opportunity= –3.07 to –0.06; *lowest* life expectancy = 67 to 72 years; *lower* life expectancy = 67 to 75 years; *low* life expectancy = 67 to 78 years

Life Expectancy and Education

Like income, numerous studies have found educational attainment [54,58–61] to be significantly related to premature mortality at the individual and group levels. Characteristics of educational environment, such as drop-out rates, teacher quality, and quality of facilities, are generally associated with educational success and higher educational attainment.[62]

To examine the relationship between education opportunity and health in Oakland, we created an index to represent education opportunity on the basis of average proficency scores in math and language arts and the percentage of the population with greater than a high school diploma (see Appendix A for more details on methods). The lowest scores on the education opportunity can be found in West Oakland, Elmhurst, Downtown, and Chinatown (Map 10).

In Oakland, we found a moderately strong positive correlation between the education opportunity index and life expectancy ($r = 0.74$, $P < 0.0001$) at the census tract level, indicating that as education opportunity increases, life expectancy tends to increase.

Highlighted in Map 11 are those Oakland census tracts that have both low levels of education opportunity and the lowest life expectancies: North Oakland, West Oakland, Central East Oakland, and Elmhurst.

Map 11:
Co-occurrence of
Education Opportunity
Index and Life Expectancy
by Census Tract,
Oakland (2002-2009).
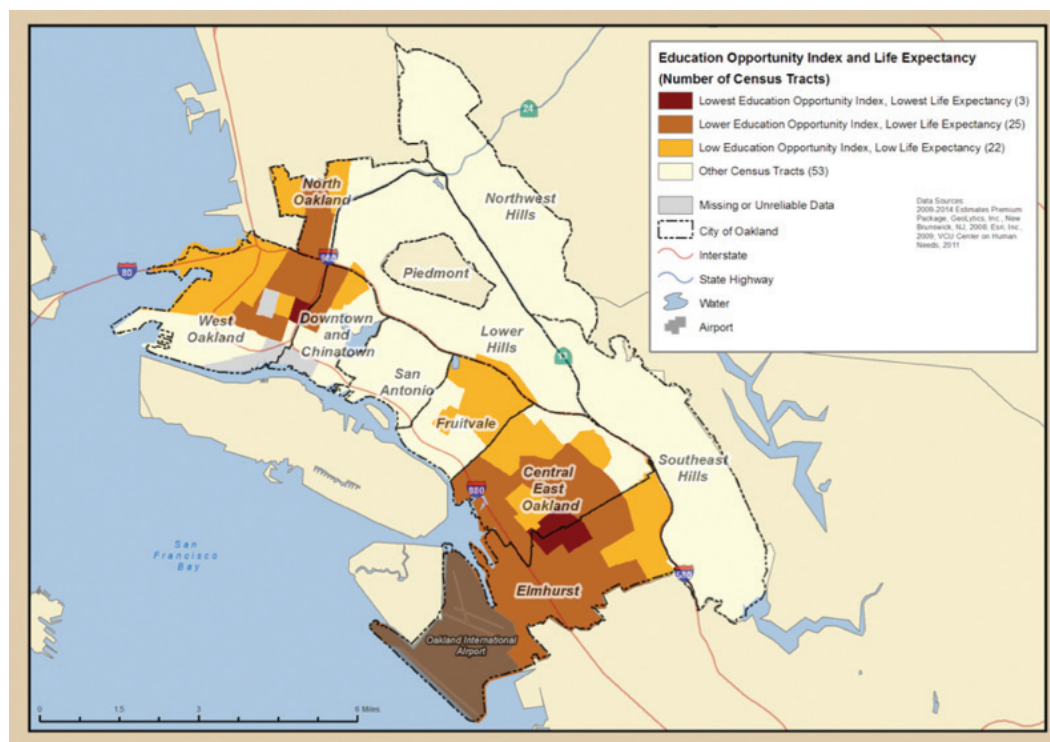
Life Expectancy and Public Safety

Living in a high-crime neighborhood can pose a number of direct risks, such as assault and homicide, as well as indirect health risks, such as increased risk for disease due to high levels of chronic stress.[63] Like other health risks, crime is not evenly distributed across communities. High crime rates are consistently observed in communities with lower educational attainment and less economic opportunity, as well as in highly segregated communities.[41,64,65] In Oakland, census tracts in the highest-crime quintile according to the public safety opportunity index are more likely to have low housing ownership rates and low educational attainment, high liquor store density, and low life expectancy (Table 4).

