ANNE CASE
Princeton University

ANGUS DEATON
Princeton University

Accounting for the Widening Mortality Gap between American Adults with and without a BA

ABSTRACT We examine mortality differences between American adults with and without a four-year college degree over the period 1992 to 2021. Mortality patterns, in aggregate and across groups, can provide evidence on how well society is functioning, information that goes beyond aggregate measures of material well-being. From 1992 to 2010, both educational groups saw falling mortality, but with greater improvements for the more educated; from 2010 to 2019, mortality continued to fall for those with a four-year degree while rising for those without; during the COVID-19 pandemic, mortality rose for both groups, but markedly more rapidly for the less educated. In consequence, the mortality gap between the two groups expanded in all three periods, leading to an 8.5-year difference in adult life expectancy by the end of 2021. There have been dramatic changes in patterns of mortality since 1992, but gaps rose consistently in each of thirteen broad classifications of cause of death. We document rising gaps in other measures relevant to well-being—background factors to the rising gap in mortality—including morbidity, social isolation, marriage, family income, and wealth.

Conflict of Interest Disclosure: This work was supported by a grant from the National Institute on Aging (NIA), given through the National Bureau of Economic Research (NBER). Anne Case serves on the National Advisory Council on Aging for the NIA. Other than the aforementioned, the authors did not receive financial support from any firm or person for this paper, or from any firm or person with a financial or political interest in this paper. Other than the aforementioned, the authors are not currently an officer, director, or board member of any organization with a financial or political interest in this paper. The discussant, Jonathan Skinner was previously a consultant for Sutter Health and is a program director at the NBER.

Brookings Papers on Economic Activity, Fall 2023: 1–44

Outcome gaps between adult Americans with and without a four-year college degree have become increasingly salient in politics, economics, demographics, and society more broadly. Voting patterns, wealth holdings, incarceration, wages, and marriage are now sharply different between the approximately one-third of the population age 25 and older with a bachelor's degree and the two-thirds without. Documenting differences in mortality between groups provides evidence on how well society is functioning beyond aggregate measures of material well-being. Compared with money-based measures of well-being, which depend on often controversial assumptions about what to include and on how to convert money into real measures, mortality is an objective measure, less subject to measurement error—someone is dead or alive—and there is little debate around which is better. Death is particularly indicative of societal failure when it is not due to a widespread infectious disease—like COVID-19—or even to failures in the medical system, but to self-inflicted causes like suicide, alcoholism, or drug overdose.

An examination of the mortality gaps between more- and less-educated Americans can tell us how the US economy is performing, not just on average, but for the majority of its population, those without a college degree. The division by education is in many ways an alternative to discussions of income distribution, for example by looking at outcomes at selected percentiles, and is a useful supplement to analysis by race and ethnicity. Educational differences are at least as salient as income differences. Similar considerations apply to international comparisons, where there has been much recent commentary on the superior economic performance of the United States relative to Europe, but where comparisons based on mortality are very different.

As we shall see in the next section, an examination of mortality for Americans with and without a college degree helps us understand the much-researched issue of why, since the 1980s, American life expectancy has performed so much worse than the life expectancies of other rich countries. This has been the topic of two reports from the National Academy of Sciences on international comparisons, Crimmins, Preston, and Cohen (2011) and Woolf and Aron (2013), as well as another more recent report on high and rising mortality in midlife in the United States, Harris, Majmundar, and Becker (2021). None of these reports focused on the mortality divide between those with and without a college degree.

We begin with an examination of life expectancy at age 25, often referred to as "adult life expectancy," which is defined as the number of years someone can expect to live beyond their 25th birthday if mortality rates were to remain at their current levels. It is denoted by e_{25}. It is of course understood that mortality rates will change, and indeed the measure varies over time as mortality rates vary. It is *not* a forecast; like other period measures, it is a convenient summary of age-specific mortality rates, a single number that conveniently aggregates the many age-specific rates. Age 25 is taken to be the age by which people either have a four-year degree (BA) or will never have one, though see below.[1] In the next section, we show data on e_{25} for the United States and twenty-two other rich countries and how the differentials between Americans with and without a college degree help interpret the difference between the United States and other rich countries.

For technical reasons, which we shall explain as we go, most of the paper works with two other measures, expected years of life between the 25th and 85th birthdays, denoted ${}_{60}e_{25}$ (where the "60" refers to the number of years after age 25) and age-adjusted mortality between the same two birthdays. These two other measures ignore mortality rates after age 85. When there is no risk of confusion, we shall refer to both e_{25} and ${}_{60}e_{25}$ as *adult* life expectancy.

For the college-educated group, both measures of life expectancy at age 25 grew continuously from 1992 up to 2019, while for those without a four-year degree, progress stalled and reversed after 2010 (Sasson 2016a, 2016b; Hayward and Farina 2023). The gap widened further in 2020 and 2021 during the pandemic. We provide a descriptive analysis of the factors contributing to the widening gap in ${}_{60}e_{25}$ and in age-adjusted mortality, focusing on causes of death, on age, and on gender, both prior to and during the pandemic. We identify the causes of death that make the largest contribution to these widening gaps, particularly "deaths of despair"—from drug overdose, alcoholic liver disease, and suicide—as well as deaths from cancer, cardiovascular disease, chronic lower respiratory diseases, and diabetes.

The differential mortality experiences of those with and without a college degree come not only from direct effects of education on individual health, for example through health behaviors or enhanced ability to deal with life, including the health care system, but also from broader social and economic forces in the communities where people work and live. Those forces change with the structure of production and with the epidemiological environment, so that, for example, educational gaps in a service economy may be different from those in a manufacturing economy and may be different during a pandemic than before and after it. Who does or does not

1. A four-year college degree may be a bachelor of arts, science, fine arts, or architecture, among others. We use "BA" as a shorthand for all four-year degrees.

complete a four-year degree is also likely to depend on health, a selection effect. A good analogy here is with the college wage premium, the percentage by which the wage for college-educated workers exceeds the wage of those without a four-year college degree. This premium, which rose from 41 percent in 1979 to 80 percent in 2019, depends not only on what a college education does to the skills and ability of each worker—the direct effect—but also on a range of indirect effects, including on how many people go to college, who they are and how they are selected, for example, on ability; on how the labor market rewards skills; on available jobs and the technology they use; on how easy it is for workers to move to places where their skills are in demand; and on how the cost of employer health insurance affects the demand for more- and less-skilled workers (Finkelstein and others 2023).[2]

Similar direct and indirect forces affect health. Among them are the increasingly difficult job situation for less-educated workers and the long-term negative impacts of a deteriorating labor market on their marriages and the communities in which they live. (The recent tight job market has improved matters for less-educated workers (Autor, Dube, and McGrew 2023) but, as has happened in the past, the benefits may not last.) There is also important recent literature on the negative effects on health of corporate-sponsored laws passed in Republican-controlled state legislatures—regarding minimum wages, right-to-work laws, pollution, guns, and tobacco taxes and controls—all of which are likely to differentially hurt working-class Americans.[3]

European countries that have long been more open to trade and trade-related disturbances have built comprehensive welfare systems that help not only with trade-related job losses but also with losses through automation (Rodrik 1998). While mortality rates and mortality trends for less- and more-educated people in other rich countries differ in both levels and trends, the United States appears to be the only wealthy country where life expectancies are trending in different directions, one up and one down (Mackenbach and others 2018; Case and Deaton 2021, 2022).

2. The rise in the premium from 41 percent in 1979 to 80 percent in 2019 is from the authors' calculations using the Current Population Survey Outgoing Rotation Groups, for men and women age 25–64, comparing median wages for those with less than a four-year college degree to those with a BA or more. The premium for some college, less than a four-year degree, relative to a high school degree changed little over this period (14 percent in 1979, 12 percent in 2019).

3. See Grumbach (2022) and Montez and others (2020), as well as Jonathan Skinner's comment on this paper.

We document how gaps in mortality and life expectancy increased from 1992 to 2021, especially rapidly from 2019 to 2021 during the COVID-19 pandemic. We distinguish three periods: from 1992 to 2010, when both those with a BA and those without saw falling mortality, but with greater improvements for the more-educated; from 2010 to 2019, when mortality was falling for those with a BA and rising for those without; and from 2019 to 2021, when mortality was rising for both groups, but much more rapidly for those without a BA. We document the contributions of different causes of death to the changing gaps—notably the contributions of deaths of despair and their components, drug overdose, alcoholic liver disease, and suicide, and those of cardiovascular disease, and of a range of cancers—and we offer a complete accounting over all the major classifications of causes of death using the International Statistical Classification of Diseases (ICD).

In the final section of the paper, we turn from death to life and document the levels and trends in a range of outcomes for the more- and less-educated adult populations. Our underlying supposition is that the widening mortality gaps have their roots in differential life experiences between the two groups. Over a range of well-being–relevant outcomes, people with a college degree have fared better than those without. We do not attempt to link specific life outcomes to mortality rates, so we are *accounting* for the mortality outcomes only in the general sense of documenting the rising gaps in life outcomes among which, somewhere, lie the causal factors driving mortality differences.

We note that the fraction of the population with a four-year degree has risen over time. As is often discussed in the literature, rising educational attainment can change the kinds of people who do or do not have a four-year degree, a selection that can increase or decrease the educational gap in mortality and other outcomes, even when other effects of education are unchanging. We examine the mortality gap changes between birth cohorts when the fraction with a degree did not change, and again where the fraction with a degree changed markedly between birth cohorts. We find each successive birth cohort has a higher mortality gap than the cohorts that came before it, regardless of the change (or lack of change) in the fraction obtaining a degree.

We also show that reported educational attainment increases within birth cohorts, even long after the normal age of educational completion. Some of the increase can be accounted for by differential mortality but only for the earlier-born cohorts seen at older ages. The increase among the other groups remains a puzzle, and we can do no more than suggest explanations such as adult education, immigration, or people as they age becoming more likely to claim having a degree when they do not.

There is a large body of literature examining the relationship between education and mortality, starting with Kitagawa and Hauser (1973). Many later studies focused, as we do, on changes in educational gaps over time; on identifying the causes of death underlying the gaps; on the differences between men and women, and between racial and ethnic groups.[4] Most recently, the perspective by Hayward and Farina (2023) emphasizes the contingent and changing nature of the relationship between education and mortality. From the earliest studies, cardiovascular disease and lung cancer were identified as important in explaining educational gaps, leading back to smoking as a key behavioral determinant, which itself differed for men and women both in prevalence and timing.

Educational attainment began to be recorded on the standard US death certificate in 1989, after which time, in principle, all decedents could be included in studies of education and mortality. Compared with mortality follow-ups using survey data, which have generated several important studies including Hummer and Lariscy (2011), Montez and others (2011), Montez and Zajacova (2013a, 2013b), the complete data permit the analysis of relatively rare causes of death, as well as disaggregation over a range of correlates. We use the death certificate information in this paper, and our work most closely follows earlier studies of the gap by Olshansky and others (2012), Meara, Richards, and Cutler (2008), and most recently and most closely, Geronimus and others (2019). Recent studies have documented that, particularly since 2010, drug overdoses, or more broadly deaths of despair, have become important in understanding the mortality gaps between those with and without a college degree (Case and Deaton 2017; Ho 2017; Sasson and Hayward 2019).

In the current paper, we update these studies in several ways and add a section on differential life outcomes other than mortality. We analyze annual data over the longer period now available, including the pandemic years 2020 and 2021. We choose a different, more limited, but sharper focus on the difference in outcomes between those with and without a four-year college degree. We are less concerned with the many possible mechanisms that account for the relation between education on health, and more with documenting differences in mortality associated with the college divide. This follows the analysis in our book *Deaths of Despair and the Future of*

4. See, for example, Preston and Taubman (1994) for an excellent early review and the more recent updates by O'Rand and Lynch (2018).

Capitalism (Case and Deaton 2020), where, among other things, we document the college divide in material well-being, morbidity, marriage, and religiosity. In the last section of this paper, we update these estimates for marriage and for morbidity, including mental distress, as well as for family income and wealth.

We use data for the thirty-year period from 1992 to 2021, though we go further back for some of the life measures whose deterioration traces back to the 1970s. The post-1992 period saw major changes in mortality patterns, including those for cardiovascular disease mortality—whose longstanding decline came to a halt—and those for several cancers, where there have been many improvements. Mortality from deaths of despair grew markedly over this period. We attempt to resolve some of the uncertainty about the relative contributions to declining life expectancy of changes in mortality from cardiovascular disease on the one hand and, on the other hand, rising mortality from deaths of despair, especially drug overdoses (Geronimus and others 2019; Mehta, Abrams, and Myrskylä 2020). The COVID-19 pandemic at the end of the period was characterized not only by COVID-19 deaths, but also by excess deaths from other causes, including an additional upsurge in deaths of despair. We document what happened to the mortality gap as mortality changed in these unprecedented ways.

We also use the classification in ICD-10 to offer a complete accounting of the contribution of all causes of death to changes in the gap and examine whether any causes of death act to reduce the mortality gap between those with and without a college degree. We ask if it matters for the gap whether the cause of death is one associated with rising mortality, falling mortality, or a change from falling to rising mortality. We also raise new questions about the measurement of educational attainment, adding to an ongoing debate about self-reports versus postmortem reports, a debate that has influenced the choice of data for studying the relationship between education and mortality.

I. Mortality: Data and Methods

In our analysis of mortality, we work with death certificates from 1992 through 2021, though in some cases we limit analysis to 1999–2021 so as to confine cause of death to the reporting structure of ICD-10, formally the International Statistical Classification of Diseases and Related Health Problems. Death certificates record age and sex, as well as highest education attained. We do not consider race or ethnicity in this paper but see Case and Deaton (2021), which documents the increasing importance for mortality of education relative to race and ethnicity. There is undoubtedly some misreporting of education on death certificates, but the divide between a four-year college degree and less than a four-year college degree appears to be minimally affected (Rostron, Boies, and Arias 2010). As we shall document, there are also problems with self-reports of educational attainment. Education on death certificates is missing for four states in 1992: Oklahoma began reporting education in 1997, South Dakota in 2004, Georgia in 2010, and Rhode Island in 2016. These states accounted for 4.55 percent of the US population in 1990, and 4.57 percent of adult deaths in 1992. For deaths without education information, we assign a BA or not in the same proportion as nonmissing by year, age, and sex. Population totals for each year, age, and sex from age 25 to 84 are taken from the Census Bureau; the totals are split between those with and without a four-year college degree using ratios estimated from Current Population Surveys until 2000 and from the American Community Surveys thereafter. Our calculated statistics, age-adjusted mortality and adult life expectancy, are averages and as such reduce the influence of measurement errors.

We make extensive use of cause of death information as listed on the death certificates; we use the underlying cause of death, not proximate causes. The National Center for Health Statistics (2022, I.B, par. 2) notes "the underlying cause of death is the disease or injury which initiated the train of morbid events leading directly or indirectly to death or the circumstances of the accident or violence which produced the fatal injury." There is clearly scope for discretion and for error here, and causes of death are never as precise as the fact of death itself. There were particular difficulties during the pandemic, especially in the early days when testing was limited and when people died of other conditions that might not have proved fatal in the absence of COVID-19.

We use standard life table methods to calculate life expectancy at age 25, an age by which most people have completed their education; increasing attainment with age beyond 25 is an issue to which we return. The use of death certificates to compute mortality at the oldest ages is prone to error, and the official estimates from the National Center for Health Statistics (NCHS) use other sources (Arias and others 2022). We can avoid this by calculating the number of years of expected life of a 25-year-old between that person's 25th and 85th birthday, in standard demographic notation ${}_{60}e_{25}$, sometimes referred to as "temporary life expectancy" (Arriaga 1984). The standard measure of adult life expectancy e_{25} replaces 60 by infinity or at least the maximum possible years. Our measure of life expectancy from age 25 to 85 is also used by Geronimus and others (2019) who compute expected numbers of years lost as 60 (the maximum possible number of years of life between age 25 and 85) minus expected life years, $60 - {}_{60}e_{25}$.[5]

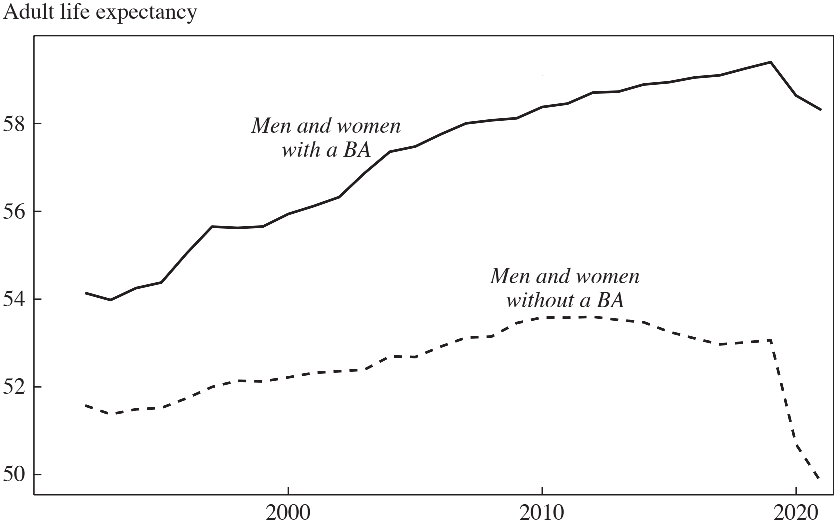
In the next section, we also report calculations of e_{25}. Here, too, we use the death certificates, extrapolating beyond age 85 using standard formulas that link mortality with age. We can provide some check on our calculations by using the same extrapolations to calculate e_{25}, not for those with and without a college degree, for which there are no official data, but for the whole population, and check against the official life tables, which we take in convenient form from the United States Mortality DataBase.[6] Our calculations are close to the official estimates; our maximum absolute error is 0.44 percent for women in 1992, and errors are smaller than that in later years, with maxima after 2000 of 0.27 percent for men in 2010 and 0.26 percent for women in 2021.

In section III and beyond, we make more complex calculations using individual causes of death, and we think it unwise to use interpolations to calculate those mortality rates at advanced ages; see above for the risk of errors at high ages. For these calculations we thus confine our attention to ${}_{60}e_{25}$ and to age-adjusted mortality between age 25 and 84. We compute age-adjusted mortality rates from age 25 to 84 for selected causes of death using the 2000 population and adjusting separately for men and women. We do not use separate reference populations by BA status; this is important because college graduates are on average younger than non-graduates, and we do not want these age differences to contribute to the gradient. We can use age-adjusted mortality rates, which are linear in both age-specific populations and causes of death, to exactly decompose the educational gaps by cause of death and by age group. For adult life expectancy, we use a variant of the cause deletion method (Beltrán-Sánchez, Preston, and Canudas-Romo 2008), in which we hold the age-, sex-, and education-specific mortality rates for selected causes at their 1992 levels, and then recompute adult life expectancy using the modified all-cause mortality rates. For example, deaths of despair rose rapidly after 1992, so to calculate the counterfactual excluding the increase, we compute ${}_{60}e_{25}$ as if that increase had not taken place, with all other mortality rates at their actual values. This is an accounting exercise, not a prediction of what would have happened. As was the case during COVID-19, deaths from other causes

5. We are grateful to John Bound for confirming that our calculations and those in Geronimus and others (2019) use the same formulas, something that is not clear in their text.

6. United States Mortality DataBase, University of California, Berkeley; usa.mortality.org (data downloaded on August 31, 2023).

Figure 1. Adult Life Expectancy for Americans with and without a Four-Year College Degree



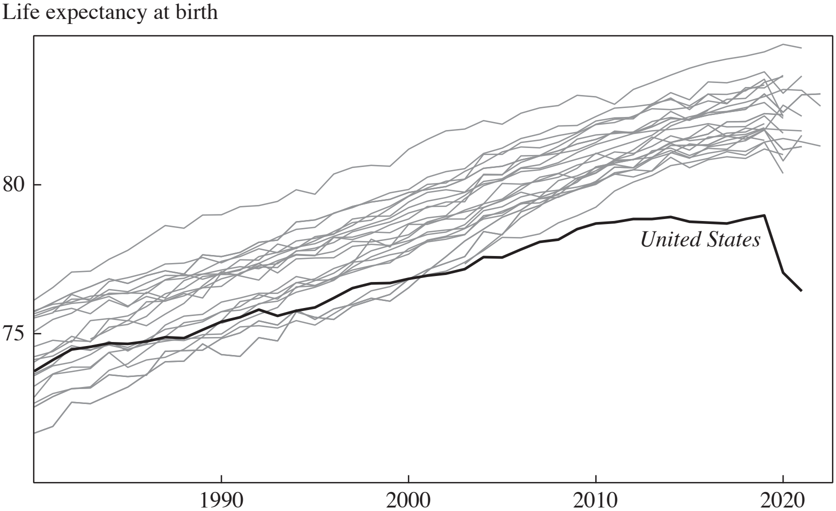
Source: National Vital Statistics System; and authors' calculations.

would almost certainly have been different had the increase in deaths of despair not happened; this is the well-known problem of competing risks, which precludes any straightforward, model-free calculation of counterfactuals. Even so, the calculations are useful in indicating orders of magnitude for the immediate consequences of modifying or eliminating different causes of death.

II. Adult Life Expectancy in the United States and Other Wealthy Countries

Figure 1 shows adult life expectancy, e_{25}, for Americans with and without a four-year college degree from 1992 to 2021; the figure combines men and women. The college-educated group experienced rising adult life expectancy until the onset of the pandemic in 2020. Those without a college degree saw their highest adult life expectancy in 2010 and have not regained it. Both groups lost years of life during the pandemic, 1.1 years for the college-educated, and 3.3 years for those without the degree. The gap widened throughout, from 2.6 years in 1992 to 6.3 years in 2019, and

Figure 2. Life Expectancy at Birth for the United States and Twenty-Two Other Rich Countries



Source: Human Mortality Database.

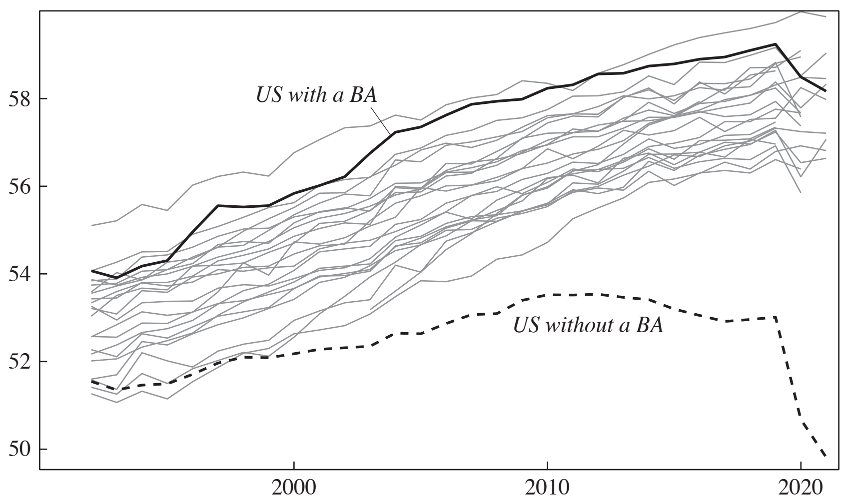
Note: The other countries shown in this figure, in order of their life expectancy in 2019, are Japan, Switzerland, Spain, South Korea, Italy, Australia, Sweden, Norway, France, Ireland, Canada, the Netherlands, Austria, Finland, Portugal, Belgium, New Zealand, Greece, Denmark, the United Kingdom, and Germany. The Israeli data end in 2016.

to 8.5 years in 2021 during the pandemic. (Note that at the time of writing, we cannot carry these calculations beyond 2021.)

We look at these results in more detail below, but we start by linking our findings to international comparisons between the United States and twenty-two other rich countries. Figure 2 shows a typical picture, here of life expectancy at birth, for the United States and for twenty-two other rich countries, with data taken from the Human Mortality Database.[7] In the mid-1980s, the US life expectancy at birth was in the middle of the range, but it has not kept up over time, and by the early 2000s, it was by far the lowest in the group. The pandemic added to an already large gap. The other countries shown in figure 2, in order of their life expectancy in 2019, are Japan, Switzerland, Spain, South Korea, Italy, Australia, Sweden, Norway, France, Ireland, Canada, the Netherlands, Austria, Finland, Portugal, Belgium,

7. Human Mortality Database, Max Planck Institute for Demographic Research (Germany), University of California, Berkeley (USA), and French Institute for Demographic Studies (France); www.mortality.org (data downloaded on May 30, 2023).

