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Increasing Disparities in Mortality by Socioeconomic Status

Barry Bosworth

Economics Studies Program, The Brookings Institution, Washington, DC 20036, USA; email: bbosworth@brookings.edu

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Abstract

This review focuses on the widening disparities in death rates by socioeconomic class. In recent years, there has been a major increase in the availability of data linking mortality risk and measures of socioeconomic status. The result has been a virtual explosion of new empirical research showing not only the existence of large inequities in the risk of death between those at the top and those at the bottom of the socioeconomic distribution, but also that the gaps have been growing. This assessment of the empirical research finds a consistent pattern of growing disparities within the United States. However, this widening gap in death rates does appear to be a uniquely American phenomenon, as the disparities by socioeconomic class appear to be stable or even declining in Europe and Canada.

INTRODUCTION

It should surprise no one to learn that the rich live longer than the poor. Using a wide range of measures of socioeconomic status (SES), such as income, education, wealth, and occupation (24, 33, 35, 36), a copious body of empirical literature has firmly established the existence of substantial inequality in mortality rates. That is, observed mortality rates show a gradual but systematic increase as we move down in the socioeconomic hierarchy. It also appears to be a global phenomenon as evidence exists of a similar pattern in other countries, even those with various versions of universal health care (30, 35, 49). A more striking finding is that a growing number of studies conclude that the differences in mortality rates across SES groups have grown significantly in the United States. However, the available studies suggest no such pattern in other high-income countries, such as Canada and those in Europe. These developments are the focus of this review.

There are several reasons for concern about the widening disparities in mortality. First, the pattern of change mimics similar developments of growing inequality in other dimensions of welfare, such as income and wealth. Income inequality narrowed considerably in the years after the Great Depression and WWII up to about 1980, but it rose sharply thereafter (7, 34). Family wealth has become more concentrated at the top of the distribution (8). Thus, from a welfare perspective, the growing inequities in mortality and life expectancy have compounded an underlying trend.

Second, the growing gaps in life expectancy are of special relevance to the design of income-support programs for the aged. The US public retirement system is highly progressive in redistributing income from high-income workers to lower-income retirees. However, a substantial portion of the redistribution is negated on a lifetime basis if lower-income retirees have a shorter life expectancy and collect benefits for an abbreviated period. The issue takes on added importance today because of proposals to raise the retirement age in line with increased average life expectancy as a primary means of controlling the system's costs. Yet, if life expectancy is increasing only for those at the top of the income distribution, an increase in the retirement age seems unfair to lower-income groups with unchanged or even reduced life expectancy.

Third, for middle-age groups in the United States, there is evidence of sharply rising mortality rates among white non-Hispanics aged 45–54, particularly those with a high school education or less (5). Case & Deaton trace the deaths to increases in suicide, alcohol, and drug poisonings, behaviors that are uncommon among those with a positive view of their broader life situation (6). These premature deaths impose significant economic and social costs in lost productivity and destruction of family support units. Finally, research on socioeconomic differences in mortality, and in health more generally, can help to identify high-risk groups toward whom health programs could be most efficiently directed.

In recent years, there has been an explosive increase in the number of empirical studies focused on differences in mortality risks across sociological groups and, in particular, the extent to which those disparities are growing over time. Changes in individual risk factors, such as smoking, obesity, and drug and alcohol abuse, are contributing factors, but they do not appear to account fully for the widening of the disparities. Some observers point to unequal access to health care and new medical technologies as primary factors, and there is growing interest in the influence of stress on physiological systems and behaviors that lead to early death; the evidence is mixed, however. This review begins with a discussion of the alternative measures of SES that are used in the empirical research, some analytical issues that arise in the comparison of results from those studies, and a consideration of the various data sources. An overview of the major studies in the United States, Europe, and Canada is provided in the concluding section.

MEASURES OF SOCIOECONOMIC STATUS

SES is broadly conceptualized as a person's position in a hierarchical social structure, encompassing notions of class, status, and power. Thus, sociologists perceive SES as more than financial well-being and educational achievement, which are often used as indicators in empirical work; more broadly, it encompasses a lifetime of access to knowledge, resources, and opportunities. For health research, it can influence individuals' exposure to health risks and their ability to seek out treatment (27). We can identify five common indicators of SES that are often linked to health and mortality outcomes: race, education, income, occupation, and wealth. However, there are concerns among researchers about some of the SES indicators that have been used in mortality studies. This concern is particularly true for those concurrent measures of SES that might be susceptible to a reverse correlation with health, which is itself a direct determinant of mortality. Questions have also been raised about the robustness of some measures, particularly in comparisons that extend over long time periods during which the distribution or composition of an indicator class may have changed.

Race

Race and ethnic differences are major factors in accounting for disparities in rates of mortality at most ages, but the interactions between roles of race and socioeconomic conditions in accounting for the differences have been the subject of some controversy. Although race/ethnicity and SES are clearly related, much of the research on mortality views them as distinct characteristics because the various SES indicators differ within and among racial and ethnic groups (11, 28, 50, 51).

