



America: Equity and Equality in Health 5

Population health in an era of rising income inequality: USA, 1980–2015

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Income inequality in the USA has increased over the past four decades. Socioeconomic gaps in survival have also increased. Life expectancy has risen among middle-income and high-income Americans whereas it has stagnated among poor Americans and even declined in some demographic groups. Although the increase in income inequality since 1980 has been driven largely by soaring top incomes, the widening of survival inequalities has occurred lower in the distribution—ie, between the poor and upper-middle class. Growing survival gaps across income percentiles since 2001 reflect falling real incomes among poor Americans as well as an increasingly strong association between low income and poor health. Changes in individual risk factors such as smoking, obesity, and substance abuse play a part but do not fully explain the steeper gradient. Distal factors correlated with rising inequality including unequal access to technological innovations, increased geographical segregation by income, reduced economic mobility, mass incarceration, and increased exposure to the costs of medical care might have reduced access to salutary determinants of health among low-income Americans. Having missed out on decades of income growth and longevity gains, low-income Americans are increasingly left behind. Without interventions to decouple income and health, or to reduce inequalities in income, we might see the emergence of a 21st century health-poverty trap and the further widening and hardening of socioeconomic inequalities in health.

Introduction

Income inequality in the USA has increased dramatically over the past four decades. The share of incomes going to the wealthiest 10% increased from 33% of total earnings in 1978 to 50% in 2014—a level of inequality not seen since before the Great Depression.¹ Incomes for poor and middle-income Americans have barely changed since the 1970s and, adjusted for inflation, have actually declined since 2000 (figure 1). Given the strong and nearly universal association between socioeconomic status and health,^{2–6} it is natural to ask whether rising gaps in income might be associated with widening gaps in health and longevity between rich and poor Americans.

Our review focuses on income-related and education-related inequalities in health. Other papers in the Series address racial inequalities in health—particularly the strikingly worse health outcomes of African-Americans—and review the implications of economic inequality for the US medical care system.

Why socioeconomic inequalities in health matter

Measurement of socioeconomic inequalities in health—also known as health inequalities—is important for several reasons. Health is a key aspect of wellbeing and health inequalities can compound (or mitigate) existing differences in wellbeing according to income. Knowledge of the distribution of health across income groups offers a more complete picture of how wellbeing is distributed across society and the effects of policy options. For example, because the poor die younger, they are short-changed by age-targeted entitlement programmes such as Medicare (the public health insurance programme for elderly people) and the Social Security retirement system.⁷ Additionally,

to the extent that socioeconomic inequalities in health are avoidable, measurement of health gaps helps to identify opportunities to target future interventions.

Search strategy and selection criteria

We reviewed studies reporting trends in survival inequalities in the USA for the period 1980–2015. We searched PubMed and Google Scholar for English-language articles published between Jan 1, 1990, and Oct 30, 2016, using the following terms: “((income) or (education)) and ((mortality) or (life expectancy)) and (united states) and ((longitudinal) or (changes) or (trends) or (over time)).” We then added the terms “((inequality) or (disparity))” to the first search. We manually searched the bibliographies of relevant articles and used Google Scholar to identify articles citing the relevant article. We included articles if they compared survival in a high-socioeconomic status group versus a low-socioeconomic status group, stratified by income or education, at least a decade apart during the period 1980–2015. Articles were critically appraised to assess socioeconomic strata compared, survival outcomes measured, whether a period versus cohort perspective was used, whether adjustments were made for changing composition across strata, and whether the data presented reflect measured outcomes or projections.

A listing of all studies identified in our review and key results can be found in the appendix. Our review highlights studies that presented raw survival measures by socioeconomic group in an early year and a late year (or gaps in an early and late year), such that changes in survival gaps could be calculated. Findings of studies reporting only relative measures were also generally consistent, and are presented in the appendix and discussed in the text.

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This is the fifth in a [Series](#) of five papers about equity and equality in health in the USA

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Key messages

- Gaps in mortality and life expectancy according to income and education have widened during the period 1980–2014.
- Life expectancy has stagnated and even declined in some groups—eg, white women without a high school diploma.
- Growth in health inequalities has been most pronounced in the bottom half of the income distribution. Since 2001, the poorest 5% of Americans experienced close to zero gains in survival. At the same time, middle-income and high-income Americans have gained over 2 years in additional life expectancy.
- Widening gaps in survival across income percentiles since 2001 are only partially explained by falling incomes among the poor. The relationship between income and survival has also grown stronger, with poverty becoming an increasingly important risk factor for mortality in the early 21st century.
- The income–survival gradient has become steeper, in part, because of several proximate factors: a shift in the burden of smoking and (to a lesser extent) obesity, underuse of essential medical care, and increased substance abuse and self-harm in lower-socioeconomic status groups.
- Distal explanations for the rising gradient are harder to evaluate, but might include differential changes in access to and uptake of determinants of health, ranging from fresh fruit and vegetables to information on new risk factors to new medical procedures; increasing geographical segregation that exacerbates inequalities in access to salutary health amenities; reduced economic mobility leading to greater persistence of poverty; mass incarceration; and, possibly, the erosion of public subsidies that previously shielded the poor from exposure to the market-determined prices of health insurance and other health inputs. These factors might have reduced access to key salutary determinants of health among low-income Americans, exacerbating income losses that have occurred since 2001.
- Changes in survival gaps over time might substantially underestimate the growth in health inequalities across birth cohorts. The gap in cohort life expectancy between the top and bottom income quintiles is projected to increase by nearly a decade within a single generation—from the 1930–60 birth cohort.
- Rising health inequalities should be addressed to avoid the emergence of a 21st-century health-poverty trap.

See Online for appendix

Health inequalities are particularly pernicious because they can reproduce and reinforce gaps in income and wealth, with negative feedback loops creating a health-poverty trap. Poor health can limit economic productivity,⁸ bankrupt households,⁹ and impoverish families.¹⁰ Poor health in childhood can also have long-term consequences for physical and cognitive development,^{11,12} educational attainment,^{13,14} and future earnings.^{14,15} Health deficits might even have intergenerational consequences,¹⁶ reproducing inequalities in income, wealth, and human capital (ie, the education, training, and health that facilitate occupational success) in future generations.¹²

Health inequalities should be understood and addressed regardless of whether they are causally linked to income inequality. However, if the relationship were causal then widening health gaps would be a troubling social cost of rising income inequality, and income redistribution could be an important policy lever to improve population health.

Rising income inequality could cause increasing health inequalities through two separate channels. First, divergence in incomes might lead mechanically to

divergence in health (by income) due to a direct causal relationship between individual-level income and health.^{17–19} Second, income inequality might also have an indirect effect on health—eg, by strengthening the political power of the wealthy with a resulting shift in policy priorities^{20,21} or via changes in social capital²² (the shared connections and values between people that encourage advantageous cooperation) or social cohesion.²³ Studies of inequality and health have not found a consistent indirect effect of inequality on aggregate health outcomes; however, this literature is contested.^{24,25} Still, the largest rise in income inequality since the Great Depression offers a case study to investigate how, if at all, changes in income distribution might be linked to inequalities in health.

In this review, we synthesise evidence on trends in income-related and education-related survival inequalities, and discuss proximate and distal mechanisms that might explain these trends.

Growing gaps in survival by income: a review

Absolute gaps in survival between rich and poor have grown over the past 40 years (table, figure 2; see appendix for a complete list of studies reviewed), with nearly all studies reviewed reporting increases in health inequalities regardless of choice of socioeconomic status measure (income vs education), choice of outcome (mortality rates vs life expectancy), and time period covered. Increases in survival inequalities were qualitatively large, with life expectancy gaps between high and low socioeconomic status groups growing by 1–2 years and even more in some demographic groups. With a few exceptions, the smallest absolute increases in survival gaps were observed in non-elderly populations with lower baseline mortality and in fact represented large relative increases in health inequalities (table).^{26,33,35}

In addition to general agreement across studies that health inequalities have widened, three noteworthy patterns emerged. First, we noted consistent differences by gender. Baseline survival gaps were generally larger among men than among women; yet the growth in survival gaps among women was equal to—or exceeded—the growth in survival gaps among men, with the result that health inequalities increased much faster for women than for men in relative terms. Second, life expectancy actually fell in some categories, particularly in white women with low income or educational attainment.^{29,31,32} Evidence on survival trends in black women with low socioeconomic status was mixed and more limited.^{29,31} Survival gaps did not increase among Hispanic Americans.³¹ Third, studies that assessed mortality experiences across birth cohorts, rather than differences across periods, reported much larger increases in survival disparities.^{7,27} This finding is to be expected: if cohort life expectancy is increasing over time, then period life expectancy, which averages across cohorts, will underestimate those increases. Cohort measures involve

projections of survival patterns at older ages and thus contain substantial uncertainty. At the same time, the period measures reported in most studies might substantially underestimate the actual growth in socioeconomic status-related health inequalities from one generation to the next.

