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"Racial and social class gradients in life expectancy in contemporary California"

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Abstract

Life expectancy, or the estimated average age of death, is among the most basic measures of a population's health. However, monitoring differences in life expectancy among sociodemographically defined populations has been challenging, at least in the United States (US), because death certification does not include collection of markers of socioeconomic status (SES). In order to understand how SES and race/ethnicity independently and jointly affected overall health in a contemporary US population, we assigned a small area-based measure of SES to all 689,036 deaths occurring in California during a three-year period (1999-2001) overlapping the most recent US census. Residence at death was geocoded to the smallest census area available (block group) and assigned to a quintile of a multifactorial SES index. We constructed life tables using mortality rates calculated by age, sex, race/ethnicity and neighborhood SES quintile, and produced corresponding life expectancy estimates. We found a 19.6 (±0.6) year gap in life expectancy between the sociodemographic groups with the longest life expectancy (highest SES quintile of Asian females; 84.9 years) and the shortest (lowest SES quintile of African-American males; 65.3 years). A positive SES gradient in life expectancy was observed among whites and African-Americans but not Hispanics or Asians. Age-specific mortality disparities varied among groups. Race/ethnicity and neighborhood SES had substantial and independent influences on life expectancy, underscoring the importance of monitoring health outcomes simultaneously by these factors. African-American males living in the poorest 20% of California neighborhoods had life expectancy comparable to that reported for males living in developing countries. Neighborhood SES represents a readily available metric for ongoing surveillance of health disparities in the US.

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Keywords

racial disparities; social class disparities; life expectancy; California; population-based; USA; socioeconomic status (SES)

INTRODUCTION

Life expectancy, or the estimated average age of death, is among the most basic measures of a population's health. Contemporary estimates of life expectancy vary substantially by nation, with some developed countries (e.g., Japan) reporting life expectancy estimates over 40 years greater than those for some developing countries (e.g., Angola) (U.S. Census Bureau, 2007). Within countries, disparities in life expectancy estimates have been reported among population subgroups according to several sociodemographic determinants, including age, sex, race/ethnicity, immigration status, education, income, and other measures of socioeconomic status (SES) (Harper, Lynch, Burris, & Davey Smith, 2007; Kaneda, Zimmer, & Tang, 2005; Meara, Richards, & Cutler, 2008; Singh & Hiatt, 2006; Singh & Siahpush, 2006; Tobias & Cheung, 2003; United Nations, 1988; Wilkinson, 1998; Wilkinson & Pickett, 2006).

Although routine surveillance of sociodemographic disparities in health is a critical first step toward ameliorating them, monitoring life expectancy differences by sociodemographic factors has been challenging, at least in the United States (US), because death certification does not include collection of detailed sociodemographic characteristics. Limited information is collected regarding the decedent's age, sex, race/ethnicity, and birthplace, and, in some states, educational attainment, although the latter is uninformative for children and adolescents and unreliably recorded for adults (Sorlie & Johnson, 1996). Based on these data, current estimates of life expectancy among racial/ethnic groups differ by at least 11 years, with the highest estimates among Asians/Pacific Islanders (83.0 years), and the lowest among African-Americans (71.1 years) (Johnson, 2004). Less clear is the extent to which these disparities are explained or exacerbated by SES. In the absence of measures of individual-level SES, markers based on the relative SES of area of residence have been used previously to detect differences in life expectancy. However, prior US studies assigned area-level SES based on county of residence (Murray, Kulkarni, Michaud, Tomijima, Bulzacchelli, Iandiorio et al., 2006; Singh & Siahpush, 2006), a highly heterogeneous geographic delimiter in the US, with some counties having hundreds and others millions of residents. Far less heterogeneous are census geographic units, for which SES information is regularly available. The smallest of these units for which data are available is the census block group, which generally contains about 1,500 residents.

To our knowledge, no prior US studies have examined life expectancy by SES using small-area-based measures of SES. Thus, to more accurately describe disparities in life expectancy defined jointly by race/ethnicity and area-level SES, we employed a census-block-group-based SES measure to estimate life expectancies by age, race/ethnicity, sex, and SES for the most populous and diverse US state of California over a three-year period (1999-2001) overlapping the most recent decennial US census.

METHODS

Mortality data

We obtained from the California Department of Health Services information regarding all 689,036 decedents recorded in the state of California for a 3-year period from January 1, 1999, to December 31, 2001. These data included information regarding the decedents' age, sex, race/ethnicity, causes of death, and residential address at death. Using the race/ethnicity information described on the death certificate, we defined six mutually exclusive racial/ethnic groups for

analysis: Hispanic (regardless of race), Asian/Pacific Islander, African-American, white, Native American, and other/unknown. In light of known discrepancies in death certificate identification (Rosenberg, Maurer, Sorlie, Johnson, & al, 1999), we improved our classification of Hispanic persons by applying a Hispanic surname list developed from US Census data, which re-classified 8,420 (+9.6%) additional persons as Hispanic. As compared to administrative classifications, surname-based methods have been shown to improve the overall validity of ethnic classifications using self-report as the gold standard (Morgan, Wei, & Virnig, 2004; Perez-Stable, Hiatt, Sabogal, & Otero-Sabogal, 1995; Stewart, Swallen, Glaser, Horn-Ross, & West, 1999; Wei, Virnig, John, & Morgan, 2006). However, little is known about the precision (e.g., reproducibility) of these methods.

We used the residential address recorded on the death certificate to geocode each address to one of the 21,920 block groups defined for California by the US Census Bureau. Each census block group was then assigned a composite area-based SES value, based on a measure developed by Yost et al.(Yost, Perkins, Cohen, Morris, & Wright, 2001) and used previously to define SES gradients in cancer incidence and other outcome measures in California (Clarke, Glaser, Keegan, & Stroup, 2005; Parikh-Patel, Bates, & Campleman, 2006; Yost et al., 2001). The measure is a composite index derived by principal components analysis and includes the following seven census variables: education level, proportion with a working-class job, proportion unemployed, median household income, proportion below 200 percent of poverty line, median rent, and median home value. Using this index, we divided the 21,920 block groups into quintiles based on the statewide distribution of the neighborhood SES index.