The issue is important because race is one characteristic for which there has been a major shift in the pattern of change in mortality rates over the past two decades. The gap in black/white death rates rose dramatically in the early 1980s, due largely to a surge in deaths from AIDS among black men. While the overall rate remains much higher for blacks than for whites, there has been substantial progress in reducing the inequalities over the past two decades. The latest data from the Centers for Disease Control and Prevention, shown in **Table 1**, indicates a halving of the

Table 1 Disparities in black–white death rates by age and cause, 1999 and 2015[a]

	Age-adjusted black–white death rate					
	Relative rate disparity %			Absolute rate disparity		
	1999	2015	Change	1999	2015	Change
1. All causes: all ages[b]	32.9	15.9	−17.0	281.1	116.9	−164.2
18–34	91.8	41.1	−50.7	80.3	41.2	−39.1
35–49	108.2	41.4	−66.8	236.1	91.2	−144.9
50–64	80.4	44.8	−35.6	600	323.6	−276.4
≥65	10.2	−2.6	−12.8	526.7	−110.9	−637.6
2. Diseases of the heart	27.6	22.2	−5.4	72.3	37.2	−35.1
3. Malignant neoplasms	27.6	13.0	−14.6	54.5	20.7	−33.8
4. Cerebrovascular diseases	37.4	39.8	2.4	22.2	14.4	−7.8
5. Unintentional injury	13.8	−20.0	−33.8	4.9	−9.2	−14.1
6. Diabetes mellitus	120.0	88.7	−31.3	49.7	37.0	−12.7
7. Homicide	434.3	504.3	70.0	16.3	16.5	0.2
8. HIV disease	706.8	641.5	−65.3	20.7	6.8	−13.9
9. Suicide	−50.7	−62.9	−12.2	−5.7	−9.5	−3.8

Source: Reference 11.

[a]Relative disparity (%) = (Black rate minus white rate) divided by white rate times 100.

[b]Note: "All ages" category includes infants and children. Death rates for all ages were age-standardized to the 2000 US projected population.

racial disparity, from 33% to 16%, between 1999 and 2015 and an elimination of the gap at age 65 and over. The gap in life expectancy at birth between blacks and whites fell to 3.4 years in 2014, down from a peak of 7.1 in 1993. The report suggests that the racial differences may be the consequence of greater exposure to psychological, economic, and environmental stressors among blacks. As highlighted in two recent papers by Case & Deaton, the racial disparities have also been influenced by a sharp increase in midlife mortality among white non-Hispanic Americans (5, 6).

Education

In examinations of the link between SES and mortality, most studies have used education because its measurement is easy and practical in survey contexts (13, 22). It is particularly common in the United States because education has been included as an element of most Americans' death certificates since 1989. Hence, the National Death Index includes education together with race, gender, and residence as part of a standard set of information on each death. Nearly all household surveys include questions about educational attainment. It is usually determined in early adulthood, and in empirical studies, it is the least likely to be subject to reverse causation from other determinants of mortality, such as general health status. It is available for individuals regardless of their participation in the labor force or retirement status.

Education as an indicator of SES has some limitations, however. First, relative to income, variability in years of education has decreased over recent decades, with a clustering of outcomes at two levels: a high school degree and college graduation. Hence, measures of educational attainment do not provide finely differentiated measures of SES, and large numbers of individuals will be recorded with identical scores. Second, the distribution of educational attainment has shifted substantially over time. For example, using Census data to classify the population over age 25 into three educational attainment groups (less than 12 years, 12 to less than 16 years, and 4 years of college or more), individuals with less than a high school degree accounted for 60% of the population over 25 in 1960 but only 12% by 2015. Meanwhile, the proportion with a college degree or more increased fourfold. Thus, it is possible that classifying individuals by completed grade or degree attained does not yield a consistent measure of SES rank across birth cohorts (4, 14, 22). This latter problem has received increased attention in recent years and can be addressed by converting to a relative as opposed to an absolute scale for years of schooling so that comparisons of mortality across birth cohorts focus on individuals at equivalent percentile points in the distribution for their own cohort.

A third problem arises from a systematic difference in self-reported measures of education as recorded by the Census or household-level surveys and the secondhand estimates of years of schooling assigned by funeral directors on death certificates. The National Vital Statistics System (NVSS), for example, provides by far the largest and most complete data set on deaths. However, a 2010 evaluation of the educational reporting on death certificates (42, 46) concluded that death certificates overstate the population with a high school degree by overstating the attainment of those with less than 12 years of schooling. Evidence has also shown a reverse understatement of high school completion rates for blacks and Hispanics. Furthermore, there is a mismatch in the education information between the death certificate data and Census population measures of the at-risk population. The US Census Bureau changed to a new questionnaire that emphasized a degree-based measure of educational attainment in 1992, whereas the change was not incorporated into the death certificate until 2003 and later. Thus, there should be a preference in empirical studies for avoiding reliance on the education attainment measure recorded on the death certificate.