Several studies documented widening survival gaps by income levels. Cristia²⁶ linked data from the Survey of Income and Program Participation to tax and Social Security records and assessed trends in survival across quintiles of long-run earnings, comparing an early period centred at 1990 and a later period centred at 2000. Life expectancy between 35 and 75 years of age increased for wealthy men and women, but did not change for poor men and actually declined for poor women (table). The top-to-bottom life expectancy differential across income quintiles increased from 2·7 to 3·6 years for men and 0·7 to 1·5 years for women. Cristia further reports that the ratio of mortality in poor versus rich Americans approximately doubled for 35–64 year olds, with smaller increases among 65–75 year olds.²⁶ Cristia's findings are consistent with those of Krieger and colleagues³⁵ and Singh and Siahpush,³⁶ who found widening survival gaps during the 1980s and 1990s by county-level income and deprivation measures.

Income-based survival gaps continued to widen in the 2000s. Chetty and colleagues⁶ linked income tax records to survival information collected by the Social Security system. Between 2001 and 2014, the life expectancy gradient across income quantiles became noticeably steeper (table). Men and women in the poorest 5% of households experienced close to zero net increase in life expectancy during this period, whereas women in the top half of the income distribution—and men in the top quarter of the distribution—gained more than 2·5 years of life expectancy (figure 3).⁶ The sharpest divergence in longevity occurred between poor and upper-middle-income Americans. We found no change in the survival gap between upper-middle-income and high-income Americans.

We note that although health inequalities widened specifically among lower-income and middle-income Americans during the period 2001–14, a very strong gradient remained between income percentile and health throughout the income distribution, with no evidence of a threshold effect; the differences in life expectancy between the wealthiest 1% and poorest 1% were 14·6 years for men and 10·1 years for women. The importance of income across the full distribution echoes findings from other individual-level studies, most famously the Whitehall study³ of British civil servants.

A strength of Chetty and colleagues' and Cristia's approach is that they adjust for changing composition by assessing survival trends within income quantiles, rather than levels. This technique reduces the potential for selection bias that emerges when the proportion of the population in different socioeconomic status categories shifts over time. At the same time, health trends by income quantile might reflect both changes in income

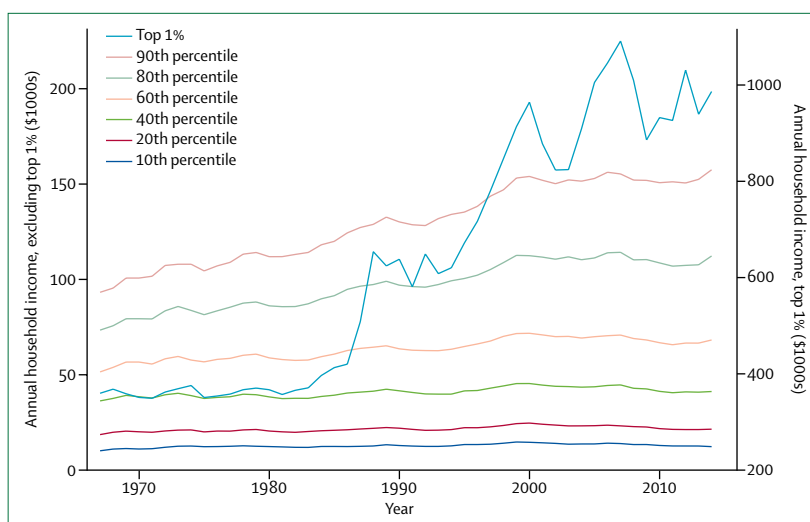


Figure 1: Inflation-adjusted annual household income at selected percentiles, 1967–2014

All series show percentiles of the distribution except for top 1%, which shows the mean of the top 1%. All income series except for the top 1% are plotted against the left vertical axis, displaying incomes from \$0 to \$200 000. The top 1% is plotted against the right vertical axis, displaying incomes from \$200 000 to \$1 000 000. Data are from the US Census Bureau Current Population Survey, 1968–2015 Annual Social and Economic Supplements and World Wealth and Income Database. Income is expressed in 2014 US\$.

for a given quantile as well as changes in the relationship between income and health (panel 1).

A natural question is whether the expansion of health inequalities across income quantiles is simply a mechanical result of rising income inequality. If the relationship between income and survival were held constant, increased dispersion in the earnings distribution would be expected to lead to growing gaps in survival as the average incomes of the top and bottom quantiles diverge. The alternative (and perhaps complementary) hypothesis is that health inequalities across income quantiles might have widened because the relationship between actual income levels and health (ie, the slope of the gradient) has changed over time.

To shed light on the contribution of distribution changes versus slope changes, we decomposed the quantile-based results from Chetty and colleagues⁶ using their supplementary data (figure 4). We found that both of these explanations have played a part in widening health inequalities. Since 2001, annual inflation-adjusted household earnings have fallen for Americans in the bottom two thirds of the income distribution (figure 4), with the largest relative losses experienced in the lower part of the income distribution. From 2001 to 2014, earnings fell by 17% for men and women in households at the 25th income percentile. Americans at the top of the distribution experienced much smaller (or non-existent) relative losses. The decline in incomes among lower-earners and moderate-earners is a new trend since 2000, reversing—and erasing—previous earnings gains during the 1990s (figure 1).

Falling incomes among poor Americans were one explanation for the divergence of life expectancy across

For results of the US Census Bureau Current Population Survey see <http://www.census.gov/programs-surveys/cps.html>

For more on the World Wealth and Income Database see <http://wid.world>

For more on the data compiled by Chetty and colleagues see <https://healthinequality.org>

	Age (years)	Socioeconomic groups compared	Early year	Late year	Adjusts for changes in composition	Measure of survival (units)	Change in survival, low SES	Change in survival, high SES	Survival gap, early year	Survival gap, late year	Absolute change in survival gap (percent change)
Income											
Cristia (2009) ²⁶											
Men	35–75	1st vs 5th quintile	1983	2003	Yes	Period life expectancy (years)	0.0	0.9	2.7	3.6	0.9 (33%)
Women	35–75	1st vs 5th quintile	1983	2003	Yes	Period life expectancy (years)	–0.4	0.4	0.7	1.5	0.8 (114%)
Chetty et al (2016) ⁶											
Men	≥40	1st vs 4th quartile	2001	2014	Yes	Period life expectancy (years)	1.0	2.6	8.4	10.0	1.6 (19%)
Women	≥40	1st vs 4th quartile	2001	2014	Yes	Period life expectancy (years)	1.3	3.0	4.5	6.2	1.7 (38%)
Men	≥40	1st vs 20th ventile	2001	2014	Yes	Period life expectancy (years)	0.3	2.3	11.5	13.5	2.0 (17%)
Women	≥40	1st vs 20th ventile	2001	2014	Yes	Period life expectancy (years)	0.0	2.9	6.3	9.1	2.9 (44%)
Waldron (2007) ²⁷											
Men	≥65	Top vs bottom half	1912 cohort	1941 cohort	Yes	Cohort life expectancy (years)	1.3	6.0	0.7	5.4	4.7 (671%)
NAS (2015) ⁷											
Men	≥50	1st vs 5th quintile	1930 cohort	1960 cohort	Yes	Cohort life expectancy (years)	–0.5	7.1	5.1	12.7	7.6 (149%)
Women	≥50	1st vs 5th quintile	1930 cohort	1960 cohort	Yes	Cohort life expectancy (years)	–4.0	5.7	3.9	13.6	9.7 (249%)
Education*											
Ho and Fenelon (2015) ²⁸											
White men	≥50	≤High school vs university	1980	2006	No	Period life expectancy (years)	4.3	5.4	4.3	5.4	1.1 (26%)
White women	≥50	≤High school vs university	1980	2006	No	Period life expectancy (years)	2.4	4.5	2.5	4.6	2.1 (84%)
Meara et al (2008) ²⁹											
All	≥25	≤High school vs university	1990	2000	Yes	Period life expectancy (years)	0.0	1.6	5.4	7.0	1.6 (30%)
White men	≥25	≤High school vs university	1990	2000	Yes	Period life expectancy (years)	0.2	1.8	6.2	7.8	1.6 (26%)
Black men	≥25	≤High school vs university	1990	2000	Yes	Period life expectancy (years)	2.0	3.3	7.1	8.4	1.3 (18%)
White women	≥25	≤High school vs university	1990	2000	Yes	Period life expectancy (years)	–0.9	1.0	3.5	5.4	1.9 (54%)
Black women	≥25	≤High school vs university	1990	2000	Yes	Period life expectancy (years)	–0.2	1.6	3.6	5.4	1.8 (50%)
Hendi (2015) ³⁰											
White men	25–85	<High school vs university	1991	2005	Yes	Period life expectancy (years)	1.6	1.8	6.7	6.8	0.1 (1%)
White women	25–85	<High school vs university	1991	2005	Yes	Period life expectancy (years)	–0.7	1.5	3.8	6.0	2.2 (58%)
Olshansky et al (2012) ³¹											
All men	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	..	..	13.4	14.2	0.8 (6%)
White men	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	–3.4	4.6	5.1	13.2	8.1 (159%)
Black men	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	3.2	4.6	6.3	10.1	3.8 (60%)
Hispanic men	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	6.4	6.4	5.5	5.5	0 (0%)

