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Socioeconomic gradients in health in international and historical context

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This article places socioeconomic gradients in health into a broader international and historical context. The data we present supports the conclusion that current socioeconomic gradients in health within the United States are neither inevitable nor immutable. This literature reveals periods in the United States with substantially smaller gradients, and identifies many examples of other countries whose different social policy choices appear to have led to superior health levels and equity even with fewer aggregate resources. The article also sheds light on the potential importance of various hypothesized mechanisms in driving major shifts in U.S. population health patterns. While it is essential to carefully examine individual mechanisms contributing to health patterns, it is also illuminating to take a more holistic view of the set of factors changing in conjunction with major shifts in population health. In this article, we do so by focusing on the period of the 1980s, during which U.S. life expectancy gains slowed markedly relative to other developed countries, and U.S. health disparities substantially increased. A comparison with Canada suggests that exploring broad social policy differences, such as the weaker social safety net in the United States, may be a promising area for future investigation.

Keywords: socioeconomic status; international; inequality; historical trends; mortality; cardiovascular disease; population health

Introduction

The previous article (Adler and Stewart) in this volume summarized a vast literature documenting socioeconomic gradients in health, primarily within the United States. This article places that literature into a broader international and historical context. The data that we present support the conclusion that current socioeconomic gradients in health within the United States are neither inevitable nor immutable. This literature reveals periods in the United States with substantially smaller gradients, and identifies many examples of other countries whose different social policy choices appear to have led to superior health levels and equity even with fewer aggregate resources.

The article also sheds light on the potential importance of various hypothesized mechanisms in driving major shifts in U.S. population health patterns. While it is essential to carefully examine individual mechanisms contributing to health patterns, it is also illuminating to take a more holistic view of the set of factors changing in conjunction with major shifts in population health. In this article, we do so by focusing on the period of the 1980s, during which U.S. life expectancy gains slowed markedly relative to other developed countries, and U.S. health disparities substantially increased. This major recent shift calls into question two popular hypotheses for factors underlying population health patterns—genetics and medical care. The genetic stock of the population did not change markedly in the 1980s, and the United States actually experienced a rapid *increase* in health care spending in the 1980s compared to other developed countries (including a major Medicaid expansion for pregnant women). Thus these two factors are unlikely in the aggregate to have been key drivers of the relative worsening of

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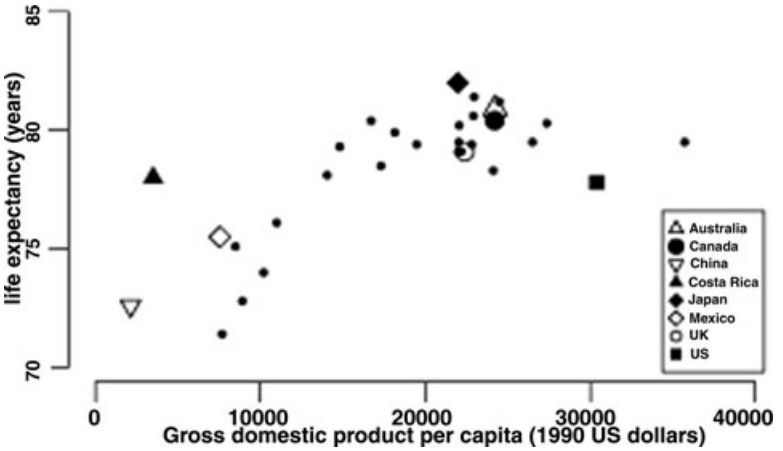

Figure 1. **Life expectancy at birth and GDP per capita by country, 2006. Life expectancy data and gross domestic product data were obtained from the Organization for Economic Cooperation and Development.**

U.S. health status during this period. A comparison with Canada suggests that exploring broader social policy differences, such as the weaker social safety net in the United States, may be a more promising area for future investigation and experimentation.

We proceed by first discussing well-known current international comparisons of life expectancy levels, and then commenting on their changes over time. We then examine in more detail the trends in U.S. mortality levels over the past century. Next, we turn to examining U.S. trends in health *gradients* over time, and finally turn to international comparisons of gradients. We conclude with a discussion comparing the Canadian experience with that of the United States over the past few decades.

International life expectancy comparisons over time

Among the most widely recognized of socioeconomic gradients in health is the cross-country relationship between health and average income. Figure 1 shows a scatter plot of recent life expectancy at birth versus per capita gross domestic product (GDP) for countries in the OECD (Organization for Economic Cooperation and Development), plus two outliers of interest (Costa Rica and China). Preston's description of the shape of this curve is well known: higher per capita GDP is associated with higher life expectancy up to intermediate income levels, but among high-income countries the relationship weakens to no association.[1] This shape of association was shown to be fairly consistent using data from the 1900s, 1930s, and 1960s, but with a generally steepening slope over time at lower levels of GDP. Using 2006 data, Figure 1 shows that among countries with greater than $15,000 per capita GDP, on average higher income per capita is not associated with better life expectancy. Despite this pattern, it is also well known that strong health–socioeconomic status gradients still exist within virtually all countries, and that the magnitudes of those disparities can vary significantly even among the wealthier countries.