Income

Some of the earliest studies of mortality used current income because it was available from the Census and/or other periodic surveys. It has long been recognized, however, that current income is a poor basic indicator of SES at the individual or family level because of its sensitivity to transitory influences. Incomes also vary over the life cycle, and income at any single age may be a poor reflection of lifetime resources.

The recent expansion of access to Social Security Administration (SSA) earnings records and Internal Revenue Service data, however, makes it possible to use an average of past earnings or income as the measure of SES (10, 15, 47). The use of an average and the introduction of a gap between the average earnings measure and the period over which deaths are observed reduce the influence of transitory income shocks. The records also contain information on whether an individual ever qualified for disability, offering a further means of controlling for the effect of health on income. The SSA record system also provides a link to information on deaths that is comparable to that of the NVSS. Although measures of earnings at the individual level are available on a consistent basis only for those who participate in the labor force, it often makes more sense to think of SES as a family characteristic and combine the resources of couples in measures of household income. As with education, income is normally employed as a relative concept as a ratio to the mean or median.

The primary advantage of income as a measure of SES is its greater range of variation compared with the clustering of educational attainment at the completion of high school and college. However, its measurement in midlife limits the analysis of mortality to later stages of life because of the potential for reverse causation flowing from health to income. Perhaps the restriction of the analysis to older ages could be justified by noting that 94% of all deaths occur at the ages of 50 and over, but the recent research by Case & Deaton (5, 6) highlighting a surge in mortality rates for younger persons weakens that argument. In addition, a paper by Ho finds that two-thirds of the difference in life expectancy at birth between the United States and other high-income countries arises from a higher US mortality rate for those below the age of 50 (20). Because it is determined in midlife, income will always be subject to a greater potential for reverse correlation from health or potential bias from the influence of other covariates. It is, however, a richer summary measure of past life events that influence mortality risk.

Occupation

Occupational status has been a more common element of mortality studies in Europe than in the United States, and it was introduced at a time when large portions of the workforce had no formal education. The basic problem is that there is no natural ranking of occupations that can be easily converted into an ordinal index. Like earnings, the occupational measures exclude persons who are not in the workforce. The classification system has been revised over the years and currently focuses on a household unit, with occupation assigned on the basis of the member with the highest income. In a modern context, detailed occupational classifications also raise difficulties in situations of frequent job changes.

Wealth

Wealth provides individuals with the resources to manage emergencies, absorb economic shocks, and obtain superior health care relative to those with less wealth. It is also a cumulative measure of lifetime income in cases where a direct measure of income is unavailable. As such, it ought to be a powerful indicator of SES. However, wealth varies widely over the life cycle. Unless the measure

is standardized by age and available well before the period of potential death, there is a heightened concern among researchers about the potential for a reverse correlation with poor health. It is also very difficult to obtain accurate data on wealth from household surveys, providing a second rationale for the limited use of wealth in mortality studies (1).

ANALYTICAL ISSUES

Following is a discussion of three different common methods of measuring and analyzing mortality rates across population subgroups: group averages, small-area estimation techniques, and individual-level analysis.

Group Averages

Until recently, most mortality analysis relied on the reporting of simple averages of groups because of the lack of data files that linked information on SES characteristics and mortality experience at the individual level. The United States was unusual in including an SES indicator, education, on the death certificate. Hence, researchers could compute average mortality rates, controlling for various demographic factors (age, race, gender) and levels of educational attainment by combining matching tabulations from the National Death Index (numerator) and Census estimates of the at-risk population (denominator). However, because information must be retrieved from two different data file systems, there are concerns among researchers that so-called numerator/denominator biases can develop between the two sources because of subtle differences in the classification of characteristics in the two populations. In any case, the analysis is limited with education as the sole SES indicator. With the increased reliance on computer systems, more countries have moved to create linked-record systems, either by use of unique personal identification numbers (e.g., Social Security numbers) or the use of probabilistic-match algorithms (38). The result has been a major increase in the number of large individual-level data files that contain extensive SES information on the at-risk population and mortality.

Even with access to data files linked at the individual level, some researchers prefer to focus on the comparison of groups rather than the comparison of individuals, viewing the former as simple summaries of the properties of the underlying individual-level data. Tabular displays, such as mortality rates by categories of educational attainment, are easier to visualize and explain. In addition, grouped data are frequently useful for revealing patterns that would be difficult to identify at the individual level. Grouping can also serve as a simple means of capturing contagion effects. However, aggregation implies a large loss of potentially useful information on within-group variation and creates added difficulties in identifying and controlling for confounding factors. The analysis of aggregated data is also prone to the ecological fallacy of attributing group effects to the individuals that make up the groups.