Figure 3. Adult Life Expectancy for Americans by College Degree and for Twenty-Two Other Rich Countries



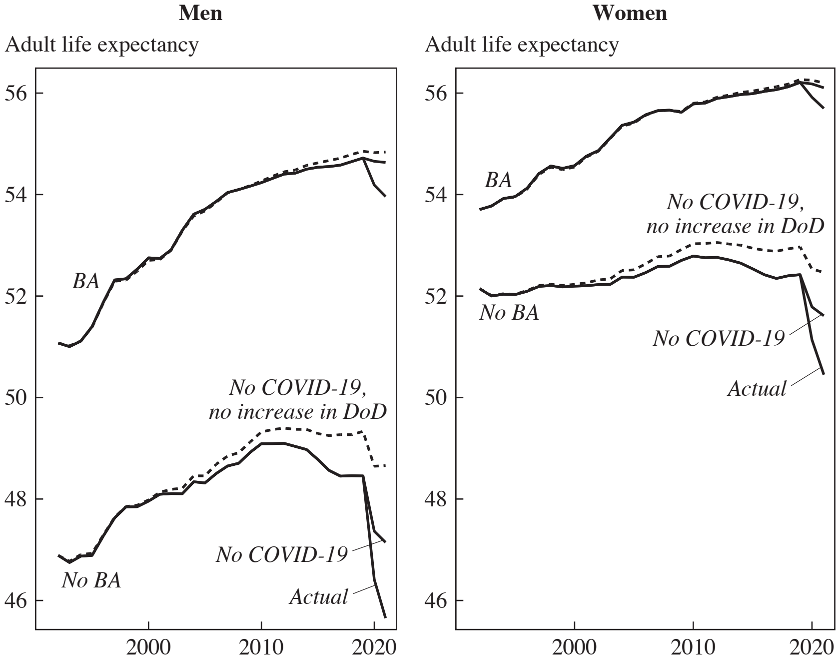
Source: Human Mortality Database; National Vital Statistics System; and authors' calculations.

Note: The other countries shown in this figure, in order of their adult life expectancy in 2019, are Japan, Switzerland, Spain, South Korea, Australia, Italy, Sweden, Norway, France, Canada, Ireland, New Zealand, the Netherlands, Austria, Finland, Belgium, Portugal, Greece, the United Kingdom, Denmark, and Germany. The Israeli data end in 2016.

New Zealand, Greece, Denmark, the United Kingdom and Germany. (The Israeli data end in 2016 with a life expectancy of 82.5 years.)

The literature lists many factors that can help explain the poor performance of the United States, and it is not our purpose to add to those accounts. Instead, we point to figure 3, which takes the Human Mortality Database data for adult life expectancy, e_{25}, for the other countries and superimposes the data from figure 1 of e_{25} for Americans with and without a college degree; this can only be done post-1992. One remarkable finding here is that Americans with a college degree, if they were a separate country, would be one of the best performers just below Japan, though there was some decline in 2020 and 2021 during the pandemic. We do not have life expectancy estimates by educational attainment for the other countries, though we do know that higher-educated people do better everywhere. But the figure shows that, without the widening gap in the United States, which is the main topic of this paper, the United States would not have done as relatively badly as it did.

Figure 4. Adult Life Expectancy with and without COVID-19 and Deaths of Despair (DoD)



Source: National Vital Statistics System; and authors' calculations.

III. Accounting for Education-Mortality Gaps in the United States

Figure 4 plots adult life expectancy from 1992 through 2021 for men and women separately, split between those with and without a BA. As noted above, we now work from here on not with e_{25}, but with ${}_{60}e_{25}$, the expected years of life between the 25th and 85th birthdays. If everyone died on their 85th birthday, the two measures would be identical. More generally, e_{25} exceeds ${}_{60}e_{25}$ by the product of life expectancy at age 85, e_{85}, and the fraction of those alive at age 25 who survive to age 85, quantities that have both been increasing as mortality rates have fallen, but both of which decreased during the COVID-19 pandemic. Since 1992, the difference $e_{25}–{}_{60}e_{25}$ (for both genders taken together and irrespective of degree status) has been between 1.9 and 3.1 years, rising from 1.95 in 1992 to 3.06 years in 2019 as mortality among the elderly fell and fewer adults died, and then falling to 2.46 years in 2020 and 2.34 in 2021.

The lower of each pair of solid black lines in each half of the figure is the actual outcome. For men with a BA, adult life expectancy, ${}_{60}e_{25}$, rose by 3.6 years from 1992 until 2019, from 51.1 to 54.7 years, then fell from 2019 to 2020 by 0.53 years, and again from 2020 to 2021 by 0.23 years. For women with a BA, our measure of adult life expectancy, ${}_{60}e_{25}$, rose by more than 2.5 years from 1992 until 2019, from 53.7 to 56.2 years, then fell from 2019 to 2020 by 0.29 years, and again from 2020 to 2021 by 0.22 years. Educated women gained less than educated men up to 2019 but lost less in the first two years of the pandemic. For men without a BA, adult life expectancy grew from 1992 to 2010 by 2.2 years, more slowly than for more-educated men over the same period, then fell by 0.6 years from 2010 to 2017, held steady for two years, and then fell dramatically during the pandemic by 2.0 years from 2019 to 2020 and by another 0.8 years from 2020 to 2021. For women without a BA, adult life expectancy grew from 1992 to 2010 by only 0.6 years, fell by 0.4 years from 2010 to 2017, held steady for two years, then fell during the pandemic by 1.3 years from 2019 to 2020, and by a further 0.6 years from 2020 to 2021. Once again, women gained less before the pandemic but lost less during it.

For both education groups, increases in life expectancy have been slower for women than for men. This is particularly dramatic for women without a college degree, for whom adult life expectancy in figure 4 in 2019, before the pandemic, was only 0.4 years higher than in 1992. Until the pandemic, men without a college degree had done better, gaining 1.5 years from 1992 to 2019, with all the gain coming before 2010. The slower gains for women are found in all rich countries, not just the United States. The main driver of mortality declines since the 1970s has been falling mortality from cardiovascular disease (CVD), primarily driven by reductions in smoking and by the use of antihypertensives and statins. But CVD is less prevalent among women who therefore had less to gain by the reduction. This effect is magnified by the fact that, in the United States as in most other countries, women were slower than men to start smoking and slower to stop, and smoking affects mortality not only through cancer but also through CVD.

The gap in adult life expectancy between the two education groups, which was 2.6 years (4.2 for men, 1.6 for women) in 1992, almost doubled to 5.0 years (6.3 men, 3.8 women) in 2019, and then exploded during the pandemic to 6.4 years (7.8 men, 4.8 women) in 2020, and 6.9 years (8.3 men, 5.2 women) in 2021. Accounting for these rising gaps is our main interest here.

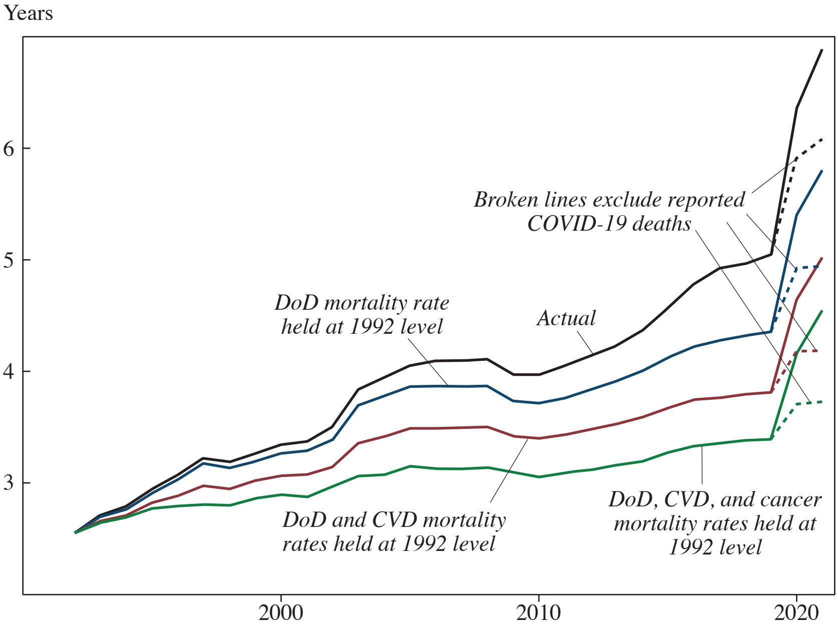
The higher of the pair of solid black lines in figure 4, which differ from one another only in 2020 and 2021, shows the effects of eliminating reported mortality from COVID-19; this deletion removes almost all of the drop for those with a BA, but only half the drop for those without. That excess deaths were greater than those reported as COVID-19 is well-known; the figure shows that the non-COVID-19 changes in mortality from 2019 to 2021, as well as the COVID-19 *excess* deaths in the pandemic years, were much larger for those without a BA. The higher dashed lines in both panels show estimates of adult life expectancy for each of the four groups when COVID-19 mortality is removed and the mortality rate from deaths of despair is held at its 1992 value. For those with a BA, the adjustment makes little difference beyond eliminating COVID-19 alone. For those without a BA, the actual and adjusted lines increasingly diverge as the epidemic of deaths of despair gathers momentum; indeed, the elimination of the increase in deaths of despair almost removes the post-2010 pre-pandemic decline in adult life expectancy for the less-educated group. It also moderates the declines during the pandemic; although the suicide rate fell in 2020, it rose again in 2021, and both drug overdose and alcohol-related liver disease mortality rates rose in both years.

Figure 4 also shows the three periods: up to 2010 when both groups were improving, but at different rates; from 2010 to the pandemic, when the groups were moving in different directions; and from 2019 when both groups were losing out, but at different rates.

Figure 5, for men and women combined, shows the evolution of the college gap from 1992 to 2021. The solid line marked "actual" is the gap; also shown are several counterfactuals. These include (1) eliminating COVID-19 deaths in 2020 and 2021; (2), as in (1) plus holding deaths of despair mortality rates at their 1992 levels; (3) as in (2) plus holding cardiovascular disease mortality rates constant at their 1992 values; then (4), all the above plus holding cancer mortality rates at their 1992 values. Each step reduces the temporal increase in the educational gradient. Note that both cardiovascular disease mortality and cancer mortality rates were falling over the period while the mortality rates from deaths of despair were rising. The figure does not show the effect on the *level* of life expectancy of, say, holding cancer mortality rates at their 1992 levels, something that would raise the mortality counterfactual in all subsequent years and lower life expectancy. Rather, the figure shows the effect of holding cancer mortality rates at their 1992 levels on *the educational gap* in life expectancy, and this, like the other counterfactuals, reduces the gap. In other words, the reduction in cancer mortality since 1992 has favored people with a college degree and has thus widened the gap.

Age-adjusted mortality data reproduce the qualitative patterns in figures 4 and 5 (online appendix figures 1 and 2). But because age-adjusted

Figure 5. Differences in Adult Life Expectancy with and without a BA



Source: National Vital Statistics System; and authors' calculations.
Note: DoD = deaths of despair; CVD = cardiovascular diseases.

mortality rates are linear in both age-specific mortality rates and population shares, they permit exact and straightforward decompositions by causes of death and by age groups. Table 1 presents pre- and post-pandemic age-adjusted mortality rates and covers eleven selected causes of death: deaths of despair, cancer, cardiovascular disease, chronic lower respiratory diseases, diabetes, transport accidents, Alzheimer's disease and related dementias, nephritis, septicemia, assault, and COVID-19. Collectively, these categories accounted for 80 percent of all deaths in 2019 for adults age 25 to 84. The ICD-9 and ICD-10 codes associated with these causes of death are listed in the notes to the table.

The first three columns of table 1 show age-adjusted mortality rates per 100,000 in 1992 for people age 25 to 84 with and without a BA, as well as the difference between them. The next three columns do the same for 2019, the last year before the pandemic. The next three columns show the changes from 1992 to 2019, so that the last column of this set shows the *differences in differences*, the changes from 1992 to 2019 in the gradient between those with and without a BA. The causes of death in the table are

Table 1. Age-Adjusted Mortality per 100,000 People, Age 25–84

	1992			*2019*			*Change 1992 to 2019*			*Change 2019 to 2021*		
Cause of death	*BA*	*No BA*	*Diff*	*BA*	*No BA*	*Diff*	*BA*	*No BA*	*Diff*	*BA*	*No BA*	*Diff*
Deaths of despair[a]	26	43	17	29	95	66	3	52	49	3	37	33
Cancer	263	297	34	136	212	77	−127	−85	43	−5	−1	4
Cardiovascular diseases[b]	331	418	87	125	247	122	−206	−171	35	4	27	22
Respiratory[c]	33	50	17	16	55	39	−17	5	22	−2	−4	−2
Diabetes	18	28	10	13	33	20	−4	5	10	3	9	7
Transport	13	20	6	6	20	13	−7	0	7	0	5	5
Alzheimer's disease[d]	11	8	−3	23	28	5	12	19	7	1	4	2
Nephritis[e]	7	10	4	7	17	10	0	6	6	0	1	1
Septicemia	6	9	3	6	13	8	0	4	4	0	2	1
Assault	3	11	8	1	10	8	−2	−2	0	0	4	4
COVID-19	0	0	0	0	0	0	0	0	0	57	164	107
Total above[f]	710	895	184	362	730	368	−348	−165	184	63	247	184
Total mortality	845	1,056	211	462	908	445	−382	−149	234	66	265	198
Decomposition of deaths of despair												
Drugs	2	6	4	7	45	38	5	39	34	2	26	24
Suicide	13	16	3	11	22	11	−2	6	7	−1	1	1
Alcohol	11	21	10	11	28	17	0	7	8	2	10	8

Source: National Vital Statistics System; and authors' calculations.

a. Deaths of despair are from drugs (ICD-9 292, 304, 305.2–305.9, 850–858, 980, ICD-10 F11–F16, F18–F19, X40–X44, Y10–Y14); alcohol (ICD-9 291, 303, 305.0, 571.0–571.3, 571.5, ICD-10 F10, K70, K74.6, G31.2, X45, Y15); or suicide (ICD-9 950–959, ICD-10 X60–X84, Y87.0).

b. Cardiovascular diseases (ICD-9 390–459, ICD-10 I00–I99).

c. Chronic lower respiratory diseases (ICD-9 490–496, ICD-10 J40–J47).

d. Alzheimer's disease and related dementias (ICD-9 331.0, 290.0–290.4, ICD-10 F01, G30, G31.0, G31.1, G31.8, G31.9).

e. Nephritis, nephrotic syndrome, or nephrosis (ICD-9 580–589, ICD-10 N00–N07, N17–N19, N25–N27).

f. Differences in partial sums are due to rounding.

ordered by their sizes in this column. Finally, the last three columns present what happened during the pandemic, showing the contribution of each of the listed causes of death to the widening of the gap from 2019 to 2021.

In 1992, age-adjusted all-cause mortality rates for those with and without a BA were 845 and 1,056, respectively, a difference of 211. The corresponding figures for 2019 were 462 and 908, a difference of 445, an increase from the 1992 gradient of 234 age-adjusted deaths per 100,000. All-cause mortality fell between 1992 and 2019 for people with a BA, and more slowly from 1992 to 2010 for those without, rising thereafter. As a result, the gap in mortality between the two education groups increased from 1992 to 2019.

The eleven causes of death in table 1 account for 184 of these 234 deaths per 100,000, or 79 percent; a complete accounting for the period from 2000 to 2021 is provided below. The largest contribution comes from deaths of despair, which added 49 deaths to the change in the gradient, followed by cancer, 43, cardiovascular disease, 35, and chronic lower respiratory diseases, 22. The contributions of diabetes, transport accidents, Alzheimer's disease, nephritis, septicemia, and assault are smaller at 10, 7, 7, 6, 4, and 0, respectively. All estimates are rounded to whole numbers. This rounding accounts for any discrepancies in totals within the table. Apart from deaths of despair, where the increase in the gradient comes from a much larger increase in deaths among those without a college degree, the next largest increases in the gradient come from causes of death that have been falling over time.

The final three columns of table 1 track the changes in age-adjusted mortality rates and educational mortality gaps from 2019 to 2021. Three numbers are particularly notable. First, note the increase (from zero) of the number of deaths from COVID-19, and the very much larger age-adjusted mortality for those without a BA. COVID-19 alone added 107 age-adjusted deaths per 100,000 to the educational gap between 2019 and 2021. Second, there was a large increase in deaths of despair from 2019 to 2021, almost exclusively among those without a BA, 37 versus 3. Third, age-adjusted deaths from CVD also rose rapidly, again largely among those without a BA, 27 versus 4. Those three causes of death widened the gradient by 162, out of 184 for the causes of death shown in the table, and out of a total of 198 age-adjusted deaths from 2019 to 2021.

The last rows of table 1 decompose deaths of despair into its three components: deaths from drugs, from suicide, and from alcohol. All three have seen consistent increases in their contributions to the education mortality gradient since the early 1990s (see online appendix figure 3). Of the three, drug overdose is the largest contributor to the increase in the gradient and has received the most attention. But suicide and alcohol deaths have also increased among those without a BA; particularly notable is the contribution of alcohol deaths to the increase in the gradient during the COVID-19 pandemic.

Table 2 shows a more complete characterization of causes of death from 2000 to 2021 using ICD-10 classifications; the shorter span of years obviates the need to match the classifications for ICD-9 and ICD-10. The table shows age-adjusted mortality rates for 2000 and 2019, as well as changes from 2000 to 2019 and from 2019 to 2021. Table 2 is constructed in parallel to table 1 but with different disease classifications. The text below the table explains the letter codes from ICD-10 and allows comparison of the two tables, despite the change in groupings. For example, deaths of despair in table 1 are now primarily captured in X and K codes. We have excluded causes that account for a small number of adult deaths so that columns 9 and 12 are now close to adding up to the totals in the last row, 137 out of 139 per 100,000 age-adjusted deaths for the change from 2000 to 2019, and 195 out of 198 per 100,000 for the pandemic years 2019 to 2021. Comparison of tables 1 and 2 shows that the former did not miss any diseases that made large contributions to the widening gradient, though table 2 identifies F codes (mental and behavioral disorders, some related to substance use), N codes (diseases of genitourinary system), A codes (certain infectious and parasitical diseases), and W codes (certain external causes, including falls) as making minor contributions to the widening gradients both before and during the pandemic.

An important result in table 2 is that, between 2000 and 2019, *all* causes of death, grouped by ICD-10 classification, contributed positively to the increase in the gap, and between 2019 and 2021, all except one did so, the exception being J codes, which cover deaths from respiratory diseases. This it true whether the mortality rate for the cause is falling for both groups (cancer, cardiovascular disease), rising for both groups (deaths of despair, respiratory diseases, Alzheimer's disease), or falling for the better-educated group and rising for the less-educated group (alcoholic liver disease, diabetes). With the one exception noted, the widening gap characterizes all time periods and all causes of death.

Figure 6 shows time series of age-adjusted mortality rates for age 25 to 84 for the three causes that contribute most to the increase of the gradient: deaths of despair, cancer, and CVD, by gender and by college degree status. Panels A and B show CVD mortality and deaths of despair, and panels C and D show cancer mortality. Panels A and B show that the rise in deaths of despair is more important for men than for women, and in both cases is almost entirely confined to those without a college degree. CVD mortality

Table 2. Age-Adjusted Mortality per 100,000 People, Age 25–84, by ICD-10 Category

	2000			*2019*			*Change 2000 to 2019*			*Change 2019 to 2021*		
Cause of death	*BA*	*No BA*	*Diff*	*BA*	*No BA*	*Diff*	*BA*	*No BA*	*Diff*	*BA*	*No BA*	*Diff*
COVID-19	—	—	—	—	—	—	—	—	—	57	164	107
X	16	34	18	21	77	56	5	43	38	1	31	29
Cancer	223	278	55	136	212	77	–88	–66	22	–5	–1	4
J	58	95	37	33	88	56	–25	–6	19	–3	–4	–1
Cardiovascular diseases	247	358	111	125	247	122	–122	–111	12	4	27	22
G	31	30	–2	44	49	8	10	19	10	2	5	3
K	23	40	17	19	44	25	–4	4	8	2	11	9
E	25	44	19	22	50	28	–2	6	8	3	12	9
F	9	13	5	15	26	12	6	13	7	1	4	3
V	11	20	9	6	19	13	–5	–1	4	0	5	5
N	12	21	9	10	23	13	–2	2	4	1	3	2
A	9	15	6	8	17	9	–1	2	3	1	2	1
W	7	10	2	9	14	5	2	4	3	1	2	1
Total above	672	957	285	444	867	423	–228	–90	138	65	260	195
Total mortality	702	1,008	307	462	908	445	–239	–101	139	66	265	198

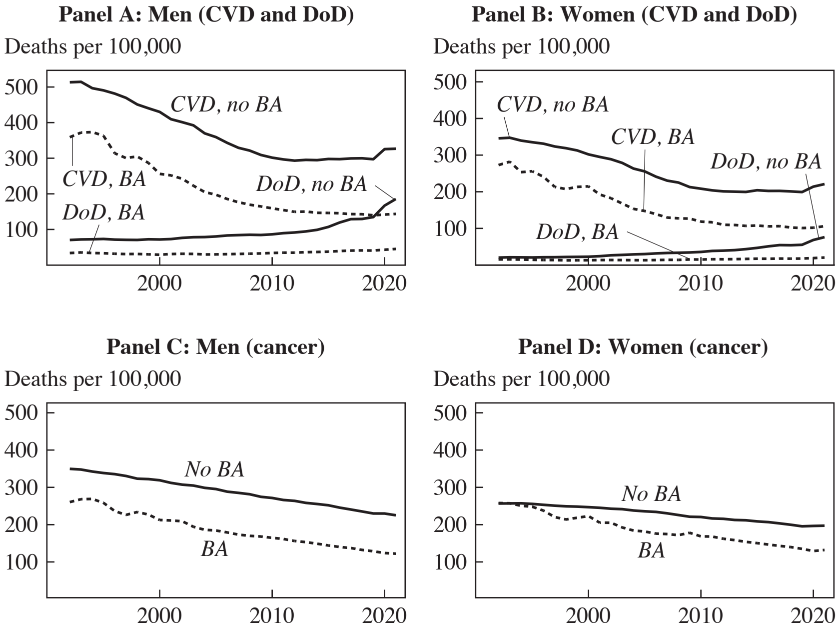
Source: National Vital Statistics System; and authors' calculations.

Note: ICD-10 codes:

X: Certain external causes, including accidental drug overdose, suicide, and assault with firearms
J: Diseases of the respiratory system, including chronic lower respiratory diseases, and influenza
G: Diseases of the nervous system, including Alzheimer's and Parkinson's diseases
K: Diseases of the digestive system, including alcoholic liver disease and cirrhosis
E: Endocrine, nutritional, and metabolic diseases, including diabetes
F: Mental and behavioral disorders, including those due to psychoactive substance use
V: Transport accidents
N: Diseases of genitourinary system
A: Certain infectious and parasitic diseases
W: Certain external causes, including falls

Certain causes of death are not shown in the table. These include ICD-10 codes B: Certain viral infections; D: Diseases of the blood and blood-forming organs; H: Diseases of the eye and adnexa, and diseases of the ear and mastoid process; L: Diseases of the skin and subcutaneous tissue; M: Diseases of the musculoskeletal system; O: Pregnancy, childbirth, and puerperium; P: Certain conditions from perinatal period; Q: Congenital malformations, deformations, and chromosomal abnormalities; R: symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere covered; and Y: Certain assaults, events of undetermined intent, sequelae of external causes.

Figure 6. Age-Adjusted Mortality Rates, Age 25-84, by BA Status

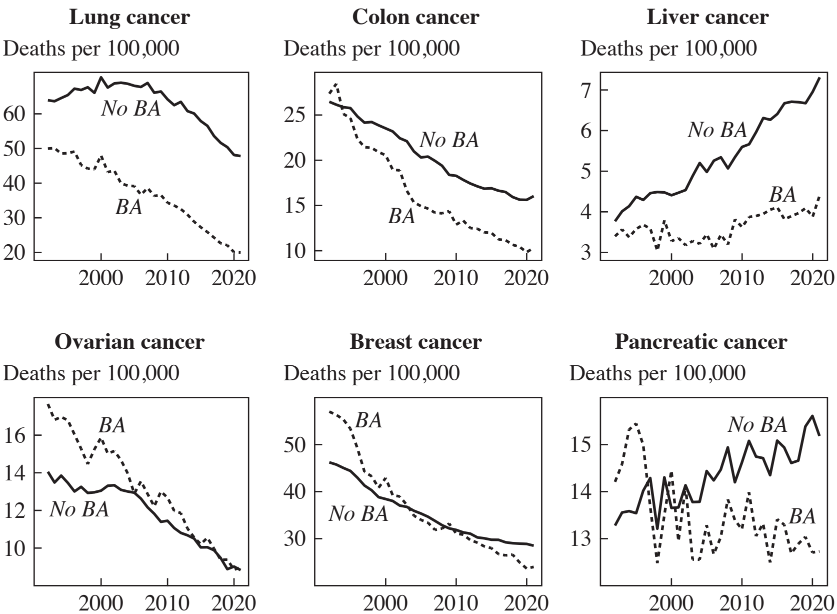


Source: National Vital Statistics System; and authors' calculations.
Note: DoD = deaths of despair; CVD = cardiovascular diseases.

also contributes to the widening gap for both men and women. The long-term decline that began in the 1970s lost momentum among those with a BA and stopped falling altogether after 2010 for those without the degree. After 2010, it rose slowly up to the pandemic and then more rapidly during it. These changes in the pattern of declining CVD mortality are recent, not well understood, and are of major importance not only for understanding the gaps but for understanding prospects for mortality more generally. Cancer mortality rates fell much more rapidly for women with a college degree than for women without. Indeed, in 1992, mortality rates from cancer were *higher* for more-educated women. For men, there is a more modest widening, with substantial decline for both those with and without a degree.

