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The Economic Value of Education for Longer Lives and Reduced Disability

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Policy Points:

- Although it is well established that educational attainment improves health and longevity, the economic value of this benefit is unknown. We estimate that the economic value of education for longer, healthier lives is comparable to or greater than the value of education for lifetime earnings.
- Policies that increase rates of completion of high school and college degrees could result in longer, healthier lives and substantial economic value for the population.
- We provide a template for assigning an economic value to the health benefits associated with education or other social determinants, allowing policymakers to prioritize those interventions that yield the greatest value for the population.

Context: Policymakers often frame the value of educational attainment in terms of economic outcomes (eg, employment, productivity, wages). But that approach may understate the value of education if it ignores the economic value of both longer lives and the reduced disability associated with more education.

Methods: In this article, we estimated the present value of the longer life and reduced disability associated with higher educational attainment at age 25 through age 84. We used prospective survival data and cross-sectional disability data from the National Health Interview Survey-Linked Mortality Files and drew on published estimates of the economic value of a statistical

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life. In addition, we used data from the Current Population Survey—Annual Social and Economic supplement to estimate the present value of education for lifetime earnings at age 25 through age 64 in order to provide a benchmark for comparing the value of education for health.

Findings: Compared with those with less than a high school degree, the longer lives of those with a high school degree are worth an additional $450,000 for males and $479,000 for females, and the additional disability-adjusted life for those with a high school degree is worth $693,000 for males and $757,000 for females. By comparison, the additional lifetime earnings for those with a high school degree, rather than less than a high school degree, is $213,000 for males and $194,000 for females. Compared with those with a high school degree, the longer lives for those with a baccalaureate degree are worth an additional $446,000 for males and $247,000 for females. The value of the additional disability-adjusted life associated with having a baccalaureate degree rather than a high school degree is $611,000 for males and $407,000 among females. By comparison, the additional lifetime earnings for those with a baccalaureate degree, rather than a high school degree, is $628,000 for males and $459,000 for females.

Conclusions: The value of education for longer, healthier lives may surpass the value for earnings. Estimates of the economic value of the social determinants of health, such as education, can help policymakers prioritize those policies that provide the greatest value for population health.

Keywords: education, population health, socioeconomic status, health disparities.

Policymakers seldom consider educational attainment as a means to improve population health and instead emphasize education as a lever for improving labor force outcomes such as earnings, productivity, and employment.[1,2] But investments in education do matter for health: Educational attainment has a strong, graded association with longer life,[3,4] and increasing spending on social services (including education) can result in healthier populations.[5,6] If the economic value of education for health is as substantial as the value of education for lifetime earnings,[7,8] then policies or interventions that promote education may yield even greater benefits per dollar invested than previously recognized. Here we have provided the first estimates of the economic value of education for long and healthy lives, which may help policymakers prioritize strategies for improving population health.

The health and labor force benefits associated with educational attainment make the failures of the US education system especially distressing. We lag behind many high-income countries in terms of high school and college completion.[9,10] The cost of education is higher in the United States than in other high-income countries, but public spending on education is decreasing, leading to underfunded schools, more private spending and debt, and poorer educational outcomes.[11-13] Although many students in the United States do complete high school and college, nonwhite, nonwealthy, and urban students are too often left behind.[14,15] Accordingly, policies that support all groups in achieving the high school and college completion rates observed for wealthy whites could result in substantial health and economic benefits.