(Table continues on next page)

	Age (years)	Socioeconomic groups compared	Early year	Late year	Adjusts for changes in composition	Measure of survival (units)	Change in survival, low SES	Change in survival, high SES	Survival gap, early year	Survival gap, late year	Absolute change in survival gap (percent change)
(Continued from previous page)											
All women	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	..	..	7·7	10·3	2·6 (34%)
White women	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	-5·3	3·3	1·9	10·5	8·6 (453%)
Black women	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	0·1	4·9	2·0	6·6	4·6 (230%)
Hispanic women	≥25	<High school vs university	1990	2008	No	Period life expectancy (years)	3·2	2·6	3·6	3·0	-0·6 (-17%)
Montez and Berkman (2014) ³²											
Men	45-84	<High school vs university	1986	2006	No	All-cause mortality (deaths per 1000 person-years)	-3·30	-2·50	32·30	31·50	-0·80 (-2%)
Women	45-84	<High school vs university	1986	2006	No	All-cause mortality (deaths per 1000 person-years)	4·90	-0·70	16·90	22·50	0·60 (33%)
Ma et al (2012) ³³											
Men	25-64	≤High school vs university	1993	2007	No	All-cause mortality (deaths per 1000 person-years)	-0·38	-0·96	4·16	4·73	0·57 (14%)
Women	25-64	≤High school vs university	1993	2007	No	All-cause mortality (deaths per 1000 person-years)	0·39	-0·52	1·65	2·56	0·91 (55%)
Case and Deaton (2015) ³⁴											
Women	45-54	≤High school vs university	1999	2013	No	All-cause mortality (deaths per 1000 person-years)	1·34	-0·57	..	..	1·91 (-)
County socioeconomic conditions											
Krieger et al (2008) ³⁵											
All	<65	1st vs 5th quintile, county income	1980	2000	No	All-cause mortality (deaths per 1000 person-years)	-0·67	-0·87	0·85	1·05	0·20 (24%)
White	<65	1st vs 5th quintile, county income	1980	2000	No	All-cause mortality (deaths per 1000 person-years)	-0·53	-0·84	0·56	0·87	0·31 (55%)
Non-white	<65	1st vs 5th quintile, county income	1980	2000	No	All-cause mortality (deaths per 1000 person-years)	-1·47	-1·42	1·82	1·77	-0·05 (-3%)
Singh and Siahpush (2006) ³⁶											
All	≥0	1st vs 10th decile, county deprivation	1980	2000	No	Period life expectancy (years)	1·7	3·4	2·8	4·5	1·7 (61%)
Men	≥0	1st vs 10th decile, county deprivation	1980	2000	No	Period life expectancy (years)	2·8	4·4	3·8	5·4	1·6 (42%)
Women	≥0	1st vs 10th decile, county deprivation	1980	2000	No	Period life expectancy (years)	0·5	2·5	1·3	3·3	2·0 (154%)
Results of all studies identified that assessed time trends in absolute survival gaps by income and education. Studies that adjusted for changes in composition accounted in some way for changing population shares across SES categories. We report absolute changes in survival over time in high-SES and low-SES groups, to highlight differences in the evolution of mortality patterns within groups. We report survival gaps ³⁷ between high-SES and low-SES groups in the early period and the late period (early year and late year are the first and last years respectively of the early and late periods compared) to capture how health inequalities have changed. We present the absolute change in survival gaps, a difference-in-differences type measure, to establish whether health inequalities are growing. Widening survival gaps are reflected as positive changes, and are presented in the units of the outcome (years for life expectancy; deaths per 1000 person-years for mortality rates). The percent change in survival gaps enables comparison across different outcomes; however, important differences across the studies in measures and methods used make direct comparisons difficult. SES=socioeconomic status. NAS=National Academies of Sciences, Engineering, and Medicine. *University education refers to undergraduate studies.											
Table: Changes in survival gaps by income, education, and county socioeconomic conditions, 1980-2014											

income quantiles since 2001 (figure 3); but they were not the only—and indeed not the primary—explanation. When the income–health gradient was held constant at its 2001 slope, changes in income distribution explained only about one third of the increase in the top versus bottom quartile life expectancy gap in men and about one sixth of the increase in women. More importantly, the income–survival gradient changed as well, becoming substantially stronger over time (figure 4). In 2001, female life expectancy was on average 1·7 years higher for every log-

point of income; by 2014, the gradient had increased to 2·4 years per log-point. (Incomes increase by a factor of 2·7 for every log-point—eg, from US\$22 000 to \$60 000 to \$163 000.) In men, the gradient increased from 3·2 years per log-point in 2001 to 3·7 years per log-point in 2014. The gradient for women is clearly steeper in the later period (figure 4). In men, the change in slope—although similar in absolute magnitude—is more difficult to see because the baseline gradient was steeper and non-linear (figure 4).

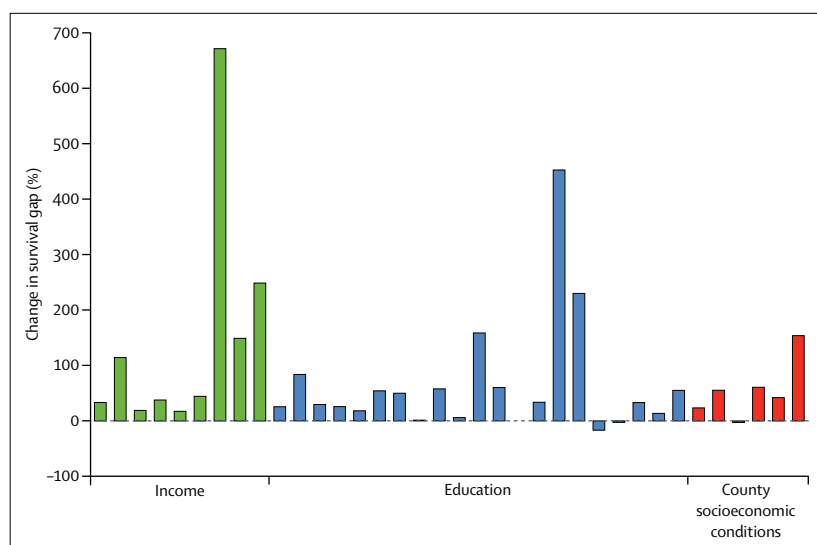


Figure 2: Percent changes in survival gaps, 1980–2014

Chart shows percent changes in income, education, and county socioeconomic condition-related survival gaps reported in the literature reviewed. Each bar represents a row in the table. The vast majority of studies reported widening survival gaps.

For more on the **Health and Retirement Study** see <http://hrsonline.isr.umich.edu>

Changes in the income–survival gradient differed across the income distribution. The life expectancy gradient increased sharply in households earning less than \$60 000 per year, with the slope rising by 37% in men (from 2.5 to 3.4 years per log-point of income) and 77% in women (from 1.4 to 2.5 years per log-point). However, the gradient did not change for men and women in households earning over \$60 000 per year (figure 4).