Figure 1 also illustrates that despite the flat slope among wealthier countries on average, there is considerable variation in life expectancy levels. Particularly notable is the case of the United States, whose life expectancy lags by a year or two behind other OECD countries. Clearly, factors other than average income are also determining population health levels. In the figure, are highlighted two countries that border the United States (Canada and Mexico), three other developed countries that have comparable liberal democracies (Australia, the United Kingdom, and Japan),[2] along with Costa Rica and China. Despite the United States outperforming these other countries in terms of GNP per capita, it is an underachieving outlier in terms of life expectancy at birth among the five countries highlighted in the upper portion of the figure. The highest life expectancy of these OECD countries (and of any country in the world, in 2006) is Japan, with two English-speaking countries, Australia and Canada,

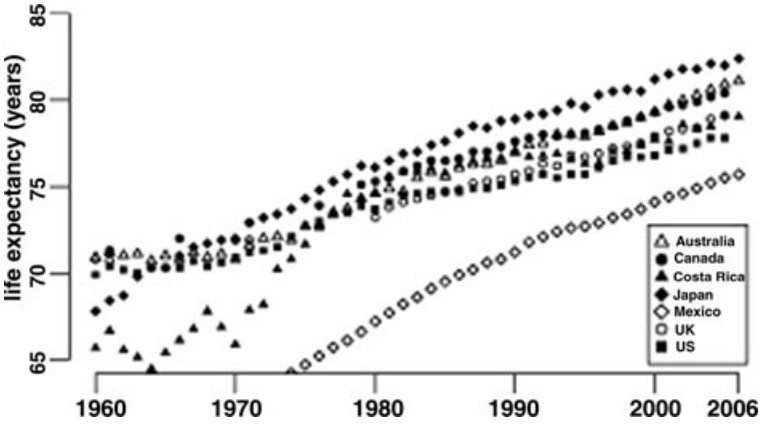

Figure 2. **Life expectancy at birth, 1960–2006. Data for all countries except Costa Rica were obtained from the Organization for Economic Cooperation and Development. Data for Costa Rica were obtained from Indicadores Demograficos Costa Rica (http://ccp.ucr.ac.cr/observa/CRindicadores/evida.htm).**

also obtaining among the higher levels of life expectancy among OECD countries. At the lower end of life expectancy attainment among the wealthier group is the United Kingdom (79.1), although it still outperforms the United States in life expectancy by over 1 year. The life expectancy level of the United States (77.8) is most similar to that of Denmark (78.3), Portugal (78.1), and South Korea (78.5), the latter two of which each have per capita GDP of approximately half that of the United States. At the lower end of GDP, both Costa Rica and China are considerable outliers. Costa Rica has achieved a level of life expectancy similar to (and slightly higher than) the United States despite having less than one-fifth of its per capita GDP. While the life expectancy of China is much lower than that of OECD countries, when comparing it with a broader set of low and middle-income countries it has a level of life expectancy as high as countries with more than double its per capita GDP. Measuring the extent of this heterogeneity around a country's current income led Preston to conclude that "factors exogenous to a country's current level of income probably account for 75–90% of the growth in life expectancy for the world as a whole between the 1930s and 1960s. Income growth per se accounts for only 10–25%."[1] Many factors are hypothesized to shape this heterogeneity, including socioeconomic factors, such as the distribution of income within countries (see Kawachi, Adler, and Dow in this volume), as well as broader government social policy.

Figure 2 plots the progression of life expectancy over the past 50 years for a smaller set of seven countries. While life expectancy steadily improves in all countries, the pace varies considerably. Again of particular interest is the case of the United States, especially since about 1980. Between 1960 and 1980, U.S. life expectancy was similar to that of the United Kingdom and Australia, only slightly worse than that of Canada. Based solely on the United States' rapid economic growth since then, we would have predicted that its life expectancy would have grown at least as fast as these other countries. But in fact, U.S. life expectancy improvements during the 1980s significantly lagged behind that of all of the countries shown, and have yet to catch up. This suggests that the United States' poor current showing in Figure 1 was not inevitable. Later in the article, we will return to consider what factors may have differed between the United States and these other countries that could have led to the United States' underperformance during this period.