Table 4:
Characteristics of
Low Public Safety and
High Public Safety
Census Tracts/Block Group in
Oakland, 2007–2009

	High public safety*	Low public safety*
Violent crime rate/100,000 personsa	441	5,001
Property crime rate/100,000 personsa	3,233	19,346
Owner-occupied households (%)b	66.2	27.7
Less than a high school diploma (%)b	5.9	34.1
Liquor store density/square milec	55.8	299.4
Life expectancy in yearsd	82.5	73.8

(a) Urban Strategies Council with data from the Oakland Police Department, 2007–2009
(b) Geolytics Projections, 2009
(c) California Department of Alcoholic Beverage Control, 2010
(d) Calculations performed by the Alameda County Health Department from data provided by California Death Masterfile 2002-2008
*High public safety values are based on the average values for block groups that fall into the lowest 20% of the index. Low public safety values are based on the average values for the highest 20%.

According to the Federal Bureau of Investigation, in 2009 Oakland had a violent crime rate of 1,679 per 100,000 residents, which is more than three times the rate for California and the United States (Table 5).[66] Oakland's violent crime rate included high rates of murder, rape, robbery, and aggravated assault that exceeded national and state averages.[66] The property crime rate and all of its subcomponents were also significantly higher in Oakland than in California or the United States.[66] It is important to note, however, that crime rates are highly dependent on the type of setting (urban versus rural) as well as the social and economic characteristics of an area.
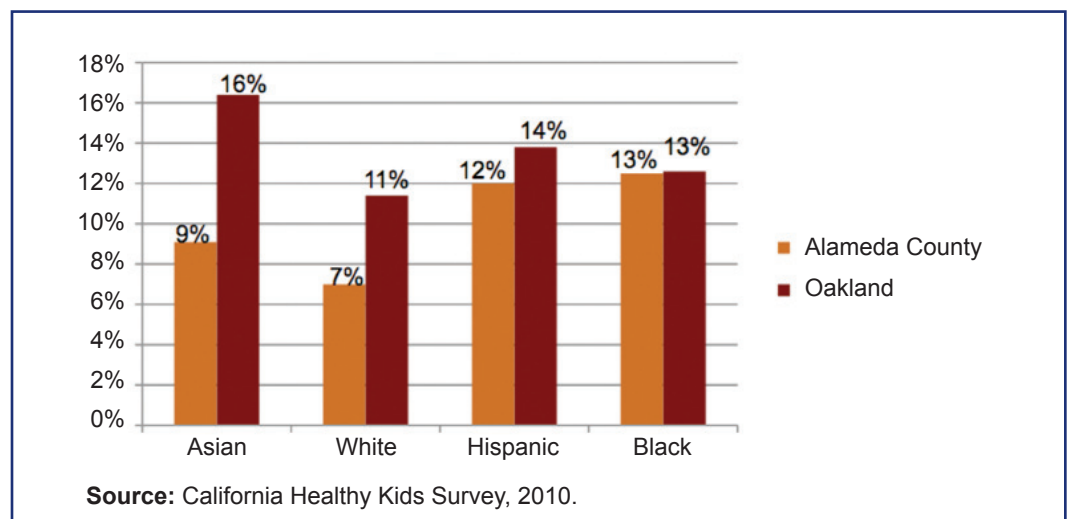
	Oakland	California	United States
Violent crime rate per 100,000	1,679	472	429
Murder and non-negligent manslaughter	26	5	5
Forcible rape	81	24	29
Robbery	716	173	133
Aggravated assault	857	270	263
Property crime rate per 100,000	4,986	2,732	3,036
Burglary	1,186	623	716
Larceny-theft	2,183	1,665	2,061
Motor vehicle theft	1,617	444	259

Source: United States Justice Department—Federal Bureau of Investigation; 2009 Crime in the United States.