Overall, 24,613 (3.7%) of death certificates lacked residential address detail (e.g., post office boxes) sufficient for geocoding to a block group. This proportion was comparable for whites (3.7%), African-Americans (3.3%), Hispanics (4.3%), and Asians/Pacific Islanders (2.1%), but was higher for Native Americans (17.2%) and for those of “other/unknown” race/ethnicity (48.9%). For each of the non-geocodable deaths, an SES quintile value was imputed based on proportional allocation by race/ethnicity within the smallest possible geographic area (ZIP code when available and county otherwise). For example, a Hispanic decedent's death certificate record that could not be precisely geocoded was replaced with 5 records each with a probability weight (summing to 1.0) assigned based on the quintile distribution for other Hispanics in the same ZIP code area. All analyses were repeated excluding deaths for which neighborhood SES was imputed, and the results did not materially change observed socioeconomic or racial/ethnic gradients in life expectancy.

Population counts

Population counts were obtained from the 2000 US Census Bureau for each block group by age, sex, and detailed race/ethnicity (allowing individuals to be assigned to multiple racial groups). As the death certificate data were based on single race categories, the population count data needed to be bridged to reflect single race categories. Thus, we reclassified the 5% of California residents who reported at least two races into single race categories using the National Center for Health Statistics' county-level bridged-race census population estimates for 2000 (National Center for Health Statistics, 2005). At the block-group level, the US Census Bureau publicly releases population counts by age and sex for each race separately, for Hispanics, and for non-Hispanic whites, but not for non-Hispanic African-Americans, non-Hispanic Asians/Pacific Islanders, or non-Hispanic Native Americans. Therefore, we used a ranking procedure (iterative proportional fitting) (Deming & Stephan, 1940) to estimate these populations by age and sex using the known marginal totals.

Life table calculations

Life expectancy at birth (e_0) represents the average number of years a newborn would live if subject to the mortality rates observed today. Mortality rates were calculated using average annual deaths over the period from 1999 to 2001 divided by the 2000 census population count of California residents. A total of 40 abridged life tables, tabulated using California's Center for Health Statistics methodology (Oreglia, 1981), were calculated, one for each combination of sex, race/ethnicity, and SES quintile. Since birth counts by block group were unavailable, infant mortality rates were based on census population counts, rather than birth registrations, as the denominator. Our life tables for African-Americans, whites, and Asians/Pacific Islanders were very similar to published tables (Ficenec, 2004; Johnson, 2004), whereas our life expectancy estimates for Hispanics were 1 to 1.5 years lower than published estimates, presumably related to our use of a Hispanic surname list to classify more deaths as Hispanic. We used bootstrap methods to estimate 95 percent confidence intervals (Shao J, 1996) for each life expectancy estimate to account for uncertainty due to sample size and the imputation of neighborhood SES for those death certificates that could not be precisely geocoded. Relative contributions to overall life expectancy according to age-specific mortality risks were assessed using Arriaga's decomposition method (Arriaga, 1984).

RESULTS

Table 1 shows the distribution of the 1999-2001 California population by race/ethnicity and neighborhood SES quintiles, confirming unequal distribution of racial/ethnic groups according to socioeconomic quintile. Numbers of deaths occurring in each group over this time period are shown in Table 2. Life expectancy estimates by sex, race/ethnicity, and neighborhood SES are presented in Table 3. Overall life expectancy of males lagged that of females by 4.8 years (75.9 vs. 80.7 years). The female excess in life expectancy was persistent across SES levels, but was largest in the lowest SES quintile (5.9 years) and smallest in the highest SES quintile (3.3 years). A socioeconomic gradient in life expectancy was evident for both sexes, but was steeper for males than females. Males living in the lowest SES quintile had a life expectancy that was seven years less than those living in the highest SES quintile (72.5 vs. 79.5 years); for females, the difference was 4.4 years (78.4 vs. 82.8 years).

Among both men and women, life expectancy was highest among Asians/Pacific Islanders, intermediate for Hispanics and whites, and lowest among African-Americans. The influence of neighborhood SES on life expectancy estimates varied strikingly by race/ethnicity. For Asian/Pacific Islander and Hispanic females, there was little difference according to SES. In contrast, a steep socioeconomic gradient in life expectancy was evident for African-American and white females. Life expectancy of African-American and white females living in the lowest SES quintile was about six to seven years less than that among females of the same race/ethnicity living in the highest SES quintile. Similar patterns were observed among males, although there was more evidence of a socioeconomic gradient among Asian/Pacific Islander males.

Figure 1 shows the age-specific mortality rate of each population relative to the overall statewide average. The starkest differential in age-specific mortality rates was found among African-American males aged 25-29 years in the lowest SES neighborhoods; in this group, the mortality rate was five times the overall average. In the same age range, the mortality rate for Asian/Pacific Islander females was just one-third of the overall statewide average. Thus, a 15-fold difference in the relative risk of mortality existed between these groups of young adults.

In general, there was a clear socioeconomic gradient in the relative rate of mortality, with those in the higher-SES neighborhoods (darker lines) having a lower relative rate than those in the lower-SES neighborhood (lighter lines). These socioeconomic differences were most extreme

at younger ages and appeared to narrow at older ages. Gender differences in relative mortality were narrower in higher SES neighborhoods. In some population groups, including Hispanic and Asian/Pacific Islander males and females, there was evidence of a mortality cross-over at the very oldest ages (75 years and older), in which individuals from lower-SES neighborhoods had a lower relative rate of mortality than those in higher-SES neighborhoods.

As a way of understanding the relative contributions of age-specific to overall life expectancy dispariaties, Figure 2 shows the contribution of age-specific mortality rate differences to overall life expectancy differences, using the statewide average life expectancy as a standard. For example, the below-average mortality rate for Asian 55-year old men contributes 0.5 greater years of life expectancy, relative to the overall population average.The large racial/ethnic and SES differences in the relative mortality rates among young adults contributed relatively little to the overall differences in longevity, since deaths were relatively uncommon at these ages. In contrast, small differences in the relative mortality rates among the elderly contributed substantially to life expectancy gaps, since death was relatively common at these ages.