Also instructive is the case of Costa Rica, which early in the 19th century had life expectancy similar to that of its Latin American neighbors, but has now converged with the life expectancy of the richest countries in the world. The most notable period of life expectancy growth was during the 1960s and 1970s, a time of rapid government investment in social programs. Although the exact determinants of Costa Rica's remarkable health success are difficult to assess, it too was not inevitable. In this instance, government policy actively strove to rapidly reduce

mortality through a wide variety of generally well-implemented programs, and it is likely that these government efforts played a major role.[3,4]

Another remarkable case of improvement is that of Japan. As of 1960, Japan's life expectancy was multiple years behind that of the United States, but rapidly rose to become the highest in the world, setting the current standard for the realm of the possible. Reinforcing the notion that life expectancy performance is malleable is the fact that relative to the highest world life expectancy at the time, the United States had a 10-year disadvantage in 1900, less than a year in 1950, and about 5 years in 2000.[5]

Historical trends in mortality in the United States over the 20th century

To gain insight into potential determinants of the historical trends in U.S. life expectancy, we now consider in more detail the U.S. mortality decline by period and cause of death. In the United States, one in 42 individuals died each year in 1900, but by 1998 it was one in 125, an age-adjusted mortality decline of 67%.[6] The rate of decline was fairly constant up until 1950, at which point the generally linear rate of decline diminished slightly, in particular for males.[7] During the later half of the 20th century the period of most rapid mortality decline in the United States was from the late 1960s to around 1980.

There are markedly different patterns of change in mortality rate by cause. Mortality rates from cardiovascular disease increased fairly rapidly from 1900 to the late 1930s, were fairly constant until around 1960, and then have experienced a rapid decline since then, with the steepest drops in mortality rates up until the late 1970s. From 1965 to 1995, age-adjusted death rates from cardiovascular disease were cut in half, declining from around 700 per 100,000 to around 350 per 100,000. Recent work has shown the decline in cardiovascular disease mortality was particularly rapid among individuals over the age of 65.[6]

The decline in overall mortality rates up until 1950 was driven primarily by a decline in infectious disease mortality.[7] There were declining rates in tuberculosis until the 1950s, and declining rates of pneumonia and influenza mortality until that same time as well. Decline in infectious disease mortality was most rapid from 1938 to 1952, but with an increase in infectious disease mortality from the early 1980s to the early 1990s primarily due to AIDS, mortality in individuals aged 25 to 64 and increases in pneumonia and influenza deaths among persons 65 and older.[8] Rates of cancer mortality have increased gradually over the 20th century, but with slightly slower increases since the middle of the century. Accidental deaths began decreasing in the 1930s, and have experienced a number of periods of more and less rapid decline since then. Deaths from diabetes increased slightly over the first half of the century, then within 1 year the mortality rate dropped by more than half with the introduction of insulin. Over the 20th century, Cutler and Meara have shown that mortality rates have improved differentially by age.[6] While older adult mortality (45–64) and elderly mortality (65+) improved by just 0.6% and 0.3% annually from 1900 to 1940, this rate of decline increased to 1.3 and 1.1, respectively, from 1960 to 1990.

Thus the consistently downward trend in U.S. mortality over the 20th century is due to irregular cause-specific patterns of mortality change. As a corollary, this likely implies different determinants for the mortality decline over time as well. Decreases in infectious disease mortality generally preceded the interventions of medical technologies, thus most attribute improvements in infectious disease mortality to improved living conditions and sanitation.[7] However, this does not preclude the continuation of the overall downward trend in mortality occurring later in the century due to successful clinical interventions for infectious diseases.[8] The same may be true for cardiovascular disease. Early decreases in cardiovascular disease due to behavioral changes (most notably reductions in smoking) may have been extended due to more recent change in the effectiveness of medical interventions.[6] Downward trends are not inevitable, as shown by the reversal of the "epidemiologic transition" (from infectious to chronic disease mortality) by the emergence of the HIV epidemic.[9] There are also concerns that increasing obesity may lead to stagnation or reversal of the decline in cardiovascular disease in the United States. Whatever the precise mechanism driving these past mortality reductions, we would expect there to be substantial scope for government intervention to influence these pathways to continuing mortality improvement in the future, as further discussed in the policy chapter (Dow, Schoeni, Adler, and Stewart).

Changing patterns of U.S. socioeconomic gradients in health over time

Understanding the evolution of socioeconomic gradients in health is of interest in and of itself, as well as being useful for understanding the underlying pathways through which aggregate population health has improved. While a great deal of research has documented changing *levels* of health and mortality over time in the United States, and socioeconomic gradients in health at single points in time, unfortunately much less research has focused on measuring how socioeconomic *gradients* in health have themselves changed over time. Nevertheless, that limited research does warrant the conclusion that socioeconomic gradients in health in the United States have expanded since the 1960s.

In part, this lack of research has been due to lack of appropriate data. Death certificates in the United States did not until recently contain socioeconomic data, and even when recorded there is evidence of substantial measurement error, in particular among older individuals.[10] Regional cohort studies over the last half century have provided useful information, yet questions of generalizability to broader populations are often of concern and limit temporal and spatial comparisons. Another approach has been to use ecological designs that make mortality comparisons based on area-level socioeconomic status (SES) one study has found that such designs may if anything underestimate gradients,[11] although they may still provide a comparable metric for studies over time.