In summary, the divergence of life expectancy for poor and middle-income Americans since 2001 (figure 3) reflects both changes in income distribution and a rise in gradient between income and health, with the latter a more important factor. Both distribution changes and slope changes were non-linear and specifically disadvantaged the poor (figure 4). From 2001 to 2014, poverty deepened in the USA; at the same time, poverty emerged as an increasingly important risk factor for mortality in American adults.

The studies discussed above presented period (ie, repeated cross-sectional) estimates of survival which might underestimate—or overestimate—changes in survival gaps across actual birth cohorts. A cohort perspective has the advantage of capturing a population's full exposure and health history from childhood, mapping health more closely to lived experiences (panel 1). The challenge in assessment of trends across birth cohorts is that age-specific mortality rates can be definitively known only for those ages observed. Cohort life expectancy estimates have to be projected from models unless all members of the birth cohort have died.

Waldron²⁷ used Social Security data on lifetime income and mortality to assess age-specific mortality rates of men with incomes above and below the median for cohorts born between 1912 and 1941 (who reached

60 years of age between 1972 and 1998). The relationship between income and age-specific mortality strengthened across birth cohorts (figure 5). Although the relationship between income and mortality could be expected to be attenuated at older ages because of survivorship bias, income-related mortality odds ratios rose across birth cohorts for all age groups observed. Based on projected future trends in age-specific mortality rates, Waldron²⁷ estimated that the gap in male life expectancy at age 65 years between the top and bottom half of the income distribution increased from less than 1 year for men born in 1912 to more than 5 years for men born in 1941 (table).²⁷

Using similar calculations, a 2015 report⁷ by the National Academies of Sciences, Engineering, and Medicine (NAS) estimated survival curves for the 1930 and 1960 birth cohorts based on data from the Health and Retirement Study. Survival was assessed by quintile of long-run earnings (averaged from ages 41 to 50 years). The study⁷ projected that life expectancy at 50 years will stagnate for men in the poorest quintile and decline for women in the bottom two quintiles (figure 5). As a result, the gap in life expectancy at age 50 years between the top and bottom income quintiles was projected to increase from 5.1 years for men born in 1930 to 12.7 years for men born in 1960; the comparable figures for women were 3.9 years and 13.6 years. The gap in cohort life expectancy between the richest and poorest 20% of Americans is projected to increase by nearly a decade in a single generation.

Estimates of cohort life expectancy should be interpreted cautiously because old-age survival has not yet been observed in recent birth cohorts, necessitating extrapolation from mortality rates observed at younger ages; for example, the NAS study⁷ projected cohort life expectancy at age 50 years even though no members of the 1960 cohort had reached that age by end of follow-up. Nevertheless, these two cohort studies^{7,27} highlight the possibility that a slow-moving disaster might be unfolding for the health of lower-income Americans who entered the labour market after the post-World War 2 boom and have spent their working years in a period of rising income inequality. The inscrutability of trends in cohort life expectancy gaps while they are emerging should not lower our vigilance. Differences in mortality across birth cohorts can still be documented at younger ages (figure 5). More importantly, policies could potentially be designed that mitigate the very large survival deficits emerging for recent cohorts of lower-income Americans (figure 5).

Growing gaps in survival by education: a review

Survival gaps by educational attainment have also widened in the past three decades.^{28–34,44–54} Although estimates differ depending on groups compared, time period analysed, ages at which mortality was assessed, and whether studies adjusted for composition changes,

Panel 1: Challenges in measuring trends in health inequalities

Studies differed with respect to data sources, indicators of socioeconomic status and health, and statistical measures used to summarise health inequalities.

Data sources

Studies have used three types of data: (1) nationally representative population-based surveys such as the National Health Interview Survey and National Longitudinal Mortality Study, which collect self-reported education and income data at a single point in time and have been linked to subsequent national death records;^{29,30} (2) income histories from individuals' tax records that have been linked with death records maintained by the Social Security system;^{6,7,26,27,38} and (3) US death certificates, which have included information on educational attainment since 1989, and can be combined with Census data to enable assessment of survival trends by education.^{31,33,34} Long-run trends dating to 1960 have been analysed using county-based measures of socioeconomic status.^{35,36,39}

Measures of socioeconomic status

Studies have used income, education, and area-based measures—each of which has its limitations. Incomes vary across the life course. Earnings measured at a single point in time might be a poor reflection of lifetime earnings, particularly for retirees, and are subject to random fluctuations which attenuate the relationship between socioeconomic status and health. Health shocks can also negatively affect earnings,⁴⁰ inflating the cross-sectional association between income and health.

Measurement of socioeconomic status by educational attainment overcomes some of these limitations, because schooling is largely determined by age 25 years and does not fluctuate. However, the coarseness of education data can make inferences difficult. For example, no clear ordinal ranking for post-university education exists, so most studies lump together all university graduates. Simply counting years of schooling ignores important variation in the quality of education that might be associated with both earnings and health. Self-reported income and education data are also subject to reporting biases, which could be substantial.⁴¹ A key threat to validity is compositional change within education categories over time. In 1920, failure to complete high school was common among people who might today be considered as middle class; over time, it has become a marker of very low socioeconomic status. Hence, analyses that use a static measure of educational attainment to indicate socioeconomic status might find a decline over time in life expectancy, even if no real change in socioeconomic status-based differences in survival has occurred.⁴² Researchers have addressed this issue by randomly reallocating people across education categories to equalise the distribution of educational attainment across time periods.^{27,29,30,43} Unfortunately, this approach is not guaranteed to eliminate bias.

To overcome these limitations, studies have increasingly analysed income as observed in tax records or Social Security data.^{5,7,26,27} Such data reduce reporting bias and can be averaged across many years to minimise the effects of year-to-year variation. A so-called washout period (eg, 2 years) can be included to reduce the influence of reverse causality from health shocks. Perhaps most importantly, health outcomes can be assessed across quantiles of the income distribution, avoiding the compositional complications of educational attainment or fixed income brackets. To the extent that a person's rank in the income distribution reflects unobserved factors that might be correlated with health, assessment of secular trends within income quantiles holds these factors constant. At the same time, health trends for specific income quantiles might reflect both changes in income for that quantile as well as changes in the relationship between income and health.

Measures of health and longevity

Studies assessing trends in survival have made different choices regarding the age groups included—eg, 25–65 years,³⁵ 35–75 years,²⁶ 40–76 years,⁶ and 50 years and older.⁷ Due to differences in age-specific mortality rates, these choices can substantially influence results. Typically, the association between low socioeconomic status and mortality is strongest on a relative scale at younger ages, but absolute differences are greatest at older ages when background mortality is higher. Most studies report age-standardised or age-adjusted mortality rates. Many report period life expectancy, combining age-specific mortality rates to create a period survival curve from which life expectancy can be estimated.

Period versus cohort measures

Period survival measures (eg, life expectancy in 2015) are the basis for international comparisons and are useful to identify the effect of exposures that simultaneously affect people of all ages, such as famine. However, period measures might miss important transformations in the risk faced by different birth cohorts—for example, AIDS caused particularly high death rates among people who were sexually active during the first decades of the epidemic.

Several studies compared survival across different birth cohorts rather than across different periods.^{7,44–47} Although cohort approaches more accurately describe the fate of specific populations, the full cohort survival curve can only be assessed after all members have died. Hence, only trends in non-elderly mortality are observed for recent birth cohorts.²⁷ Cohort life expectancy can be projected by extrapolating current survival patterns and imputing future age-specific mortality rates,^{7,27} but such estimates should be interpreted with caution, as they are projections of future events rather than observed estimates.

