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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.

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

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(83.0 years), and the lowest among African–Americans (71.1 years) (Johnson & Hayes, 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 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 1500 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 et al., 1999), we improved our classification of Hispanic persons by applying a Hispanic surname list developed from US Census data, which reclassified 8420 (+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 & Hayes, 2004), whereas our life expectancy estimates for Hispanics were 1–1.5 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 & Sitter, 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,