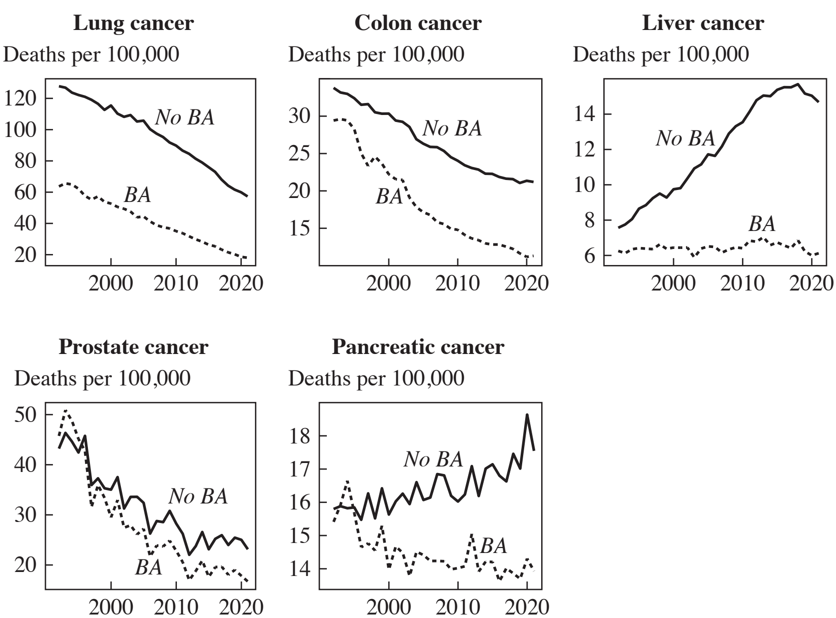
Figures 7 and 8, for women and men respectively, document patterns of mortality by education for the major cancers: for women, lung, breast, colon, ovarian, liver, and pancreatic cancer; and for men, lung, prostate, colon, liver, and pancreatic cancer. In the years immediately after 1992, lung cancer mortality was still rising for women without a BA but falling for those with

Figure 7. Age-Adjusted Cancer Mortality Rates, Women, by BA Status



Source: National Vital Statistics System; and authors' calculations.

Figure 8. Age-Adjusted Cancer Mortality Rates, Men, by BA Status



Source: National Vital Statistics System; and authors' calculations.

a BA. After 2006, lung cancer mortality fell for both groups in parallel, and since 2014 the gap has modestly narrowed. The contribution of lung cancer to widening the gradient for women comes before 2006. For men, who stopped smoking earlier than women, lung cancer mortality fell for both groups from 1992 to 2021, though more rapidly for those without a college degree, so that changes in lung cancer mortality for men worked to narrow the mortality gap. In 1992, breast cancer mortality was higher for women with a college degree, a long-standing finding that is often attributed to the protective effects of early childbearing.

But, as predicted by Link and others (1998), as scanning and effective treatment became available, breast cancer mortality fell more rapidly for the more-educated group who were first to use the technologies, contributing to a widening of the gradient. Prostate cancer mortality has fallen for men with and without a college degree, but more rapidly for those with, adding a relatively small amount to the widening of the mortality gap.

Among women, mortality from both colon and ovarian cancer were higher among those with a college degree in 1992, but as was the case for breast cancer, mortality fell more rapidly among women with a BA, crossing over for colon cancer and converging for ovarian cancer. As with breast cancer, screening and treatment were almost certainly both important. Mortality from liver cancer, whose risk factors include excessive alcohol use and cirrhosis, has been rising over time for both men and women, primarily among men and women without a college degree. Pancreatic cancer mortality has risen for both men and women without a college degree, while holding relatively steady after 2000 among those with a degree.

A key takeaway from figures 7 and 8 is that while different cancer mortality rates have behaved differently, with some falling and some rising, and while for some cancers mortality is or was higher for those with a college degree, for all the cancers examined here, with the exception of lung cancer for men, the educational gaps in mortality widened over time. Advances in medical treatments for many cancers and protective behavioral changes have had larger effects for those with a BA.

Table 3 calculates the college mortality gap by age group for 1992, 2019, and 2021. Column 1 gives the shares of each group in the population in 2000; these are the weights that can be applied to columns 2 through 6 to give the population totals in the bottom row. Column 2 gives the age-adjusted mortality rates in 2000 irrespective of educational status, while columns 3, 4, and 5 give the gaps—the differences in age-adjusted mortality rates between those with and without a four-year college degree. Column 6 shows the change in the gaps from 1992 to 2021; these changes are,

Table 3. College Gaps in Age-Adjusted Mortality by Age Group

Age group	*(1) Population shares in 2000 (%)*	*(2) Age-adjusted mortality rate[a] in 2000*	*(3) Mortality gap 1992[b]*	*(4) Mortality gap 2019[b]*	*(5) Mortality gap 2021[b]*	*(6) = (5)–(3) Change 1992 to 2021*	*(7) = (6)/(2) Change as a percentage of 2000 rate*
25–34	22.3	102	96	149	231	135	133
35–44	25.3	199	126	203	324	198	100
45–54	21.3	422	213	334	502	289	69
55–64	13.7	986	409	649	882	472	48
65–84	17.3	3,706	327	1,157	1,629	1,301	35
All 25–84	100	939	211	445	643	432	46

Source: National Vital Statistics; US Census Bureau; and authors' calculations.

a. Deaths per 100,000 persons.

b. Difference in mortality rate for people without and with a four-year college degree.

unsurprisingly, larger in groups with higher baseline mortality. Column 7 shows the changes as a percentage of the baseline mortality rates in 2000. The baseline of 2000 was chosen to align with its use in age standardization.

The overall increase in the gradient from 1992 to 2021 is 432 deaths per 100,000, to which the largest contribution comes from those age 65 and over, $(0.173 \times 1301)/432 = 52$ percent. The largest share of this is due to education differences in COVID-19 mortality, though there are also substantial contributions from cancer and CVD. As a percentage of baseline mortality, younger age groups saw larger increases in education gradients over this period; for the age group 25 to 34, the increase in the gap exceeded baseline mortality. Two-thirds of the increase among the youngest group was from deaths of despair. As we move from young to old, COVID-19 mortality becomes more important in contributing to the gradient, as does, to a lesser extent, mortality from CVD and cancer; deaths of despair become progressively less important with age.

IV. The Effects on Health of Education and of Rising Education

Our main interest is in documenting the changing differences in mortality between those with and without a four-year college degree, breaking up the patterns by cause of death, by gender, and by age. Our focus is not on the *reasons* for the better health of college-degree holders, which may include some or all of the following: (a) schooling in and of itself brings better health, better health behaviors, and better skills at dealing with health care, though the causal effect of education on health will always depend on the epidemiological environment, general health knowledge, and the structure of the health care system, as in fundamental cause theory (Link and Phelan 1995); (b) those who go to college are different in health-related ways, for example, in their health in childhood or in health-favoring personal characteristics (health-related selection) (Case, Fertig, and Paxson 2005; Farrell and Fuchs 1982); and (c) social and economic treatment if those without a college degree credential face a more difficult economic and social environment, including, for example, greater risk of job loss and community destruction. We might include in (c) the formulation, common in much of the sociological and epidemiological literature, that the main driver of health is socioeconomic status as measured by *rank* in the distribution of education (Adler and others 1994; Marmot 2004). It is only under (a) that we can argue that increasing the fraction with a BA might directly improve mortality rates; under (b) or (c) there is no such supposition.

Changes in health care provision, such as the Affordable Care Act (ACA), may differentially affect those with and without a BA, for example by increasing access to care among the less-educated group. We are skeptical that health care has large effects on population mortality rates, though in the diseases that we identify, the ACA may have reduced the gaps in cancer care and preventive treatment for cardiovascular disease. Given its design and purpose, the ACA surely played no role in *widening* the gaps.

Dynamic health-related selection can come into play when the fraction with a BA changes. Between 1992 and 2021, the fraction of the adult population age 25–84 with a BA or more rose from 22 to 36 percent. The increase for women, 18 percentage points, was larger than that for men, 10 percentage points, and these increases might contribute to the rising gap.[8] If the new college attendees are healthier than those who remain in the noncollege group, then a rising proportion of the population going to college will leave a noncollege group that is increasingly negatively selected on health. The effects of rising attainment on the educational health gap are not clear a priori because dynamic health selection as described will increase mortality rates for both groups, as the healthier nongraduates leave the pool of nongraduates, making the nongraduate group less healthy, and join an initially healthier graduate group, also reducing health in that group. (Despite the reduction in health in both groups, average health is unchanged.) As to the gap, it is straightforward to construct examples each of which yields different results. For example, if health h is uniformly distributed between zero and one, and those with $h > \theta$ go to college, a fraction $(1 - \theta)$, the average health in the two groups is $\theta/2$ and $(1 - \theta)/2$, and the gap is always 1/2, which does not depend on θ. If h has a standard normal distribution, the gap between average health of the college and the noncollege groups rises as the fraction going to college increases until half the population is in college and decreases thereafter. If h is exponentially distributed, the gap always *decreases* as more people go to college. Finally, if a subgroup of the noncollege people has poor health, and the rest are as healthy as the college group, then selection of the healthy previously noncollege group into college will have no effect on the average health of the college group, but it will decrease the average health of those not in college, thus widening the gap. Additional work and empirical evidence would be required to

8. Authors' calculations using the Current Population Survey Annual Social and Economic Supplement 1992 and the American Community Survey 2021.

document which, if any, of these illustrative calculations are relevant; we discuss the existing empirical evidence below.

No matter the effects of selection on the gap, the age-adjusted mortality rates and life expectancy numbers are not themselves affected. Selection does not challenge the facts, only their interpretation and what to do about them, if anything; this is not a situation in which selection leads to a biased estimate. In the extreme case where dynamic selection accounts for all of the increase in the gap, it might be argued that the widening is an inevitable and innocuous by-product of a desirable trend, the increase in education. We do not take this position, as we argue below, but simply note it.

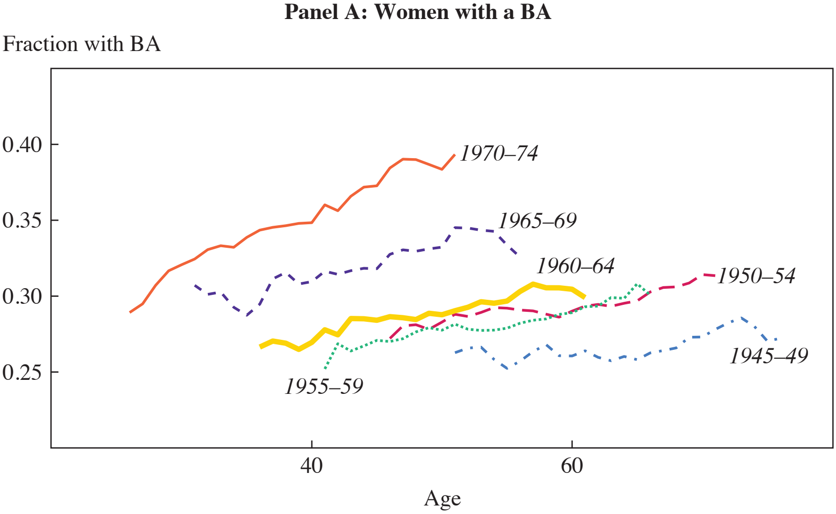
Several papers in the literature have made corrections for possible selection effects. Meara, Richards, and Cutler (2008) randomly reallocate some of their observations to keep constant the proportions in each of their groups. Others have worked with percentiles of the distribution of years of schooling, including Novosad, Rafkin, and Asher (2022) and Geronimus and others (2019) whose focus, similar to ours, is on mortality gaps between more- and less-educated Americans. While we look at people with and without a college degree, Geronimus and others (2019) compare outcomes for people in the bottom quartile of the education distribution with those in the top three quartiles. Even if educational qualifications were measured continuously, it is unclear why what happens at a particular percentile is of interest given that jobs and social standing depend more on qualifications than on percentiles, nor how, in the presence of health selection, looking at percentiles identifies a specific parameter of interest. Geronimus and others (2019) assign quartiles within (birth year, sex, race) cells for Black and white non-Hispanic individuals. For white non-Hispanic individuals, examination of the data shows that the bottom quartile has been defined by a high school degree since the birth cohorts born in the early 1920s, and for Black individuals since the early 1940s. As a result, a comparison of the bottom quartile to the rest of the distribution is similar to a comparison between those with no more than a high school degree to those with at least some college education. Their categorization differs from ours, in practice, in allocating the group with some college but less than a BA to their "high" education category. In previous work, we have shown that socioeconomic outcomes and mortality patterns for those with some college but no BA are closer to those with a high school degree or less than to those with a college degree. (We update and explore this in online appendix figure 4.) Despite this difference, their estimates are qualitatively similar to ours. That this is so provides evidence that the selection effects on the gap are not very important.

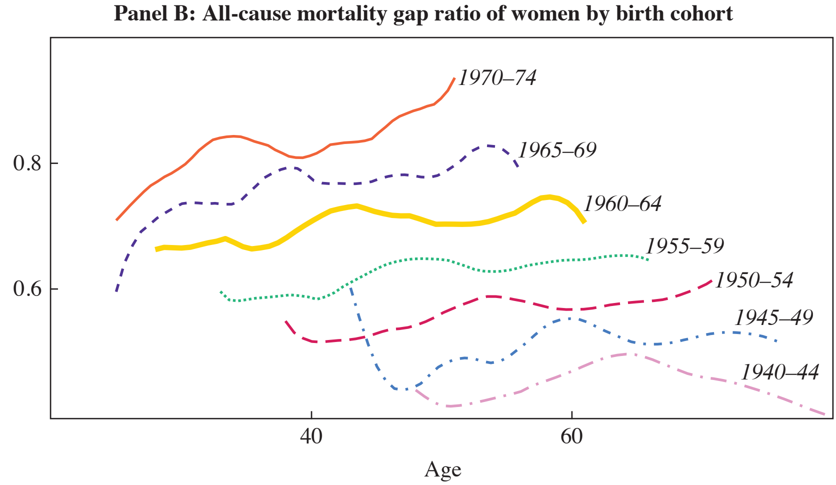
Similar and even clearer evidence comes from Novosad, Rafkin, and Asher (2022) who believe that it is educational rank that matters, not educational attainment, and who develop a method of estimating mortality change over time at fixed percentiles by age, race, and sex. Because educational attainment is discrete rather than continuous, it is only possible to estimate mortality change within an interval, but the payoff to the method is that the selection effects are eliminated by holding percentiles constant. Figure 6 in Novosad, Rafkin, and Asher (2022), for 1992 to 2018, shows very large percentage increases in mortality for white males and females below the 10th percentile (these are primarily high school dropouts). They also show mortality increases for those under age 50 that extend in some cases up to the 70th percentile, essentially to everyone without a BA. Setting aside the broad issue of whether it is qualifications or ranks that matter, these estimates eliminate health-based selection into education and so provide direct evidence that (fixed groups of) less-educated Americans have seen substantial mortality increases while those with the highest education levels have seen a continuing mortality decline.

Yet more evidence comes from examining the changes in college completion and changes in mortality gaps for women in the United States born between 1940 and 1974, using the fact that women's college completion did not increase by the same amount between successive birth cohorts. Panel A of figure 9 presents the fraction of women who completed a BA in each of seven five-year birth cohorts from 1940–1944 through 1970–1974, using data drawn from the American Community Survey. College completion increased between the cohort of 1940–1944, when approximately 21 percent of women completed a BA, to the cohorts of 1945–1949 (26 percent) and 1950–1954 (28 percent). There was then a period of stagnation for the birth cohorts from 1950–1954 through 1955–1959 and 1960–1964, after which the upward trend in the fraction of women with a BA in successive birth cohorts resumed. Explanations for rising mortality gaps that rely on selection would suggest that increases in mortality gaps between the first and second birth cohorts (1940–1944 and 1945–1949) and the increases between the last three cohorts (between 1960–1964 and 1965–1969 and between 1965–1969 and 1970–1974) should be larger than those for women born at midcentury.

We look at this using a relative mortality gap measure. For each age and year, we calculate the mortality gap ratio $(m_{noBA} - m_{BA})/m_{ALL}$, the mortality difference between those without a BA and those with a BA or more, scaled by the mortality rate for the population of the whole cohort. Note that this measure is corrected for any age effects that affect numerator and

Figure 9. College Completion and Mortality Gap Ratios of Women by Birth Cohort





Source: American Community Survey 2000–2021 (panel A); US National Vital Statistics 1992– 2021 (panel B).

denominator proportionately. We present these gap ratios for each of the seven birth cohorts in panel B of figure 9, where we smooth between ages within each birth cohort using a second-degree polynomial smoother. Contrary to what would be expected if selection were the driving force in mortality gaps, we find that the gap ratios rise by approximately 6 percentage points between each cohort; there is no pause for the cohorts born at midcentury when women's college completion rates did not change. In contrast, for later- and earlier-born cohorts, for whom education increased substantially, the increase in the mortality gap ratios was similar to that for the cohorts where education was not changing. In general, the upward movement in the mortality gaps appears to have no relation to changing fractions with a BA.

Men's college completion followed a different path between birth cohorts. Attainment of a BA rose between the birth cohort of 1940–1944 and that of 1945–1949. However, this was followed by a drop in the rate of college completion, a drop that held through the birth cohort of 1960–1964, after which the fraction of cohort members with a BA began to rise in successive birth cohorts. Once again, this pattern is not matched by that found in the mortality gap ratios for men, which follows the pattern observed for women in panel B of figure 9. Successive birth cohorts of men from those born in the early 1940s to those born in the early 1970s have seen increases in the mortality gap ratio that average 5.5 percentage points between birth cohorts, regardless of the fraction of the cohort with a BA (see online appendix figure 6).

Finally, we note that in their review of the literature on education and mortality, Hayward and Farina (2023, 401) conclude that "although selection cannot be completely ruled out, most of the evidence runs counter to what one would expect given negative selectivity." Our evidence supports that conclusion. We are unaware of any studies to the contrary that show dynamic health selection to be quantitively important.

Examination of educational attainment within each birth cohort shows that the fraction of those reporting a college degree increases as the cohort ages. For example, for those born in 1940, a regression of degree attainment on age attracts a coefficient of 0.0011, so that between when we first see them at age 52 and last see them at age 81, the fraction with a college degree has increased by more than 3 percentage points. For younger cohorts, the numbers are larger; for example, for the cohort born in 1970, the fraction reporting a degree increases by 14 percentage points from age 25 to 51. Differential mortality rates—which we have in our data—will differentially select out the less-educated as each cohort ages, but this effect is negligible for the younger cohorts. For the cohort born in 1940, differential mortality should increase the fraction with a degree by 4 percentage points, but for the 1970 cohort, the increase is less than 1 percentage point. According to the National Center for Education Statistics, about a quarter of college graduates in 2012 obtained their degree between age 25 and 39, presumably mostly at the lower end of that range.[9] Even so, there is upward drift within cohorts beyond age 30 (and even beyond age 40) in the reported fraction of degree holders.

The upward drift in reported possession of a bachelor's degree for later-born cohorts cannot be explained by differential mortality and is unlikely to be fully explicable by people going to college at later ages. Immigrants are about as likely as native-born Americans to have a college degree (Krogstad and Radford 2018), and results on upward drift are similar when we restrict our sample to the native-born population, so we are left with the supposition that people are granting themselves degrees as they age. There are certainly great incentives to do so, and perhaps few risks to people checking a box on a website for jobs in the hope that prospective employers will not check.

What does this imply for the analysis in this paper, or indeed for other papers in the literature that assume that education is complete by age 25? Effects ascribed to having a college degree are, at least in part, confounded with the effects of compositional change, even within birth cohorts. Several papers have questioned the use of education as reported on death certificates on the grounds that it is *not* self-reported and have taken that as a reason to work with the (much smaller) mortality follow-up of the National Health Interview Survey (Hendi 2017; Masters, Hummer, and Powers 2012). Yet our results show that self-reports may also be problematic. If the main concern is adults going back to college, the analysis can be confined to those age 35 (or 45) and above, and we note that figures 4 and 5 show the same patterns of widening gradients if we work with ${}_{50}e_{35}$ or ${}_{40}e_{45}$ in place of ${}_{60}e_{25}$. Our parallel with calculations of the college wage premium is unaffected in the sense that the health and wage premia are both based on potentially exaggerated degree attainment. Each should be interpreted as the difference in earnings or mortality outcomes between those who have or claim to have a college degree and those who do not. Many people who

9. National Center for Education Statistics, "Integrated Postsecondary Education Data System," https://nces.ed.gov/ipeds/datacenter/DataFiles.aspx?year=2012&surveyNumber=3&gotoReportId=7&, accessed April 9, 2023.

falsely claim to have a degree may still receive at least some of the social and economic benefits of having one.

V. Mortality: Discussion

Meara, Richards, and Cutler (2008) examine mortality by education up to 2000 and entitle their paper “The Gap Gets Bigger.” Their title works just as well for the mortality gap between Americans with and without a bachelor’s degree in the subsequent years, from 2000 to 2021. Indeed, the rate of widening accelerated after 2010 and exploded during the pandemic.

The years between 1992 and 2021 were years in which patterns of mortality changed dramatically, and those changes were different for men and for women. What is remarkable is that the widening of the gap transcended these changes in the mortality patterns. This would have been remarkable enough for the gap in all-cause mortality as the underlying causes of death changed. What is more surprising is that the widening gap is seen in virtually all the major groupings of causes of death. We see it in deaths whose rates have risen in the last thirty years, like deaths of despair and COVID-19; we see it in deaths whose rates have fallen in the last thirty years, like cancer; we see it in deaths whose rates have fallen and then risen, like deaths from cardiovascular disease; and we see it in deaths whose rates were originally higher for those without a BA (most diseases) and those that were originally lower for those without a BA (colon, liver, ovarian, and breast cancer for women, and prostate and pancreatic cancer for men). Even though the mechanisms and stories are different for each disease, and sometimes different for men and women, the widening gap is almost always there.

The words *virtually* and *almost* are there to note the only exception that we found, which occurred during the two-year period from 2019 to 2021 for the category of ICD-10 labeled “diseases of the respiratory system, including chronic lower respiratory diseases, and influenza,” which excludes deaths from COVID-19. From 2000 to 2019, the gap in this category widened, as in other causes of death. During 2020 and 2021, the pandemic years, some respiratory diseases may have been misclassified as COVID-19 and, given that COVID-19 deaths were much more common among those without a BA, the narrowing of the gap in respiratory diseases could be due to misattribution. Note again our earlier comments on the difficulties of assigning cause of death in such complex cases.

We note too that while an increasing mortality gap is seen in cancer as a group, the gap is shrinking for one specific cancer, lung cancer. Men with a BA gave up smoking much earlier than men without, but in the past thirty years the latter have been quitting too, which has narrowed the gap for men. For women, the mortality gap in lung cancer increased until 2006 before stabilizing, while continuing to increase in other cancers.