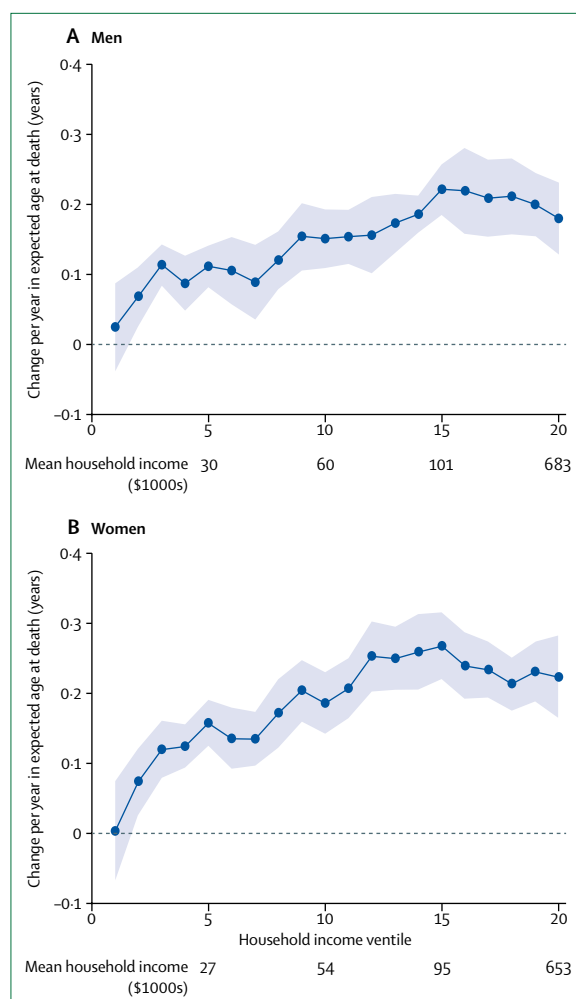


Figure 3: Changes in life expectancy across the income distribution, 2001–14
Figure shows average annual change in life expectancy by household income ventile. Shaded areas show 95% CIs. Reproduced from Chetty et al,⁶ by permission of the American Medical Association.

the studies we reviewed were broadly consistent in pointing to widening survival inequalities by educational attainment (table, appendix).

Combining data from death certificates and US Census data, Olshansky and colleagues³¹ compared period life expectancy at age 25 years for Americans with a university education (undergraduate; ≥ 16 years of education) versus Americans with less than a high-school education (< 12 years of education; table). From 1990 to 2008, education-related life expectancy gaps increased by 0.8 years for men and 2.6 years for women. Trends varied by race ethnicity, with life expectancy gaps widening by more than 8 years among white people, about 4 years among black people, and holding steady among Hispanic people. During the 1990s and early 2000s, life expectancy outright declined by 5.3 years for women and 3.4 years for men among white people with fewer than 12 years of schooling.³¹

Using a smaller sample enabling analysis of trends beginning in 1980, Ho and Fenelon²⁸ compared life expectancy at age 50 years for white university-educated (≥ 16 years of education) Americans versus white Americans with a high-school education or less (≤ 12 years of education; table). Between 1980 and 2006, the gap in life expectancy increased by 1.1 years (26%) for men and 2.1 years (84%) for women.²⁸

Several other studies reported education-specific trends in mortality rates that were consistent with these findings. Ma and colleagues³³ assessed trends in age-standardised premature mortality (ages 25–64 years) from 1993 to 2007, by educational attainment (0–12 years of education, 13–15 years, and ≥ 16 years) as reported in death certificates. Premature mortality fell by 34% for men with a university education and by just 5% for men with a high-school education or less. For university-educated women, premature mortality fell by 29%, but increased by 11% in women with 12 years of schooling or fewer.³³ The difference in mortality risk associated with low (vs high) education increased by 14% in men and 55% in women (table).³³ Focusing on white Americans aged 45–84 years, Montez and Berkman³² found that between 1986 and 2006, age-standardised mortality fell by 22% among university-educated men and by 8% among men with fewer than 12 years of schooling; mortality fell by 11% in university-educated women but increased by 21% in women with fewer than 12 years of schooling. Case and Deaton³⁴ and Cutler and colleagues⁵⁴ also report widening gaps in mortality rates by educational attainment.

Changes in the composition of education groups (eg, the shrinking proportion of Americans failing to complete high school) might confound analyses of trends in education-based health inequalities (panel 1).³⁰ Studies correcting for composition shifts have nonetheless found growing gaps. Meara and colleagues²⁹ found that between 1990 and 2000, mortality at ages 25–84 years fell for people with at least some university education, but not for those without higher education; the education gap in life expectancy at age 25 years increased by 1.6 years (table). Adjusting for composition, Hendi³⁰ found that the gap in life expectancy between white women who completed university and those that did not complete high school increased by 2.2 years from 1991 to 2005; however, the gap for white men rose by only 0.1 years (table). Life expectancy declined by 0.7 years for white women with fewer than 12 years of schooling.³⁰ Although changes in composition played a role—explaining 26% of the widening gap in women and 87% of the widening gap in men by one estimate³⁰—the studies^{29,30,52} reviewed nevertheless found consistent evidence of widening survival inequalities, even after adjustment for composition.

Several studies have assessed the education–survival gradient across successive birth cohorts, rather than time periods.^{44–47} Masters and colleagues⁴⁵ found that the widening gap in mortality across education groups

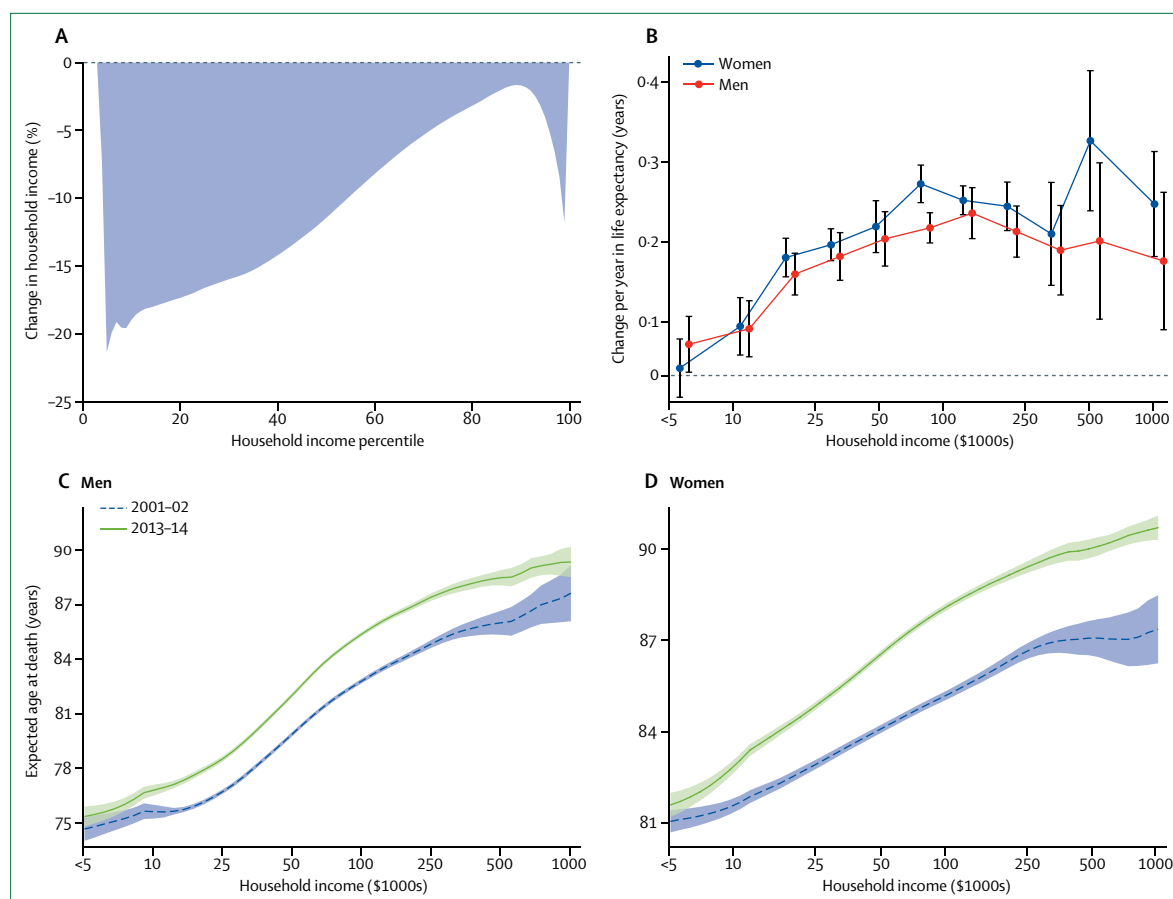


Figure 4: Decomposition of trends: changes in life expectancy across the income distribution, 2001–14

Graphs show (A) percentage change in household income from 2001 to 2014, by income percentile, for men (similar trends were observed for women); (B) the average annual change in life expectancy by household income category over the period 2001–14 (whereas figure 3 shows changes by income percentile); and the income–life expectancy gradient in 2001–02 and 2013–14 for men (C) and women (D), shown as a kernel-weighted moving average. Household income is expressed in 2012 US\$, based on US tax records, and is presented on a log scale. In (B), income categories were defined in 0.5 log-point bins: 8.5, 9.0, 9.5, ..., 14.0; male datapoints are offset for visualisation purposes. Differential changes in life expectancy by income percentile were the result of both (A) falling incomes among the poor and (B–D) a steeper gradient between income and life expectancy. Data are from Chetty et al.⁶

was attributable entirely to cohort rather than period exposures, consistent with the theory that trends in survival inequalities are driven primarily by differences across—rather than within—individuals.⁴⁵ The gains in survival enjoyed by white men and women with at least a high-school education were not experienced by black men and women, suggesting that the health benefits of education might be modified by factors associated with race and ethnicity.⁴⁵ Studies by Everett and colleagues⁴⁴ and Krueger and colleagues⁴⁷ also identified increased education–mortality hazard ratios in more recent cohorts. A challenge in these studies is that more recent birth cohorts are observed only at younger ages when the education–mortality gradient is typically strongest (eg, figure 5); separation of cohort effects from age-related effect modification in a regression context without additional assumptions is difficult.