Studies increasingly document indirect threats to health when there is inadequate community safety. Children and youth living in high-crime neighborhoods have been shown to have higher levels of chronic psychological distress.[67] This elevated stress because of perceived lack of safety has been associated with chronic stress and elevated risk for stress-related diseases.[63,67,68] Youth living in high-crime areas may suffer from pressures to participate in criminal activity because of limited economic opportunity,[64] the need to protect themselves from threats of physical violence, or perceived social norms.[69] In

Source: California Healthy Kids Survey, 2010.

2009, arrests of youth under age 18 represented more than 14% of all arrests across the United States.[63,67,70] Arrests of individuals under age 25 accounted for 43.6% of all arrests.[66,70] Students in Oakland appear to be disproportionately affected by neighborhood crime. According to the California Healthy Kids Survey, students of all racial and ethnic groups in Oakland, as compared with Alameda County and California, were more likely to report feeling unsafe or very unsafe at school (Figure 7). Likewise, gang membership in Oakland schools is higher among all racial and ethnic groups as compared with Alameda County and California (see Figure 8).

Source: California Healthy Kids Survey, 2010.
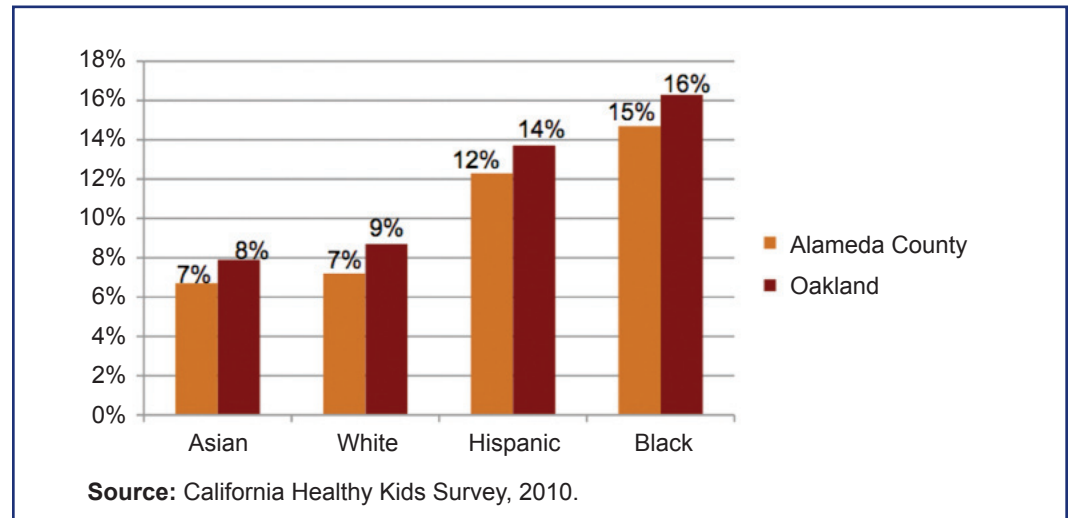
In Oakland, crime rates are strongly associated with life expectancy. We created a public safety opportunity index as a composite index for Oakland based on the following indicators: the violent crime rate, property crime rate, and percentage of the population currently on probation. Higher scores represent higher levels of risk. In a bivariate linear regression predicting life expectancy, the crime index alone accounted for 48% of the variability in life expectancies across census tracts in Oakland ($n = 103$ census tracts, $R^2 = 0.48$, $P < 0.0001$). Furthermore, in a multivariate regression model, crime remained a significant predictor of life expectancy after controlling for educational attainment and economic factors ($P < .0001$, $R^2 = 0.51$). For more information about development of the crime index and statistical findings, see Appendix A.