Some of the confusion in evaluating mortality trends in grouped data is the result of the use of different summary measures. For example, mortality risk is not a constant over a person's life cycle, and it needs to be measured at a specific age interval or as an average age-adjusted rate for a standard (reference) population. In addition, if mortality rates are compared across populations or over time, the differences can be reported as absolute or relative (percentage) differences. It is possible to conclude that inequality has declined across SES categories in absolute terms while the relative differences have widened (31). The absolute difference is the simple change between two numbers that are already ratios, whereas the relative rate expresses the difference as a ratio of the ratios. As such, the relative rate measure is sensitive to the size of the denominator, rising for low probability events (43). This issue arises in many areas of analysis beyond health, and the

general recommendation is to rely on the absolute difference because it maintains the units of the underlying basic measure and is less subject to misunderstandings. However, the reporting of relative changes is common in health studies, and a common compromise is to report both.

Small-Area Estimation

The second analytical approach to deriving relationships between SES and mortality risk involves linking county-level socioeconomic data from the Census or similar surveys with the geographical identifiers of the national mortality data. There is less concern about numerator/denominator bias because both the National Death Index and the Census incorporate strong definitions of county jurisdictions. Counties are, in turn, ranked by their average value of a specific SES indicator or a broader-based weighted average of individual indicators (12, 25, 44, 45). Mortality rates or measures of life expectancy can be compared across the distribution from least- to most-disadvantaged areas. Area-based composite deprivation indices are employed extensively in analyzing and monitoring health and mortality differentials in Europe, Australia, and New Zealand. The major challenge to such analysis is that people move and the place of death may have little to do with the SES characteristics of the area where they spent the largest portion of their lives. In addition, counties can be quite heterogeneous in their socioeconomic characteristics; the averaging across a geographical entity dampens the observed differences in the SES indicators.

Individual-Level Analysis

Finally, the increased availability of individual-level data files, which link information from household-level surveys with the information from the National Death Index, greatly expands the richness of the research. The large data files have enabled regression-based analysis of mortality risks. This approach commonly takes the form of a simple logistic regression in which the dependent variable is expressed as a probability (of death or survival) such as

$$\left(\frac{h_{it}}{1-h_{it}}\right) = \exp\left(\beta_{ij}{}^{*}\mathbf{X}_{\boldsymbol{ijt}}\right),$$

where $h_{it} = Pr(Y_{it} = 1/Y_{it-1} = 0)$ is the hazard that person i will die in year t and $\mathbf{X}_{\boldsymbol{ijt}}$ is a vector of potential determinants of mortality risk. The determinants include the person's SES, age, birth year (cohort), and other covariates that may influence mortality. In addition, an interaction of the SES measure with the birth year provides a means of estimating a rise or decline in differential mortality across successive birth cohorts. One of the earliest examples of the application of a logistic model to mortality risk is that of Elo & Preston (17). The regression framework does impose a rigid linearity assumption on the basic estimation, but alterative functional forms can be easily explored with categorical variables, regression splines, and interaction terms.

DATA SOURCES

The data requirements needed for an accurate estimation of changes in mortality inequalities by SES group are considerable, and many countries have been able to meet those requisites only in recent years. First, the estimation requires access to nationally representative surveys that collected information on socioeconomic characteristics of the at-risk population. Second, the information on the survey participants must be linked to some version of a national death registry, and the information on deaths must be extended for a number of years after the original SES survey. Third, the survey must be of sufficient size to compare the mortality risks of persons in different birth cohorts at matching ages.

The United States is able to meet these needs. It has a large and relatively complete National Death Index that has included an SES indicator (educational attainment) since 1989, and estimates of the at-risk population (the denominator) can be obtained from the decennial Censuses. Hence, a large number of studies simply use the mortality files of the NVSS and rely on education as the primary SES control, together with information on age, gender, race, and area of residence.

The United States has also been an early adopter in creating large individual-level data files that link information on socioeconomic characteristics with future mortality outcomes. Although the initial work relied on files of the SSA linked through Social Security numbers, this practice raised significant concerns about privacy and confidentiality. In recent years, the possibilities of linking diverse individual-level data files have been greatly extended by the use of probabilistic-match algorithms to link records across data files on the basis of little more than name, date of birth, and place of residence (38). Hence, the dual source problem of numerator/denominator bias can be largely resolved. By its very nature, however, analysis of mortality in a survey is limited to the years after it was conducted, requiring the passage of considerable time to obtain mortality information for different birth cohorts at comparable ages. Also, the baseline surveys usually exclude individuals who are resident in institutions.

The National Vital Statistics System

The NVSS is the basic registration system for all births and deaths in the United States, and it is maintained by the National Center for Health Statistics. The major advantages of the national mortality file are its size, geographic detail, and breadth of information on the decedents. Beginning in 1989, the Multiple Cause of Death files incorporate information from death certificates of every death occurring in the United States in each year: sex, race/ethnicity, age at death, place/country-of-birth, place of residence, educational attainment, occupation, industry, and marital status, together with underlying and multiple causes of death. Because of its size and the inclusion of a measure of education attainment, the Multiple Cause of Death file is sometimes used directly as the source for mortality studies that employ education as the indicator of SES status. It is one of the few informants, for example, on residents of institutions, composed of high-risk individuals who are excluded from most survey-based data sets. However, the educational classification on the death certificate is suspect because it is supplied by funeral directors (42, 46). The measure of educational attainment, together with the ascertainment of race, changed with the 2003 revision to the form, which has been implemented by a majority but not all reporting jurisdictions.