Taken as a whole, the literature suggests a pattern of widening gaps in survival across income and education

groups (table, figure 2, appendix). The trends identified have origins that precede 1980. Studies have identified widening survival gaps in earlier decades not covered by our literature search. Among white men aged 25–64 years, the mortality rate ratio between the top and bottom income categories rose from 1.8 in 1960⁵⁵ to 2.2 in 1973–78.⁵⁶ A study⁵⁷ comparing 1960 and 1986 mortality rates by income and education found a similar pattern. By contrast, a study³⁵ of non-elderly mortality by county income quintile identified narrowing survival inequalities between the mid-1960s and 1980. Consolidation of a longer, internally comparable individual-level time-series and decomposition into longer-run trends are important avenues for future research.

Finally, education and income levels are not simply proxies for a single underlying construct. Rather, they are distinct factors that might be related to health in different ways and which, if causally related, would imply different interventions.

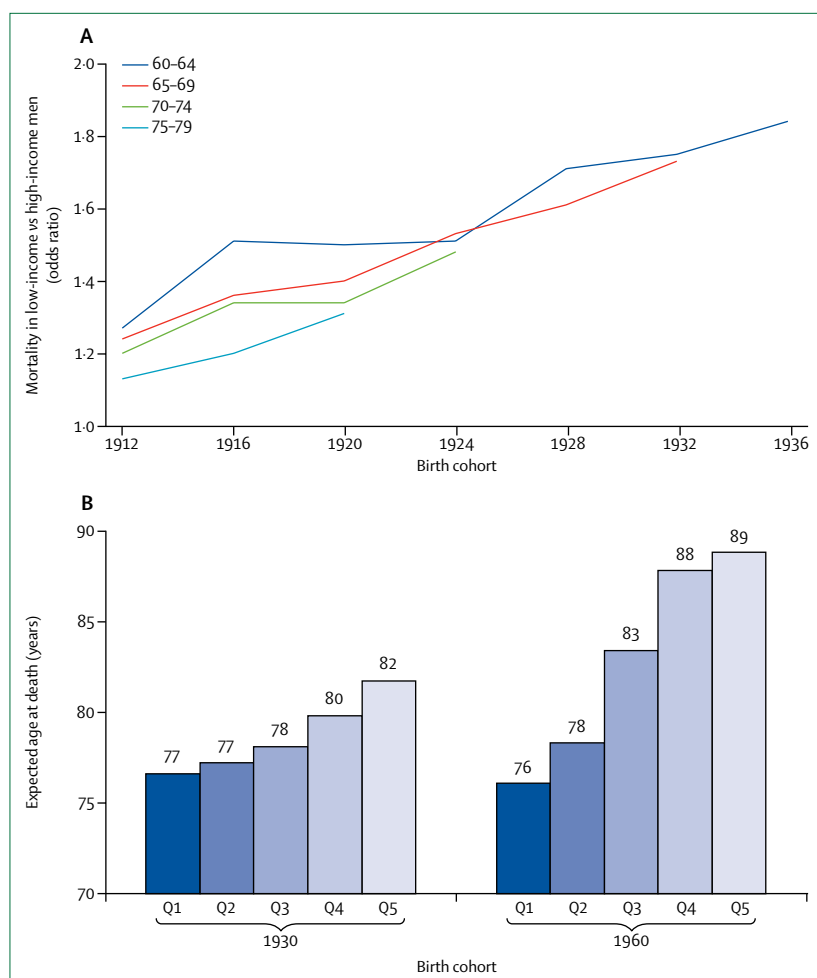


Figure 5: Widening income-related inequalities in survival across birth cohorts

(A) Excess mortality (odds ratio) associated with lifetime income in the lower (vs upper) 50% of the income distribution is shown at different ages for men born in 1912–38. Birth cohorts were grouped into 3-year intervals; the start of the interval is labelled on the horizontal axis. The association between income and mortality increased across birth cohorts for all observed age groups. Data are from Waldron (2007).²⁷ (B) The projected life expectancy at age 50 is shown for 1930 and 1960 birth cohorts, by income quintile—Q1 (poorest) to Q5 (richest). Life expectancy is displayed as expected age at death, conditional on reaching age 50. Estimates for 1930 cohort are based on observed and projected age-specific mortality rates; estimates for 1960 cohort are based entirely on projections. Underlying data for these projections come from the Health and Retirement Study. Projections presented are for men; similar divergence in life expectancy by income was projected for female birth cohorts. Cohort life expectancy for the bottom two quintiles of the 1930 birth cohort was 76.6 years (Q1) and 77.2 years (Q2). Data are from the National Academies of Sciences, Engineering, and Medicine study.⁷

Education is a causal determinant of both earnings and health,^{58,59} and evidence suggests that both of these relationships have strengthened over time. Economic returns to higher education have increased in the past 40 years, due to a phenomenon described by economists as skill-biased technical change.⁶⁰ New technologies, chiefly the rise of computers in the office and factory floor, have increased the wage returns to education-related expertise, while reducing demand for less skilled clerical labour. Divergence in earnings across education groups is one reason for the growth in income inequality and might be the cause of growing health inequalities. At the same time, the relationship between education and

health might be increasing over time for reasons independent of changes in the labour market value of education. Increases in education might have facilitated the adoption of and adherence to healthful behaviours, such as condom use,⁶¹ smoking cessation,⁶² and medication compliance,⁶³ as new health information and interventions have become available.⁶⁴ Studies of the so-called sheepskin effect—the benefits of receiving a diploma over and above the effect of a single year of schooling—suggest that both labour market and non-labour market factors might explain the growing association between education and survival.⁵¹ Another possibility is that education, income, and survival are all consequences of in-utero and childhood health exposures (which in turn bear the imprint of early-life socioeconomic circumstance).^{65,66}

With these comments on the relationship between income, education, and health, we now turn to the evidence for different mechanisms. Why have socioeconomic differences in health widened during the past 40 years? We consider specific causes of death and individual-level risk behaviours, often described as proximate causes, as well as more fundamental or distal causes that might give rise to changes in the distribution of specific risk factors and in turn to widening health gaps.⁶⁷

Proximate factors mediating widening health gaps

Evidence on mechanisms for widening health gaps comes from cause-specific mortality data—available from death certificates—and studies on the evolution of individual-level risk factors across different socioeconomic groups.

A leading hypothesis is that widening mortality gaps result from differential trends in individual-level risk factors. Research has focused on the triad of risk factors central to clinical recommendations for the prevention and control of cardiovascular and metabolic disease in the USA: do not smoke, maintain a healthy weight, and adhere to prescribed medication.^{63,64} Smoking prevalence has fallen much faster among well-educated and higher-income Americans than among lower socioeconomic status Americans,²⁸ leading to the emergence of substantial differences in the burden of smoking-related disease.^{28,54} A similar phenomenon is emerging with obesity.⁶⁸ But how much of the widening survival gap do these risk factors explain?