The Economic Value of Education for Longer, Healthier Lives

Our first aim was to estimate the economic value of education for longer lives for those between the age of 25 through 84. We used the value of a statistical life year (VSLY) to calculate the value of the longer lives associated with higher levels of education. Researchers have estimated the economic value of a life in various ways. One strategy is calculating the increased wages that individuals demand for working in more dangerous jobs that require the same skills as used in less dangerous jobs (eg, construction work on a ten-story building versus a one-story building). Those higher wages represent compensation for the increased risk of death and thus the risk of forgoing other valued activities.[16,17] VSLY estimates recognize that individuals act as though their lives have finite value when they pursue enjoyable or productive activities that entail an increased risk of death (eg, working in dangerous jobs, eating raw or undercooked foods, driving faster than the speed limit).[16,17] Individuals place a value on their lives that is greater than wages alone because they also value nonwork activities, including time spent with family, participation in community life, or pursuit of hobbies.[18] Indeed, federal agencies have used VSLY estimates that range from $100,000 to $500,000.[19,20] We assume that VSLY is the same for everyone but that those who live fewer years are deprived of the value of those years.

Estimates of the economic value of life saved by some intervention (eg, increasing educational attainment) can help policymakers identify places to invest scarce resources. The US Department of Transportation (DOT) uses estimates of the value of a life to identify those places to improve roads that will yield the greatest reductions in death or disability per dollar invested.[21] Policymakers also use estimates of the value of life saved by some intervention to evaluate the economic benefit of that intervention. The US Environmental Protection Agency estimated that the Clean Air Act resulted in 14 additional years of life for an average adult in midlife, resulting in a value of approximately $2.9 million (ie, the discounted value of 14 years multiplied by $293,000, their VSLY in 1990 dollars).[19,22] Estimates of the economic value of education for population health outcomes can support policymakers' efforts to prioritize interventions that cost less than the value of the years of life saved.[16]

Our second aim was to estimate the economic value of education for longer lives and lower levels of disability. Whereas death implies a complete loss of the value of life, disability implies the partial loss of the value of a year of life.[23,24] Disability can lead to lost productivity in both the workplace and the household, higher medical expenditures, and reduced quality of life.[25] Educational attainment is associated with reduced disability in addition to longer lives.[26] Indeed, the positive association between educational attainment and active (ie, nondisabled) life expectancy is stronger than the positive association between education and total life expectancy.[26] Considering both survival and disability provides a more comprehensive economic valuation of education for health than does focusing solely on survival.

We emphasized two comparisons throughout our analyses. First, we focused on the value of the additional life associated with having at least a high school degree. There is substantial room to improve high school graduation rates in the United States,[14] and research increasingly suggests a causal association between education and survival, with the strongest evidence at the lower end of the educational distribution.[27-29] Second, we focused on the value of the longer, healthier lives associated with having a baccalaureate degree rather than a high school degree. Baccalaureate degrees are increasingly becoming the pathway to the middle class in the United States,[1,2] and the 25% of adults aged 25 to 34 who have currently completed a baccalaureate degree may also receive substantial survival benefits.[30]

Methods

We drew on mortality rates, disability prevalence, and earnings for the US population, which we estimated with data from the National Health Interview Survey and the Current Population Study.

National Health Interview Survey

We estimated mortality rates and disability prevalence with data from the National Health Interview Survey (1986-2009), an annual, cross-sectional survey that collects information from a nationally representative sample of noninstitutionalized adults.[31] The average response rate was 91% for the survey years we examined. The NHIS is matched to prospective mortality from the National Death Index, the Social Security Administration, and the Centers for Medicare and Medicaid through December 2011 via the Linked Mortality Files (LMF), resulting in a follow-up of up to 26 years.

We excluded individuals who were ineligible to be linked to mortality because they did not provide information on the matching criteria; we used sample weights provided by the National Center for Health Statistics to adjust for their exclusion.[32] We also excluded foreign-born adults because education received abroad may not be comparable to education received in the United States and because their deaths may be undercounted if they return to their countries of origin before death. Finally, we excluded adults who were younger than age 25 at baseline who may not have completed their education, or who were aged 85 or older at baseline because their ages were top-coded and we could not identify their precise age at interview and, thus, death. Our final sample included 1,183,134 respondents at baseline, of whom 224,707 died during the follow-up period.