DISCUSSION

In contemporary California, we found a gap of nearly twenty years between the sociodemographic group with the shortest life expectancy—African-American males living in neighborhoods of the lowest SES quintile (65.3 years)—and that with the longest life expectancy—Asian/Pacific Islander females living in neighborhoods of the second-highest SES quintile (84.9 years). This gap is of comparable magnitude to those observed between developing and developed countries internationally and is of similar size to that, for example, between Bangladesh (63 years) and Japan (82 years) in 2008 (U.S. Census Bureau, 2008) We also observed marked positive socioeconomic gradients in life expectancy among African-American and white males and females, averaging 1.4 additional years of life expectancy per quintile of increasing SES.

To our knowledge, our analysis is the first to use sub-county level measures of area SES to examine life expectancy in the US. A recent assessment using county-level SES classifications reported a socioeconomic gradient in life expectancy about half the size observed in our data: an increase of +0.7 years per quintile for all races/ethnicities combined (Singh & Hiatt, 2006). However, a different assessment of US disparities in life expectancy using county-level data found a comparable difference of 20.7 years between the groups with high (Asian females) and low life expectancy (African-American males living in "high risk urban areas" (Murray et al., 2006). As the authors of these studies noted, their use of county-level SES characteristics likely underestimate disparities among groups. Although we used the smallest geographic unit available from the US census (the block group averaging about 1500 residents), it is likely that some of these units were heterogeneous with respect to SES. Of course, regardless of the size of the available geographic unit, these and all analyses using area-level SES classifications may underestimate disparities occurring at the individual level. In the absence of individual-level measures, we are unable to address the likelihood of "ecologic fallacy", when area-level effects differ from individual-level effects. Thus, our neighborhood measure implies that the observed gradients reflect an unspecified mix of individual- and neighborhood-level (e.g., contextual) factors. Individual-level SES may influence access to health care, insurance coverage, health knowledge and awareness, and the reverse effects of health on ability to work and subsequent economic achievement, all of which can be additionally modified by neighborhood-level features of the social or physical environment.

In our California data, life expectancy for African-Americans was consistently two to four years lower than that for whites across all levels of neighborhood SES. This observation, based on a large and representative US population, confirms prior reports of a mortality disparity

between African-Americans and whites after accounting for various measures of SES (Lin, Rogot, Johnson, Sorlie, & Arias, 2003). Reasons for this persistent disparity are discussed at length elsewhere (David R. Williams & Collins, 1995) and, briefly, may involve racial differences in early life experiences or cultural norms, health impacts of factors associated with racism and discrimination, or augmented coping resulting in intensified stress among African-Americans (James, 1994; James, Keenan, Strogatz, Browning, & Garrett, 1992; D. R. Williams, Haile, Gonzalez, Neighbors, Baser, & Jackson, 2007).

In contrast to the clear SES gradient in life expectancy observed among African-Americans and whites, there was virtually no such gradient seen among Hispanics and Asians/Pacific Islanders, with the exception of a slight positive gradient among Asian/Pacific Islander males. These results are consistent with those of numerous studies that have identified a so-called “Hispanic paradox”: that life expectancy of Hispanics in the US is greater than would be expected based on their socioeconomic position (Markides & Eschbach, 2005). Goldman and colleagues recently elaborated on the absence of an educational gradient in health measures in populations of Mexican origin (Goldman, Kimbro, Turra, & Pebley, 2006). This study suggests a similar paradox to that described in US Hispanics for US Asians/Pacific Islanders.

There are several possible explanations for the lack of neighborhood socioeconomic effects on life expectancy among California Hispanics and Asians/Pacific Islanders, among whom there is a large foreign-born contingent. At the individual-level, immigrants may be self-selected for good health, and be physiologically or psychologically hardier than their counterparts at home. Compared to those born in the US, foreign-born Asians/Pacific Islanders have been reported to have higher markers of some health status indicators (Frisbie, Cho, & Hummer, 2001). Immigrants who do suffer from ill health may be more likely to return to their country of origin (Palloni & Arias, 2004). This combination of “immigrate-when-healthy” and “emigrate-when-sick” patterns may lead to a highly selected group of healthy individuals. In addition, immigrants may continue healthful behaviors or attitudes, such as dietary or physical activity habits, associated with their country of birth, and these may counteract the negative health effects associated with lower SES in the US. Although data suggest that the generally more favorable health among immigrants wane with years in the US and increasing levels of acculturation (Frisbie et al., 2001), the extent to which this varies with SES is unclear. Third, Hispanic and Asian/Pacific Islander groups may have more extensive family and neighborhood social networks for support (e.g., ethnic enclaves), again counteracting the negative effects of lower SES, or of living in a lower-SES neighborhood on health. Some of these patterns may be particularly pronounced among older Hispanics and Asians/Pacific Islanders, resulting in the observed cross-over with lower mortality rates among lower, rather than higher, neighborhood SES groups at advanced ages.

It is also possible that data limitations in our study masked a socioeconomic gradient in life expectancy among Hispanics and Asians/Pacific Islanders. As each of these racial/ethnic groups comprise different cultural and linguistic subgroups with heterogeneous disease profiles, this heterogeneity may have varied across SES strata. For example, SES gradients in health among Mexican-Americans could be obscured when they are combined into a single, larger group of Hispanics. A strong neighborhood-SES gradient in mortality rates at ages 20-64 years has been reported among Mexican-Americans in the US, with a magnitude similar to that observed among whites and African-Americans (Winkleby & Cubbin, 2003). This apparent discrepancy in results could relate to differences between the US Mexican-American population and the California Hispanic population, although 77.1% of Hispanics in California were of Mexican origin according to the 2000 US census (U.S. Census Bureau, 2001).

In addition to independent contributions of race/ethnicity and SES, we also noted an important interaction by age to the observed disparities in life expectancy. Differences in age-specific

mortality rates among racial/ethnic and SES groups tended to converge at the older ages, suggesting that Medicare and other programs providing universal health insurance coverage to older adults may be helping to reduce health inequalities among older Americans. However, the convergence of mortality rates at older ages in our data appears to begin in the late 40s—well before the age of Medicare eligibility, perhaps implying a role for the relocation of persons from higher- to lower-SES neighborhoods after retirement. Furthermore, even among those over age 65 years, important differences were evident across race/ethnicity and SES, with lowest-SES elderly African-Americans and whites facing mortality rates 33% above the statewide average. Thus, Medicare and similar health insurance programs cannot entirely account for the reduction in health disparities among older adults, nor are they likely to completely ameliorate such imbalances. Some of the attenuation of life expectancy disparities at older ages may be due to a "healthy survivor" effect, by which individuals in certain high-risk subgroups, especially among African-Americans, whites, and those of lower SES, die at a younger age, leaving a healthier older population. For instance, young African-Americans have a higher prevalence of health-risk behaviors (Eaton, Kann, Kinchen, Shanklin, Ross, Hawkins et al., 2008) and a higher rate of deaths due to homicide than whites, Hispanics, and Asians/Pacific Islanders (Karch, Lubell, Friday, Patel, & Williams, 2008).