The population on probation is a particularly powerful predictor of life expectancy. Without controlling for potentially confounding factors, this indication accounted for 70% of the variability in life expectancies across census tracts in Oakland ($n = 103$ census tracts, $R^2 = 0.70$, $P < 0.0001$). Controlling for all other risk factors, the population on probation is one of only two variables that remained significant, the other being the mean standardized test score in mathematics. Including 10 additional indicators accounted for only an additional 6% of the variability in life expectancy ($n = 103$ census tracts, $R^2 = 0.76$, $P < 0.0001$). Although we do not believe the percentage of the population on probation directly affects life expectancy, the indicator appears to at least serve as a strong proxy for community-level and demographic risk factors associated with mortality.

The distribution of public safety in Oakland is shown in Map 12. The lowest safety opportunity block groups have high rates of property crime and violent crime and a high percentage of the population currently on probation. Neighborhoods with the lowest public safety opportunity index scores include Fruitvale, Elmhurst, and Central and East Oakland.
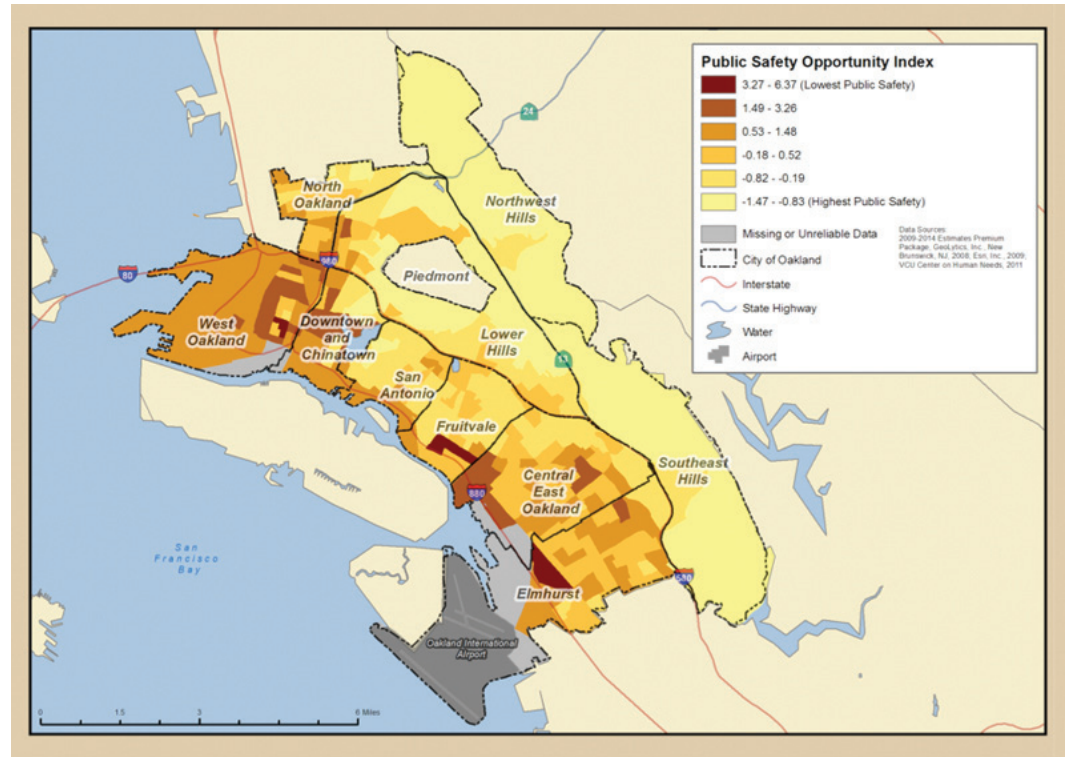
Note: The public safety opportunity index is a composite index based on the following indicators: violent crime rate, property crime rate, and percentage of population currently on probation. Higher scores represent the lower public safety opportunity areas.

Census tracts in Oakland with the lowest public safety opportunity index scores are shown in Map 13, together with the lowest life expectancies. These are in Fruitvale, Elmhurst, Central East Oakland, and West Oakland.

Note: *Lowest* public safety opportunity = 1.49 to 2.79; *lower* public safety opportunity = 0.56 to 2.79; *low* public safety opportunity = 0.08 to 2.79; *Lowest* life expectancy = 67 to 72 years; *lower* life expectancy = 67 to 74 years; *low* life expectancy = 67 to 77 years.