Variables. All-cause mortality was coded as died or survived the follow-up period. Disability was coded dichotomously as any limitation to daily activities (eg, dressing, eating, toileting, bathing/showering, getting out of beds or chairs) or no disability. Educational attainment at baseline was coded categorically as less than a high school degree, high school degree or equivalent, some college but no degree, baccalaureate degree, and postbaccalaureate education. Age was measured continuously in quarter years and ranged from 25.0 to 84.75 at baseline.

Birth cohort was coded continuously in quarter years and ranged from 1901.25 to 1984.75. Sex was measured dichotomously. Race was coded categorically as non-Hispanic white, non-Hispanic black, Hispanic, and other.

Mortality Rates. To estimate mortality rates, we converted the NHIS-LMF data (a prospective cohort) into a person-period data set in which individuals contribute observations for each time period from the quarter of the interview until their age of death or censor at the end of 2011. Age was time-varying; our baseline sample included adults up to age 84.75, but we prospectively followed them through age 95.75.[32] We used a complementary log-log hazard model to estimate the age-to-death in the person-period data.[33] The best-fitting model to identify the baseline hazard included linear splines with knots at ages 45, 65, and 85.[34] To account for widening educational disparities in mortality across cohorts,[4,35] we subtracted 1955 from our birth cohort variable and then included interactions between birth cohort and educational attainment. We used educational disparities in mortality specific to the 1955 birth cohort (when cohort equals 0) because those adults were aged 65 in 2015, so their survival remained relevant to working-aged adults and because we had enough deaths in that cohort to ensure stable estimates.

We stratified our analyses by sex when estimating educational disparities in survival, given the sex differences in educational attainment and survival. Throughout, we used race-adjusted mortality rates. Education, the only variable of interest with missing data, is missing for 1.2% of the respondents. We created five multiply imputed data sets, each of which contains a separate set of plausible values, conditional on other observed variables.[36]

We used fitted mortality rates from our models to create life tables with standard methods.[37] Our models made use of variability in survival within and between cohorts to estimate mortality rates specific to the 1955 birth cohort,[37] a technique that has been used elsewhere.[35] Life tables allowed us to estimate the survivor function: the proportion of a hypothetical population starting at age 25 that survives to subsequent ages.[33]

Disability Prevalence. We used complementary log-log models to predict prevalent disability with the baseline (ie, cross-sectional) NHIS data. The best-fitting model included age and age-squared. Given our interest in flexibly modeling educational disparities in disability across age, we included indicators for educational attainment as well as interactions between education and the age variables. As with mortality, we multiply imputed education, stratified our models by sex, and adjusted for race.

Current Population Survey

We estimated the value of education for earnings as a benchmark with which we compared the value of education for longer lives. We used the Current Population Survey—Annual Social and Economic supplement (CPS-ASEC) from 2010 to 2015[38] to estimate the median earnings for full-time, full-year (including vacation and paid sick leave) workers aged 25 through 64, by age, sex, and educational attainment. The average response rate for those years was 88%. We pooled cross-sectional data from multiple years to ensure stable estimates. Like the NHIS, the CPS-ASEC is representative of the civilian, noninstitutionalized population, and we excluded adults who were younger than age 25 or were foreign born. We also excluded adults aged 65 and older because they were likely to have transitioned out of full-time work and into retirement. Our final CPS-ASEC sample included 250,787 respondents.

Our measure of earnings comprised all pre-tax wages, salary, or earnings in the previous year, from sources including overtime pay, bonuses, commissions and tips from all employers, and self-employment in a business or farm. To inflate all values to 2015 dollars, we used the consumer price index. CPS imputes missing data with relational (eg, drawing information from family members) and hot-deck methods.[38] All estimates were weighted to the US population. Given the sparse data for some combinations of sex, education, and age, we estimated median earnings in 5-year age groups.