From the late 19th to the mid 20th century in the United States, most studies of life expectancy and all-cause mortality showed substantial socioeconomic gradients. However, these studies were typically not drawn from national samples, and used differing measures of SES. One early study found double the annual death rate for nontaxpayers versus taxpayers in Providence, RI in 1865. The age groups where there was the greatest difference in mortality was for ages 40–50 (tenfold higher) with a two- to threefold difference at other adult ages, with no difference among those 70 and over.[12] In another study, achieving closer to a generalizable sample of men that allowed a temporal analysis, among Metropolitan Life policyholders who were in industrial versus ordinary occupations, gradients were shown to decrease from a 1.87 relative risk (age adjusted) in 1922–1924 to 1.44 relative risk in 1937–1939.[13] As previously observed, the highest ratios were again found in those aged 25–55. Rates in this study were based on very large sample sizes, though significant concerns about external validity remain. Many of the earlier examinations of socioeconomic gradients in health were reviewed by Antonovsky.[14] He qualitatively concludes that early century comparisons between the least and most affluent groups were of an approximately 2:1 ratio, narrowing to approximately 1.4:1 by the 1940s. The contributions of New Deal government safety net expansions as a possible determinant of the apparent decline in the health gradient have not been investigated.

In the latter half of the 20th century, gradients were examined using more generalizable populations and better measures of SES. By the middle 20th century, development of linkage studies using administrative records and national death registries allowed better attention to sampling as well as more attention to issues of confounding, even if based primarily on basic demographic factors (e.g., attention to accounting for differences in age distribution, migration, race/ethnicity). The Kitagawa and Hauser study of socioeconomic differentials in mortality using data from 1960 was a landmark in the analysis of socioeconomic gradients in health.[15] This study for the first time used mortality data linked to census data to give nationally representative estimates of socioeconomic differentials in mortality, with a sample size ($n = 62{,}487$) large enough to allow cause-specific and subgroup analysis of these trends. It also allowed for the first time examination of differences in mortality by family income level. For white men and women ages 25–64, mortality was 64% and 105% higher for the least compared with the most educated. For nonwhite men and women, the comparable difference in mortality by education was 31% and 70%, respectively.

Using data from 1986 (26 years later), Pappas *et al.* examined the extent of change in these educational differences, showing that while there had been an absolute mortality decline in each of these groups, the decline was more rapid among the higher educated individuals, resulting in increased relative educational differences in mortality.[16] Comparison of the 1960 matched records data with data from the 1971–1984 National Health and Nutrition Examination Survey (NHANES) mortality follow-up gave similar findings, but showed that the increasing

mortality differentials were primarily among men, and educational differentials among women remained relatively constant.[17] Consistent with the causes of death that declined most rapidly during this period of time, differences in heart disease mortality were responsible for much of the change in educational disparities among men.[17] More recent examination of the robustness of these claims support the widening differentials in mortality for males but with age-dependent differences for females since 1960.[18] Specifically, among women aged 25–64, educational inequalities actually diminished over this period of time, and they remained constant for women 65–74. In examining the age-dependent nature of these trends among men, consistent with where the age gains in mortality have occurred over this time period, the inequality trends are worse for persons over the age of 65.[18] However, there are not consistent relationships between socioeconomic inequality trends and mortality trends across other age groups.

Several studies have attempted to analyze similar relationships through the year 2000, finding evidence of increasing disparities through the 1980s and 1990s. Using an ecological approach based on county median income data to characterize socioeconomic quintiles, Krieger *et al.* showed rapidly decreasing mortality for all groups in the 1970s, then stagnating declines among the most deprived counties during the 1980s and early 1990s for all-cause premature mortality (under 65).[19] In Figure 3, we report similar results, but for ages 25 and over, broken out by sex. Figure 3 indicates that these disparities were at their narrowest around 1980, and increased through the late 1980s and 1990s.

In related work using a deprivation index at the county level, Singh and Siahpush found that women and men in the least deprived as compared to the most deprived deciles of counties had life expectancies at birth 3.8 and 1.3 years longer in 1980 as compared to 5.4 and 3.3 years longer in 2000.[20] This was due primarily to improving life expectancy among those in the least deprived counties, in particular among women, while life expectancy in the most deprived counties improved by only 0.5 year between 1980 and 2000. Using a different ecological metric, Murray *et al.* created "8 Americas," finding that disparities did not markedly change overall between their groupings from 1982 to 2001, but that the most disadvantaged male group experienced a widening gap compared to the least deprived during the late 1980s and 1990s due to HIV and homicide.[21]

Using individual-level data that avoid the ecological fallacy interpretation problems, Meara, Richards, and Cutler[22] find that although adult mortality gaps by race and sex narrowed somewhat by the 1990s, education gradients in mortality expanded from the 1980s to the 1990s, with little mortality improvement among low-educated groups. This expanded gradient appeared across various causes of death and also among those both below and above age 65, suggesting that it was not due to the crack epidemic or uninsurance among younger people; rather, the authors suggest differential smoking rates as a potentially important factor.