Despite the convergence in mortality rates with age, differences among racial/ethnic and SES groups at older ages contribute substantially to the life expectancy gap. We found that 70% of the gap in life expectancy between the most advantaged and least advantaged population groups related to differences in mortality risk after age 45 years. While significant media and public health attention has conventionally been focused on disparities in mortality risks for infants, teenagers, and young adults, our data suggest that the major contributors to disparities in overall longevity lie in smaller differential risks at older ages.

Our estimates are based on large, routinely collected sources of vital statistics and population data. However, our results should be interpreted in light of several well-known possible sources of bias in using these kinds of data. Numerator/denominator bias, which occurs whenever case counts are collected using different methods than population estimates, is a possibility. Relatedly, it is possible that race and ethnicity were classified inconsistently for US census and vital statistics resources. In the US census, people self-identify their race and ethnicity, whereas on death certificates, race and ethnicity information are entered by the person (usually the funeral director) responsible for recording the death certificate, and is done through either direct observation or questioning of relatives. This kind of misclassification may have led to Hispanic and Asian/Pacific Islander deaths being undercounted on death certificates (Rosenberg et al., 1999; Swallen & Guend, 2003), which may have resulted in underestimation of Hispanic and Asian/Pacific Islander mortality rates. Within these groups, there may be additionally important differences in tabulation between those born in the US and those born abroad.(Eschbach, Kuo, & Goodwin, 2006) We attempted to correct for the underestimation of Hispanic deaths through the use of a surname list. However, we did not correct for Asian/Pacific Islander misclassification in the absence of a similarly well-tested surname-list based method of adjustment. As a result, our findings for the Asian/Pacific Islander population may understate true mortality rates and thereby represented inflated estimates of life expectancy.

The 2000 US census data are subject to error, with overall counts estimated to be 1.2 percent lower than the true population (National Research Council, 2001), and larger undercounts for younger persons, African-Americans, Hispanics, and persons who rent their homes. By contrast, death registration is believed to be nearly 100 percent complete among all population groups. Therefore, the use of census-based denominators may result in overestimated mortality rates, and the degree of overestimation may be larger for African-Americans and neighborhoods with larger proportions of renters. Additionally, self-reporting of age has been reported to be misclassified in US census data, with older individuals more likely to overstate

their age. Census age misclassification has been reported to be more common among older African-Americans, which may underestimate mortality rates among older age groups (Elo IT, 1997). In this analysis, we were unable to adjust the census counts for undercounts and age misclassification, although some of the effects of the latter could have been mitigated by grouping together persons aged 85 years and older for analysis.

In addition, the meaning of our neighborhood measure of SES may vary by racial/ethnic group. In particular, residential segregation by race/ethnicity and factors related to SES may have produced heterogeneity of neighborhoods within the same neighborhood SES quintile. Thus, unmeasured features of neighborhoods that correlate with both neighborhood SES quintile and individual race/ethnicity may have influenced our life expectancy estimates. Second, although census-based SES measures were originally developed as a readily-available proxy for individual-level measures of SES (Berkman & Macintyre, 1997; Geronimus & Bound, 1998; Krieger, 1992, 1993, 2001; Krieger & Fee, 1994; Yeracaris & Kim, 1978), more recent studies have shown that both individual-level and aggregate-level SES measures have independent effects on health (Chandola, Bartley, Wiggins, & Schofield, 2003; Diez Roux, 2001, 2004; Haan, Kaplan, & Camacho, 1987; Kubzansky, Subramanian, Kawachi, Fay, Soobader, & Berkman, 2005; Pickett & Pearl, 2001; Subramanian, 2004; Winkleby & Cubbin, 2003; Yen & Kaplan, 1999), that is, contextual measures can capture attributes of the neighborhood environment over and above individual-level characteristics. It is increasingly recognized that contextual SES measures account for complex relationships between individual- and neighborhood-level SES measures, and that SES on several levels can independently affect health (Winkleby & Cubbin, 2003).

Our findings suggest that small-area SES is a meaningful differentiator of life expectancy disparities at least among whites and African-Americans in the state of California, which represents one-ninth of the US population and demonstrates variation in SES similar to that observed in the US as a whole (Reynolds, Hurley, Quach, Rosen, Von Behren, Hertz et al., 2005). Quantification of the magnitude of racial/ethnic and socioeconomic health disparities should be an important goal of public health surveillance. As most public health surveillance entities rely heavily on US census data as well as statewide death, cancer, or other health registries, these agencies need to consider adding routine collection of more meaningful measures of SES, preferably an individual-level measure that can be assessed in conjunction with the neighborhood or other small-area-based measures based on residential street address. Quantifying disparities among population groups is a necessary first step to remediating them, and is also necessary to document the impact of policies and programs designed to reduce health disparities. If life expectancy is ever to be equalized among population groups in the US—a lofty goal requiring the strong collaboration of policy makers, public health professionals, health care providers, and community members—we must continue to identify more and better mediators of health disparities and incorporate their measurement into our routine surveillance.

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REFERENCES

Arriaga EE. Measuring and explaining the change in life expectancies. Demography 1984;21(1):83–96. [PubMed: 6714492]

Berkman, LF.; Macintyre, S. The measurement of social class in health studies: old measures and new formulations. In: Kogevinas, M.; Pearce, N.; Susser, M.; Boffetta, P., editors. Social Inequalities and Cancer. International Agency for Research on Cancer; Lyon: 1997. p. 51-64.

Chandola T, Bartley M, Wiggins R, Schofield P. Social inequalities in health by individual and household measures of social position in a cohort of healthy people. J Epidemiol Community Health 2003;57(1): 56–62. [PubMed: 12490650]

Clarke CA, Glaser SL, Keegan TH, Stroup A. Neighborhood socioeconomic status and Hodgkin's lymphoma incidence in California. Cancer Epidemiol Biomarkers Prev 2005;14(6):1441–1447. [PubMed: 15941953]

Deming WE, Stephan FF. On a Least Squares Adjustment of a Sampled Frequency Table When the Expected Marginal Totals are Known. The Annals of Mathematical Statistics 1940;11(4):427–444.