Value of Education Estimates

We used three strategies to estimate the value of education. This section of our article details each strategy. Throughout, we calculated the present value (at age 25, in 2015 dollars) of the discounted value of future years of life or earnings.[39] The discount rate (ie, the interest rate) represents the penalty that individuals would incur for receiving a lump-sum payout of the value of future earnings or years of life, just as lottery winners receive less money if they take all their winnings immediately rather than a series of smaller payouts into the future.[7] We used a discount rate of 3%, which is within the bounds used in prior policy analyses.[7,21]

Our first strategy was to estimate the value of education for lifetime earnings to provide a benchmark for our estimates of the value of education for longer lives. We replicated prior work[7,8] and estimated the present value of the additional earnings associated with having a high school degree or more education, compared with those with less than a high school degree, at age 25 through 64:

$$PV_E = \sum_{a=25}^{64} \frac{E_{j,a} - E_{J,a}}{(1+r)^{a-24}} \tag{1}$$

where E is the median earnings for individuals with educational attainment j, at age a. Educational attainment j can take the values of high school degree, some college, college degree, or postbaccalaureate degree. From those earnings, we subtracted the age-specific earnings of those with less than a high school degree (J). The values for equation (1) will be greater than 0 only when individuals with a high school degree or more education have higher earnings than those with less than a high school degree. In the denominator, r is the discount rate. We raised the denominator to the exponent ($a-24$) so that expected earnings at the end of age 25 (ie, $25-24$) were already discounted by one year. The results for median earnings, as well as for the 25th and 75th percentiles of earnings, represent variability in earnings across educational groups.

Our second and third strategies used the VSLY to estimate the present value of education for longer and healthier lives, at age 25 through age 84. We calculated VSLY as the value of a statistical life (VSL) divided by the sum of the discounted probability of surviving through each age (S_{a+1}), for ages 25 through age 84:[18,19]

$$VSLY = VSL \Bigg/ \sum_{a=25}^{84} \left[\frac{S_{a+1}}{(1-r)^{a-24}} \right] \tag{2}$$

The other terms have already been defined. When estimating the VSLY, we derived our survivor function from mortality rates estimated from a survival model that pools all the adults in our data; adjusted for sex, education, and race/ethnicity; and then set those covariates at their means. Thus, we estimated the average VSLY across the groups in our data. In doing so, we assumed that VSL was the same regardless of education, age, sex, race, or other attributes.[16] Some evidence suggests that VSL may be greatest for adults who are in their prime working ages or who earn higher wages, but given ethical concerns about valuing some lives more highly than others, we followed governmental agencies and avoided those assumptions.[19,21]

Dividing VSL by the sum of the age-specific survival probabilities from age 25 through age 84 provides an estimate of the value of each year of expected life during that interval. Our calculations assumed that the VSLY was the same for each year of life, although the out-years were discounted more steeply. Because VSLY depends on the number of years over which VSL is discounted, our estimates differ from those provided elsewhere.[18,19]

Our VSL estimates come from a US DOT report that used estimates from nine papers deemed of highest quality by a panel of experts, and then adjusted those estimates to account for inflation and growth in real income over time.[21] The US DOT report provides a point estimate that is consistent with earlier meta-analyses,[17] as well as lower and upper bounds to represent the uncertainty in VSL estimates. The upper and lower bounds do not represent an underlying probability that the true VSL falls within the interval but instead reflects the range of plausible values identified in prior work.[21] Given a discount rate of 3%, the VSL point estimate of $9.6 million reported by US DOT[21] yields a VSLY of $370,624, and the lower- and upper-bound VSL estimates of $5.4 million and $13.4 million yield upper- and lower-bound VSLY estimates of $208,476 and $517,330, respectively.