Fundamental cause theory says that, whenever there exists the means to prevent death, those means will be more effectively seized by those with power and resources (Link and Phelan 1995). What we are seeing here are fundamental cause mechanisms on steroids; the gap is not just present but expanding, and expanding at an accelerating rate. Either the gap in power and resources is expanding or the means of preventing disease has been growing; we suspect both are true. We do not have a well-documented account of how and why this is happening, but point instead to the fact that these gaps between those with and without a BA are widening across a range of life outcomes that we have reason to care about, not just mortality, but also morbidity—including many kinds of pain—as well as marriage rates, childbearing outside of marriage, religious observance, institutional attachments, and wages and participation in employment.[10]

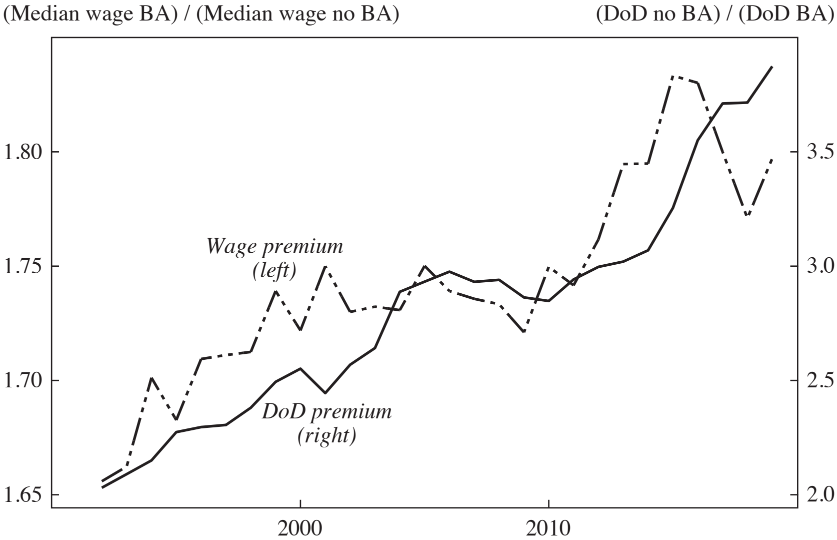
Figure 10 sets the stage for section VI and illustrates with one such comparison, between wage rates and deaths of despair. The dotted line (left-hand axis) shows the college wage premium defined as the ratio of median wages for those with a BA or more to median wages for those without a BA, while the solid line (right-hand axis) shows the ratio of the age-adjusted mortality rate from drugs, alcohol, and suicide for those without a BA to the age-adjusted mortality rate for those with a BA or more. In both cases, we look at age 25 to 64. Note that we are not arguing for a direct causal connection here; instead, we think of these series as two of many ways of documenting the deterioration in the situation of less-educated people in today's United States. Note that both comparisons show rising gaps up to 2000, then a period of relative pause, followed by an acceleration after 2010. A closing of mortality gaps may be an elusive goal while gaps in other domains continue to increase.

VI. Gaps among the Living

The decades-long increase in mortality gaps we have documented are matched by widening gaps in many measurable outcomes among the living, of which figure 10 is one example. We do not try to pin causality on any of the measures we document, though differences in adult mortality,

10. See Case and Deaton (2020) and section VII.

Figure 10. Ratios of Median Wages (BA/no BA) and Age-Adjusted Mortality Rates, Drugs, Alcohol and Suicide (no BA/BA), Age 25–64



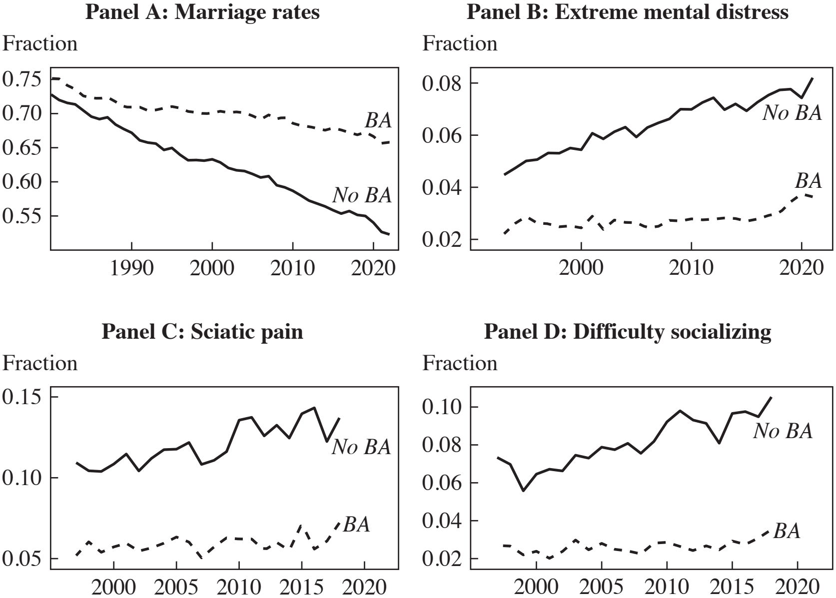
Source: CPS Outgoing Rotation Groups; National Vital Statistics Study; and authors' calculations.
Note: DoD = deaths of despair.

especially differences in mortality that are essentially self-inflicted, are certainly rooted in differences in the lives that preceded them. In such accounts, causality would certainly operate slowly and cumulatively or, to borrow a phrase, with long and variable lags. We do not attempt to disentangle the potential roles of the factors we consider in affecting either deaths of despair or overall mortality. That said, we note the excellent work on the precursors of deaths of despair by Olfson and others (2021). Merging individual data from the American Community Survey with death records, Olfson and others (2021) report the risk of dying from drugs, alcohol, or suicide (each analyzed separately) is higher for those who are single, those who have less than a four-year degree, and those who report lower income; they show that the difference between people with and without a BA remains after controlling for a number of other factors.

We examine gaps and changes in gaps by BA status in marriage, social isolation, pain, mental health, income, and wealth. Our findings parallel the earlier documentation of gaps in mortality in that the gaps between those with and without a BA have been widening since at least the mid-1990s.

Figure 11 plots marriage rates, as well as rates of physical pain and mental distress. All are age-adjusted to the 2000 US population and combine men

Figure 11. Marriage Rates and Rates of Physical and Mental Distress



Source: Current Population Survey 1980–2022 (panel A); Behavioral Risk Factor Surveillance System 1993–2021 (panel B); National Health Interview Survey 1997–2018 (panels C and D); and authors' calculations.

and women age 25 to 79. The pain measure relates to sciatic pain—a type of pain that is specific and likely reliably reported. It and the fraction of people who report that they have difficulty socializing ("visiting friends, attending clubs") come from the National Health Interview Survey (NHIS) and run from 1997 to 2018; the NHIS was redesigned after 2018, and the later data are not comparable. The "difficulty socializing" measure captures one aspect of loneliness, a condition recently described as an epidemic by the Surgeon General of the US Department of Health and Human Services (2023); the standard surveys on which we rely do not have the more sophisticated questions that would be preferable.

The measure of extreme mental distress comes from the Behavioral Risk Factor Surveillance System (BRFSS) and was first suggested and used by Blanchflower and Oswald (2020) to analyze educational differences in mental health. The question asks, "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" The graph plots the fraction of the population who replied thirty days, that is, whose mental health was not good on every day of the past thirty. Finally, marriage rates are taken from the Current Population Survey.

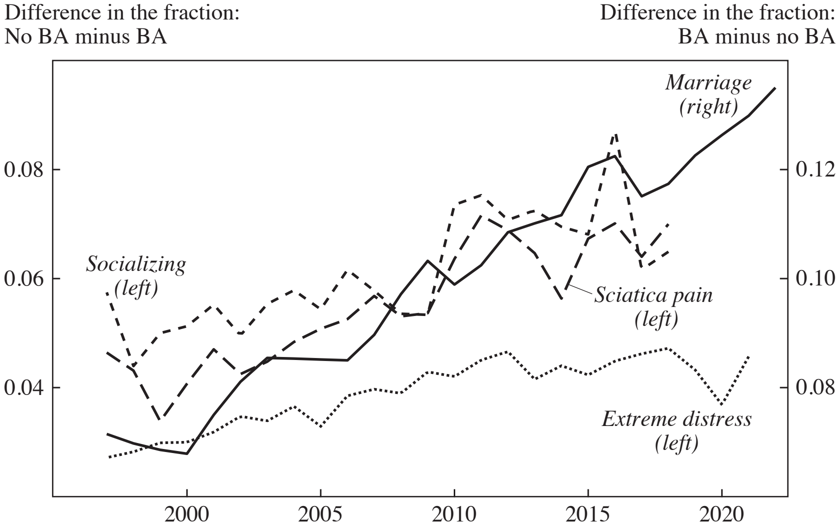
The fraction of adults currently married has been declining for those without and with a BA. From 1980 to 1990, the two lines fell in parallel, but since then, the fall has been markedly more rapid among those without a college degree (see online appendix figure 5). The decline persisted and perhaps slightly accelerated during and immediately after the COVID-19 pandemic. The long-established decline has been explored in the sociological literature on “fragile families,” which describes the still-increasing phenomenon of serial cohabitation, often with children, who then live separated from one or the other of their parents (McLanahan 2004; Cherlin 2014); the decreased attachment to the institution of marriage is part of a wider detachment from social institutions, including religion, by working-class Americans (Edin and others 2019).

The other three measures in figure 11 are all rising over time, getting worse for both educational groups, but the increase is much more pronounced for those without a four-year college degree. Extreme mental distress has risen steadily since the early 1990s for those without a college degree and by little for those with a degree before 2015. In 2019 to 2020, and 2020 to 2021, the two groups moved in opposite directions, down and then up for the less educated and up then down for those with a BA. These contrary movements during the COVID-19 pandemic are worth further analysis. The measures of sciatic pain and of difficulty socializing come from the NHIS whose sample size is smaller, and are relatively noisy; even so the greater prevalence of both among the less-educated is clear. As reported in Lamba and Moffitt (2023), the largest increase in reported pain occurred for those without a BA during the financial crisis, and the increase in this gap persisted through 2018.

Figure 12 summarizes the gaps in single picture in which the gaps for all four measures are rising over time. This graph shows a parallel with our findings on mortality in that the gaps between the two groups have grown and are growing over time. Of course, we should not push the analogy too far; all four of the measures here are worsening over time, while several of the mortality rates, particularly for cancers, were improving.

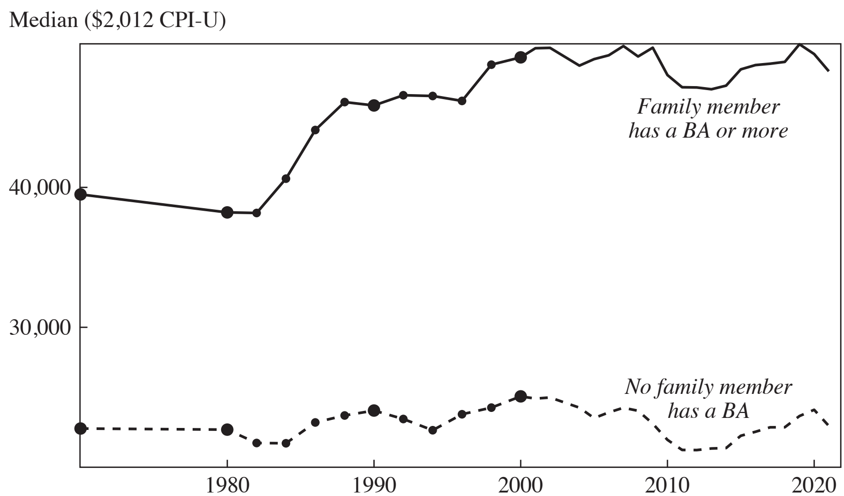
When we turn to income and wealth, the general trends are of improvement, albeit at different rates for the two groups. Figure 13 shows real family incomes from 1970 to 2021; 1970 is often identified as the year after which broadly shared general prosperity broke down. The data come from the US Census in 1970, 1980, 1990, and 2000, shown as large dots; from the CPS for the non-census years from 1980 to 1999, shown as smaller dots;

Figure 12. Education Gaps in Marriage and Mental and Physical Health



Sources: Authors' calculations using data in figure 11.

Figure 13. Real Family Total Income per Equivalence Unit ($2,012 CPI-U)



Source: US Census (1970, 1980, 1990, 2000); Current Population Survey (1982–1988, 1992–1998); American Community Survey (2001–2021); and authors' calculations.

and from the American Community Survey annually since 2001. We have deflated by the Consumer Price Index for All Urban Consumers (CPI-U) to real 2012 dollars and calculated family equivalents in which each child under 18 counts as 0.7 of an adult and where the sum of adults plus 0.7 children is raised to the power of 0.7 to capture economies of scale.[11] If we were to use the price deflator of per capita expenditure in place of the CPI-U, both income measures would rise somewhat more rapidly, though the change in the gap does not change qualitatively. There is scope for much argument about the choice of price indexes, but the main difference between the two is different weights, with the personal consumption expenditures (PCE) deflator including many items that families do not directly purchase.

The headline from this figure is that the gap in real equivalized family income increased, from $16,500 in 1970 to more than $25,000 in 2022. The increase was not steady over the half century shown. It fell slightly from 1970 to 1980, rose rapidly in the 1980s, rose more slowly from 1990 to 2010, and has been trendless since. We know the underlying anatomy of these changes. Part is the increase in the college wage premium, from 41 percent in 1979 to 80 percent in 2019.[12] The 1980s and, to a lesser extent, the 1990s were also periods of rising family income inequality, to which the gap between the education groups contributed. The changes also reflect rates of labor force participation that differ by educational status, as well as by men and women. For those without a BA, the employment-to-population ratio for men has been falling, albeit with cyclical interruptions, since 1980, while for women, the ratio rose until 2000 and fell thereafter. For men and women with a BA, the patterns are similar, but the increases and decreases are much smaller. As a result, differential participation rates contribute to widening the gap until around 2010. In the recovery from the pandemic, these patterns have changed, with better outcomes for low-skilled workers, but it is too early to tell whether the long-term pattern has changed. To the extent that the increase in employment by less-educated women after 1970 was a compensatory, but sometimes unwelcome, response to falling real wages by men, changes in family income may overstate changes in well-being.

We have not attempted to adjust the gaps for taxes paid—these are pretax incomes, though they include benefits such as unemployment compensation,

11. See Citro and Michael (1995) for this and other measures.

12. Authors' calculations of the wage premium, measured as the ratio of median real wages for those with a BA to median real wages for those without a degree, for workers age 25 to 64 in the Current Population Survey Outgoing Rotation Groups.

workers' compensation, supplemental security income, and public assistance or welfare payments. Nor do we adjust for any increase in quality that is missed in the CPI, let alone for possible differentials in the rates of quality improvement between groups. We do not include employer contributions to health insurance as income; we note that those are not very different for less- and more-educated workers, though there are presumably differences by employment. Given that those with a BA are more likely to have such coverage, incorporating such contributions would increase the gap. We do not attempt to put a value on coverage nor to subtract out the part of costs that is due to health care industry rents. Nor, finally, do we add in the value of Medicaid and Medicare as some have argued for (Burkhauser and others 2024). Corrections of this kind, if indeed they can be justified as corrections, would have uncertain effects on the gap, although they would undo some of the stagnation of real incomes among families without a BA.

Wealth data from the Survey of Consumer Finances can be used to study differences by education. In particular, the infographic provided by the Board of Governors of the Federal Reserve System showed (as of July) that, taking all components of household wealth together, the total in 1990:Q1 was $20.91 trillion, rising to $140.56 trillion by 2023:Q2.[13] In 1990, the fraction owned by those without a college degree was 49 percent, a fraction that had fallen to 27 percent by 2023, so that those with a college degree had moved from owning half of wealth to nearly three-quarters over this period. A good deal of this change is accounted for by the rising share of households with at least one member with a college degree. There were 26 million households where a member had a college degree in 1990, but 59 million in 2022. By contrast, the number of households with no BA was almost unchanged, rising from 68 million to 69 million.

VII. Mortality and Well-Being: Discussion

The results in this paper, on how people live and on how they die, should be seen in two different ways. The first is the documentation that the gaps between those with and without a college degree are not confined to one dimension of well-being, such as the mortality rates with which we began, but are pervasive across aspects of life that are important to people. Wherever we look, the more-educated group is faring better; sometimes

13. Board of Governors of the Federal Reserve System, "DFA: Distributional Financial Accounts," https://www.federalreserve.gov/releases/z1/dataviz/dfa/distribute/chart/, accessed July 23, 2023.

the college-educated are doing well and the noncollege-educated are losing ground, and sometimes both are seeing progress but the better-educated are seeing more.

The other way to look at the results is to use them to think about accounts of what is happening, about the *why* as well as the *what*. In our book on deaths of despair (Case and Deaton 2020), we suggest several mechanisms—the effects of globalization and automation without a European-style safety net and with an employer-based health insurance system that destroys good jobs, widens inequality, and lowers wages for less-skilled workers. Other rich countries do not finance health care this way. In our book we reference work that has documented an increase in corporate power relative to workers, the decline of unions, the spread of monopsony, and the decreased mobility of workers from less to more successful places. We also note again the evidence on some state legislatures passing business-written laws that harm workers.

Finally, we note the possibility that jobs are not always allocated by matching necessary or useful skills, but by the use of the BA as an arbitrary screen. We are encouraged by efforts by both public and private employers to remedy this; it is a low-cost policy that could have large benefits.

ACKNOWLEDGMENTS This is an extended and much revised version of NBER Working Paper 31236, May 2023; we are grateful to Jan Eberly, Jon Skinner, and Caroline Hoxby for comments on earlier versions. We gratefully acknowledge support from the National Institute of Aging through an award to the NBER, award number R01AG060104. We thank Andrew Foote for advice on education data and John Bound for clarification of the methods in Geronimus and others (2019).

References

Adler, Nancy E., Thomas Boyce, Margaret A. Chesney, Sheldon Cohen, Susan Folkman, Robert L. Kahn, and S. Leonard Syme. 1994. “Socioeconomic Status and Health: The Challenge of the Gradient.” *American Psychologist* 49, no. 1: 15–24.

Arias, Elizabeth, Jiaquan Xu, Betzaida Tejada-Vera, Sherry L. Murphy, and Brigham Bastian. 2022. “U.S. State Life Tables, 2020.” *National Vital Statistics Reports* 71, no. 2. Hyattsville, Md.: National Center for Health Statistics.

Arriaga, Eduardo E. 1984. “Measuring and Explaining the Change in Life Expectancies.” *Demography* 21, no. 1: 83–95.

Autor, David, Arindrajit Dube, and Annie McGrew. 2023. “The Unexpected Compression: Competition at Work in the Low Wage Labor Market.” Working Paper 31010. Cambridge, Mass.: National Bureau of Economic Research. https://www.nber.org/papers/w31010.

Beltrán-Sánchez, Hiram, Samuel Preston, and Vladimir Canudas-Romo. 2008. “An Integrated Approach to Cause-of-Death Analysis: Cause-Deleted Life Tables and Decompositions of Life Expectancy.” *Demographic Research* 19, article 35: 1323–50.

Blanchflower, David G., and Andrew J. Oswald. 2020. “Trends in Extreme Distress in the United States, 1993–2019.” *American Journal of Public Health* 110, no. 10: 1538–44.

Burkhauser, Richard V., Kevin Corinth, James Elwell, and Jeff Larrimore. 2024. “Evaluating the Success of the War on Poverty since 1963 Using an Absolute Full-Income Poverty Measure.” *Journal of Political Economy* 132, no. 1: 1–47.

Case, Anne, and Angus Deaton. 2017. “Mortality and Morbidity in the 21st Century.” *Brookings Papers on Economic Activity*, Spring, 397–443.

Case, Anne, and Angus Deaton. 2020. *Deaths of Despair and the Future of Capitalism*. Princeton, N.J.: Princeton University Press.

Case, Anne, and Angus Deaton. 2021. “Life Expectancy in Adulthood Is Falling for Those without a BA Degree, but as Educational Gaps Have Widened, Racial Gaps Have Narrowed.” *Proceedings of the National Academy of Sciences* 118, no. 11: e2024777118.

Case, Anne, and Angus Deaton. 2022. “The Great Divide: Education, Despair, and Death.” *Annual Review of Economics* 14: 1–21.

Case, Anne, Angela Fertig, and Christina Paxson. 2005. “The Lasting Impact of Childhood Health and Circumstance.” *Journal of Health Economics* 24, no. 2: 365–89.

Cherlin, Andrew J. 2014. *Labor’s Love Lost: The Rise and Fall of the Working-Class Family in America*. New York: Russell Sage Foundation.

Citro, Constance F., and Robert T. Michael, eds. 1995. *Measuring Poverty: A New Approach*. Washington: National Academies Press.

Crimmins, Eileen M., Samuel H. Preston, and Barney Cohen, eds. 2011. *Explaining Divergent Levels of Longevity in High-Income Countries.* Washington: National Academies Press.

Edin, Kathryn, Timothy Nelson, Andrew J. Cherlin, and Robert Francis. 2019. "The Tenuous Attachments of Working-Class Men." *Journal of Economic Perspectives* 33, no. 2: 211–28.

Farrell, Philip, and Victor R. Fuchs. 1982. "Schooling and Health: The Cigarette Connection." *Journal of Health Economics* 1, no. 3: 217–30.

Finkelstein, Amy, Casey McQuillan, Owen Zidar, and Eric Zwick. 2023. "The Health Wedge and Labor Market Inequality." *Brookings Papers on Economic Activity,* Spring, 425–75.

Geronimus, Arline T., John Bound, Timothy A. Waidman, Javier M. Rodriguez, and Brenden Timpe. 2019. "Weathering, Drugs, and Whack-a-Mole: Fundamental and Proximate Causes of Widening Educational Inequity in U.S. Life Expectancy by Sex and Race, 1990–2015." *Journal of Health and Social Behavior* 60, no. 2: 222–39.

Grumbach, Jacob M. 2022. *Laboratories against Democracy*: *How National Parties Transformed State Politics.* Princeton, N.J.: Princeton University Press.

Harris, Kathleen Mullan, Malay K. Majmundar, and Tara Becker, eds. 2021. *High and Rising Mortality Rates among Working-Age Adults.* Washington: National Academies Press.

Hayward, Mark D., and Mateo P. Farina. 2023. "Dynamic Changes in the Association between Education and Health in the United States." *Millbank Quarterly* 101, no. S1: 396–418.

Hendi, Arun S. 2017. "Trends in Education-Specific Life Expectancy, Data Quality and Shifting Educational Distributions: A Note on Recent Research." *Demography* 54, no. 3: 1203–13.

Ho, Jessica Y. 2017. "The Contribution of Drug Overdose to Educational Gradients in Life Expectancy in the United States, 1992–2011." *Demography* 54, no. 3: 1175–202.

Hummer, Robert A., and Joseph T. Lariscy. 2011. "Educational Attainment and Adult Mortality." In *International Handbook of Adult Mortality*, edited by Richard G. Rogers and Eileen M. Crimmins. Berlin: Springer Dordrecht.

Kitagawa, Evelyn Mae, and Philip M. Hauser. 1973. *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*. Cambridge, Mass.: Harvard University Press.

Krogstad, Jens Manuel, and Jynnah Radford. 2018. "Education Levels of U.S. Immigrants Are on the Rise." Pew Research Center, September 14. https://www.pewresearch.org/fact-tank/2018/09/14/education-levels-of-u-s-immigrants-are-on-the-rise/.

Lamba, Sneha, and Robert A. Moffitt. 2023. "The Rise in American Pain: The Importance of the Great Recession." Working Paper 31455. Cambridge, Mass.: National Bureau of Economic Research. https://www.nber.org/papers/w31455.

Link, Bruce G., Mary E. Northridge, Jo C. Phelan, and Michael L. Ganz. 1998. "Social Epidemiology and the Fundamental Cause Concept: On the Structuring of Effective Cancer Screens by Socioeconomic Status." *Milbank Quarterly* 76, no. 3: 375–402.

Link, Bruce G., and Jo C. Phelan. 1995. “Social Conditions as Fundamental Causes of Disease.” *Journal of Health and Social Behavior* (extra issue): 80–94.

Mackenbach, Johan P., José Rubio Valverde, Barbara Artnik, Matthias Bopp, Henrik Brønnum-Hansen, Patrick Deboosere, and others. 2018. “Trends in Health Inequalities in 27 European Countries.” *Proceedings of the National Academy of Sciences* 115, no. 25: 6440–45.

Marmot, Michael. 2004. *The Status Syndrome: How Social Standing Affects Our Health and Longevity*. New York: Times Books.

Masters, Ryan K., Robert A. Hummer, and Daniel A. Powers. 2012. “Educational Differences in U.S. Adult Mortality: A Cohort Perspective.” *American Sociological Review* 77, no. 4: 548–72.

McLanahan, Sara. 2004. “Diverging Destinies: How Children Are Faring under the Second Demographic Transition.” *Demography* 41, no. 4: 607–27.

Meara, Ellen R., Seth Richards, and David M. Cutler. 2008. “The Gap Gets Bigger: Changes in Mortality and Life Expectancy, by Education, 1981–2000.” *Health Affairs* 27, no. 2: 350–60.

Mehta, Neil K., Leah R. Abrams, and Mikko Myrskylä. 2020. “US Life Expectancy Stalls Due to Cardiovascular Disease, not Drug Deaths.” *Proceedings of the National Academy of Sciences* 117, no. 13: 6998–7000.

Montez, Jennifer Karas, Jason Beckfield, Julene Kemp Cooney, Jacob M. Grumbach, Mark D. Hayward, Huseyin Zeyd Koytak, Steven H. Woolf, and Anna Zajacova. 2020. “US State Policies, Politics, and Life Expectancy.” *Milbank Quarterly* 98, no. 3: 668–99.

Montez, Jennifer Karas, Robert A. Hummer, Mark D. Hayward, Hyeyoung Woo, and Richard G. Rogers. 2011. “Trends in the Educational Gradient of U.S. Adult Mortality from 1986 to 2006 by Race, Gender, and Age Group.” *Research on Aging* 33, no. 2: 145–71.