Life Expectancy and the Built Environment
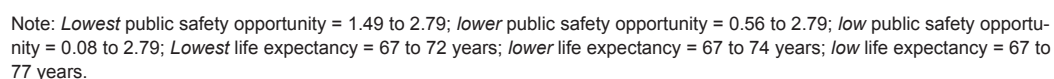
Social determinants of health are not restricted to the characteristics of individuals and families. Socioeconomically disadvantaged communities and communities of color often face additional health risks because of characteristics of the physical environment, such as exposure to environmental hazards, lack of access to healthy food choices, and few opportunities for safe physical activity. Based on indicators of interest to the Alameda County Place Matters team, we attempted to create an index using measures of respiratory risk and density of liquor stores, grocery stores, and parks to examine the relationship between the "built environment" and life expectancy. However, these variables did not fit well into a reliable index, so they are explored individually below (see Appendix A for more details).

Previous research has documented that closer proximity to hazardous sites and heightened exposure to pollution are more common in neighborhoods populated by people of color and the economically disadvantaged.[71–76] Some longitudinal studies suggest that toxic facilities are deliberately sited in minority communities,[77] possibly because such neighborhoods are socially isolated and hold limited political power to resist undesirable land-use decisions by governments and corporations.[78] These findings appear consistent with some environmental hazard data for Oakland.

The very same communities often lack nutritious food options and have a surfeit of unhealthy options, including fast food outlets and liquor stores. Access to grocery stores and green space are considered important for promoting healthy diets[79–81] and physical activity,[82–85] which may affect some health outcomes such as obesity and related health complications.[86] In Oakland, however, we did not observe a relationship between these measures and life expectancy. Map 14 shows the distribution of liquor stores in Oakland. Compared with Oakland as a whole, liquor store density is 1.5 times higher in the lowest–life expectancy census tracts and at least 3.5 times higher in the highest-crime census tracts. The literature does not suggest that liquor store density is directly associated with mortality; however, studies have found significant positive associations between liquor store density and both violent crime and economic disadvantage, which in turn are associated with poor health outcomes.[87–90]