To better understand the role of risk factors, such as smoking, we note that while overall decreases in ischemic heart disease have occurred since 1950, disparities in ischemic heart disease mortality have increased.[23] Before 1950, there was no association between cardiovascular disease and SES, and some studies showed even higher rates among higher SES individuals.[24,25] Then in the 1950s, studies of ischemic heart disease gradients began to show lower rates of mortality among higher SES individuals.[26–28] To characterize SES changes over time in key cardiovascular risk factors, Figure 4 reports trends since 1960 in obesity, hypertension, cholesterol, and smoking for adults ages 25 to 74 (25 and above for smoking) by gender and education level (greater than a high school education vs. high school or less). These four factors are perhaps the most important risk factors for the most common cause of mortality in the United States, cardiovascular disease. Obesity and smoking are also two of the most important risk factors for the second most important cause of death in the United States, cancer. Data are from the National Health Examination Survey and the National Health and Nutrition Examination Surveys (for obesity, high cholesterol, and hypertension) and from the National Health Interview Survey (for smoking). Overall, the prevalence of hypertension, high cholesterol, and smoking have all decreased over this 40-year time period, consistent with the decreasing trends in cardiovascular mortality. Thus although obesity has increased, its effects on hypertension and cholesterol have been mitigated by other factors. In examining the patterns of disparities in these figures as a whole, there are

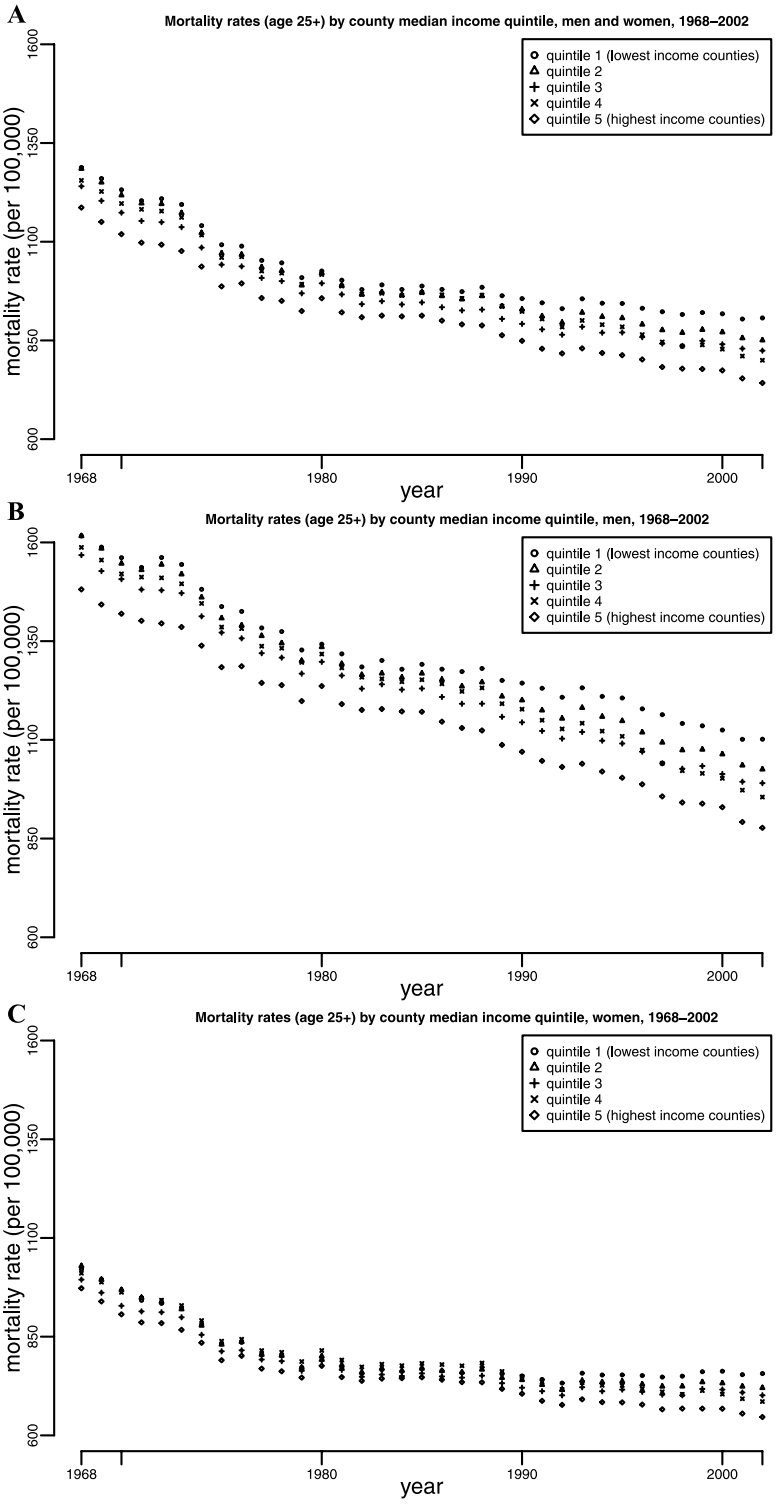

Figure 3. Mortality and population data were obtained from the National Center for Health Statistics compressed mortality files. All rates are age standardized to the year 2000 standard population.