Montez, Jennifer Karas, and Anne Zajacova. 2013a. “Explaining the Widening Education Gap in Mortality among U.S. White Women.” *Journal of Health and Social Behavior* 54, no. 2: 166–82.

Montez, Jennifer Karas, and Anne Zajacova. 2013b. “Trends in Mortality Risk by Education Level and Cause of Death among US White Women from 1986 to 2006.” *American Journal of Public Health* 103, no. 3: 473–79.

National Center for Health Statistics. 2022. *Instructions for Classification of Underlying and Multiple Causes of Death—Section 1—2022*. Washington: US Department of Health and Human Services. https://www.cdc.gov/nchs/nvss/manuals/2022/2a-2022.htm.

Novosad, Paul, Charlie Rafkin, and Sam Asher. 2022. “Mortality Change among Less Educated Americans.” *American Economic Journal: Applied Economics* 14, no. 4: 1–34.

Olfson, Mark, Candace Cosgrove, Sean F. Altekruse, Melanie M. Wall, and Carlos Blanco. 2021. “Deaths of Despair: Adults at High Risk for Death by Suicide, Poisoning, or Chronic Liver Disease in the US.” *Health Affairs* 40, no. 3: 505–12.

Olshansky, S. Jay, Toni Antonucci, Lisa Berkman, Robert H. Binstock, Axel Boersch-Supan, John T. Cacioppo, and others. 2012. "Differences in Life Expectancy Due to Race and Educational Differences Are Widening, and Many May Not Catch Up." *Health Affairs* 31, no. 8: 1803–13.

O'Rand, Angela M., and Scott M. Lynch. 2018. "Socioeconomic Status, Health, and Mortality in Aging Populations." In *Future Directions for the Demography of Aging: Proceedings of a Workshop*, edited by Malay K. Majmundar and Mark D. Hayward. Washington: National Academies Press.

Preston, Samuel H., and Paul Taubman. 1994. "Socioeconomic Differences in Adult Mortality and Health Status." In *Demography of Aging*, edited by Linda G. Martin and Samuel H. Preston. Washington: National Academies Press.

Rodrik, Dani. 1998. "Why Do More Open Economies Have Bigger Governments?" *Journal of Political Economy* 106, no. 5: 997–1032.

Rostron, Brian L., John L. Boies, and Elizabeth Arias. 2010. *Education Reporting and Classification on Death Certificates in the United States.* Vital and Health Statistics Series 2, no. 151. Hyattsville, Md.: National Center for Health Statistics.

Sasson, Isaac. 2016a. "Diverging Trends in Cause-Specific Mortality and Life Years Lost by Educational Attainment: Evidence from United States Vital Statistics Data, 1990–2010." *PLoS One* 11, e0163412.

Sasson, Isaac. 2016b. "Trends in Life Expectancy and Lifespan Variation by Educational Attainment: United States, 1990–2010." *Demography* 53, no. 2: 269–93.

Sasson, Isaac, and Mark D. Hayward. 2019. "Association between Educational Attainment and Causes of Death among White and Black US Adults, 2010–2017." *Journal of the American Medical Association* 322, no. 8: 756–63.

US Department of Health and Human Services. 2023. "New Surgeon General Advisory Raises Alarm about the Devastating Impact of the Epidemic of Loneliness and Isolation in the United States." Press release, May 3. https://www.hhs.gov/about/news/2023/05/03/new-surgeon-general-advisory-raises-alarm-about-devastating-impact-epidemic-loneliness-isolation-united-states.html.

Woolf, Steven H., and Laudan Aron, eds. 2013. *U.S. Health in International Perspective: Shorter Lives, Poorer Health*. Washington: National Academies Press.

Comments and Discussion

COMMENT BY
CAROLINE HOXBY

STRENGTHS OF THE PAPER Case and Deaton thoroughly and transparently document that Americans who have a BA experience age-adjusted mortality at lower rates than those without such a degree.[1] They show, moreover, that this "mortality gap" has been growing over time. Adopting a novel approach, they mainly rely on death certificate data. These data have limitations, as discussed below, but they also have great advantages—namely, information on two variables that are central to the exercise. These variables are age at death and the proximate cause of death. While death certificate data are not available for all states in the years studied by Case and Deaton, it appears that when a state does make the individual-level data available, the data are comprehensive. Thus, sampling error is not an issue. Also, unlike Social Security death information, the death certificate data contain some demographic data.

I am persuaded by the authors' argument that mortality is an important indicator of a person's welfare and has several advantages over a measure such as wages. First, notwithstanding Horace's "Dulce et decorum est pro patria mori" (often translated as "It is sweet and fitting to die for one's country"), the vast majority of people agree that it is unambiguously negative to die unduly early or to die in suffering.[2] Second, mortality is a lifetime measure that can sum up many years and types of experience. In that sense,

1. The authors focus on two outcomes: age-adjusted mortality and life expectancy for 25-year-olds. For conciseness, I hereafter refer to these outcomes simply as mortality.

2. *Horace: Odes and Epodes*, trans. Niall Rudd (Cambridge, Mass.: Harvard University Press, 2004), 144–45.

Brookings Papers on Economic Activity, Fall 2023: 45–78 © 2024 The Brookings Institution.

it resembles lifetime income rather than fluctuating wages. We also need not debate how to divide the earnings of salaried workers into wages and hours. Third, mortality is unusually comparable across time and space. There is no need to account for inflation or differences in the cost of living.

I am also persuaded that thought-provoking information is contained in a person's cause of death. As we know from their previous work, Case and Deaton (2017, 2020, 2022) are especially interested in "deaths of despair," in which they include deaths from drug overdoses, alcoholic liver disease, and suicide. The phrase is apt: these are often premature deaths associated not only with physical suffering but also with mental suffering. However, other causes of death are informative as well. Death from chronic lower respiratory disease may indicate a lifetime of tobacco smoking or exposure to air pollution. Death from diabetes hints at a lifetime of poor-quality foods, which can be cheaper than less-processed, fresher foods. Some of the evidence that may be unanticipated by readers suggests that part of the widening mortality gap may come from *breakthroughs* in medical treatment. Breast cancer is the most salient example. Breast cancer has traditionally been more prevalent in women who are better educated and more affluent.[3] Therefore, positive breakthroughs in breast cancer treatment are likely disproportionately to benefit more-educated women, widening the mortality gap. In short, cause of death may prompt us toward certain theories about mechanisms that lead to mortality.

Strikingly, the paper shows that the widening mortality gap is associated with causes that are becoming less prevalent for both BA holders and non-BA holders (cancer, cardiovascular disease), becoming more prevalent for both groups (deaths of despair, respiratory diseases, Alzheimer's disease), and becoming less prevalent among BA holders and more prevalent among non-BA holders (alcoholic liver disease, diabetes). This is remarkable: the widening mortality gap arises through all the possible channels. These findings suggest, at a minimum, that many mechanisms may contribute to the gap.

On a cautionary note, my review of the literature suggests that previous researchers have found that the cause of death information on death certificates is incorrect as much as half the time.[4] I return to this issue briefly below when discussing COVID-19.

3. Although some studies claim that the breast cancer–education correlation is due to more-educated women having later first births, a recent meta-analysis suggests that the evidence for this mechanism is less clear than commonly thought. See Løyland and others (2024).

4. There is a large body of research, often based on audits, showing that misreporting of cause of death is common. A good entry into the literature is McGivern and others (2017). My understanding is that age is much less likely to be inaccurate except in cases where the decedent does not die in a hospital, nursing home, or other health care facility.

A noteworthy strength of the paper is that many of the results can be immediately discerned from the figures. The tables mainly serve as confirmation.

DEATH CERTIFICATE DATA AND REVERSE CAUSALITY It is important to flag a potentially major reverse causality issue at the outset.

Since the educational attainment variable on death certificates is so important to the authors' exercise, it is crucial to know whether this variable is recorded accurately. With potential help from the next of kin, funeral directors usually fill in the answers to the questions on educational attainment, occupation, marital status, race, and ethnicity. Funeral directors do not ask for documentation such as college diplomas, college transcripts, or other evidence that a person has attained a BA.

This matters because of reverse causality. Suppose that the funeral director or the next of kin perceived the decedent to be intelligent, conscientious, articulate, planful, and capable of dealing with people who were college educated. Perhaps the decedent had an occupation that we would associate with a BA degree. Then the funeral director or next of kin might check the BA box on the form regardless of whether the decedent actually attained the degree. This action might seem appropriate to them, and their intentions would presumably be innocent. After all, the box-checking person would likely have no idea that the data might later be used to establish the empirical relationship between BA attainment and mortality.

However, inaccuracy of this type would matter a great deal because the decedent's BA designation would *not* be a cause of her acting intelligently, conscientiously, and so on. Rather, her behavior would be the cause of her BA classification. Since the same behavior could also presumably affect her mortality, it is crucial to know how death certificate data stand up to cross-validation from other, more authoritative, administrative sources. It would be unfortunate if reverse causality were an important explanation for the authors' results.

Rather surprisingly, the authors do not discuss the known tendency of educational attainment data from death certificates to overstate what people self-report through the Current Population Survey.[5] (The linked data set is known as the National Longitudinal Mortality Study.) I hesitate even to treat Current Population Survey data as a gold standard because people who are inclined to overstate their education on a survey may also overstate it to their family members. Ideally, we would like to have audits that rely on an authoritative administrative source such as the National Student

5. See Rostron, Boies, and Arias (2010); Rostron (2010); Feldman, Makuc, and Mussolino (1997); Sorlie and Johnson (1996); and Shai and Rosenwaike (1989).

Clearinghouse, which derives its individual-level longitudinal data from postsecondary institutions' records. Even validation using more aggregated data that institutions report to the US Department of Education (the Integrated Postsecondary Education Data System [IPEDS] and its predecessors) would be helpful.

Of course, what we want to know is not just whether BA attainment is overstated on death certificates. We want to know *for whom* it is overstated. Is it overstated for those whose behavior and environment are associated with low mortality (reverse causality)? Or is it overstated at random? The studies that rely on the National Longitudinal Mortality Study do not contain enough detail to answer this question well, but their findings provide a couple of hints. First, education is more likely to be overstated for people who are older when they die. Second, the studies find that much of the overstatement is among people who self-reported that they attended some high school or some college but who did not graduate with a high school degree or a BA, respectively. In other words, funeral directors and next of kin may use their discretion to "round up" to the next degree.

Later, I discuss the authors' within-cohort test for selection versus causality. That test relies on the assumption that people do not attain additional education after a certain age. Because reverse causality may affect death certificate data, that test is frail. In the funeral director and next of kin example above, the decedent would appear to have attained a BA late in life.

I discuss an additional problem with the relevant test below.

THE GENERAL PROBLEM OF CAUSALITY VERSUS SELECTION The alert reader may have noticed that, so far, I have avoided the language of causality but have written of associations, correlations, hints, suggestions, and the like. This restraint is because all of the facts and mechanisms described in the paper are consistent both with causal effects and selection. A causal effect would be one in which getting a BA degree literally causes people to change their behavior or environment in a way that reduces mortality. The most obvious example would be taking up an occupation that requires a BA degree because of licensing or a similar rule. If that occupation were physically safer, involved less exposure to pollution, or qualified people for more generous preventative health insurance, then the BA-to-mortality link would have a mechanism that could probably be demonstrated using statistical indices of on-the-job accidents, workplace air quality meters, or take-up of recommended tests (such as for colon cancer) that were paid for by health insurance.

However, the people who select into getting a BA degree may differ on numerous dimensions from non-BA holders. For instance, they may discount the future less, as a matter of preference, and therefore invest more in both education and behaviors likely to prolong life. For instance, it is very plausible that people who discount the future less will find it preferable to refrain from smoking. Or, people who select into obtaining a BA may have higher native aptitude and thus be more likely to read medical instructions or compute nutritional content correctly. These would *not* be causal effects of the BA if the findings on the BA-mortality relationship would change substantially—or even disappear—if we were randomly to prevent some people from obtaining a BA that they would otherwise attain. We might also randomly treat some people with a degree (literally, force them through education and diploma receipt that they would otherwise not obtain), but this is a harder experiment to imagine.

The degree to which the BA-mortality relationship reflects causality or selection matters greatly because the policy implications differ. If the relationship is largely causal, society could improve mortality by inducing a larger share of people to attain a BA. Society could then not worry about addressing other possible mechanisms directly because the degree itself would generate the desired behaviors. The BA itself would cause smoking to fall. Anti-smoking laws and tobacco taxes would not be nearly as necessary.

It seems likely that some mechanisms are indeed causal as illustrated by the occupational example given above. Moreover, if selection into getting a BA had not changed over the period under study, one could not credibly construct a scenario in which selection accounted for much of the *change* in the mortality gap. That is, causal mechanisms would have to be at work if there were no changes in the nature of selection in BA attainment. Unfortunately for the causal case that the authors clearly wish to make (given the causal language that they consistently use), there have been very substantial changes in selection. Specifically, the share of each cohort obtaining a BA has risen greatly over time (shown below) even though the share of each cohort who are prepared for college has not improved in a parallel way. This makes it very unlikely that selection has not changed.

The authors are aware that changes in the nature of selection could pose a serious problem for causal interpretation of their findings. Indeed, the paper contains a short section that notes that selection could interact with mortality risk in ways that could be problematic and that cannot be ruled out except by making assumptions that cannot be verified with observable data. These issues, while known to the authors, were not covered in sufficient detail for audience members to grasp them fully. Thus, it might be helpful to show a few simple figures to illustrate the problem.

Fundamentally, we cannot observe a person's *latent mortality risk*, which is defined as the risk stemming from all factors that would exist in the absence of attaining a BA. It may help to think of a randomized trial in which some people are randomly forbidden to get a BA but are exactly the same people they would otherwise be. Factors that make latent mortality risk unobservable include preferences, aptitudes, genetics, home environment, and many behaviors that a statistician or econometrician cannot see or measure at all well.

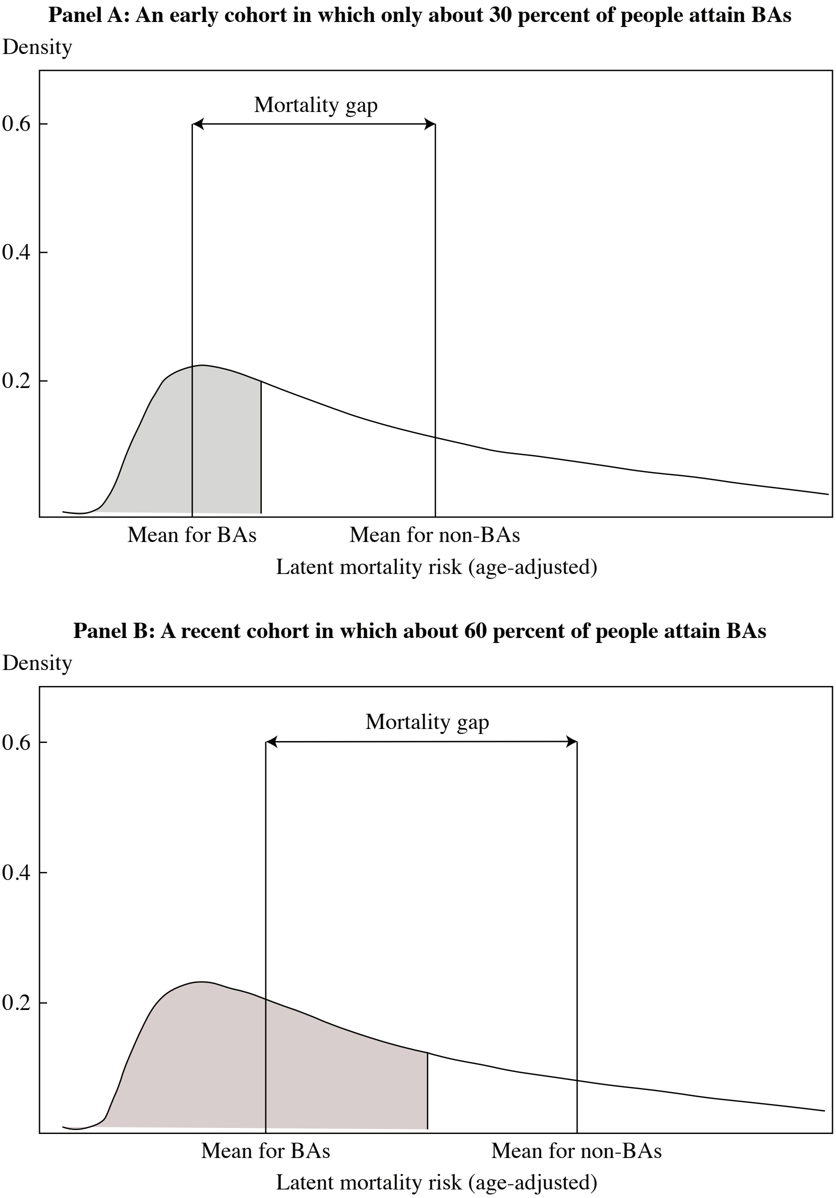
It is highly probable that the factors that affect latent mortality risk also affect a person's latent educational attainment—the education that a person would attain in the absence of any randomized intervention such as that described above. Any given factor might have a different effect on latent mortality risk than on latent attainment, so the two latent variables need not be highly correlated. However, to keep the figures in two rather than three dimensions, I assume that they are perfectly correlated. This is without loss of generality, but it makes the figures easier to interpret.

The figures are necessarily stylized since we do not know the distribution of latent mortality risk. Nevertheless, I have used Gompertz probability density functions since research suggests they fit *observed* mortality well, which, although not the same as *latent* mortality risk, probably reflects some of the shape of the latent risk (Juckett and Rosenberg 1993). I have also tried to stick fairly close to the facts, shown below, on the changing nature of selection into attaining a BA. For instance, I show the share of people with BA attainment rising by a realistic amount from early cohorts (about 30 percent) to recent cohorts (about 60 percent). It should be understood, however, that this is a demonstration of the importance of knowing the distribution of latent mortality. It is not an empirical analysis.

Figure 1 illustrates a situation in which the changing nature of selection into the BA is only a moderate problem. In panel A, about a third of an early cohort, shown in the shaded part of the probability density function, get a BA degree. The BA holders are drawn from the lowest part of the mortality risk distribution. Thus, BA holders have lower average mortality risk than the average risk of non-BA holders. The latent mortality gap is the distance between the non-BA holders' average risk and the BA holders' average risk.

Panel B represents a recent cohort in which BA attainment is less selective. That is, a larger share of the cohort, shown as two-thirds of the distribution, get a BA. Again, the mortality gap is shown as the distance between the non-BA holders' average risk and the BA holders' average risk. The mortality gap has risen by about 28 percent due entirely to the changing nature of

Figure 1. Mortality Gap Derived from a Latent Mortality Risk Distribution with a Low Peak



Source: Author's illustration.

Note: The figure is a stylized representation in which people who attain BAs have lower latent mortality than people who do not attain BAs. The mortality gap is defined as the average latent mortality risk among non-BAs minus the average latent mortality risk among BA holders. The distribution is based on the shape of a Gompertz distribution with $\alpha = 1.3$, $\beta = 1.2$, and $\gamma = 0.7$.

selection, with BA attainment having no causal effect on mortality. (The exact percentage increase does not matter.) The mortality gap, in the case illustrated, rises moderately purely through selection because the marginal "switchers" into the BA group have sufficiently low mortality risk that, although their joining the BA group raises the average risk in both groups, it raises it more in the non-BA group than in the BA group.

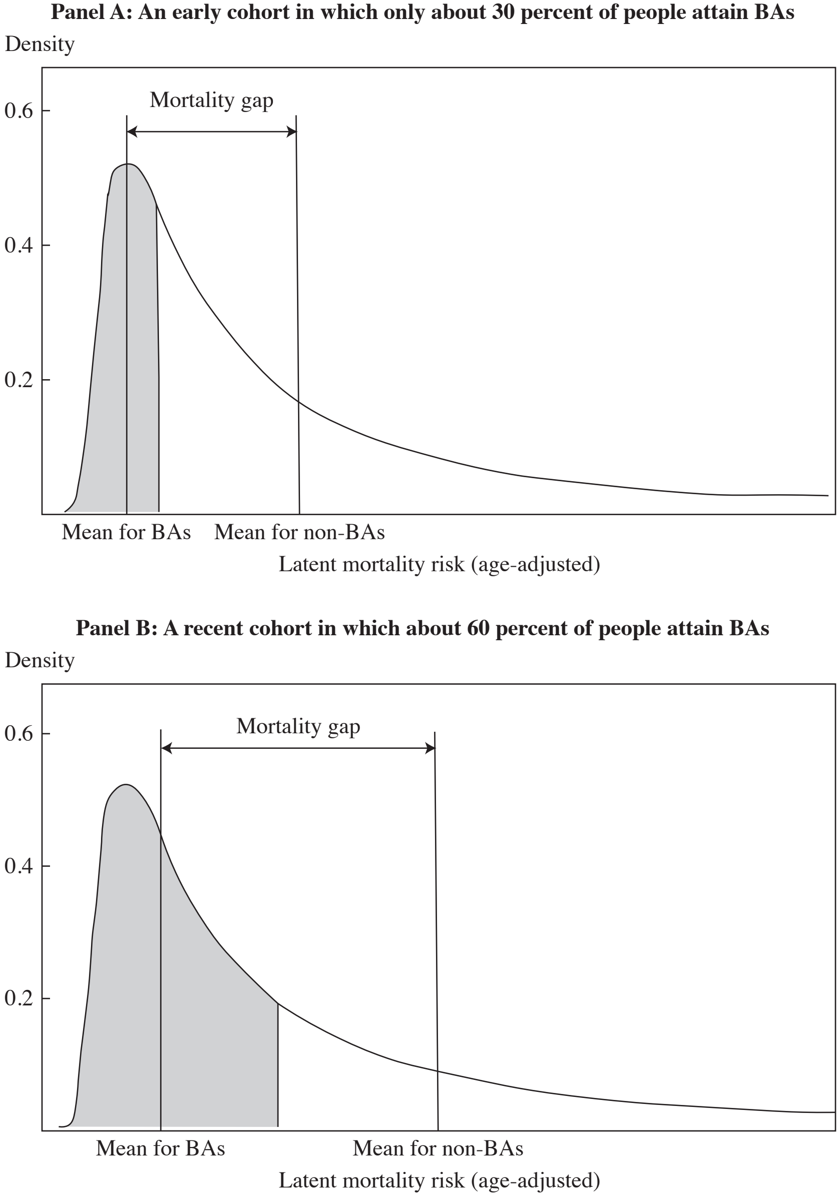
Fgure 2, panel A, shows an early cohort with a Gompertz-type density that is more strongly peaked in the lower range of mortality risk. (By more strongly peaked, I mean that α is lower while β and γ are the same as in figure 1.) Again, about a third of the early cohort get a BA degree. They are in the shaded part of the distribution and have very low average mortality risk owing to the shape of density function. Average latent mortality risk among non-BA holders is substantially higher. Notice that the non-BA holders include both some very low-risk people and a long tail of high-risk people. As in the previous figure, the mortality gap is the difference in average latent mortality risk between the non-BA holders and the BA holders.

Finally, figure 2, panel B, represents a recent cohort with the more strongly peaked distribution of mortality risk. As in figure 1, panel B, about two-thirds of the cohort get a BA because, in recent years, attainment has become less selective. Compared to that of the early cohort (panel A), the mortality gap has risen sharply. Specifically, the mortality gap has risen by about 60 percent due entirely to the changing nature of selection, with BA attainment having no causal effect on mortality. As in the previous example, the switchers into the BA group raise the average risk of both the BA holder and the non-BA holder groups. However, since the density is so peaked in the lower range of risk, the BA holders' risk does not rise nearly as much as the non-BA holders' risk, the latter of which reflects the distribution's long tail.

It should now be clear that the *shape* of the latent mortality distribution matters a great deal. But this is a shape that we cannot observe because the latent risk is, well, *latent*. Thus, both of the previous examples are plausible, and it is impossible to determine the true role of selection in causing the mortality gap to expand.

Since the latent distribution's shape matters, it is possible to devise examples in which selection has no effect on the mortality gap because the switchers generate an equal rise in the mortality risk of both the BA and non-BA groups. This type of example is one emphasized by the authors. It is even possible to devise examples in which selection lowers the mortality gap because the shape of distribution is such that switchers generate only a small rise in risk among non-BA holders but generate a large rise in risk among BA holders. However, this type of example is not worth illustrating

Figure 2. Mortality Gap Derived from a Latent Mortality Risk Distribution with a High Peak



Source: Author's illustration.