Diez Roux AV. Investigating neighborhood and area effects on health. Am J Public Health 2001;91(11): 1783–1789. [PubMed: 11684601]

Diez Roux AV. The study of group-level factors in epidemiology: rethinking variables, study designs, and analytical approaches. Epidemiol Rev 2004;26:104–111. [PubMed: 15234951]

Eaton DK, Kann L, Kinchen S, Shanklin S, Ross J, Hawkins J, et al. Youth risk behavior surveillance--United States, 2007. MMWR Surveill Summ 2008;57(4):1–131. [PubMed: 18528314]

Elo IT, PS. Racial and Ethnic Differences in Mortality at Older Ages. In: Martin L, SB., editor. Racial and Ethnic Differences in the Health of Older Americans. National Academy Press; Washington, DC: 1997.

Eschbach K, Kuo YF, Goodwin JS. Ascertainment of Hispanic ethnicity on California death certificates: implications for the explanation of the Hispanic mortality advantage. Am J Public Health 2006;96 (12):2209–2215. [PubMed: 17077407]

Ficenec S. C. D. o. H. Services. Abridged Life Tables for California, 2002. Data Matters: Center for Health Statistics. 2004

Frisbie WP, Cho Y, Hummer RA. Immigration and the health of Asian and Pacific Islander adults in the United States. Am J Epidemiol 2001;153(4):372–380. [PubMed: 11207155]

Geronimus AT, Bound J. Use of census-based aggregate variables to proxy for socioeconomic group: evidence from national samples. Am J Epidemiol 1998;148(5):475–486. [PubMed: 9737560]

Goldman N, Kimbro RT, Turra CM, Pebley AR. Socioeconomic gradients in health for white and Mexican-origin populations. Am J Public Health 2006;96(12):2186–2193. [PubMed: 17077396]

Haan M, Kaplan GA, Camacho T. Poverty and health. Prospective evidence from the Alameda County Study. Am J Epidemiol 1987;125(6):989–998. [PubMed: 3578257]

Harper S, Lynch J, Burris S, Davey Smith G. Trends in the black-white life expectancy gap in the United States, 1983-2003. Jama 2007;297(11):1224–1232. [PubMed: 17369405]

James SA. John Henryism and the health of African-Americans. Cult Med Psychiatry 1994;18(2):163–182. [PubMed: 7924399]

James SA, Keenan NL, Strogatz DS, Browning SR, Garrett JM. Socioeconomic status, John Henryism, and blood pressure in black adults. The Pitt County Study. Am J Epidemiol 1992;135(1):59–67. [PubMed: 1736661]

Johnson HP, Hayes JM. The Demographics of Mortality in California. California Counts: Population Trends and Profiles 2004;5(4)

Kaneda T, Zimmer Z, Tang Z. Socioeconomic status differentials in life and active life expectancy among older adults in Beijing. Disabil Rehabil 2005;27(5):241–251. [PubMed: 16025751]

Karch DL, Lubell KM, Friday J, Patel N, Williams DD. Surveillance for violent deaths--National Violent Death Reporting System, 16 states, 2005. MMWR Surveill Summ 2008;57(3):1–45. [PubMed: 18401333]

Krieger N. Overcoming the absence of socioeconomic data in medical records: validation and application of a census-based methodology. Am J Public Health 1992;82(5):703–710. [PubMed: 1566949]

Krieger N. Analyzing socioeconomic and racial/ethnic patterns in health and health care. Am J Public Health 1993;83(8):1086–1087. [PubMed: 8342712]

Krieger N. Socioeconomic data in cancer registries. Am J Public Health 2001;91(1):156–157. [PubMed: 11189815]

Krieger N, Fee E. Social class: the missing link in U.S. health data. Int J Health Serv 1994;24(1):25–44. [PubMed: 8150566]

Kubzansky LD, Subramanian SV, Kawachi I, Fay ME, Soobader MJ, Berkman LF. Neighborhood Contextual Influences on Depressive Symptoms in the Elderly. Am J Epidemiol. 2005

Lin CC, Rogot E, Johnson NJ, Sorlie PD, Arias E. A further study of life expectancy by socioeconomic factors in the National Longitudinal Mortality Study. Ethn Dis 2003;13(2):240–247. [PubMed: 12785422]

Markides KS, Eschbach K. Aging, migration, and mortality: current status of research on the Hispanic paradox. J Gerontol B Psychol Sci Soc Sci 2005;60(Spec No 2):68–75. [PubMed: 16251594]

Meara ER, Richards S, Cutler DM. The gap gets bigger: changes in mortality and life expectancy, by education, 1981-2000. Health Aff (Millwood) 2008;27(2):350–360. [PubMed: 18332489]

Morgan RO, Wei II, Virnig BA. Improving identification of Hispanic males in Medicare: use of surname matching. Med Care 2004;42(8):810–816. [PubMed: 15258483]

Murray CJ, Kulkarni SC, Michaud C, Tomijima N, Bulzacchelli MT, Iandiorio TJ, et al. Eight Americas: investigating mortality disparities across races, counties, and race-counties in the United States. PLoS Med 2006;3(9):e260. [PubMed: 16968116]

National Center for Health Statistics. Bridged-race Vintage 2004 postcensal population estimtes for July 1, 2000- July 1, 2004, by yeah, country, single-year of age, bridged rrace, HIspanic origin, and sex. 2005

National Research Council. The 2000 Census: Interim Assessment. National Academy Press; Washington, DC: 2001.