Trends in causes of death provide some insight. Across birth cohorts, education gaps in heart disease and lung cancer mortality increased, but gaps did not widen for non-preventable cancers, suggesting the importance of changes in modifiable risk factors and use of medical care.⁴⁵ Between 1968 and 1998, male cardiovascular mortality declined faster in high-socioeconomic status counties than in low-socioeconomic status counties.³⁶ The absolute gap in diabetes mortality between university graduates and people with a high-school education or

less increased from 1993 to 2007.³³ Mortality due to heart disease, stroke, and cancer declined in all education groups, yet absolute differences between groups remained approximately constant, thus increasing relative differences.³³ Among white women without a high-school education, mortality from smoking-related causes (including lung cancer and chronic lower respiratory disease), diabetes, and Alzheimer's disease increased between 1986 and 2006, accounting for much of the divergence in mortality in this category relative to higher education groups.⁶⁹

Further evidence can be found from trends in risk behaviours. Smoking patterns have diverged, with an increasing burden among people with the least education.²⁸ However, one study⁵⁴ found that divergent smoking rates were not sufficient to explain the widening mortality gap. Another study²⁸ found that smoking trends explained 25–50% of the growth in the life expectancy gap across education groups for women, but did not contribute to widening survival gaps in men. Additionally, at the county level, increases in the association between mortality and county income from 1980 to 2002 were attributed in part to changes in mortality unrelated to smoking.^{35,39} Among adults, trends in obesity and management of hypertension and cholesterol have been similar across education groups over time, suggesting that these factors do not substantially mediate the changes in survival inequalities. Furthermore, the education–mortality gradient increased over time—even after adjusting for these individual-level risk factors.⁵⁴ In sum, differential smoking trends by socioeconomic status are an important part of the explanation, but do not tell the whole story. Obesity has not contributed substantially to historical trends, although it might lead to future gaps in survival.⁷⁰

Substance abuse and addiction might also be contributing to widening health inequalities. Ma and colleagues' 2012 analysis³³ of premature deaths in 26 states between 1993 and 2007 concluded that the differential increase in accidental deaths for people with 12 years of schooling or fewer (relative to university graduates) was responsible for 23% of the total increase in the all-cause-mortality gap among women and 49% of the total increase among men. Many of these deaths were attributable to poisoning by prescription drugs, presumably mostly opioids.

Case and Deaton³⁴ found that between 1999 and 2013, all-cause mortality in the USA among white, non-Hispanic adults aged 45–54 years fell from 235·1 to 178·1 deaths per 100 000 person-years in university-educated adults, but increased from 601·4 to 735·8 deaths per 100 000 person-years in those without higher education—a 52% increase in the education-based mortality gradient in just 14 years.³⁴ During this period, deaths from poisonings increased by four times, leap-frogging deaths due to lung cancer in this age group. The increase in deaths from poisonings, suicide, and liver disease (plausibly intravenous drug-

related or alcohol-related) together accounted for half of the total increase in mortality in adults with a high-school education or less.³⁴

Because abuse of alcohol and of prescription or illicit drugs and self-harm behaviours affect morbidity as well as mortality, these mortality trends are probably only the most visible signal of larger trends in chronic physical pain, mental illness, and addiction. Indeed, Case and Deaton³⁴ note very large increases in poor physical health days (28%), poor mental health days (25%), and the proportion of people unable to work because of disability (49%) among middle-aged white adults. The rise in adverse coping behaviours among Americans of low socioeconomic status—namely, abuse of controlled substances including tobacco, alcohol, and prescription drugs, as well as self-harm—should thus be seen in the context of growing epidemics of disability, chronic pain, and multiple morbidity⁷¹ amidst shrinking capacities to cope.⁷²

Rising mortality due to adverse coping behaviours explains a substantial portion of the divergence in survival chances for low-income and poorly educated Americans since the 1990s.

Distal mechanisms for widening health gaps

Distal mechanisms that underlie changing health inequalities are difficult to pin down.⁵³ However, an exclusive focus on individual-level behaviour as a mechanism would miss the larger structural factors that might be driving these trends. We highlight several potential explanations for why health inequalities have increased in an era of rising income inequality: (1) differential adoption of technological innovations in medicine as well as non-medical health inputs (eg, information about complex health risks and preventive behaviours), with differences driven both by diffusion behaviour and by cost barriers; (2) increasing geographical segregation that creates inequalities in access to salutary health amenities; (3) reduced economic mobility leading to increased persistence of poverty for low-income Americans; (4) the repercussions of rising incarceration rates; and (5) the erosion of public subsidies for health insurance and other health inputs, and increasing exposure to market prices. These distal hypotheses are not intended to be exhaustive. However, they highlight potential reasons for the changing relationship between income and health at the bottom of the income distribution. Although a full investigation is beyond the scope of this paper, we note that several of these hypotheses could be linked indirectly to growing income inequality higher in the distribution and its effect on technological innovation, housing markets, economic opportunity, and political appetite for redistributive policies.

Innovations in medical care and new information on health risks might lead to widening health inequalities if high-income or well-educated Americans are the first to

adopt new healthful technologies and behaviours.⁶³ Health gaps might shrink as innovations fully diffuse, but could persist with continuous innovations. Several factors are at play here. First, education and income might improve people's ability to consider and incorporate new information on health risks (or prevention strategies) into their decision making, from smoking to medication adherence, leading to faster adoption.⁶⁴ Second, the non-health benefits of many risk behaviours—eg, the temporary relief of stress, pain, and hunger afforded by tobacco, opioids, and calorie-dense, nutrient-poor foods—might be valued more by low-income Americans who face more of these stressors. Third, if medical innovation increases the availability of effective but costly interventions (and if these interventions are not fully subsidised), then differences in ability to pay might lead to widening disparities in access. A similar argument applies to other health inputs, such as the increased availability of healthy, yet costly, food options. Fourth, not all innovation is healthful, and even health-promoting innovations such as pain relievers might be marketed for abuse. High-socioeconomic status Americans might have more options to mitigate exposure to new health risks.

The graded diffusion of health inputs by socioeconomic status is not new. For example, in the early 20th century, child mortality in the USA declined much faster among children of professionals than among children of labourers, with the discovery of germ theory and hand-washing information campaigns.⁷³ However, the importance of differential adoption has probably increased over time with the rapid growth in accurate health information and effective medical technologies and the relative importance of these innovations for health compared with earlier eras. Studies have attributed approximately half of all life expectancy gains since 1950 to medical innovations,⁷⁴ including statins,⁷⁵ antihypertensives,⁷⁶ and coronary care units,⁷⁷ with further gains attributable to changes in health risk behaviours such as smoking and diet spurred by the diffusion of new scientific knowledge.⁷⁷ Although many of these innovations pre-dated the period of study, the 1980s and 1990s were a period of rapid diffusion, with large declines in smoking prevalence and increases in use of medication to control cholesterol and hypertension. The implications for health inequalities depend on the nature of the innovation. New treatments for diabetes and HIV led to differential uptake by educational attainment that exacerbated inequalities.⁶³ However, classes of antihypertensives that simplified compliance led to widespread uptake and reduced usage gaps.^{78,79}

A second potential explanation for rising health inequalities is the increasing geographical segregation of high-income and low-income Americans, resulting in differential access to neighbourhood-level health amenities. Income segregation across school districts in the USA increased by 15% between 1990 and 2010, and within-district segregation across schools increased by 40%.⁸⁰ Factors contributing to rising segregation include

the increased concentration of economic growth in specific regions, the rise in housing prices during the 1990s and early 2000s, which has priced many Americans out of specific geographical housing and rental markets, and widening income inequality itself. Residential segregation might translate into health inequalities through a range of social and environmental exposures including crime, gun ownership, access to green space and supermarkets, air pollution, social capital, community norms, and local policies that affect population health. Several studies^{6,35,36,81} have identified rising inequalities in health across geographical units such as US counties, with richer counties pulling away from the rest.

A third possible pathway is the reduction in economic mobility for low-income Americans, which could lead to the hardening of class boundaries and to the persistence of poverty both within and across generations.^{82,83} Because current earnings are correlated with future earnings, rising income inequality implies even larger gaps in future income. Furthermore, this correlation might have increased over time with growing inequalities in returns to on-the-job experience in higher (vs lower) skilled occupations.⁸⁴ To the extent that health decisions are made with an eye to the future, increasingly bleak prospects for economic mobility might lead to reduced investment in health and divergence in health behaviours across income groups. Economic insecurity and vulnerability, including anxiety about the possibility of catastrophic health expenses,⁹ might also contribute to stress with direct health consequences.⁸⁵ The rising burden of disease associated with substance abuse and self-harm among low-income Americans might reflect lower future optimism and efforts to cope with stressors including economic vulnerability. In turn, disinvestments in health—including use of addictive substances—can reduce future productivity and earnings.⁸⁶ The rising epidemic of opioid addiction, as well as other adverse coping behaviours, might signal the emergence of a 21st century health-poverty trap, a negative feedback loop between poverty and poor health.