Furthermore, while the mortality file provides the information on deaths, it must be combined with another source, such as Census records, for information on the population-at-risk to construct a mortality rate. Thus, numerator/denominator biases (discussed above) can develop between the two sources because of differences in the classification of characteristics in the two populations.

National Longitudinal Mortality Survey

The National Longitudinal Mortality Survey (NLMS) consists of samples of the noninstitutional population obtained from the Annual Social and Economic Supplement (ASEC) to the Census Bureau's Current Population Surveys. It is currently available from 1973 to 2011. The files are linked in turn to the individual-level mortality data of the NVSS. The household-level data contain extensive demographic and socioeconomic information from the annual supplement, and the study incorporates mortality and cause of death information from the death certificate data maintained in the NVSS. The linking of the data at the individual level to later information on mortality eliminates the problem of numerator/denominator bias; however, by excluding institutionalized

individuals, the survey reports on a group that is systematically healthier than the overall population. The file currently has 3.8 million person records and more than 550,000 deaths. The ASEC is an annual one-time survey of ~50,000 households with no follow-up, implying that much of the social and economic information on individuals becomes outdated with time.

National Health Interview Survey

The National Health Interview Survey (NHIS) is the principal source of information on the health status of the civilian noninstitutional population of the United States (39). Like the ASEC, the NHIS is conducted using one-time interviews of a representative sample of ~35,000 households and persons in noninstitutional group quarters in each year, but it uses a different sampling design. It collects data on a wide range of topics, including health status and limitations, injuries, behavior indicators, health care access and utilization, health insurance, and a core set of demographic and SES measures. As with the NLMS, the NHIS data files are linked to the NVSS mortality information and the administrative records of the SSA (some years), Medicare, and Medicaid. Versions of the files are available back to the mid-1980s.

The Survey of Program Participation

The Survey of Program Participation (SIPP) is conducted by the US Census Bureau, and it has a multi-interview or longitudinal structure with reinterviews (waves) at four-month intervals over 2.5–4 years, again limited to the noninstitutional population. The SIPP and the ASEC have identical sampling frames, but the SIPP has more detailed information on government transfer programs, retirement, and pension plans. It is linked to the SSA administrative files on earnings, benefits, and deaths and is the basis for much of the SSA research. The survey began in 1984 and currently has mortality data through 2014, a 30-year period. The initial size of the samples has varied between 20,000 and 50,000, and nonresponse rates rise in the later waves.

The Health and Retirement Study

The Health and Retirement Study (HRS), based at the University of Michigan, is limited to individuals in the noninstitutional population over the age of 50. The HRS is unique because it has a longitudinal panel structure with follow-up interviews on a two-year cycle, and new age cohorts are added every five years. In its follow-up interviews, the HRS continues to include individuals even if they enter an institution. The study contains a wealth of SES measures and self-reported health conditions, behaviors related to health, and administrative data from the SSA, Medicare, and Medicaid, and it currently includes ~20,000 individuals with oversampling of blacks and Hispanics. It incorporates detailed information on the date and cause of death. The HRS is also the model for similar surveys in ~30 other countries, providing an expanding capability for international comparisons.

EMPIRICAL RESEARCH

Following the path-breaking work by Kitagawa & Hauser in 1973 (24), there has been an explosion of epidemiological research on the link between mortality and different measures of SES. The early research was limited by difficulties in combining detailed mortality data with comprehensive measures of SES. Kitagawa & Hauser combined information from the long form of the 1960 Census with a national sample of death records. Research of this type has been greatly accelerated by the creation of the National Death Index and the microlevel data sets with links between

the SES information and mortality outcomes. Early examples were Feldman and others (18) and Pappas and others (33). A 1995 paper by Preston & Elo (35) reviewed a number of those studies and reported a mixed story in which the mortality differential had clearly widened since 1960 for white males, but it appeared to have declined or remained stationary for women. As shown in later reviews by Elo (16) and Bor and his coauthors (2), the most recent studies have been highly confirming of increases in the mortality differential within the United States.

Education

Meara and her coauthors (29) examined mortality patterns from the Multiple Cause of Death data file (1990 and 2000) and the NLMS (1981–1988 and 1991–1998). They restricted their analysis to non-Hispanic blacks and whites and used educational attainment (12 years and less and 13 years and more) as the SES measure. They found that the increase in life expectancy at age 25 in both surveys was limited largely to those at the top of the educational distribution with a significant widening of the gap in life expectancy for both men and women of ~1.5 years between 1990 and 2000. They reported that mortality differentials actually declined across both gender and race.