Map 14:
Density of Liquor Stores and Store Locations by Block Group, Alameda County (2011).
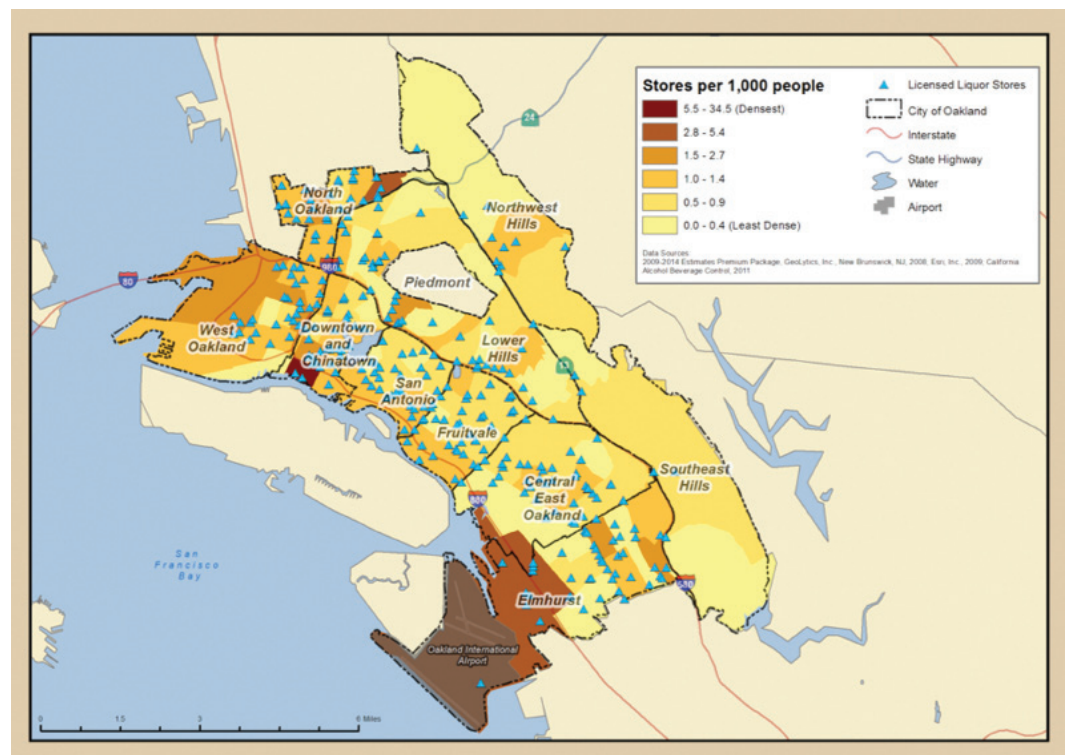
Exposure to environmental hazards, lack of access to healthy foods, and a high density of liquor stores often occur in the same Oakland communities that are home to the highest crime, lowest educational attainment, and fewest economic opportunities.
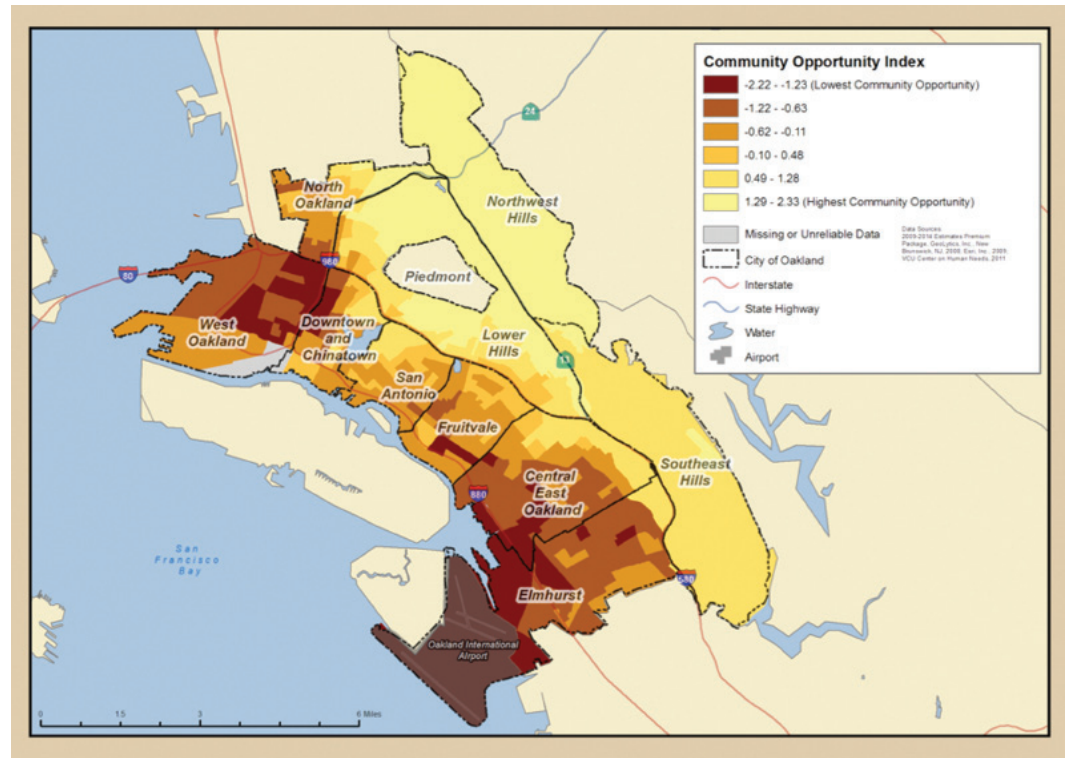
Life Expectancy and Community Opportunity

To sum up the association between neighborhood economic conditions, educational attainment, and public safety, we developed a single "community opportunity" index to estimate the comparative level of opportunity for health in Oakland neighborhoods. We statistically combined components of each of the measures described above to create a community opportunity index for each block group (see Appendix A for details). The final community opportunity index was calculated using the following factors: percentage of population above 150% of the FPL, percentage of population with at least a high school education, average language arts and mathematics proficiency scores, the violent crime rate, the property crime rate, percentage of population currently on probation, the foreclosure rate, the employment rate, percentage of owner-occupied households, and the percentage of households with an automobile. These factors are strongly interrelated, and each has a significant association with life expectancy.