The wave of incarceration that began during the 1970s is a fourth possible mechanism underlying the widening health inequalities between the poor and middle class. As discussed in detail in a companion paper⁸⁷ a large proportion of poor men, especially black men, are current or former prisoners, and incarceration appears to inflict substantial economic and health damage on prisoners, their families, and their communities.⁸⁸

A final potential mechanism is the increased exposure of Americans to the prices of health inputs. Technological change has increased the armamentarium of effective medication and procedures. Concurrently, the proportion of medical costs covered by insurers has fallen over time, with rising deductibles and co-payments shifting more of the costs of care onto users. Although some economists and policy leaders have

promoted user fees as a way to dampen health-care cost growth, cost sharing—ie, passing more of the costs for a given service on to patients—discriminates by ability to pay. Since the early 2000s, health spending for wealthier Americans has soared, whereas expenditures have risen modestly for the middle class and actually fallen for those with low incomes.⁸⁹ Medical spending in the USA was historically highest among the poor, who have the greatest medical need and whose care is subsidised by Medicaid. However, the income-spending gradient has now reversed—a phenomenon known as the Inverse Care Law.⁹⁰ Although the health implications of greater cost sharing are not fully understood, cost sharing might possibly have led the poor to avoid needed services, which might have contributed to the widening health gap between poor and middle-income Americans. Whether the rising inequalities in medical spending will translate into even more divergent health outcomes is unknown. Impoverishing medical expenses⁹ could also lead to worse health outcomes—a health-poverty trap driven by medical cost. Price exposure to health inputs extends beyond medical care, to include healthy food, good childcare, safe neighbourhoods, and the wide range of social determinants of health that are—at least in part—priced in the market.

Exposure to prices of health care and other health inputs can be mitigated—and has been mitigated in the past—through public subsidies. For instance, in the early 20th century, massive improvements in the health of low-income Americans were achieved through control of infectious disease via publicly funded centralised water filtration and purification.⁹¹ Elites were willing to fund expensive water infrastructure and other public goods to avoid epidemics of typhoid and cholera that could spread to them.⁹² Although investments in the control of non-communicable diseases cannot be motivated by fear of contagion,⁹³ investments in the health of the poor might nevertheless be driven by political demands. On a global scale, demands for justice and equality led to the commitment to “health for all” at the 1978 International Conference on Primary Health Care in Alma Ata, Kazakhstan. In the USA, widespread mobilisation for social justice that coalesced during the Civil Rights Movement led to the introduction of Medicare⁹⁴ and Medicaid (the health insurance programme for the poor),⁹⁵ racial integration of hospitals,⁹⁶ public investments in community health centres,⁹⁷ early childhood investments such as Head Start,⁹⁸ and other Great Society and War on Poverty programmes. This ensemble of reforms led to mid-century gains in survival among poor Americans, especially black Americans. Comparison across high-income countries reveals evidence that social protection policies mediate the effect of macroeconomic fluctuations on health of the vulnerable—eg, reducing incidence of suicides.⁹⁹ Welfare-state expansions have been associated with life expectancy improvements and might explain, in

part, the large health gaps between the USA and Europe.¹⁰⁰ At the same time, health inequalities have persisted—and grown—even in the most redistributive northern European countries.¹⁰¹ Exploration of the effects of specific health and social policies on health inequalities is a key area for future research.

More recently, widespread dissatisfaction with the health-care financing system in the USA triggered passage of the Affordable Care Act. As discussed in detail in another paper¹⁰² in this Series, that legislation has reduced gaps in insurance coverage, although it remains to be seen whether the Affordable Care Act will stop the growth in income-related health inequalities. The future of the Affordable Care Act—and access to health insurance for millions of low-income Americans—is now in question with the transition in 2017 to a Republican-controlled government that has promised to dismantle the legislation.

Future areas of research

In light of existing literature, we highlight several important areas for future research on this topic in panel 2.

Panel 2: Areas for future research

- Further characterisation of the burden of disease associated with poverty and limited economic opportunity in the 21st century, including—but not limited to—epidemics of addiction and self-harm.
- Assessment of trends in socioeconomic inequalities in morbidity. Most of the literature has focused on mortality. Existing behavioural risk factors such as smoking, drinking, and medication adherence do not fully capture the increased burden of disease among the poor. Chronic pain and mental health issues are key under-researched aspects of disease burden.³⁴
- Research into the implications of increased geographical segregation by socioeconomic status, including the increased sorting of people by economic opportunity and implications for health inequalities.
- Investigation of geographical predictors of health among the poor, with high levels of area-related heterogeneity shown in recent research.⁶
- Assessment of the role of early-childhood exposures in explaining widening health gradients. Although a growing body of literature points to childhood health as an origin of adult disease, it is notable that mortality gaps are widening among ageing baby boomers born into a post-World War 2 society that was (at least for white Americans) more equal than current society. Nevertheless, a full account of childhood exposure could unearth alternative explanations for the divergence in adult health.
- Research into the mediating role of public institutions and social programmes and their capacity to weaken the link between income, education, and health.
- Evaluations of policies and programmes using credible causal designs (eg, randomised trials and natural experiments) to understand policy options to reduce the strong association between poverty and poor health.
- Evaluations of interventions to alleviate poverty and reduce income inequality, with particular attention to which types of interventions—eg, tax credits, job training, employment programmes—are the best for health.
- Evaluations of interventions to reduce the financial burden of ill health, including the Affordable Care Act and other policies designed to increase access to health coverage, as well as health systems reforms that might reduce access to care.

Our review should be interpreted in light of its limitations. We reviewed the extant literature on trends in socioeconomic inequalities in health in the USA over time. Although we have discussed some potential reasons for these changes, this literature is by nature descriptive and does not support inferences about the effects of specific policy interventions. Interventions to prevent or mitigate the 21st-century burden of disease associated with poverty, including epidemics of addiction and self-harm, are needed. Further research using robust causal designs (eg, randomised trials and natural experiments) is urgently needed to better understand how we can halt and close the widening gap in life chances between lower-income and upper-income Americans. We emphasise further the importance of more finely grained data on morbidity, risk factors, and causes of death to identify opportunities for intervention.

Conclusion

The rise in income inequality in the USA in 1980–2015 has coincided with widening inequalities in health and longevity. Not only do the poor have lower incomes, they increasingly live shorter lives than do higher-income Americans.

Growth in income inequality is most visible in the soaring incomes of top earners. By contrast, rising health inequalities have been observed across the full income distribution and, in recent years, chiefly among low-income and middle-income Americans. Whereas the top 1% of earners take home a larger share of total earnings than at any time since the Great Depression, their health outcomes still represent just 1% of the population. Changes in survival gaps during the period 1980–2015 are not simply a reflection of rising life expectancy among top earners.

Our review attributes rising survival inequalities to two factors. First, since 2001, real incomes have declined for poor and middle-income Americans; these income losses, experienced by those who can least afford them, might very well have implications for health and longevity. Second, the association between income and life expectancy has become stronger over time. Factors including technological innovation, increased geographical segregation, mass incarceration, reduced economic mobility, and increased exposure to prices might have contributed to a steepening gradient between income and health and to the increasing importance of poverty as a risk factor for poor health. Gaps have widened in causes of death linked to smoking and other adverse coping behaviours, although the aggregate trends have yet to be explained fully. Importantly, the increased correlation between health and income might contribute to negative feedback loops, making mobility along either axis more difficult. Interventions to decouple income and health—in addition to interventions targeted solely to improving health and economic prospects—might be needed.

Although these explanations are necessarily speculative, understanding the reasons behind rising health inequalities is of crucial importance. Estimates of cohort life expectancy project that the gap in life expectancy between the richest and poorest quintiles will have increased by nearly a decade within a single generation.⁷ Mitigation of these gaps might still be possible. Public investments in the health of low-income Americans have led to large health improvements in the past. New investments in the health of poorer Americans might be necessary to avoid a 21st century health-poverty trap and to ensure that low-income Americans have an equal opportunity to lead long, healthy lives.

Contributors

All authors contributed equally to the writing of the manuscript.

Declaration of interests

We declare no competing interests.

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