Olshansky and others (32) also relied on mortality data from the Multiple Cause of Death file matched with estimates of the population by age, sex, race, and educational attainment from the US Census Bureau for the period of 1990–2008. They also found evidence of rapidly widening mortality differentials. Life expectancy at birth actually fell for white males and females with less than 12 years of schooling, whereas it increased for blacks and Hispanics. However, the study has been criticized for not correcting for the changes over time in the composition of the educational categories (4). Hendi (19) utilized data from the NHIS and reported a widening of the education differentials for non-Hispanic whites between 1991 and 2005. However, after adjustment for changes in the composition of the educational groups, he found a substantially smaller increase in differential mortality compared with Olshansky and others.

Income

Similar results have been obtained in studies that used income as the measure of SES. Waldron (47) worked with administrative records that contained information on career earnings (average over ages 45–55) and age at death to measure the widening disparities for men covered by Social Security. Her measure of differential mortality was based on data for the 1912 and 1941 birth cohorts, with an increase of 4.7 years in the differential between the top and bottom half of the earnings distribution between the two birth cohorts. Cristia (10) also constructed career earnings from Social Security records as the indicator of SES and reported substantial increases in differential mortality by income quintiles for the period of 1983–2003. In 2015, work by the National Academies of Sciences, Engineering, and Medicine (30), using data from the HRS, estimated the increase in life expectancy at age 50. The differential between the top and bottom income quintiles was projected to increase from 5 years for men born in 1930 to 13 years for men born in 1960. The estimates for women were 3.9 years and 13.6 years. A similar 2016 study by Bosworth and his coauthors (3) used career earnings as well as education to measure the role of SES. They reported that the difference in life expectancy between the first and tenth decile of career earnings increased between the 1920 and 1940 birth cohorts by 8.7 years for men and 6.4 years for women. Furthermore, even though differences in educational attainment were statistically significant predictors of mortality, the variation in career earnings had the greater explanatory power.

Finally, Chetty and his coresearchers linked Internal Revenue Service income tax records to the mortality registry of the Social Security system (9). These data were used to estimate life expectancy at 40 years of age by household income percentile, sex, and geographic area. Between

2001 and 2014, life expectancy increased by 2.3 years for men and 2.9 years for women in the top 5% of the income distribution, but there was essentially no change for those in the bottom 5%.

Area Studies

Additional support can be obtained from several small-area studies. Singh & Siahpush (44, 45) constructed area-based composite deprivation indexes, a range of SES indicators from the 1970, 1980, and 1990 Censuses (education, occupation, wealth, income distribution, unemployment, poverty, and housing quality indicators), at the level of 3,097 individual counties and used those indexes to define area deprivation by decile. The indexes were then linked to the US mortality data at the county level. The authors focused on life expectancy and found that the least-deprived decile had an average life expectancy at birth of 2.8 years more than that of the most-deprived group of counties in 1980–1982. By 1998–2000, that differential had increased to 4.5 years. A related county-based study by Krieger and others (25) covering persons below the age of 65 reported a narrowing of the mortality disparities between areas of high and low SES for the period of 1960–1980 and showed no significant change in absolute differences between 1980 and 2002. Currie & Schwandt (12) focused on the period of 1990–2010 and reported a slight widening of the mortality rate differentials for middle-age and older Americans but a significant narrowing for younger cohorts. The study of Chetty and others also included some area analysis; they reported that low-income individuals live longest in affluent cities with more educated people and higher local government expenditures, suggesting contagion effects.

Case–Deaton

Two recent studies by Case & Deaton (5, 6) have received great public attention because of their finding of a sharp break around 2000 in the prior pattern of declining mortality for middle-age non-Hispanic whites: The death rate stopped going down and started going up. That shift and its dramatic contrast with the experience of other high-income countries are highlighted in **Figure 1**, taken from their study. The change in the mortality pattern is also not evident for blacks and Hispanics for whom mortality risk continued to fall. Additionally, they find that the increase in mortality is concentrated among persons with a high-school education or less. Finally, they attribute a large portion of the increase in deaths to drug overdoses, alcohol abuse, and suicide. Their emphasis on a widening of the mortality difference by educational attainment and its link to drug overdoses is echoed in a recent study by Ho (21). Analyses of the geographical distribution of drug-poisoning deaths found a broad-based phenomenon with large increases in both rural and urban areas (40, 41).

Case & Deaton argue that the above findings are indicative of a broader social crisis in the United States, which they characterize as the "economics of despair" (6, p. 398): Less-educated whites have worsening economic opportunities that spill over into other areas of social behavior such as reduced marriage prospects and increased drug abuse. That perspective is similar to the arguments of Putnam who believes that economic and social transformations have contributed to a growing inequality of opportunity in the United States (37). However, the research on the causes of the increased midlife mortality is in its early stages, and there is uncertainty about whether it reflects a broad social crisis or a health epidemic not dissimilar from the crack epidemic of the 1980s or that of AIDS in the 1980s and early 1990s.