Note: The figure is a stylized representation in which people who attain BAs have lower latent mortality than people who do not attain BAs. The mortality gap is defined as the average latent mortality risk among non-BAs minus the average latent mortality risk among BA holders. The distribution is based on the shape of a Gompertz distribution with $\alpha = 0.8$, $\beta = 1.2$, and $\gamma = 0.7$.

here because it does not seem pertinent to the paper under discussion. Moreover, it is easiest to create such examples with distributions that have long left tails and peak density on the right. While I cannot miraculously observe latent densities, it is doubtful whether distributions with such shapes are relevant. This is owing to the aforementioned tendency of Gompertz-shaped distributions to fit observed mortality data best.[6]

Even though I kept my examples simple, they make it clear that there are no easy ways to quantify the degree to which the observed increase in the mortality gap reflects causal effects versus selection. I discuss possible quasi experiments below.

A BRIEF REVIEW OF THE CHANGING NATURE OF SELECTION INTO BA ATTAINMENT It is worthwhile showing just a few obvious pieces of evidence on the changing nature of selection into BA attainment.

In a nutshell, a larger share of each high school graduating cohort has obtained a BA. This is despite later cohorts being apparently no more prepared than earlier cohorts. This suggests that BA granting has become a less selective and probably less challenging process over time. This is not surprising because many of the additional seats that have been added in postsecondary education are in colleges that have always been nonselective or barely selective.[7] That is, seats have been disproportionately added at schools that anyone with a high school degree or General Educational Development (GED) can attend. Seats have also been disproportionately added at institutions that are for-profit, online, or both.

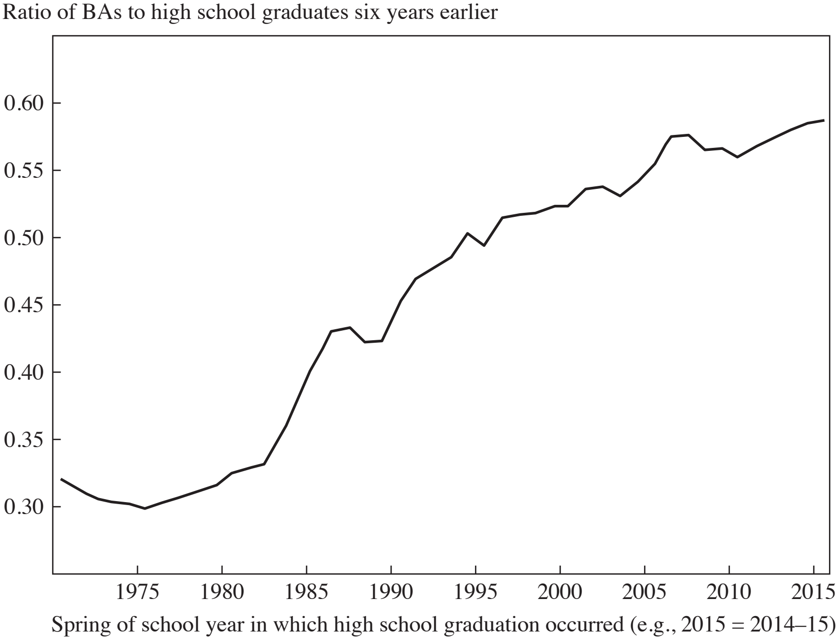
Figure 3 shows that the ratio of the number of BAs conferred to the number of high school graduates doubled from 30 percent among 1975 high school graduates to 59 percent among their 2015 counterparts.[8]

6. Distributions that compete with Gompertz are the Weibull and lognormal distributions. These have similar shapes to the Gompertz distributions and do not exhibit long left tails and density peaks in the high-risk range. See Juckett and Rosenberg (1993).

7. Author's calculations based on IPEDS data up through 2022 (the most recent year). For a summary of similar results that are not quite so recent, see Baum, Kurose, and McPherson (2013).

8. High school graduates in 2015 are the most recent for whom such numbers are available. It is conventional in education policy research to allow a lag of six years between high school graduation and the attainment of a BA. This is known as completion within 150 percent of time, and statistics on on-time completion tend to be recorded with this lag. See online documentation for IPEDS. The *Digest* data used to construct figure 3 are derived from the school-level data in IPEDS and the Common Core of Data, both of which are provided by the National Center for Education Statistics. One can make more-detailed calculations using IPEDS institutional data on completions by age for 150 percent of time and 200 percent of time. Such calculations produce similar patterns as figure 3 shows. The complexities involved in making such calculations could not be properly described in a short discussion.

Figure 3. Ratio of BAs to High School Graduates Six Years Earlier: High School Graduates from 1970 to 2015



Source: Author's calculations based on NCES, *Digest of Education Statistics*: 2021, tables 219.10 and 322.10; 2018, table 322.10; 2013, table 318.10; 1995, tables 98 and 236.

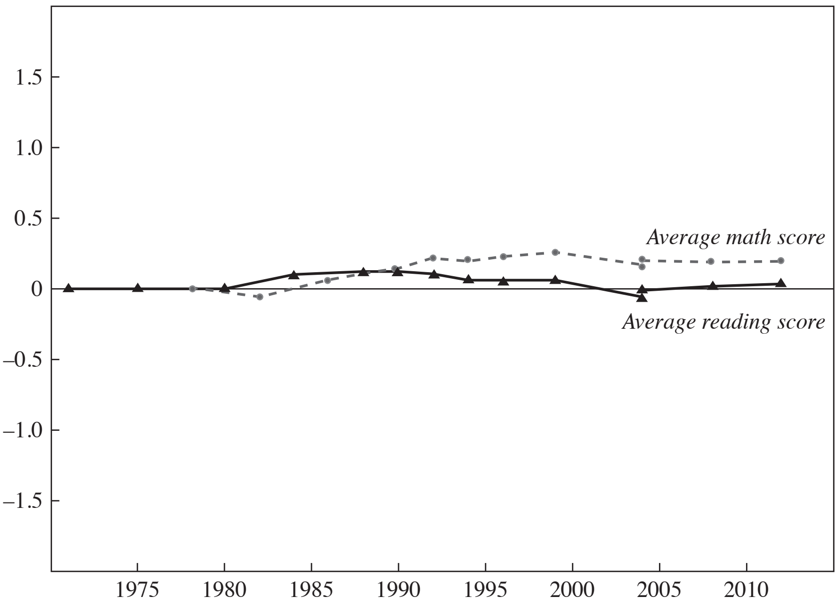
Note: Later *Digest* published numbers are used in preference to earlier published ones, which are more likely to have been revised.

We can get a sense of the changing nature of selection when we compare the doubling of the share attaining a BA to the lack of improvement in precollege achievement. Figure 4 shows the results of high school seniors (17 years old) on the National Assessment of Education Progress (NAEP) long-term trend tests in mathematics and reading. These are tests given to nationally representative samples of students. The long-term trend tests are deliberately designed to facilitate comparisons over decades. Figure 4 shows the results in standard deviation units where the earliest year's results are normalized to zero, both for reading and mathematics. This is a conventional way to represent scores that would otherwise be on an unfamiliar scale that readers would find hard to interpret.[9]

9. See Beaton and Chromy (2010). Page 52 is especially relevant.

Figure 4. NAEP Math and Reading Scores among 17-Year-Olds (High School Seniors): High School Students from 1970 to 2012

Normalized earliest year = 0, standard dev units



Source: Author's computations based on reports derived from the NAEP long-term trend data reports for 17-year-olds, https://www.nationsreportcard.gov/ndecore/xplore/ltt.

Note: Scale scores are normalized so that the earliest year shown has its score equated to zero. The scores are shown in standard deviation units, and the standard deviations are based on Beaton and Chromy (2010).

If US students' achievement were improving relative to the earliest years in which the tests were given, then we would expect a rise in scores by at least one standard deviation between the 1971 high school senior cohort (the earliest) and the 2012 cohort (the latest). These are, after all, forty-two cohorts who cover the dramatic growth in BA attainment, shown in figure 3. It is not only the *average* high school senior's NAEP scores that have hardly budged over four decades. The *distribution* of scores (not shown here) has also not changed much. Based on the latest 2019 "main NAEP" tests of high school seniors, only about 24 percent could fairly confidently be predicted to be "college-ready" in mathematics, according to the ACT's empirically based standard. A similar percentage are "college-ready" in reading. In short, only about a quarter of high school seniors are well prepared to thrive in college.[10] Yet, in recent cohorts, about 60 percent attain a BA. Selection into the BA has apparently changed.

Other evidence that selection into the BA has changed comes from the National Center for Education Statistics high school longitudinal studies of the high school graduating classes of 1972, 1982, 1992, and 2004.[11] These studies contain mathematics tests taken by nearly all the participants, and the tests are designed to be comparable over all the graduating classes.[12] The study participants are followed for at least eight years after their senior year of high school.

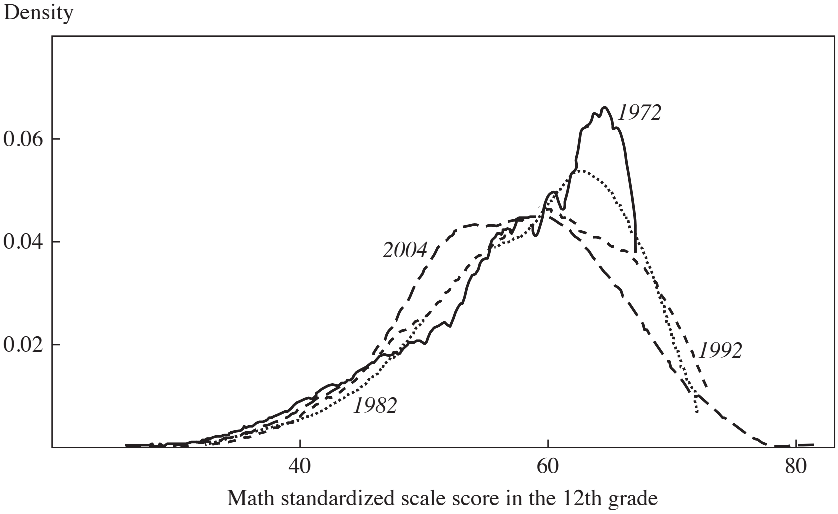
Figure 5 shows that the distribution of high school mathematics scores among BA holders has been shifting downward from the 1972 graduating cohort to the 1982 cohort to the 1992 cohort to the 2004 cohort. The mean, median, and mode are all shifting downward. Moreover, the distribution

10. There is a strong psychometric relationship between the long-term trend NAEP and main NAEP, the latter of which is designed to be more flexible across years. See Beaton and Chromy (2010). See Xi and others (2020), pages 10–11 for conversions between the main NAEP and college-readiness. In mathematics, one can be about 80 percent confident that students who meet the Proficiency standard (score of 176) on the main NAEP are college-ready (a very similar score of 180). The source for the 2019 percent Proficient and Above mathematics number is *Digest of Education Statistics*: 2022, table 222.12. In reading, the college-readiness standard (a score of 324) lies midway between the Proficient standard (a score of 302) and Advanced standard (a score of 346) on the main NAEP. Since only about half (about 15.5 percent) of the Proficient students are college-ready while all 6 percent of the Advanced students are college-ready, the total percent of the students who are college-ready in reading is approximately 21.5 percent. The source for the 2019 percent Proficient and Advanced reading numbers is *Digest of Education*: 2022, table 221.12.

11. The studies are the National Longitudinal Study of the Class of 1972 (NCES 1981), High School and Beyond (class of 1982), the National Education Longitudinal Study (class of 1992), and the Education Longitudinal Study (class of 2004). Unfortunately, the most recent study (class of 2013) has not yet been followed up long enough for us to ascertain who will and will not earn a BA. For a description of all the studies and their design, see National Center for Education Statistics (NCES), "Secondary Longitudinal Studies Program," https://nces.ed.gov/surveys/slsp/. The data sources are NCES, *National Longitudinal Study of 1972: Base Year (1972) through Fourth Follow-Up (1979)*, electronic data (1981); *High School and Beyond Fourth Follow-up (Sophomore Cohort) HS&B 1992,* electronic data from NCES 95305 (1995); *National Education Longitudinal Survey of 1988 (NELS88) Base Year through Fourth Follow-up*, electronic data from NCES 2003-348 (2003); *ELS: 2002 Base Year to Third Follow-up Postsecondary Transcripts*, electronic data in NCES 2015-314 (2015); *National Longitudinal Study of 1972: Base Year (1972) through Fourth Follow-Up (1979)*, electronic data (1981).

12. Unfortunately, only mathematics tests are available for all of the cohorts. However, mathematics scores are highly correlated with reading, science, and social studies scores for the cohorts that have the full array of scores available. The sample in each study is designed to be nationally representative when the appropriate sample weights are used.

Figure 5. Distribution of Math Scores among High School Seniors: High School Seniors in the Graduating Classes of 1972, 1982, 1992, and 2004



Source: Author's calculations.

Note: Density plots of 12th-grade math scores of participants in secondary school longitudinal surveys implemented by NCES for 1981, 1995, 2003, and 2015.

of college-incoming scores has been widening, mainly because additional density has been added to low range of scores. Simply put, students whose scores would not have led them to BAs in earlier years are, in recent years, attaining BAs. This is an indicator that selection into the BA has changed.

Over time, much of the growth in BAs has come from schools that have never been selective in the sense that any student can enroll who has a high school degree or passing score on the GED test. While some of the growth is attributable to publicly controlled colleges, much of the recent growth is attributable to for-profit schools, a good share of which are wholly or partly online (Hoxby 2018a). There is controversy about whether these schools provide rigorous educational experiences. At these schools, a large share of students who are enrolled in BA programs drop out long before attaining a BA. However, the students who do persist, even if they are not stellar academically, may have traits that are valuable for reducing mortality risk. For instance, the students who attain BAs in these unpropitious environments may have high long-term orientation, grit, motivation, or support from their families. This is a speculation based on my analysis that shows that only students who persist over five or more years realize returns to this type of postsecondary education (Hoxby 2018b).

While on the topic of nonselective, for-profit, and online schools, it should be noted that students at these institutions are, on average, in their mid-thirties, not in their late teens or early twenties. The average age is 35 among students in schools that are at least partially online, and numerous students are in their forties (Hoxby 2018b). Such students often say that they are seeking BAs because they are "getting their life together" or realize that they made poor educational decisions when they were younger. These facts matter because the authors' main test of whether selection matters depends on there being little or no actual growth in BA attainment within a cohort over time, but schools that serve older students represent the fastest growing sector of postsecondary education and the older students who do attain BAs may be especially capable.

MIGHT NATURAL OR QUASI EXPERIMENTS IDENTIFY THE CAUSAL EFFECTS OF BA ATTAINMENT ON MORTALITY? While preparing to discuss the authors' paper, I wracked my brain in an attempt to think of a natural or quasi experiment that could credibly identify the causal effects of a BA degree on mortality among Americans. I did this for two reasons. The first is simply that I enjoy being constructive in this way. The second is that the exercise is a good way to sharpen one's thinking on the sources of variation in an outcome. If one cannot think of any exogenous or arbitrary sources of variation in an outcome that could account for the observed scale of the variation in the outcome, then perhaps there really is not much exogenous variation. Some phenomena are generated by interactions that are too complex or subtle to be reduced to an effect that can be described simply, such as the effect of having a BA. This does not mean that the phenomena are not real. For instance, many people believe that love is a real phenomenon and that people who experience more love have better outcomes. However, it would seem almost absurd to argue that if person A could just induce person B to love her, person A would have better outcomes. This would be the stuff of love elixirs from Jacobean drama.

Returning to the problem of BA attainment, I considered the numerous natural, policy, or quasi experiments that credibly prompt some people to get a BA when they would not otherwise do so. Most often, these are scholarships or other inducements to attain a BA degree. Relevant studies occasionally rely on actual randomization but more often rely on empirical designs such as a regression discontinuity in the eligibility for the scholarship. Such studies credibly identify the causal effects of BA receipt on early career earnings, unemployment, and many more outcomes. However, these studies typically do not lend themselves to mortality as an outcome because it is so uncommon among the relatively young that almost any study that does not depend on a very large-scale experiment will fail for reasons of statistical power.

Angrist (1990), in a well-known paper, used a person's draft lottery number as an instrument for serving in the Vietnam War. This is a quasi experiment on such a large scale that statistical power is not an issue. Moreover, veterans were eligible for generous college financial aid after returning to the United States. So one might surmise that draft lottery numbers were a credible instrument for attaining a BA and thus for obtaining estimates of the causal effects of a BA on mortality. Indeed, Vietnam era people are sufficiently aged at present that they are at reasonable risk of mortality. However, as Angrist himself would almost certainly argue, the draft lottery affected outcomes other than educational attainment—most importantly, service in Vietnam. Since such service might easily affect mortality through exposure to war-related disabilities, trauma, exposure to Agent Orange, and a myriad of other phenomena, it would be nigh impossible to disentangle the role of BA attainment on mortality. Quasi experiments along these lines, including those that rely on various GI Bill benefits, often run into such difficulties, although the difficulties can sometimes be overcome.

Another quasi experiment that is seemingly close to what the authors want to turn on and off is the Chinese Cultural Revolution, during which many people who would otherwise have obtained a university degree were forcibly sent to rural China and forbidden from pursuing higher education. One might think that exposure to the Cultural Revolution was quasi-random. After all, some people were born in a cohort that was less exposed. Others were born in a proximate cohort that was fully exposed. Here, we have an experiment of incredibly large scale in which not merely the university diploma is turned on and off. Many of the mechanisms that the authors describe as influenced by BA receipt are potentially affected as well. The problem is that the Cultural Revolution had dramatic general equilibrium effects. It greatly changed universities (depriving them of skilled faculty), generated chaos in the economy, and affected some people and regions far more than others ("conservative" people were more likely targets, and some areas experienced much more violence).

A final quasi experiment, one that may hold some promise for exercises like the authors', is relying on differences among US states in the timing and level of their support for public universities. Increases in such support appear to induce more students to complete BAs (Bound, Lovenheim, and Turner 2010). Since death certificates include specific locational data as well as age data, one might gain traction on causality versus selection using state-by-time differences in colleges' funding and seats. A researcher would need to argue that the timing of sharp funding differences is quasi-random within proximate cohorts and is unrelated to other coincident phenomena such as local economic downturns. The study closest in spirit is Fletcher and Noghanibehambari (2024), although they use college expansions, which have been shown to have problematic associations with variables that reflect an area's improving population and/or improving economy.

Summing up, the exercise of thinking through numerous quasi experiments did not impress me with the idea that BA attainment has been affected by exogenous forces of sufficient scale and impact to account causally for all—or even the vast majority—of the observed changes in the relationship between mortality and BA completion. I would therefore counsel more reticence regarding language and arguments that explicitly or implicitly make claims for causal effects, even if causal effects account for a substantial share of the facts described. Descriptive evidence makes important contributions to economics because it arms us with facts that we must work to explain. However, a conflation between descriptive evidence and credibly causal evidence—such as often occurs in nonexperimental health research—is not especially helpful to refining economists' logical skills.

HAVING A BA AND REMOTE WORK DURING COVID-19 The authors are careful to show the mortality gap with and without deaths attributed to COVID-19. Such evidence is helpful, and I was grateful for it when reading the paper. However, I find the COVID-19 evidence to be somewhat unconvincing because many deaths that were related to COVID-19 did not record the virus as the proximate cause of death. This has been shown convincingly in studies of excess mortality (Paglino and others 2024). Thus, removing the deaths that were formally attributed to COVID-19 does not solve the problem that mortality gaps expanded in a way that were highly anomalous during the pandemic. I find the chasmal mortality gaps in that period to be uninformative.

Moreover, when the authors argue, albeit with caution, that the pandemic-related changes in the mortality gap are useful, they unintentionally undermine their argument that selection is unimportant. Selection into COVID-19 exposure was involuntary for many people whose *existing* jobs made it difficult to work remotely or telecommute, in the language used by the Bureau of Labor Statistics (BLS). The pandemic was a temporary and unforeseen shock to the mortality risk associated with being in proximity to other people. It was not a shock to BA attainment. It also did not trigger a permanent change in mortality risks that might be *caused* by attaining a BA—such as a BA being a condition for a license in occupations that are permanently associated with low health risks or better health insurance. Rather, people

Table 1. Percentage of Employed People Who Worked Remotely during COVID-19 and in Occupations Classified as Suitable for Remote Work, by Educational Attainment

Educational attainment	*Teleworking during COVID-19, by educational attainment*	*In a suitable job for teleworking*
Less than a high school diploma	3.3	10.2
High school graduate, no college	8.8	25.8
Some college, associate's degree	16.9	40.3
Bachelor's degree only	40.6	63.4
Advanced degree	54.4	71.3

Source: Data from Dey and others (2021).

who already lacked BAs were disproportionately likely to be incumbents in jobs that were unsuitable for temporary remote work. This is not an argument for the power of the causal mechanisms that could plausibly have been the source of the growth in the mortality gap *over decades*. If grocery store cashiers or meat-processing workers had experienced helicopter drops of BA diplomas, their COVID-19-related exposure risks would not have decreased precipitously because they would have, say, suddenly and voluntarily adopted healthier behaviors. Therefore, the sharp and dramatic mortality increases among non-BA holders is not a causal effect of their lacking BAs.

In table 1, I show results from a recent BLS study that shows that non-BA holders were much less likely to work remotely during the height of the pandemic. The second column in the table shows that a primary explanation for this phenomenon is that their existing jobs were less suitable for remote work. The BLS study does not attempt to argue that a lack of attainment *caused* the non-BA holders voluntarily to adopt less healthy behaviors or that having a BA would have quickly switched them to healthier environments.

ADDITIONAL THOUGHTS I do not see why, based on causal logic, one would prefer a binary BA/non-BA measure to more continuous measures of cognition, achievement, or attainment. Nearly all of the causal arguments made by the authors are inherently *continuous*, not discrete at the margin of obtaining a BA. For instance, if improved health behaviors are caused by increases in knowledge, such improvements would surely be continuous in educational attainment, not affected discretely by the receipt of a BA diploma.

Once a state starts asking about educational attainment on its death certificates, its categories are several, not just non-BA versus BA. For instance, a Pennsylvania death certificate provides multiple categories of attainment: 8th grade or less, 9th through 12th grades with no diploma, high school graduate or GED, some college but no degree, associate's degree, bachelor's degree, master's degree, doctorate or professional degree. Since the causal arguments for the effects of educational attainment on mortality are continuous, there would seem to be little reason for the authors to rely exclusively on the binary BA measure. The literature on signaling has long associated certain degrees with being signals of unobserved aptitudes. Classic signaling is an expression of equilibrium *selection on unobserved traits*. While I am certainly not one to argue that most education is a signal rather than an investment in human capital, I see no reason to focus on the discrete BA measure. By using more continuous measures of attainment, the authors might allay some concerns about selection versus causality.

It would be useful to distinguish between changes over time that are due to behaviors that people themselves at least partially control (diet, substance abuse) and changes that could not possibly be controlled by an individual (medical advances in heart surgery or cancer treatment). The distinction is important because the latter causal mechanisms can only run through processes that are observable and thus testable. For instance, suppose a person has a cancer for which there is a medical breakthrough. It might be that BA holders get the new treatment first or attend their therapy sessions more regularly. However, the BA holders do not determine the timing of the breakthrough: earlier cohorts might have died even if they were vigilant about preventative medicine and diagnosis. Furthermore, medical data would allow us to observe that BA holders were indeed obtaining the breakthrough procedures. We would also likely be able to link the BA holders to what was allowed under their health insurance. Such intermediate evidence on mechanisms can help support arguments for causality.

In contrast, individuals' actual diets are largely under their control and mysterious to econometricians—sometimes even to their fellow household members. Even Nielsen households can strategically omit to record their consumption of junk food or alcohol. Thus, we have no real hope of getting accurate, administrative data on dietary mechanisms that would be analogous to the data we could obtain on cancer treatment. As a result, the problem of selection is far less remediable for certain proposal channels—such as diet—of causal BA effects.

Summing up, I derived a lot of benefit from this paper for all of the reasons stated in the first section. It is extremely thorough and contains many striking results, presented coherently. However, my own interpretation is much more cautious, with regard to causality, than that of the authors.

REFERENCES FOR THE HOXBY COMMENT

Angrist, Joshua D. 1990. "Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records." *American Economic Review* 80, no. 3: 313–36. http://www.jstor.org/stable/2006669.

Baum, Sandy, Charles Kurose, and Michael McPherson. 2013. "An Overview of American Higher Education." *Future of Children* 23, no. 1: 17–39.

Beaton, Albert E., and James R. Chromy. 2010. *NAEP Trends: Main NAEP vs. Long-Term Trend*. San Mateo, Calif.: American Institutes for Research. https://www.air.org/sites/default/files/2021-06/NAEP_Trends_12-6-10_0.pdf.

Bound, John, Michael F. Lovenheim, and Sarah Turner. 2010. "Why Have College Completion Rates Declined? An Analysis of Changing Student Preparation and Collegiate Resources." *American Economic Journal: Applied Economics* 2, no. 3: 129–57.

Case, Anne, and Angus Deaton. 2017. "Mortality and Morbidity in the 21st Century." *Brookings Papers on Economic Activity*, Spring, 397–476.