Oreglia A. Methodology for Constructing Abridged Life Tables for California, 1977. Data Matters: Center for Health Statistics, California Department of Health Services. 1981

Palloni A, Arias E. Paradox lost: explaining the Hispanic adult mortality advantage. Demography 2004;41 (3):385–415. [PubMed: 15461007]

Parikh-Patel A, Bates JH, Campleman S. Colorectal cancer stage at diagnosis by socioeconomic and urban/rural status in California, 1988-2000. Cancer 2006;107(5 Suppl):1189–1195. [PubMed: 16835910]

Perez-Stable EJ, Hiatt RA, Sabogal F, Otero-Sabogal R. Use of Spanish surnames to identify Latinos: comparison to self-identification. J Natl Cancer Inst Monogr 1995;(18):11–15. [PubMed: 8562210]

Pickett KE, Pearl M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. J Epidemiol Community Health 2001;55(2):111–122. [PubMed: 11154250]

Reynolds P, Hurley SE, Quach AT, Rosen H, Von Behren J, Hertz A, et al. Regional variations in breast cancer incidence among California women, 1988-1997. Cancer Causes Control 2005;16(2):139–150. [PubMed: 15868455]

Rosenberg HM, Maurer JD, Sorlie PD, Johnson NJ, al e. Quality of death rates by race and Hispanic origin: A summary of current research, 1999. Vital Health Stat 1999;2(128)

Shao J SRR. Bootstrap for Imputed Survey Data. Journal of the American Statistical Association 1996;91 (435):1278–1288.

Singh GK, Hiatt RA. Trends and disparities in socioeconomic and behavioural characteristics, life expectancy, and cause-specific mortality of native-born and foreign-born populations in the United States, 1979-2003. Int J Epidemiol 2006;35(4):903–919. [PubMed: 16709619]

Singh GK, Siahpush M. Widening socioeconomic inequalities in US life expectancy, 1980-2000. Int J Epidemiol 2006;35(4):969–979. [PubMed: 16684899]

Sorlie PD, Johnson NJ. Validity of education information on the death certificate. Epidemiology 1996;7 (4):437–439. [PubMed: 8793373]

Stewart SL, Swallen KC, Glaser SL, Horn-Ross PL, West DW. Comparison of methods for classifying Hispanic ethnicity in a population-based cancer registry. Am J Epidemiol 1999;149(11):1063–1071. [PubMed: 10355383]

Subramanian SV. The relevance of multilevel statistical methods for identifying causal neighborhood effects. Soc Sci Med 2004;58(10):1961–1967. [PubMed: 15020011]

Swallen K, Guend A. Data quality and adjusted Hispanic mortality in the United States, 1989-1991. Ethn Dis 2003;13(1):126–133. [PubMed: 12723021]

Tobias MI, Cheung J. Monitoring health inequalities: life expectancy and small area deprivation in New Zealand. Popul Health Metr 2003;1(1):2. [PubMed: 12773214]

U.S. Census Bureau. Census 2000 Summary File 2. US Department of Commerce, Economics and Statistics Adminstration. 2001

U.S. Census Bureau. Table 1305. Vital Statistics, by Country or Area: 2006 and 2010. 2007

U.S. Census Bureau. International Database (IDB). 2008

United Nations, D. o. I. E. a. S. A., Population Division. Sex differentials in life expectancy and mortality in developed countries: an analysis by age groups and causes of death from recent and historical data. Popul Bull UN 1988;25:65–107. [PubMed: 12315555]

Wei II, Virnig BA, John DA, Morgan RO. Using a Spanish surname match to improve identification of Hispanic women in Medicare administrative data. Health Serv Res 2006;41(4 Pt 1):1469–1481. [PubMed: 16899019]

Wilkinson RG. Mortality and distribution of income. Low relative income affects mortality. BMJ 1998;316(7144):1611–1612. [PubMed: 9616035]

Wilkinson RG, Pickett KE. Income inequality and population health: a review and explanation of the evidence. Soc Sci Med 2006;62(7):1768–1784. [PubMed: 16226363]

Williams DR, Collins C. US SOCIOECONOMIC AND RACIAL DIFFERENCES IN HEALTH: PATTERNS AND EXPLANATIONS. Annual Review of Sociology 1995;21(1):349.

Williams DR, Haile R, Gonzalez HM, Neighbors H, Baser R, Jackson JS. The mental health of Black Caribbean immigrants: results from the National Survey of American Life. Am J Public Health 2007;97(1):52–59. [PubMed: 17138909]

Winkleby MA, Cubbin C. Influence of individual and neighbourhood socioeconomic status on mortality among black, Mexican-American, and white women and men in the United States. J Epidemiol Community Health 2003;57(6):444–452. [PubMed: 12775792]

Yen IH, Kaplan GA. Neighborhood social environment and risk of death: multilevel evidence from the Alameda County Study. Am J Epidemiol 1999;149(10):898–907. [PubMed: 10342798]

Yeracaris CA, Kim JH. Socioeconomic differentials in selected causes of death. Am J Public Health 1978;68(4):342–351. [PubMed: 645980]

Yost K, Perkins C, Cohen R, Morris C, Wright W. Socioeconomic status and breast cancer incidence in California for different race/ethnic groups. Cancer Causes Control 2001;12(8):703–711. [PubMed: 11562110]