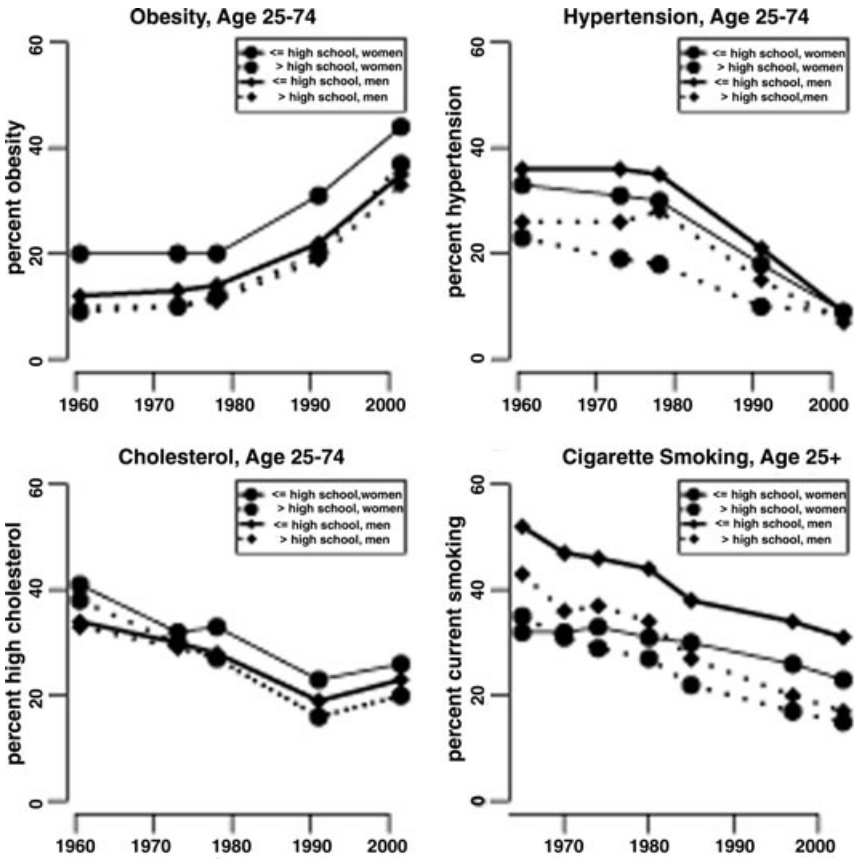

Figure 4. Data for obesity, hypertension, and cholesterol are from the National Health and Nutrition Examination Surveys. Data for smoking are from the National Health Interview Survey. All prevalences are age standardized to the year 2000 standard population. Obesity is defined as having a body mass index greater than 30. Hypertension is defined as systolic blood pressure greater than or equal to 140 mmHg or diastolic blood pressure greater than or equal to 90 mmHg. High cholesterol is defined as total cholesterol greater than or equal to 240 mg/dL.

not large uniform changes that can generally be observed across gender and risk factor over time. In fact, for the two risk factors (cholesterol and hypertension) that have been amenable to medical treatment, only very small educational differences in prevalence exist. In fact, educational differences in hypertension have *decreased* over time, both in absolute and relative comparisons. Educational differences in high cholesterol have remained generally constant, even after the introduction of statins. This suggests that although smoking-related behavior change (and its socioeconomic antecedents) may plausibly play a role in the widening mortality gradients, these other factors do not. Based on these data, it is unlikely that SES-related changes in access to chronic disease drug management (due, for example, to increasing uninsurance among low SES groups) are a primary explanation of the mortality trends observed either. As a whole, the above evidence reinforces the importance of moving beyond traditional cardiovascular risk factors, widening the research effort to more deeply explore other biomarkers and systems in order to better understand how SES may be "getting under the skin" and shaping these changing gradients over time.

Comparing U.S. gradients with gradients in other countries

What is known about how U.S. SES gradients in health compare with those in other countries? There have been relatively few studies of this nature until

recently, due partly to challenges of the comparability of SES measures and outcomes, as well as availability of representative data of a comparable time period. That is now changing with the availability of comparable health and retirement surveys across numerous OECD countries. A few unique examples of high-quality surveys from less industrialized countries also exist, but most comparisons are only able to be made to other OECD countries.