Case, Anne, and Angus Deaton. 2020. *Deaths of Despair and the Future of Capitalism*. Princeton, N.J.: Princeton University Press.

Case, Anne, and Angus Deaton. 2022. "The Great Divide: Education, Despair, and Death." *Annual Review of Economics* 14: 1–21.

Dey, Matthew, Harley Frazis, David S. Piccone Jr., and Mark A. Loewenstein. 2021. "Teleworking and Lost Work during the Pandemic: New Evidence from the CPS." *Monthly Labor Review*, Bureau of Labor Statistics. July. https://www.bls.gov/opub/mlr/2021/article/teleworking-and-lost-work-during-the-pandemic-new-evidence-from-the-cps.htm.

Feldman, Jacob J., Diane M. Makuc, and Michael E. Mussolino. 1997. "Validity of Education and Age as Reported on Death Certificates." In *1996 Proceedings of the Social Statistics Section*. Alexandria, Va.: American Statistical Association.

Fletcher, Jason, and Hamid Noghanibehambari. 2024. "The Effects of Education on Mortality: Evidence Using College Expansions." *Health Economics* 33, no. 3: 541–75. https://doi.org/10.1002/hec.4787.

Hoxby, Caroline M. 2018a. "Online Postsecondary Education and Labor Productivity." In *Education, Skills, and Technical Change: Implications for Future US GDP Growth*, eds. Charles R. Hulten and Valerie A. Ramey. Chicago: University of Chicago Press.

Hoxby, Caroline M. 2018b. "Online Postsecondary Education and the Higher Education Tax Benefits: An Analysis with Implications for Tax Administration." *Tax Policy and the Economy* 32, no. 1: 45–106.

Juckett, David A., and Barnett Rosenberg. 1993. "Comparison of the Gompertz and Weibull Functions as Descriptors for Human Mortality Distributions and Their Intersections." *Mechanisms of Ageing and Development* 69, no. 1–2: 1–31.

Løyland, Borghild, Ida Hellum Sandbekken, Ellen Karine Grov, and Inger Utne. 2024. "Causes and Risk Factors of Breast Cancer, What Do We Know for Sure? An Evidence Synthesis of Systematic Reviews and Meta-Analyses." *Cancers (Basel)* 16, no. 8: 1583.

McGivern, Lauri, Leanne Shulman, Jan K. Carney, Steven Shapiro, and Elizabeth Bundock. 2017. "Death Certification Errors and the Effect on Mortality Statistics." *Public Health Reports* 132, no. 6: 669–75.

Paglino, Eugenio, Dielle J. Lundberg, Elizabeth Wrigley-Field, Zhenwei Zhou, Joe A. Wasserman, Rafeya Raquib, and others. 2024. "Excess Natural-Cause Mortality in US Counties and Its Association with Reported COVID-19 Deaths." *Proceedings of the National Academy of Sciences* 121, no. 6: e2313661121.

Rostron, Brian L. 2010. "Socioeconomic Differences in Education Reporting and Their Effect on Estimates of Life Expectancy by Educational Attainment in the U.S." Paper prepared for the Population Association of America 2010 Annual Meeting, Dallas, Texas, April 15–17. https://paa2010.populationassociation.org/papers/100300.

Rostron, Brian L., John L. Boies, and Elizabeth Arias. 2010. "Education Reporting and Classification on Death Certificates in the United States." *Vital and Health Statistics* Series 2, no. 151. Hyattsville, Md.: National Center for Health Statistics.

Shai, Donna and Ira Rosenwaike. 1989. "Errors in Reporting Education on the Death Certificate: Some Findings for Older Male Decedents from New York State and Utah." *American Journal of Epidemiology* 130, no. 1: 188–92.

Sorlie, Paul D., and Norman J. Johnson. 1996. "Validity of Education Information on the Death Certificate." *Epidemiology* 7, no. 4: 437–39.

Xi, Nuo, Mei-Jang Lin, Laura Jerry, David Freund, and Helena Jia. 2020. "NAEP Grade 12 Academic Preparedness Research: Establishing a Statistical Relationship between NAEP and ACT Assessments in Reading and Mathematics." Washington: National Center for Education Statistics.

COMMENT BY

JONATHAN SKINNER[1] The association between education and mortality has been well understood for more than a half century. In a remarkable study, Kitagawa and Hauser (1968, 1973) and their team linked 340,000 death records from 1960 to the recently conducted 1960 US Census to measure the education-mortality gradient at the national level. For people with fewer than eight years of education (which at the time comprised nearly a quarter of the population), they found 48 percent higher midlife (age 25–64) mortality among white men and 68 percent among white women, compared to those with some college. While these mortality gaps in 1960 were substantial, they have grown much larger since then. By 1986, the midlife mortality ratio for college graduates relative to those without a high school degree had risen to 171 percent for white men and 88 percent for white women

1. I am grateful to Christopher Foote and Ellen Meara for helpful suggestions.

(Pappas and others 1993).[2] The corresponding rate for Black men was 123 percent, and for Black women 182 percent.

As Case and Deaton have documented in this paper, the gap is not just "rising" as Meara, Richards, and Cutler (2008) documented during the 1980s and 1990s, but "exploding."[3] As they show, for people age 25–84, the mortality gap between noncollege graduates and college graduates has risen from 211 per 100,000 in 1992 to 643 per 100,000 in 2021. The corresponding midlife (age 25–64) mortality rate by 2019 for noncollege graduates was four times the rate for college graduates (Foote and others 2024). As Case and Deaton (2021) have shown, the difference in life expectancy between college and noncollege graduates exceeds the gap between Black and non-Hispanic white populations and between Hispanic and non-Hispanic white populations.

One may be concerned with these comparisons given selection effects; the fraction of people who are college graduates has been rising since 1992, while the fraction of those who did not complete high school has been declining rapidly. Case and Deaton argue persuasively that selection is not the likely explanation for their results, although there is some question about whether "noncollege graduates" masks heterogeneity within this group. While Leive and Ruhm (2021) show a widening educational gradient in mortality across all percentiles of the education distribution, Novosad, Rafkin, and Asher (2022) argue that most of the decline in mortality for noncollege graduates is the consequence of a steeply increasing gradient at the very bottom of the education distribution.

THE COVID-19 PANDEMIC Unlike previous studies by Case and Deaton, which focused on midlife mortality and later the average number of years lived from 25–75, this paper considers the average number of years lived between age 25–84 (so the theoretical maximum is sixty years). This lengthier horizon dilutes the impact of deaths of despair somewhat because they are only a small fraction of total deaths (although weighted more heavily because of the greater loss in life-years). But considering these older populations better captures the differential impact of the COVID-19 pandemic, which disproportionately affected older people. As Case and Deaton show, the pandemic caused a dramatic increase in the educational

2. It is difficult to line up measures of "high" and "low" education over time as rates of high school and college graduation have risen since 1960; these selection issues are discussed below.

3. Focusing on life expectancy, Meara, Richards, and Cutler (2008) found life expectancy from the late 1980s to the late 1990s grew by 1.4 years for people with high levels of education compared to just 0.5 years for those with lower levels of education.

gradient, a result that has also been found for the income gradient (Schwandt and others 2022).

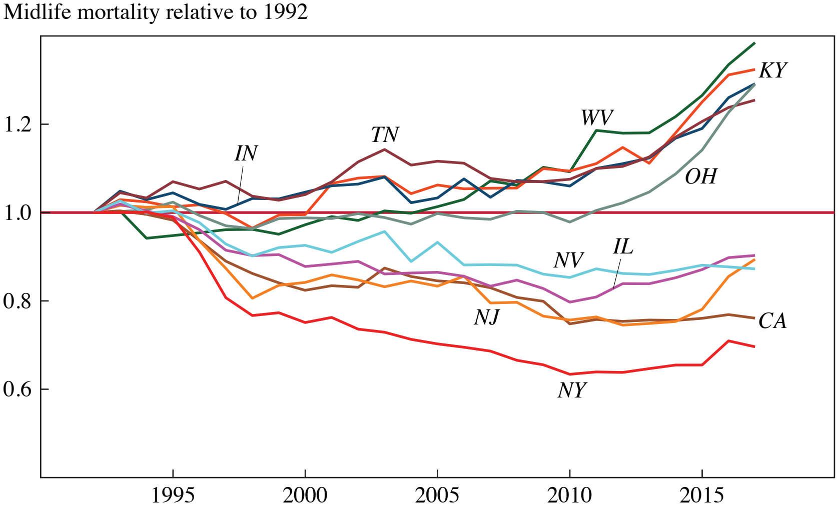
We might expect the COVID-19 educational gradient to subside somewhat simply because the number of deaths reported where COVID-19 was the underlying cause or a contributing cause declined from about 463,000 in 2021 to just 61,000 through the first week of November 2023.[4] Yet, in many ways Case and Deaton's most striking finding is the increase in non-COVID-19 mortality, particularly from deaths of despair, which would be less likely to be misdiagnosed or caused directly by COVID-19. These only accelerated during the pandemic, with alcohol-related deaths for those without a BA rising by ten per 100,000 between 2019 and 2021, more than the entire increase of seven per 100,000 during the twenty-seven years prior to the pandemic. There are fewer signs that these non-COVID-19 shifts in mortality are reverting to pre-COVID-19 levels; opioid deaths continued to exceed 100,000 in 2022 (NCHS 2023).

WHAT CAN EXPLAIN THE DIVERGENCE IN MORTALITY BY EDUCATION? There is substantial literature on the higher life expectancy associated with education, but understanding why such differences exist is less well understood (Cutler and Lleras-Muney 2010). It could be that education per se—skills and reasoning learned in the classroom—could lead to greater longevity, but the empirical evidence supports at best just modest effects of an exogenous increase in schooling on longevity and health (Galama, Lleras-Muney, and van Kippersluis 2018; Meghir, Palme, and Simeonova 2018; Clark and Royer 2013), nor can this explanation reasonably explain the sharp increase in the education-mortality gradient.

But there are other mechanisms by which life expectancy gaps may diverge. One would be lifestyle factors at the individual level, as Case and Deaton show in this paper. For example, the rising gap in marriage rates between people with a BA and those without a BA would be expected to increase the mortality gap given the beneficial health effects of marriage (Rendall and others 2011), but it's unlikely to explain the acceleration since 2010. Other potential factors include physical and social environments, policies, and social values (Woolf and Aron 2013). Still, one would expect that if local and state policies were key determinants of the rising educational gradient, as in Montez and others (2019, 2020), we would expect to see heterogeneity in the evolution of the education gradient across states, a hypothesis considered in the next section.

4. Centers for Disease Control and Prevention, National Center for Health Statistics, "Deaths by Week and State," https://www.cdc.gov/nchs/nvss/vsrr/COVID19/index.htm, accessed November 20, 2023.

Figure 1. Midlife Mortality Rates for Noncollege Graduates by Year Relative to the 1992 Baseline Mortality Rate for the Five States with the Largest Increase and Five States with the Greatest Decline

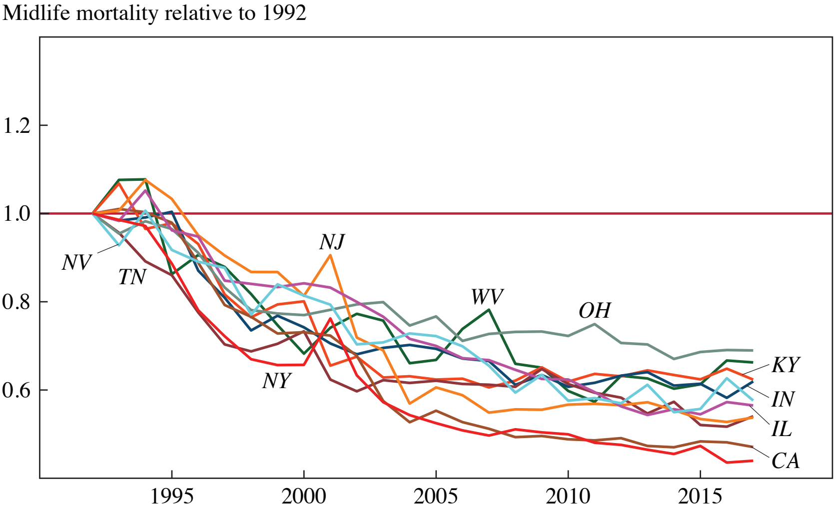


Source: Archived data from Couillard and others (2021).
Note: The remaining thirty-four states in the sample would be inside the gap between the two groups of states.

STATE-LEVEL VARIATION IN COLLEGE AND NONCOLLEGE MIDLIFE MORTALITY I use data from Couillard and others (2021) on midlife mortality by state, year, and education between 1992 and 2017 for forty-four states with complete data, and thus do not address the influence of COVID-19 on state-level mortality.[5] As well, the data focus only on midlife mortality (25–64) and so miss the evolution of mortality for older populations. To give a sense for the patterns across states, I consider in figure 1 the five states that experienced the greatest increase in mortality for noncollege graduates between 1992 (the reference year) and 2017—West Virginia, Kentucky, Indiana, Ohio, and Tennessee—and for the five states with the greatest relative decrease—New York, California, Nevada, New Jersey, and Illinois. While the fanning out is by design (the remaining thirty-four states are between these two groupings), it still indicates the divergence across states, with some experiencing more than 30 percent growth in midlife mortality (Kentucky and West

5. All calculations are based on the archival data supporting Couillard and others (2021): https://www.openicpsr.org/openicpsr/project/144041/version/V1/view.

Figure 2. Midlife Mortality Rates for College Graduates by Year Relative to the 1992 Baseline Mortality Rate for the Five States with the Largest Increase and Five States with the Greatest Decline



Source: Archived data from Couillard and others (2021).

Virginia), while for California and New York, the declines were 24 percent and 30 percent, respectively.[6]

Figure 2 shows the same trends in mortality for college graduates in each of the ten states considered above. While the top and bottom five states exhibit generally similar rankings, it is striking how closely the mortality patterns for college graduates track together; those in Tennessee—one of the five states with the greatest increases in noncollege-graduate mortality—experienced a decline in mortality for those with college educations equal to 46 percent, similar in magnitude to New Jersey (46 percent), Illinois (44 percent), and Nevada (42 percent). While a considerable degree of dispersion across states in mortality remains for college graduates (the standard deviation of log mortality in 2017 is similar for college and noncollege graduates), it is apparent from figure 2 that on average by state, people with a college degree experienced an expanded lifespan regardless of where they lived; the same could not be said for noncollege graduates.

It is increasingly clear that recessions were not the culprit for declining life expectancy, whether for health more generally (Ruhm 2000; Finkelstein

6. See also Montez and others (2019).

and others 2024) or as an explanation for the widening mortality gaps by education (Case and Deaton 2017). Indeed, Couillard and others (2021) found that even decades-long changes in regional income or unemployment (1993–2017) were uncorrelated with changes in contemporaneous log mortality rates. But the change in mortality is correlated with the initial level of state-level income in 1992 (a correlation coefficient of –0.58 for non-college graduates and –0.54 for college graduates, both highly significant), and with the 1968 state-level income. This puzzling correlation is consistent with the work by Montez and others (2020), who have argued that the long-term effects of state-level policies such as tobacco taxes and smoking bans, minimum wages (and local minimum wage bans), gun control, civil rights, Medicaid, and environmental policies have led to widening longer-term increases in mortality dispersion across states. That many of these policies were enacted in the late twentieth century by higher-income states, and that they would have the greatest impact on noncollege graduates, is certainly consistent with the empirical patterns we observe.

There are two methodological difficulties in assessing how (and whether) state-level policies affect (or are just associated with) secular changes in mortality rates. The first is figuring out whether state policies are causal or instead reflect individual health preferences of the state residents. For example, smoking rates between 1992 and 2017 fell by more in New York than in Mississippi; this was likely affected by policies in New York designed to reduce smoking such as its $4.35 tax per pack in 2016, compared to those in Mississippi, with a 2016 tax of $0.66 (Couillard and others 2021). But it also likely reflects the preferences of New Yorkers both for less smoking and support for state legislation to reduce smoking (Besley and Case 2000). It's not clear that the package of New York policies would have had the same health effects had it been enacted in Mississippi.

Second, state policies are likely to affect health outcomes with (to paraphrase Milton Friedman) a long and variable lag. Teenage smoking restrictions and generous Medicaid benefits for children are unlikely to reduce mortality until many decades in the future; similarly, heavy drinking often takes many years to translate into premature death. (The exceptions are for opioid overdoses and suicides.) Combined with the potential endogeneity of state-level policies noted above and the very large number of state-level policies (well more than the number of states), this makes estimating the causal impact of state policies difficult. Still, Montez and others (2020) have pointed to the state-level private labor restrictions, tobacco taxes, environmental regulations, and civil rights legislation (among other factors) as those making the largest contributions to mortality reductions.

By the same token, we might expect the "long-term deterioration in opportunities for less educated Americans" (Case and Deaton 2020, 144), independent of state policies, to exhibit long and variable lags with respect to their impact on mortality rates. The long-term impact of stress arising from the loss of stable well-paying jobs, domestic instability, and the loss of community networks during the 1980s and 1990s is likely to contribute to the reversal of the previous growth in life expectancy, particularly for diseases such as cardiovascular disease or cancers (Geronimus and others 2019).

DISCUSSION This most recent study by Case and Deaton has documented an important and disturbing trend in the education gradient since the early 1990s, with an acceleration in the gap between college and noncollege graduates since 2010, especially during the COVID-19 pandemic. The authors have suggested several plausible mechanisms for why the gap has continued to grow. While parsing out individual effects is difficult, I agree with Case and Deaton that there were multiple causes for the rapidly widening gradient—a perfect storm of several correlated adverse factors, with the most recent being COVID-19.

Understanding why the education-mortality gradient continues to expand is important, especially in predicting whether it might stabilize or even reverse course after expanding for the past six decades. While we have a comprehensive list of suspects, untangling the influences of wages, labor force participation, factory closings, connections to the community, health care quality, health behaviors, local policies, and domestic living arrangements is difficult. But even a partial understanding of the state policy effects can contribute to lives saved in the future.

With the sharply declining mortality rate from COVID-19, it's likely that the jump in the education-mortality gradient arising from COVID-19 will become attenuated, with a disproportionate benefit to older people most at risk of COVID-19. That older people are affected disproportionately by COVID-19, while younger people are affected by deaths of despair, does lead to a broader point that the effectiveness of specific policies will be quite different for those at midlife (25–64) compared to those for older (65–84) people. For example, initiatives designed to reduce deaths of despair or to reduce future cancer and cardiovascular disease mortality, are more effective for younger populations by encouraging stable employment, domestic stability, and healthy behaviors. While health habits and stability may be important for 75-year-olds, the challenges for this group—at least among those who survived to age 75—is to manage chronic diseases to improve quality of life and longevity, a very different set of policy priorities. In sum, the study by Case and Deaton has made it crystal clear the extent and magnitude of the problem facing the United States regarding the widening disparities in life expectancy by education, as well as providing a road map for what factors are likely contributors to the gap. Figuring out how to reverse this trend in the education gradient should be a major priority for the federal government and state governments, as it seems unlikely that the trend will reverse on its own.

REFERENCES FOR THE SKINNER COMMENT

Besley, Timothy, and Anne Case. 2000. "Unnatural Experiments? Estimating the Incidence of Endogenous Policies." *Economic Journal* 110, no. 467: 672–94.

Case, Anne, and Angus Deaton. 2017. "Mortality and Morbidity in the 21st Century." *Brookings Papers on Economic Activity*, Spring, 397–443.

Case, Anne, and Angus Deaton. 2020. *Deaths of Despair and the Future of Capitalism*. Princeton, N.J.: Princeton University Press.

Case, Anne, and Angus Deaton. 2021. "Life Expectancy in Adulthood Is Falling for Those without a BA Degree, but as Educational Gaps Have Widened, Racial Gaps Have Narrowed." *Proceedings of the National Academy of Sciences* 118, no. 11: e2024777118.

Clark, Damon, and Heather Royer. 2013. "The Effect of Education on Adult Mortality and Health: Evidence from Britain." *American Economic Review* 103, no. 6: 2087–120.

Couillard, Benjamin K., Christopher L. Foote, Kavish Gandhi, Ellen Meara, and Jonathan Skinner. 2021. "Rising Geographic Disparities in US Mortality." *Journal of Economic Perspectives* 35, no. 4: 123–46.

Cutler, David M., and Adriana Lleras-Muney. 2010. "Understanding Differences in Health Behaviors by Education." *Journal of Health Economics* 29, no. 1: 1–28.

Finkelstein, Amy, Matthew J. Notowidigdo, Frank Schilbach, and Jonathan Zhang. 2024. "Lives vs. Livelihoods: The Impact of the Great Recession on Mortality and Welfare." Working Paper 2024-14. Chicago: University of Chicago, Becker Friedman Institute. https://bfi.uchicago.edu/working-paper/lives-vs-livelihoods-the-impact-of-the-great-recession-on-mortality-and-welfare/.

Foote, Christopher, Ellen Meara, Jonathan Skinner, and Luke Steward. 2024. "Geography and the Widening Educational Divide in U.S. Midlife Mortality." Working Paper, Dartmouth College.

Galama, Titus J., Adriana Lleras-Muney, and Hans van Kippersluis. 2018. "The Effect of Education on Health and Mortality: A Review of Experimental and Quasi-Experimental Evidence." Working Paper 24225. Cambridge, Mass.: National Bureau of Economic Research. https://www.nber.org/papers/w24225.

Geronimus, Arline T., John Bound, Timothy A. Waidman, Javier M. Rodriguez, and Brenden Timpe, 2019. "Weathering, Drugs, and Whack-a-Mole: Fundamental and Proximate Causes of Widening Educational Inequity in U.S. Life Expectancy by Sex and Race, 1990–2015." *Journal of Health and Social Behavior* 60, no. 2: 222–39.

Kitagawa, Evelyn Mae, and Philip M. Hauser. 1968. "Education Differentials in Mortality by Cause of Death: United States, 1960." *Demography* 5, no. 1: 318–53.

Kitagawa, Evelyn Mae, and Philip M. Hauser. 1973. *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*. Cambridge, Mass.: Harvard University Press.

Leive, Adam A., and Christopher J. Ruhm. 2021. "Has Mortality Risen Disproportionately for the Least Educated?" *Journal of Health Economics* 79: 102494.

Meara, Ellen R., Seth Richards, and David M. Cutler. 2008. "The Gap Gets Bigger: Changes in Mortality and Life Expectancy, by Education, 1981–2000." *Health Affairs* 27, no. 2: 350–60.

Meghir, Costas, Mårten Palme, and Emilia Simeonova. 2018. "Education and Mortality: Evidence from a Social Experiment." *American Economic Journal: Applied Economics* 10, no. 2: 234–56.

Montez, Jennifer Karas, Jason Beckfield, Julene Kemp Cooney, Jacob M. Grumbach, Mark D. Hayward, Huseyin Zeyd Koytak, Steven H. Woolf, and Anna Zajacova. 2020. "US State Policies, Politics, and Life Expectancy." *Milbank Quarterly* 98, no. 3: 668–99.

Montez, Jennifer Karas, Anna Zajacova, Mark D. Hayward, Steven H. Woolf, Derek Chapman, and Jason Beckfield. 2019. "Educational Disparities in Adult Mortality across U.S. States: How Do They Differ, and Have They Changed since the Mid-1980s?" *Demography* 56, no. 2: 621–44.

National Center for Health Statistics (NCHS). 2023. "Provisional Data Shows U.S. Drug Overdose Deaths Top 100,000 in 2022." Blog post, May 18, Centers for Disease Control and Prevention. https://blogs.cdc.gov/nchs/2023/05/18/7365/.

Novosad, Paul, Charlie Rafkin, and Sam Asher. 2022. "Mortality Change among Less Educated Americans." *American Economic Journal: Applied Economics* 14, no. 4: 1–34.

Pappas, Gregory, Susan Queen, Wilbur Hadden, and Gail Fisher. 1993. "The Increasing Disparity in Mortality between Socioeconomic Groups in the United States, 1960 and 1986." *New England Journal of Medicine* 329, no. 2: 103–9.

Rendall, Michael S., Margaret M. Weden, Melissa M. Favreault, and Hilary Waldron. 2011. "The Protective Effect of Marriage for Survival: A Review and Update." *Demography* 48, no. 2: 481–506.

Ruhm, Christopher J. 2000. "Are Recessions Good for Your Health?" *Quarterly Journal of Economics* 115, no. 2: 617–50.

Schwandt, Hannes, Janet Currie, Till von Wachter, Jonathan Kowarski, Derek Chapman, and Steven H. Woolf. 2022. "Changes in the Relationship between Income and Life Expectancy before and during the COVID-19 Pandemic, California, 2015–2021." *Journal of the American Medical Association* 328, no. 4: 360–66.

Woolf, Steven H., and Laudan Aron, eds. 2013. *U.S. Health in International Perspective: Shorter Lives, Poorer Health*. Washington: National Academies Press.