International Experience

The research on the question of whether the size of differential mortality is increasing over time in other countries remains surprisingly limited. While agreeing that there is a strong global pattern

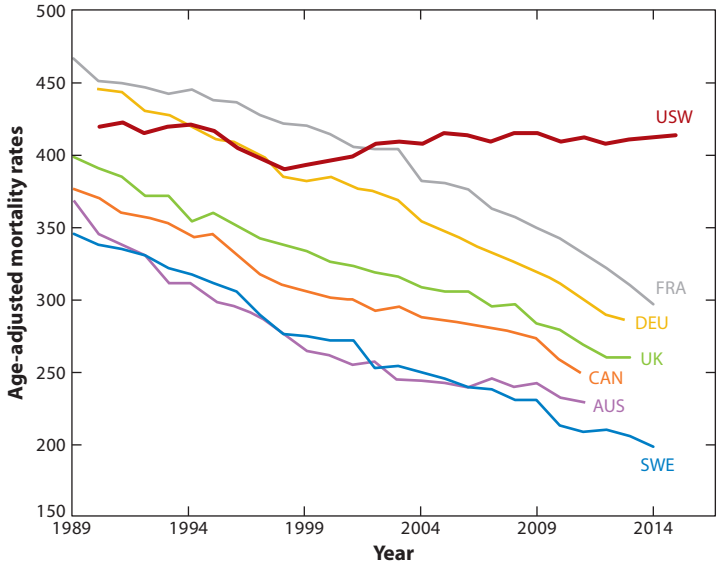

Figure 1

Age-adjusted mortality rates, ages 45–54, major countries. Adapted with permission from Reference 6. Abbreviations: AUS, Austria; CAN, Canada; DEU, Germany; FRA, France; SWE, Sweden; UK, United Kingdom; USW, US non-Hispanic whites.

of large differences in mortality across educational categories, a National Research Council panel report (31) was reluctant to draw a firm conclusion about trends in the mortality differentials. Until recently, most countries other than the United States lacked data files in which the demographic and socioeconomic characteristics of individuals could be linked to subsequent mortality experience. That situation has changed substantially within Europe as more countries have moved to construct linked files for analysis. In a series of reports, Mackenbach and his colleagues have provided assessments of that research for a growing number of countries. The latest report included data from 11 countries over the period of 1990–2010 (26) and examined change in mortality between the lowest and highest levels of educational attainment. They conclude that relative inequities in mortality have increased, but the absolute differences in mortality rates narrowed in all the countries. In that regard, European countries provide a striking contrast to the US experience.

Canada also provides a useful comparison to the United States because, while it shares some similarities in the measures of SES, it has long provided an advanced national health care system that is available to all. Research on the link between indicators of SES and mortality, however, has been limited by the lack of individual-level linked data files with measures of SES and mortality experience. Hence, much of the analysis has relied on small-area analysis of mortality averages. A 2007 study examined mortality trends for 1971, 1986, 1991, and 1996 for metropolitan areas and grouped the areas into income quintiles on the basis of the percent of low-income residents (23). The study demonstrated a substantial narrowing of the disparities in age-standardized mortality. A similar earlier study undertaken in 2002 likewise concluded that inequalities in mortality had declined substantially over time (48).

CONCLUSION

The empirical research on differential mortality in the United States yields a very persuasive finding of growing gaps in adult mortality and life expectancies across both education and income.

However, it does appear to be a largely American phenomenon, as the disparities by socioeconomic class appear to be stable or even declining in Europe and Canada.

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Annual Review of Public Health
Volume 39, 2018

Contents

Symposium

Commentary: Increasing the Connectivity Between Implementation Science and Public Health: Advancing Methodology, Evidence Integration, and Sustainability
David A. Chambers 1

Selecting and Improving Quasi-Experimental Designs in Effectiveness and Implementation Research
Margaret A. Handley, Courtney R. Lyles, Charles McCulloch, and Adithya Cattamanchi 5

Building Capacity for Evidence-Based Public Health: Reconciling the Pulls of Practice and the Push of Research
Ross C. Brownson, Jonathan E. Fielding, and Lawrence W. Green 27

The Sustainability of Evidence-Based Interventions and Practices in Public Health and Health Care
Rachel C. Shelton, Brittany Rhoades Cooper, and Shannon Wiltsey Stirman 55

Epidemiology and Biostatistics

Selecting and Improving Quasi-Experimental Designs in Effectiveness and Implementation Research
Margaret A. Handley, Courtney R. Lyles, Charles McCulloch, and Adithya Cattamanchi 5

Agent-Based Modeling in Public Health: Current Applications and Future Directions
Melissa Tracy, Magdalena Cerdá, and Katherine M. Keyes 77

Big Data in Public Health: Terminology, Machine Learning, and Privacy
Stephen J. Mooney and Vikas Pejaver 95

Environmental Determinants of Breast Cancer
Robert A. Hiatt and Julia Green Brody 113

Meta-Analysis of Complex Interventions
Emily E. Tanner-Smith and Sean Grant 135

Precision Medicine from a Public Health Perspective
Ramya Ramaswami, Ronald Bayer, and Sandro Galea 153