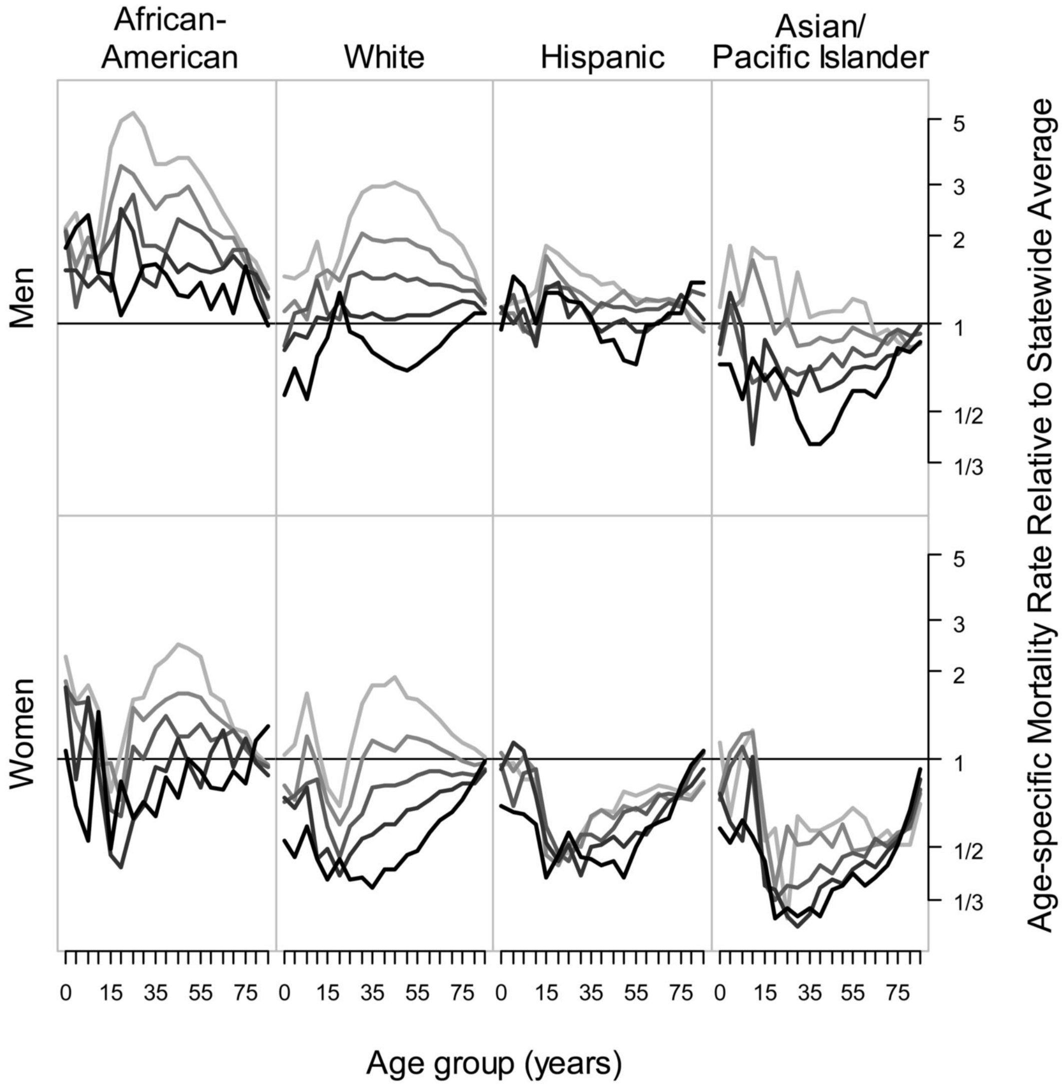

FIGURE 1.
Age-specific mortality rates by sex, race/ethnicity, and neighborhood socioeconomic status (SES) relative to statewide average rates in California, 1999-2001.
Legend: SES quintiles are colored from lightest (lowest SES quintile) to darkest (highest SES quintile).

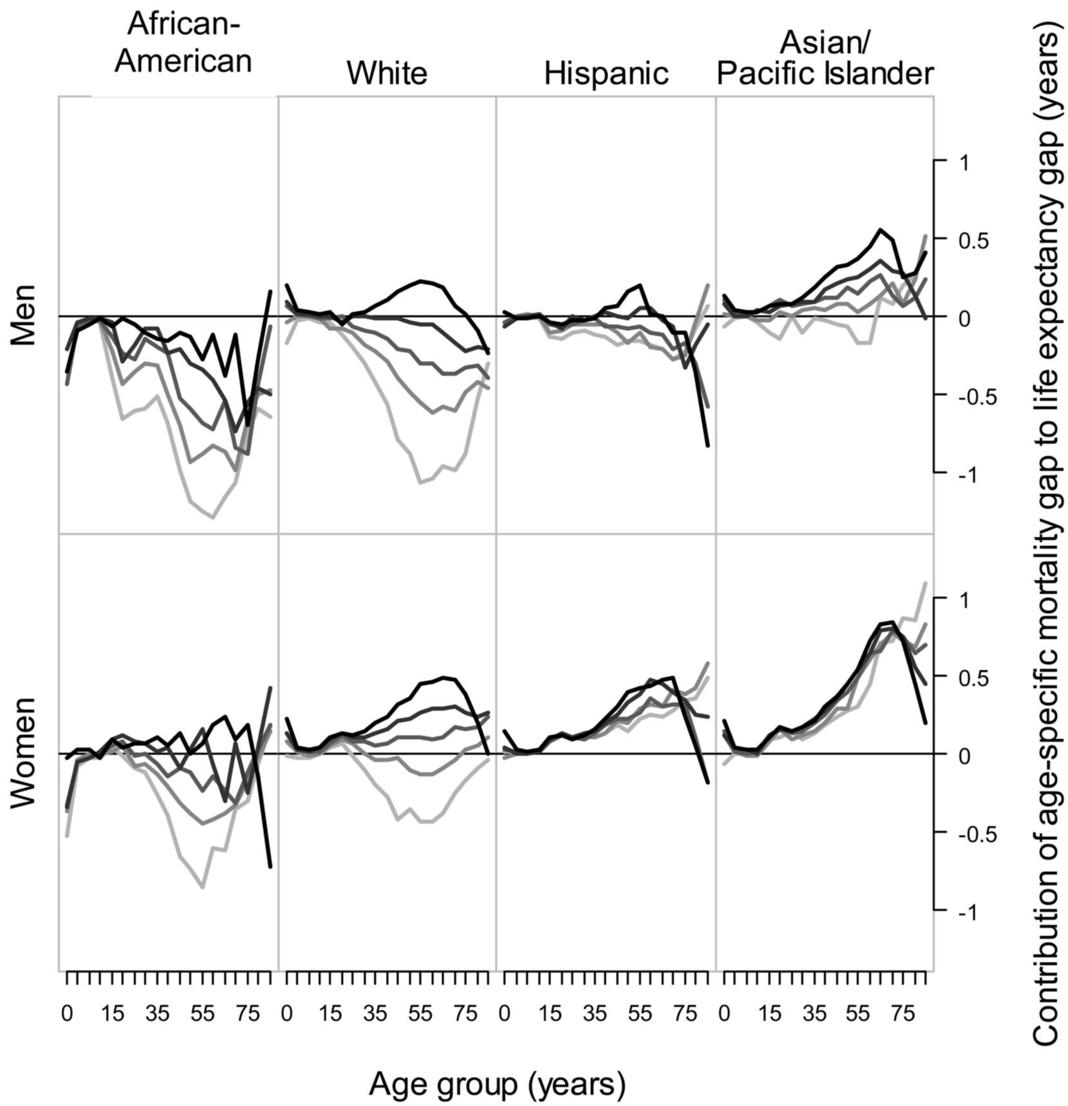

FIGURE 2.