A recent study by Avendano[29] compares a variety of health indicators and cardiovascular risk factors among adults 50–75 in the United States, England, and 10 European countries in 2004. While gradients exist in all countries examined, the United States has both the worst health levels, as well as generally larger gradients, with the disadvantage most marked in the lowest wealth tertile. Adjusted health gradients by wealth tertile were in many cases similar in the United States and England though, which is also consistent with similar comparisons with English males by Banks *et al.*;[30,31] this latter article finds that in fact smoking gradients are smaller in the United States than Europe. One implication of these findings is that universal lifetime health care access in England does not dominate other health disparity determinants.

The larger U.S. gradients in these recent risk factor studies contrast with a prior study using 1980s data[32] that instead studied mortality, though only for ischemic heart disease causes. That study found that the ischemic heart disease gradients by occupational class were larger for northern Europe than for southern Europe, with the United States in-between. English gradients were similar to those of Scandinavian countries, and thus were somewhat higher than U.S. gradients (though formal tests would likely not have rejected that U.S. and European gradients were statistically equal). That study was recently updated among a wider set of European countries for the 1990s and early 2000s, but the United States was not included.[33] This latter study confirmed the larger gradients in northern Europe than southern Europe, despite the generally stronger welfare states in northern Europe. Furthermore, it found that countries with large obesity gradients were not necessarily the same countries that had large mortality outcome gradients; obesity gradients were larger in southern countries that had smaller mortality gradients. They argue that smoking gradients are more consistent with the mortality gradients within Europe, since smoking gradients are larger in northern European countries, but in general it is quite difficult to tease out the precise causal factors influencing health levels and gradients from these types of cross-sectional cross-country comparisons. Given these conflicting results between higher current *risk factor* gradients in the United States, versus earlier estimates of lower actual *mortality* gradients in the United States, it remains unclear how mortality gradients would currently compare with Europe. This literature would benefit from further high-quality studies comparing mortality disparities between the United States and other countries.

A small set of studies has also compared U.S. disparities with other non-European countries. In Costa Rica, for example, one study has shown little socioeconomic gradient in mortality over age 60,[4] much smaller than the over 60 SES differences in the United States.[34] Although some have argued that this may be due to Costa Rica's strong safety net, a more complex picture has emerged when examining a broader set of risk factors, with strong expected health gradients in some factors that are counteracted by currently inverted gradients in other markers, such as those related to nutritional behaviors.[3] With similar health and retirement surveys now being collected or planned in a broad range of other countries, such as Korea, China, and India, a much richer set of cross-country disparity comparisons will be possible in the next few years.

Case study: U.S. versus Canadian health trends during the 1980s

Potentially more powerful than the above cross-sectional comparative studies are those that compare changes in disparities over time, particularly if in response to some shock. This final section of the article compares and contrasts the experience of the United States during the 1980s with that of its most similar neighbor, Canada. Siddiqi and Hertzman approach this question by qualitatively examining relationships between macrolevel social influences, such as GDP, income distribution, and employment policies with male and female life expectancy over long periods of time.[35] As discussed earlier in the article and shown in Figure 2, U.S. life expectancy growth has lagged that of Canada, in particular during the 1980s. What factors might explain this?

Siddiqi and Hertzman argue that macroeconomic growth differentials are not a plausible hypothesis in this case. GDP growth was similar in the two countries from the mid 1970s through the 1990s, except for the period 1988–1993 when growth was *slower* in Canada. Similarly, Canadian unemployment rates diverged to become 2–4% *higher* than that of the United States starting in the 1980s.

Another unlikely hypothesis relates to medical care. Manuel and Mao[36] find that avoidable mortality during the 1980s and early 1990s was higher in the United States than Canada, consistent with Canada's universal health insurance coverage, but they show no evidence of changes in avoidable mortality over time. Canada did not expand health insurance during this period, while U.S. health spending rose much more quickly during this period than did Canada's, including a dramatic 50% expansion in the U.S. Medicaid program. Thus, if health care was the explanation, one would have expected to see a diminishing gap in the United States, which did not occur (although there is a possibility of lagged effects from Canada's earlier universal insurance expansions).

To investigate more deeply, it is useful to further disaggregate health trends by SES. In Figure 3, we showed that U.S. life expectancy gradients increased during the 1980s and into the 1990s, and above we discussed findings of little mortality improvement over this period among less educated groups.[22] In contrast, Wilkins *et al.*[37] find no growth in ecologically defined SES disparities in life expectancy over this period in Canada, with instead evidence of decreases in such disparities for cardiovascular causes, such as ischemic heart disease. What could cause this increasing gradient and stagnation of low-SES health gains in the United States but not in Canada?