GENERAL DISCUSSION James Stock commented on the role that obesity trends might play in the authors' results, noting that the level of obesity is higher among lower-educated individuals. He observed that according to Centers for Disease Control and Prevention's Adult Obesity Prevalence Maps,[1] the overall adult obesity rates of the worst five states mentioned in Jonathan Skinner's discussant remark—West Virginia, Kentucky, Indiana, Tennessee, and Ohio—are all in the higher tiers, while the rates for Skinner's best five states—California, New Jersey, Illinois, Nevada, and New York—are in lower tiers. He suggested that the differential trends in cardiovascular disease might be related to these facts.

Anne Case acknowledged the crucial role of obesity in public health in America but disagreed with the notion that it would play a key role in the trends the authors identified. She pointed to the fact that even as obesity has risen for decades, deaths from cardiovascular disease continued to fall; since then, progress has largely flatlined across the English-speaking world, despite distinct obesity trends in different countries and states. Case suggested that, ultimately, there is something going on with the relationship between obesity and cardiovascular disease that experts do not yet understand, and given these often conflicting trends, obesity was an unlikely culprit to be driving changes in differential mortality, even as it remained a pressing public health challenge.

Robert Gordon followed up on Stock's comment, noting that beyond the dividing deaths between "deaths of despair" and other causes, we should also consider whether deaths are related to personal responsibility. He suggested that the obesity-related diabetes and heart disease are examples of the latter, and there is a distinction between lack of economic access to health care (e.g., due to lack of insurance) and geographic distance from health care in rural areas.

Martin Baily agreed with Gordon's point about personal responsibility. He also remarked that if selection is not a major concern, the authors' policy recommendations should have included encouraging college attendance. He further expressed surprise that the increased health coverage associated with Medicare expansion would not have moderated the effects they found during the COVID-19 pandemic.

Betsey Stevenson pointed out that, selection or not, the aggregate data suggest the United States is falling behind. She emphasized that policy

1. Centers for Disease Control and Prevention, "Adult Obesity Prevalance Maps," updated September 21, 2023, https://www.cdc.gov/obesity/data/prevalence-maps.html.

and education could influence people's ability to make informed choices about their health and well-being. Stevenson also remarked that notwithstanding comments about selection, education might play a causal role in the trends discussed in the paper. In particular, she pointed to the role of higher education in individuals' ability to interpret information and make healthy lifestyle choices.

Responding to the comments by Gordon and Baily, Case first noted that obesity is a poor example of personal responsibility and should instead be considered an addiction: some individuals "soothe the beast" through alcohol or drugs, while others do so through unhealthy relationships with food. She further argued that, while it is true that people choose their behaviors, we must ask why those kinds of choices are disproportionately made by people without a college degree or those who lack economic resources and access to physical or mental health treatment.

Benjamin Harris highlighted the role of labor force attachment, noting that work is an important source of social interaction and intellectual stimulation along with wages. He suggested that since labor force participation varies by place and by educational attainment, the divergence in labor force participation among both older and younger workers might play a role in the effects presented by the authors.

Alan Blinder followed up on the issue of selection raised by the discussants. He first remarked that getting a BA is perhaps a component of getting one's life together, and that there might be important differences in personality between those who complete a BA and those who don't. He continued by expressing doubt about whether, if the share of the population who complete a BA continues to rise, the economy would be able to provide good jobs utilizing the skills taught in those degrees to 50 percent or more of the population.

Justin Wolfers suggested that there might possibly be a simple mathematical calibration exercise that could verify whether selection into BA programs could plausibly explain a significant share of the authors' results.

Stan Veuger also commented on the issue of selection that, to the extent selection is a problem in the paper, encouraging college attendance may have limited impact as a policy solution. He observed that restricted housing supply in high-income cities and states could explain some of the patterns identified in the cross-sectional data if people without a BA who can afford to live in the richest cities and states are increasingly positively selected. In reference to Baily's comment on Medicare expansion, Veuger mentioned that some researchers have found insurance expansions might also offer more access to opioids, thereby exacerbating opioid addiction, which could explain some of these unexpected effects, even though these studies may not be particularly rigorous.

Pinelopi Goldberg cast doubt on the idea that selection was a major driver of the authors' findings, noting that, as the authors previously documented, the overall life expectancy in the United States is declining on average and this indicates real effects that selection could not plausibly have driven. She also returned to Skinner's comments on place in his discussion and emphasized that the interaction between college education and place may be key to understanding the authors' results. In particular, relating this idea to the trade literature, the China trade shock may not have resulted in lower wages or income in affected areas but did result in lower employment, worse mental health, and other outcomes that might lead to deaths of despair. Thus, income is not the main driver, she argued. Finally, Goldberg concluded that if selection is a concern, selection in terms of residential location would be more pronounced as it relates to higher education. She reiterated that the interaction between the two might be important in understanding the widening gap in mortality.

Case responded to the comments on selection, emphasizing that selection could not plausibly explain many of their findings. In particular, Case highlighted the evidence that although the share of women with a BA did not increase between 1950 and 1965, the rate of deaths of despair nevertheless rose from one birth cohort to the next over this span of birth cohorts. The gap in deaths of despair continued to rise whether or not the share of people with BA was rising. She explained that these findings indicate large and policy-relevant effects that could not plausibly be driven by selection. She also referred to papers by Arline Geronimus and David Cutler, which suggest that selection is not significant enough to drive the lion's share of findings on differential mortality.[2]

Angus Deaton began by discussing the issue of causality and selection. He reflected on the growing focus on causal inference in economics, noting that the development of these tools had helped fill important blind spots in the field, but he also expressed his discomfort with the profession's recent obsession with causality. Deaton stated that while precisely identifying causal channels could be important for prescribing policy remedies, causality is

2. Ellen R. Meara, Seth Richards, and David M. Cutler, "The Gap Gets Bigger: Changes in Mortality and Life Expectancy by Education, 1981−2000," *Health Affairs* 27, no. 2 (2008): 350–60; Arline T. Geronimus, John Bound, Timothy A. Waidmann, Javier M. Rodriguez, and Brenden Timpe, "Weathering, Drugs, and Whack-a-Mole: Fundamental and Proximate Causes of Widening Educational Inequity in U.S. Life Expectancy by Sex and Race, 1990–2015," *Journal of Health and Social Behavior* 60, no. 2 (2019): 222–39.

not the only—or the best—metric to judge a finding, and that even trends driven by selection can be of crucial importance. He also argued that their paper's evidence on the widening mortality gaps within birth cohorts—even those whose education did not change later in life—suggests that selection could not plausibly explain a large share of their findings. Of course, denying the importance of selection does not mean that a college degree directly causes better health.

Elaine Buckberg remarked that the Affordable Care Act does not seem to have ameliorated the divergence in outcomes even for illnesses that are not related to behavior and that this raises questions about disparities in timeliness, quality, and quantity of care. Specifically, she pointed out that insurance coverage is not a binary variable, and that issues including marginal charges for care, wait time for appointments, and access to preventative screenings might play an important role in health outcomes even within the group of individuals with insurance coverage.

Hoyt Bleakley inquired about these results related to earlier work by Case and others on the emergence in childhood of health differences by parental education and income. He suggested that policies intended to close health disparities among adults might be less effective given prior research on the lasting impact of early life conditions on health.

In reference to the long-standing hunt by education and health economists to identify whether there is a causal effect of education on health outcomes, Deaton remarked that one of the most important contributions to the debate came not from economists at all, but from the sociological "fundamental causes theory" developed by Jo Phelan and Bruce Link.[3] In the theory, Phelan and Link describe how the power and status that come with wealth, income, and education will affect one's health if and only if there is an opportunity through which health can be affected. To illustrate the importance of this idea, Deaton described how until about 1750 in England, there was no income or education gradient for death rates—the rates among aristocrats and nobles were roughly the same as those among the general population because there simply were not methods to stop disease-related mortality regardless of education and income. It was only after 1750, when these mechanisms started to become available, that the rich and powerful were able to take advantage and began living longer.[4] Deaton contended

3. B. G. Link and J. Phelan, "Social Conditions as Fundamental Causes of Disease," *Journal of Health and Social Behavior*, special edition (1995): 80–94.

4. Angus S. Deaton, *The Great Escape: Health, Wealth, and the Origins of Inequality* (Princeton NJ: Princeton University Press, 2013), chapter 2.

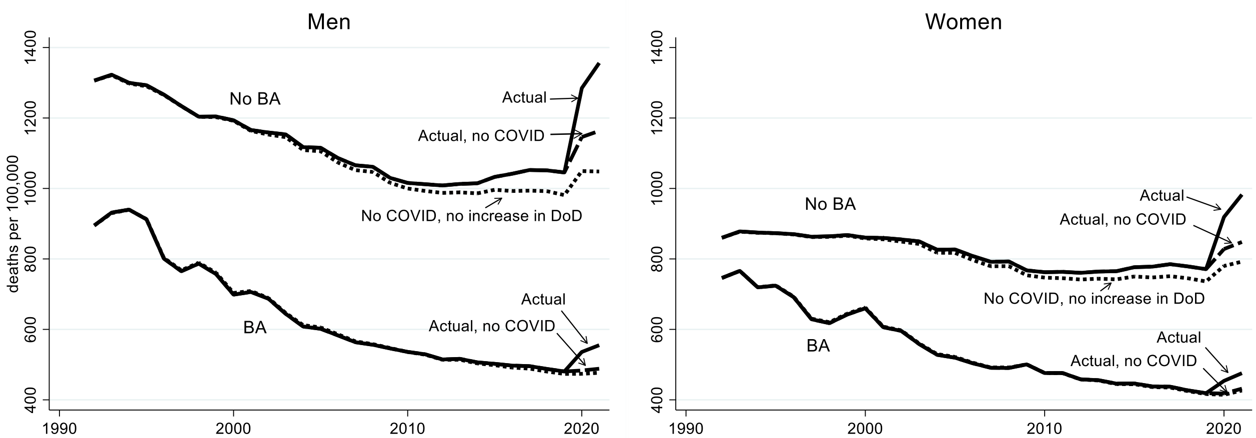
that a similar finding could apply to the portions of their paper dealing with cancer mortality. Education still does not significantly affect mortality from brain cancer, as there are not sufficiently effective treatments for education and income to begin affecting health in this area, and it has only recently begun to affect mortality from breast cancer and some other cancers, because innovations in screening and treatment have provided pathways through which women can use their education and income to bring down mortality rates. Mortality rates from breast cancer, once higher for more educated women, are now lower.

Case noted that while health care is a crucial piece of the puzzle, the problems underlying rising mortality gaps will not all be solved in a doctor's office: the United Kingdom is also experiencing differential mortality trends despite its universal health coverage. Making progress on these issues, she commented, would require broader social and economic changes beginning in early life, including addressing the challenges facing children who have already lost their parents to drugs, alcohol, and suicide.

Case and Deaton

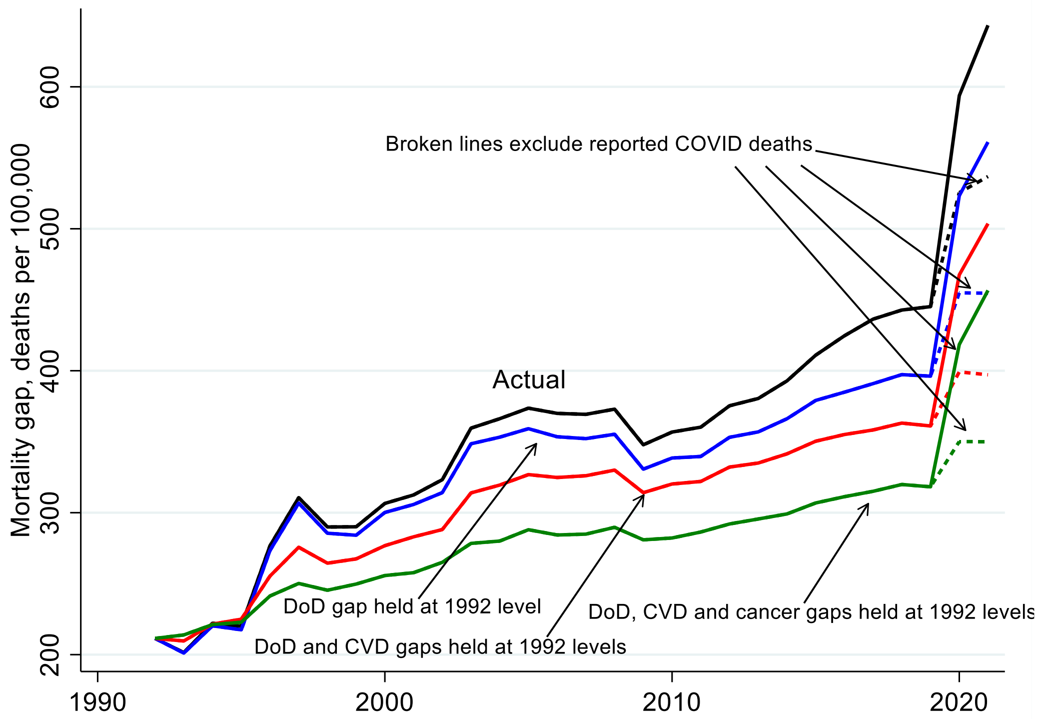
Accounting For the Widening Mortality Gap Between American Adults With and Without a BA, Appendix Figures

Appendix Figure 1.
Age-adjusted 25-84 mortality rates, with and without COVID-19 and deaths of despair



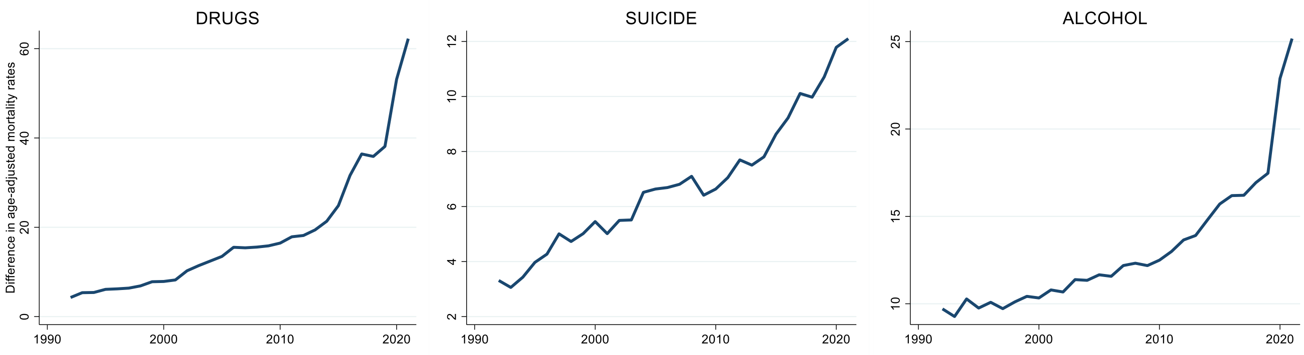
Sources: National Vital Statistics System; authors' calculations.

Appendix Figure 2.
Age-adjusted 25-84 mortality gaps between those without and with a BA



Sources: National Vital Statistics System; authors' calculations.

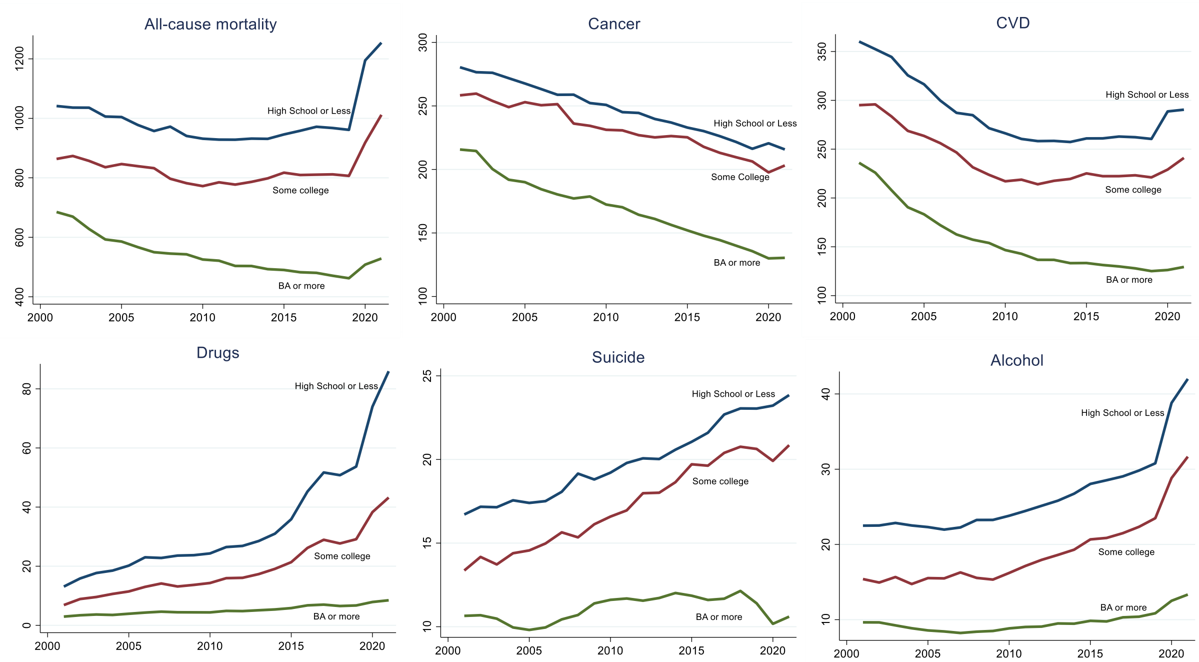
Appendix Figure 3.
Age-adjusted 25-84 mortality gaps between those without and with a BA



Sources: National Vital Statistics System; authors' calculations.

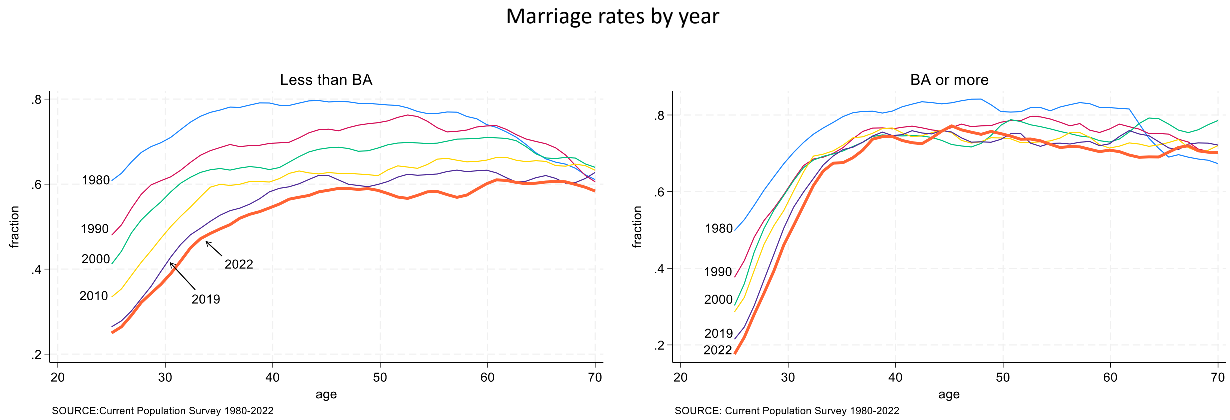
Appendix Figure 4.

Mortality by Cause for Three Education Groups: High School or Less, Some College, and BA or more

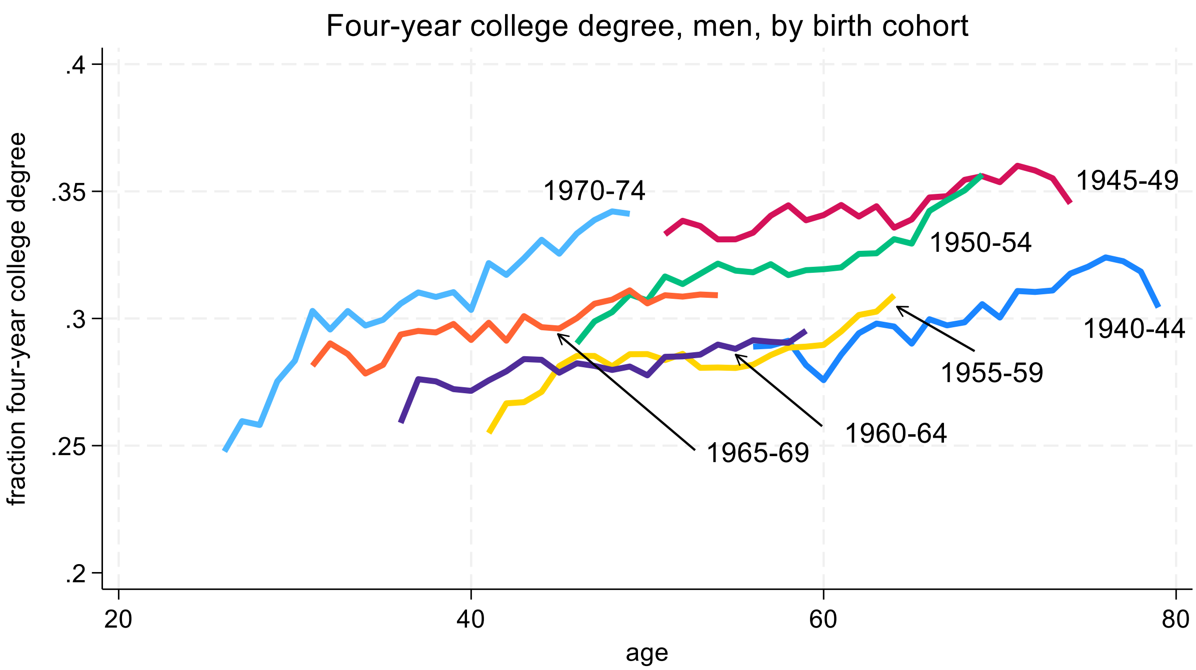


Sources: National Vital Statistics System; authors' calculations.

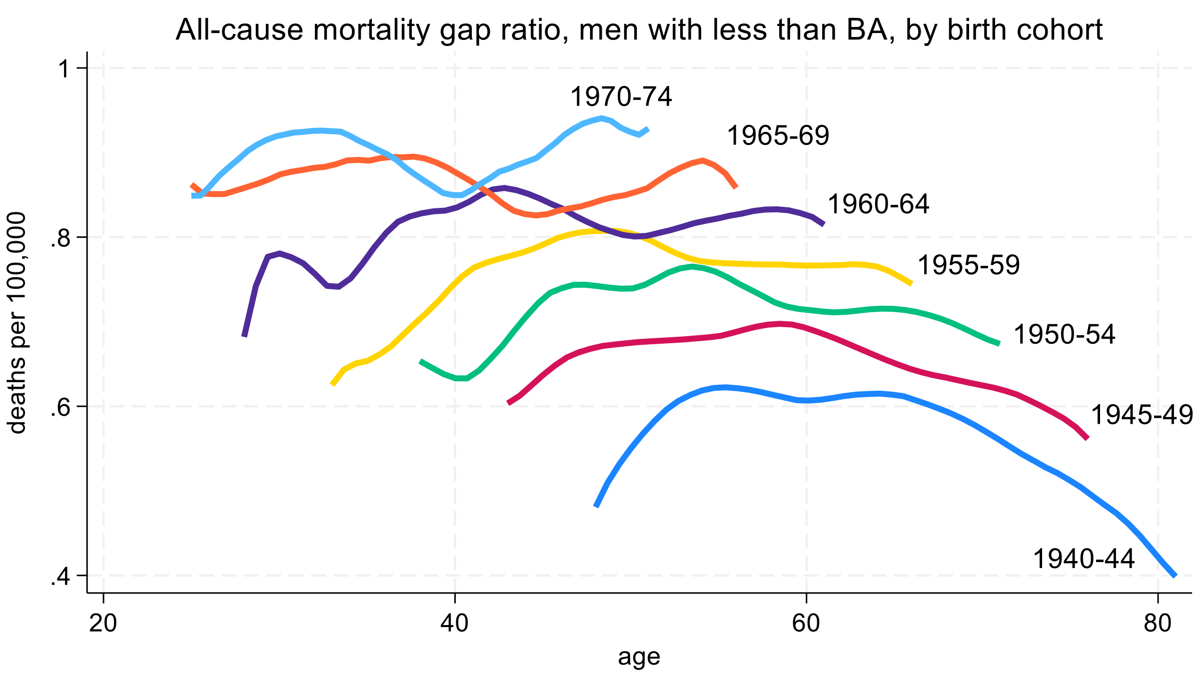
Appendix Figure 5.
Marriage rates by education and year



Appendix Figure 6.
College completion and mortality gap ratios of men, by birth cohort



SOURCE: American Community Survey 2000-2019



SOURCE: US National Vital Statistics 1992-2021