Neighborhood-level characteristics in high- versus low-opportunity communities are compared in Table 6, based on the highest and lowest quintiles of the Community Opportunity Index.

Table 6:
Characteristics of Low and High Community Opportunity Census Tracts/Block Group in Oakland, 2002–2009

	High community opportunity*	Low community opportunity*
Crime		
Violent crime rate/100,000 persons$_a$	497.1	2,755.4
Property crime rate/100,000 persons$_a$	3,578.4	7,874.4
Probationers/1,000 persons$_b$	2.1	23.4
Economic characteristics		
Below 150% of the FPL (%)$_c$	8.4	46.7
Percentage of household with no automobile$_c$	5.3	27.7
Employed (%)$_c$	68.5	34.6
Owner-occupied households (%)$_c$	68.5	25.6
Foreclosure rate/1,000 persons$_d$	11.6	39.7
Education		
Less than a high school diploma (%)$_c$	6	43
Bachelors degree or higher (%)$_c$	43	7
Average math proficiency score$_e$	400.2	311.0
Average language arts proficiency score$_e$	391.2	311.8
Life expectancy in years$_f$	83.1	73.2

(a) Urban Strategies Council with data from the Oakland Police Department, 2007–2009
(b) Alameda County Public Health Department with data from the Alameda County Probation Department, 2005–2006
(c) Geolytics Projections, 2009
(d) Alameda County Public Health Department, with data from HUD's Neighborhood Stabilization Program, ABAG's Projections 2007, and Urban Strategies Council, 2006–2009
(e) Alameda County Public Health Department, with data from Oakland Unified School District; school year 2008–2009
(f) Calculations performed by the Alameda County Health Department from data provided by California Death Masterfile 2002–2008
*Low Community Opportunity values are based on the average values for block groups which fall into the lowest 20% of the community opportunity index. High Community Opportunity values are based on the average values for the highest 20%.

The geographic distribution of community opportunity in Oakland is illustrated in Map 15. Areas with the lowest levels of community opportunity include West Oakland, Downtown, Chinatown, Fruitvale, Central East Oakland, and Elmhurst.

Note: The community opportunity index is a composite index based on the following indicators: percent employed, percentage of owner-occupied houses, the percentage of households with an automobile, percentage of population above 150% of the FPL, foreclosure rate, percentage of population with at least a high school education, average language arts and mathematics proficiency scores, violent crime rate, property crime rate, and percentage of population on probation. Higher scores represent the highest levels of risk.

There is a strong geographic relationship in Oakland between community opportunity and life expectancy: Census tracts with the lowest level of community opportunity have lower average life expectancy. The community opportunity index and life expectancy are geographically clustered in West Oakland, Elmhurst, and Central East Oakland (Map 16).

Map 16:
Co-occurrence of
Community Opportunity
and Low Life Expectancy
by Census Tract, Oakland
(2002–2010).