Contributions of age-specific differences in mortality to total differences in life expectancy for population subgroups defined by sex, race/ethnicity, and neighborhood socioeconomic status (SES) in California, 1999-2001.

Legend: SES quintiles are colored from lightest (lowest SES quintile) to darkest (highest SES quintile).

TABLE 1

Population and death counts by race/ethnicity and neighborhood socioeconomic status (SES) in California, 1999-2001

		Population						
			Self-identified race/ethnicity					
Neighborhood SES Quintile	**Census Block Groups (%)**	**Total (%)**	**African-American**	**White**	**Hispanic**	**Asian/ Pacific Islander**	**Native American**	**Other**
1 (lowest)	4,392 (20%)	7,110,714 (21%)	647,564 (30%)	1,146,281 (7%)	4,684,271 (43%)	449,773 (12%)	42,611 (24%)	9,208 (14%)
2	4,392 (20%)	6,805,879 (20%)	575,163 (27%)	2,507,926 (16%)	2,810,854 (26%)	644,117 (17%)	51,701 (29%)	13,169 (20%)
3	4,392 (20%)	6,833,242 (20%)	456,682 (21%)	3,537,888 (22%)	1,800,946 (16%)	748,184 (20%)	41,771 (23%)	14,822 (22%)
4	4,392 (20%)	6,578,011 (19%)	308,235 (14%)	4,032,807 (26%)	1,085,751 (10%)	883,334 (24%)	27,607 (15%)	15,406 (23%)
5 (highest)	4,392 (20%)	6,474,976 (19%)	143,436 (7%)	4,521,012 (29%)	565,424 (5%)	1,018,267 (27%)	16,640 (9%)	14,683 (22%)
Total	21,960 (100%)	33,802,822 (100%)	2,131,080 (100%)	15,745,914 (100%)	10,947,246 (100%)	3,743,675 (100%)	180,330 (100%)	67,288 (100%)

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TABLE 2

Total numbers of deaths by race/ethnicity and neighborhood socioeconomic status (SES) in California, 1999-2001

	Numbers of deaths					
		Race/ethnicity as designated on death certificate				
Neighborhood SES Quintile	**Total (%)**	**African-American**	**White**	**Hispanic**	**Asian/ Pacific Islander**	**Other**
1 (lowest)	120,403 (17%)	20,612 (39%)	54,005 (11%)	37,880 (39%)	7,350 (17%)	556 (22%)
2	147,494 (21%)	14,445 (27%)	98,681 (20%)	24,424 (26%)	9,134 (21%)	810 (33%)
3	154,145 (22%)	9,647 (18%)	118,207 (24%)	16,906 (18%)	8,807 (20%)	578 (23%)
4	141,147 (20%)	5,897 (11%)	114,490 (23%)	10,787 (11%)	9,640 (22%)	333 (13%)
5 (highest)	125,834 (18%)	2,679 (5%)	107,319 (22%)	6,131 (6%)	9,500 (21%)	205 (8%)
Total	689,023 (100%)	53,280 (100%)	492,702 (100%)	96,128 (100%)	44,431 (100%)	2,482 (100%)

TABLE 3

Life expectancy at birth by sex, race/ethnicity, and neighborhood socioeconomic status (SES) in California, 1999-2001

Population Group	Neighborhood SES quintile					
	1 (lowest)	**2**	**3**	**4**	**5 (highest)**	***Overall***
	e_0 (95% ci)	e_0 (95% ci)	e_0 (95% ci)	e_0 (95% ci)	e_0 (95% ci)	e_0 (95% ci)
Males:	72.5 *(72.4,72.6)*	73.8 *(73.7,74.0)*	75.5 *(75.4,75.6)*	77.4 *(77.3,77.5)*	79.5 *(79.4,79.6)*	75.9 *(75.9,76.0)*
African-American	65.3 *(65.0,65.7)*	68.7 *(68.3,69.1)*	71.2 *(70.7,71.6)*	73.0 *(72.5,73.5)*	75.2 *(74.4,76.1)*	69.4 *(69.2,69.6)*
White	68.9 *(68.7,69.1)*	72.6 *(72.5,72.8)*	75.1 *(75.0,75.2)*	77.2 *(77.1,77.3)*	79.4 *(79.3,79.6)*	75.9 *(75.8,76.0)*
Hispanic	76.0 *(75.8,76.3)*	76.6 *(76.3,77.0)*	76.2 *(76.0,76.6)*	77.5 *(77.1,77.9)*	77.2 *(76.8,77.7)*	76.4 *(76.3,76.6)*
Asian/Pacific Islander	78.4 *(77.8,79.0)*	79.8 *(79.3,80.4)*	80.4 *(80.0,80.9)*	80.9 *(80.5,81.4)*	82.7 *(82.2,83.2)*	80.8 *(80.6,81.0)*
Women:	78.4 *(78.2,78.5)*	79.3 *(79.2,79.4)*	80.5 *(80.4,80.6)*	81.8 *(81.7,82.0)*	82.8 *(82.7,82.9)*	80.7 *(80.7,80.8)*
African-American	72.8 *(72.4,73.1)*	75.1 *(74.7,75.5)*	76.7 *(76.3,77.2)*	78.3 *(77.7,79.0)*	78.7 *(78.0,79.9)*	75.4 *(75.2,75.6)*
White	75.2 *(74.9,75.4)*	78.2 *(78.0,78.3)*	80.2 *(80.0,80.3)*	81.5 *(81.4,81.7)*	82.7 *(82.5,82.8)*	80.5 *(80.4,80.5)*
Hispanic	81.5 *(81.2,81.8)*	82.1 *(81.7,82.4)*	81.0 *(80.6,81.3)*	82.2 *(81.8,82.8)*	82.0 *(81.4,82.5)*	81.6 *(81.5,81.8)*
Asian/Pacific Islander	84.5 *(83.8,85.2)*	84.5 *(83.9,85.2)*	84.8 *(84.3,85.5)*	84.9 *(84.4,85.4)*	84.8 *(84.4,85.3)*	84.8 *(84.6,85.1)*
TOTAL	75.4 *(75.4,75.4)*	76.6 *(76.5,76.6)*	78.0 *(77.9,78.0)*	79.7 *(79.6,79.7)*	81.2 *(81.1,81.2)*	78.3 *(78.3,79.3)*