Factors such as the population's genetic endowment are unlikely to have changed much from decade to decade. Meara *et al*. show that education gradients in the United States exhibit large increases among both whites and non-Hispanic blacks; although migration could play some role for whites, it is unlikely to explain this pattern among non-Hispanic blacks.[22] Similarly, factors, such as the population distribution of education, social support, or the proportion of adults who had access to effective early childhood education, are unlikely to have changed so quickly in the United States relative to Canada, though there were some differences. For example, Card and Freeman[38] note that the ratio of college graduates to high school graduates among young male workers fell in the United States during the 1980s while it rose in Canada, which can partially explain the United States' relative income inequality increases. It is possible as well that social factors interact with economic shocks, for example, via social capital that modifies the availability of social support in a downturn, or via the ability of higher educated individuals to better take advantage of the changing labor market opportunities. But with regard to social support in the 1980s, female labor force participation increased faster in Canada than the United States, suggesting that the United States' worse performance is not due to obvious differences in female availability to provide social support.

Personal health behaviors are also a common hypothesis for explaining health patterns. In Figure 4, we showed that obesity was actually converging across education groups over this period in the United States, though smoking gradients were worsening as those with higher education quit faster than those with lower education. In Canada, there was little smoking divergence among men, but a strong increasing smoking gradient among women. Thus it is possible that faster widening of smoking disparities could be a factor underlying the increased health disparities over this period—but given that smoking rates were still decreasing in the United States even among low-educated groups (in addition to falling hypertension and cholesterol rates), there must still be other important factors explaining why U.S. mortality among low-educated groups would exhibit little improvement at all.

Alternatively, Siddiqi and Hertzman argue that differences in government social policy may have played a key role. The 1980s was a period of rapidly increasing returns to skills, with relative wages for highly educated groups increasing much more quickly than those for low-educated groups. Given Canada's higher unemployment, it could be expected that poverty would have relatively increased in Canada—but in fact the reverse occurred. Card and Freeman[38] cite information that from 1979 to 1986 U.S. poverty rates increased by more than 25%, while Canadian poverty rates *decreased* 10%. Among single-parent families, U.S. poverty rates increased from 34% to 41%, while Canadian rates

decreased from 32% to 26%, thus moving from a 2 percentage point difference to a 15 percentage point difference between the countries. Card and Freeman[38] and Blank and Hanratty[39] argue that social policy is the key difference, particularly Canada's safety net transfer programs, and that much of U.S. poverty could be eliminated if the country adopted a safety net program as generous as Canada's. These safety net institutions during the 1980s included more generous and longer duration unemployment benefits; leave for maternity, sickness, and training; family allowance; more generous eligibility and benefits for means-tested cash assistance, etc. Overall, Siddiqi and Hertzman report that while social expenditure accounted for about 13% of GDP in both the United States and Canada in 1980, and was about the same in the United States in 1990, in Canada it had expanded to about 18% of GDP. The longer run cost and benefits of such increased expenditures in Canada will depend on tradeoffs between disincentive effects of higher tax burdens versus benefits of resulting human capital investments (relative to whatever alternative private use was crowded out by taxation). The health benefits of such expenditures are still not well understood (as detailed in the Kawachi, Adler, and Dow article in this volume), particularly the differences between government transfers that are designed to prevent income loss (such as unemployment compensation) as opposed to those targeted at increasing incomes (such as the earned income tax credit). There are compelling hypotheses that poverty reduction of this magnitude should improve population health, but causal empirical analysis of health benefits have proven tricky. Given the magnitude of the life expectancy improvements experienced by Canada relative to the United States over this period, a worthwhile priority for future research would be to develop clever designs to exploit such natural experiments to further quantify the population health benefits of these types of social investments.

Discussion

Levels and trends in health outcomes and health disparities are often examined separately. This article has explored them jointly in order to use each for informing hypotheses about determinants of the other. We argue that differences in association either over time, or across country context, indicate that aggregate health achievement and/or health disparities are not fixed, but rather subject to time and context-dependent causes. This broader viewpoint suggests that current U.S. health disparities need not continue inevitably. Although the most effective and desirable policies for addressing disparities are subject to debate, and it could take generations for such policies to have full effect, there is strong evidence that over these longer periods population health patterns are indeed malleable.

Examining the time periods when health improves most rapidly (or stagnates) or the places where health achievement is highest (and lowest) provides a focus for etiologic and causal investigations of the most important causes of overall population health and health disparities. Identification of key causes of health and health disparities at the individual level should be considered to be more robust and generalizable if consistent with the broader international and historic trends in overall patterns of health and socioeconomic disparities. If a causal factor is identified in individual-level etiologic investigations that remains generally static over a period of time, yet over this same time period the outcome of interest changes, it is likely that other causal factors may be playing a greater role in the determination of the population health outcome, either independently or through interaction with the alleged causal factor. Thus aggregate population trends over time and space may provide a further validity check to individual causal investigations. While genetic endowment surely influences cross-sectional health levels, and recent medical technology advances have improved outcomes once people fall ill, many have argued that these factors have been overemphasized in popular and policy discussions about health determinants. The international comparisons of changes over time examined in this article suggest that in addition to studying the socioeconomic determinants of health behaviors and pathways, the effects of the broader social policy arena may be an important and underappreciated area for increased policy research and experimentation toward improving population health levels and disparities.

Conflicts of interest

The authors declare no conflicts of interest.

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