Note: *Lowest* community opportunity index = –2.04 to –1.22; *lower* community opportunity index = –2.04 to –0.65; *low* community opportunity index = –2.04 to –0.13; *Lowest* life expectancy = 67 to 72 years; *lower* life expectancy = 67 to 75 years; *low* life expectancy = 67 to 78 years
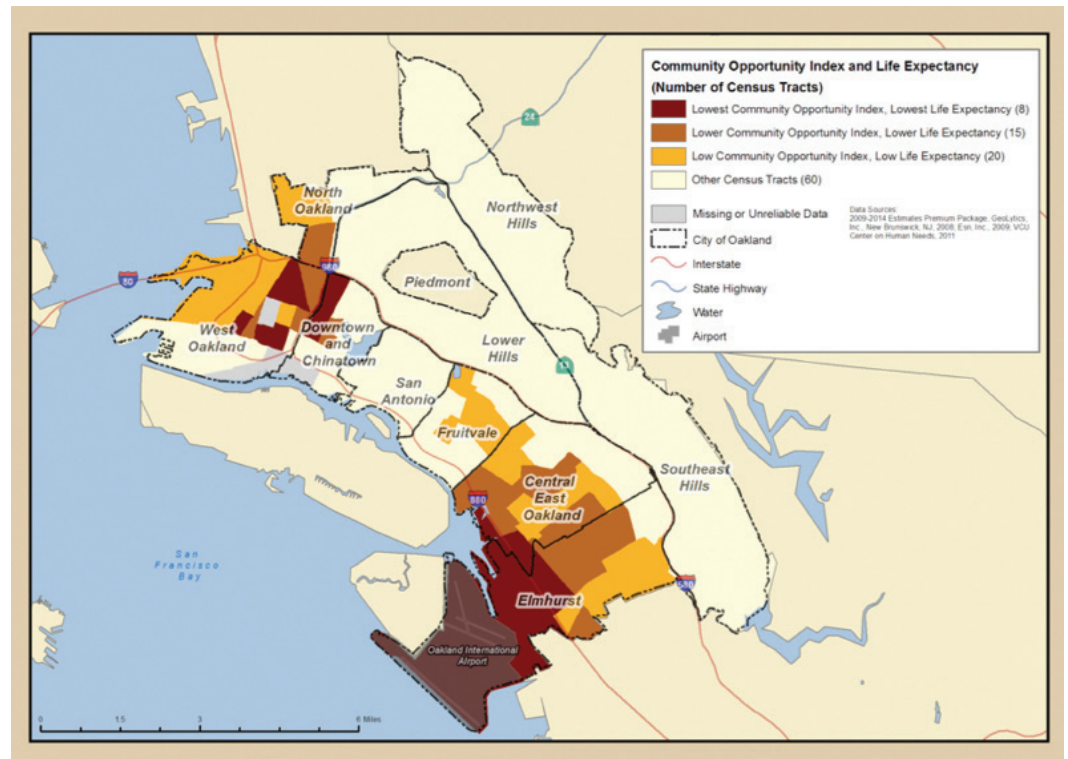
The observed relationship between community opportunity and life expectancy does not provide evidence for a causal relationship. A variety of factors may affect life expectancy, including social, environmental, and behavioral factors—many of which are themselves associated with the indicators measured by the community opportunity index. To some degree, the observed association between our index and life expectancy may represent the influence of these confounding variables and not a causal role of the measured indicators themselves.

Furthermore, data on life expectancy were only available at the census-tract level, and thus individual-level analyses of relationships between socioeconomic characteristics, crime, education, the built environment, and life expectancy were not possible. Nonetheless, our analyses showed that areas with high census-tract-level community opportunity factors had significantly higher life expectancies.

III. Conclusions

The analyses presented here have shown that crime, economic conditions, education, and the built environment are strongly linked with life expectancy in Oakland at the neighborhood level. Indicators that comprised these indices (poverty, foreclosure rates, home ownership, employment, percentage of population with an automobile, education, crime rates, density of individuals on probation, and average standardized test scores) are also strongly correlated with life expectancy. Together, these factors explain more than half of the variability in life expectancy in Oakland.

Understanding of the causal relationship between crime, economics, education, and the built environment and health is still evolving. The analyses included in this report are entirely cross-sectional (studies of the relationship between two variables at one point in time rather than sequentially) and ecological (studies of the characteristics of populations rather than individuals) and do not address the literature that examines the mechanisms by which these and other factors might relate to the natural history of disease or mortality.

Health disparities associated with economic opportunity, education, and the environment are complex, multifactorial relationships that cannot be reduced to a single etiology or mitigated by a single policy solution. The literature and this analysis suggest, however, that interventions aimed at crime prevention, community and economic development, and improving educational opportunities may be important public health strategies in Oakland, particularly in West Oakland, Central East Oakland, and Elmhurst.

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