Relative Roles of Race Versus Socioeconomic Position in Studies of Health Inequalities: A Matter of Interpretation
Amani M. Nuru-Jeter, Elizabeth K. Michaels, Marilyn D. Thomas, Alexis N. Reeves, Roland J. Thorpe Jr., and Thomas A. LaVeist 169

Social Environment and Behavior

The Debate About Electronic Cigarettes: Harm Minimization or the Precautionary Principle
Lawrence W. Green, Jonathan E. Fielding, and Ross C. Brownson 189

Harm Minimization and Tobacco Control: Reframing Societal Views of Nicotine Use to Rapidly Save Lives
David B. Abrams, Allison M. Glasser, Jennifer L. Pearson, Andrea C. Villanti, Lauren K. Collins, and Raymond S. Niaura 193

E-Cigarettes: Use, Effects on Smoking, Risks, and Policy Implications
Stanton A. Glantz and David W. Bareham 215

Increasing Disparities in Mortality by Socioeconomic Status
Barry Bosworth 237

Neighborhood Interventions to Reduce Violence
Michelle C. Kondo, Elena Andreyeva, Eugenia C. South, John M. MacDonald, and Charles C. Branas 253

The Relationship Between Education and Health: Reducing Disparities Through a Contextual Approach
Anna Zajacova and Elizabeth M. Lawrence 273

Environmental and Occupational Health

Building Evidence for Health: Green Buildings, Current Science, and Future Challenges
J.G. Cedeño-Laurent, A. Williams, P. MacNaughton, X. Cao, E. Eitland, J. Spengler, and J. Allen 291

Environmental Influences on the Epigenome: Exposure-Associated DNA Methylation in Human Populations
Elizabeth M. Martin and Rebecca C. Fry 309

From Crowdsourcing to Extreme Citizen Science: Participatory Research for Environmental Health
P.B. English, M.J. Richardson, and C. Garzón-Galvis 335

Migrant Workers and Their Occupational Health and Safety
Sally C. Moyce and Marc Schenker 351

Mobile Sensing in Environmental Health and Neighborhood Research
Basile Chaix 367

Public Health Practice and Policy

Commentary: Increasing the Connectivity Between Implementation Science and Public Health: Advancing Methodology, Evidence Integration, and Sustainability
David A. Chambers 1

Building Capacity for Evidence-Based Public Health: Reconciling the Pulls of Practice and the Push of Research
Ross C. Brownson, Jonathan E. Fielding, and Lawrence W. Green 27

The Sustainability of Evidence-Based Interventions and Practices in Public Health and Health Care
Rachel C. Shelton, Brittany Rhoades Cooper, and Shannon Wiltsey Stirman 55

The Debate About Electronic Cigarettes: Harm Minimization or the Precautionary Principle
Lawrence W. Green, Jonathan E. Fielding, and Ross C. Brownson 189

Harm Minimization and Tobacco Control: Reframing Societal Views of Nicotine Use to Rapidly Save Lives
David B. Abrams, Allison M. Glasser, Jennifer L. Pearson, Andrea C. Villanti, Lauren K. Collins, and Raymond S. Niaura 193

E-Cigarettes: Use, Effects on Smoking, Risks, and Policy Implications
Stanton A. Glantz and David W. Bareham 215

Neighborhood Interventions to Reduce Violence
Michelle C. Kondo, Elena Andreyeva, Eugenia C. South, John M. MacDonald, and Charles C. Branas 253

Mobile Sensing in Environmental Health and Neighborhood Research
Basile Chaix 367

Policy Approaches for Regulating Alcohol Marketing in a Global Context: A Public Health Perspective
Marissa B. Esser and David H. Jernigan 385

Problems and Prospects: Public Health Regulation of Dietary Supplements
Colin W. Binns, Mi Kyung Lee, and Andy H. Lee 403

Health Services

Achieving Mental Health and Substance Use Disorder Treatment Parity: A Quarter Century of Policy Making and Research
Emma Peterson and Susan Busch 421

Data Resources for Conducting Health Services and Policy Research
Lynn A. Blewett, Kathleen Thiede Call, Joanna Turner, and Robert Hest 437

Designing Difference in Difference Studies: Best Practices for Public Health Policy Research
Coady Wing, Kosali Simon, and Ricardo A. Bello-Gomez 453

How Much Do We Spend? Creating Historical Estimates of Public Health Expenditures in the United States at the Federal, State, and Local Levels
Jonathon P. Leider, Beth Resnick, David Bishai, and F. Douglas Scutchfield 471

Modeling Health Care Expenditures and Use
Partha Deb and Edward C. Norton 489

Promoting Prevention Under the Affordable Care Act
Nadia Chait and Sherry Glied 507

Treatment and Prevention of Opioid Use Disorder: Challenges and Opportunities
Dennis McCarty, Kelsey C. Priest, and P. Todd Korthuis 525

Indexes

Cumulative Index of Contributing Authors, Volumes 30–39 543

Cumulative Index of Article Titles, Volumes 30–39 549

Errata

An online log of corrections to *Annual Review of Public Health* articles may be found at http://www.annualreviews.org/errata/publhealth