Our second strategy addresses our first aim by using our VSLY estimates to calculate the economic value of the longer lives associated with additional education. We calculated the present value of the additional life associated with having a high school degree or more education, compared with those having less than a high school degree, at age 25 through age 84:

$$PV_{(VSLY|S)} = VSLY \cdot \sum_{a=25}^{84} \frac{(S_{j,a+1} - S_{J,a+1})}{(1+r)^{a-24}} \quad (3)$$

where we used the VSLY estimates from equation (2); the other terms have already been defined. The numerator of equation (3) shows that values depend on educational differences in the proportion of adults surviving from ages 25 through 84.

Our third strategy addresses our second aim by drawing on both our VLSY estimate and the prevalence of disability across education groups to calculate the economic value of longer, healthier lives. We calculated the present value of the additional disability-adjusted life associated with having a high school or more education, compared with those with less than a high school degree, at age 25 through age 84. Building on the strategy developed in equation (3), we then incorporated the prevalence of disability through age 84:

$$PV_{(VSLY|S,A)} = VSLY \cdot \sum_{a=25}^{84} \frac{S_{j,a+1} * \left[1 - \left(D_{j,a} \cdot W\right)\right] - S_{J,a+1} * \left[1 - \left(D_{J,a} \cdot W\right)\right]}{(1+r)^{a-24}} \quad (4)$$

where D is the probability of being disabled at age a, W is a disability weight, and the other terms have already been defined. When the probability of being disabled is high *and* the disability weight is high, then one minus their product $\{1-(D * W)\}$ will be small, and the survival probability will be decremented more steeply. But if either the probability of being disabled or the disability weight is zero, then one minus their product will equal one, and the survival probability will not be decremented. Thus, the numerator of equation (4) will be large when the survival probability is large and the probability of being disabled is small for those having a high school degree or more education, compared with those having less than a high school degree.

We followed Sullivan's method when multiplying prevalent disability by survival probabilities to estimate disability-adjusted life.[40] Sullivan's method is easy to implement when estimates of prevalent disability are available, but it may produce biased estimates of disability-adjusted life when disability incidence and recovery are changing rapidly in a population. Simulation studies, however, suggest that for most realistic scenarios, those biases will be small.[41] Because a disability weight for activity limitations was not estimated in earlier research, we assigned a disability weight of 0.30, where a value of 1 indicates a disability equivalent to death and a value of 0 indicates a disability resulting in no reduction in the quality of life. We chose this value by considering the lowest level of disability that would almost certainly lead to limitations on activity. Examples of conditions with values around 0.30 are severe low back pain with leg pain (disability weight = 0.325), Parkinson's disease of moderate severity (disability weight = 0.267), long-term consequences of stroke with cognition problems (disability weight = 0.316), and moderate dementia (weight = 0.377).[42]

Results

Figures 1 through 3 summarize the data we used to estimate the value of education. Figure 1 shows the survival curves from ages 25 through 84 by education and sex. The proportion surviving declines with age, and those declines are faster for those with less education. The proportion surviving is greater among women than men at each level of education. For example, the proportion surviving from age 25 to age 65 is 0.73 for men with less than a high school degree and 0.93 for men with a postbaccalaureate education and is 0.79 for women with less than a high school degree and 0.95 for women with a postbaccalaureate education.

Figure 2 shows, by education and sex, the proportion of adults aged 25 through 84 who are disabled (ie, have an activity limitation). Although the proportion disabled increases with age for all educational groups, it is consistently highest for those with less than a high school degree. At age 65, the proportion disabled is 0.43 for men with less than a high school degree and 0.16 for men with a postbaccalaureate education, and it is 0.44 for women with less than a high school degree and 0.18 for women with a postbaccalaureate education.

Figure 3 shows, by education and sex, the median earnings for ages 25 through 64, in 2015 dollars. Median earnings increase with education and are higher for men than for women. Of men aged 45 to 49, those with a high school degree have median earnings of $45,000, and those with a college degree have median earnings of $81,000. However, for women aged 45 to 49, those with a high school degree have median earnings of $33,000, and those with a college degree have median earnings of $55,000.

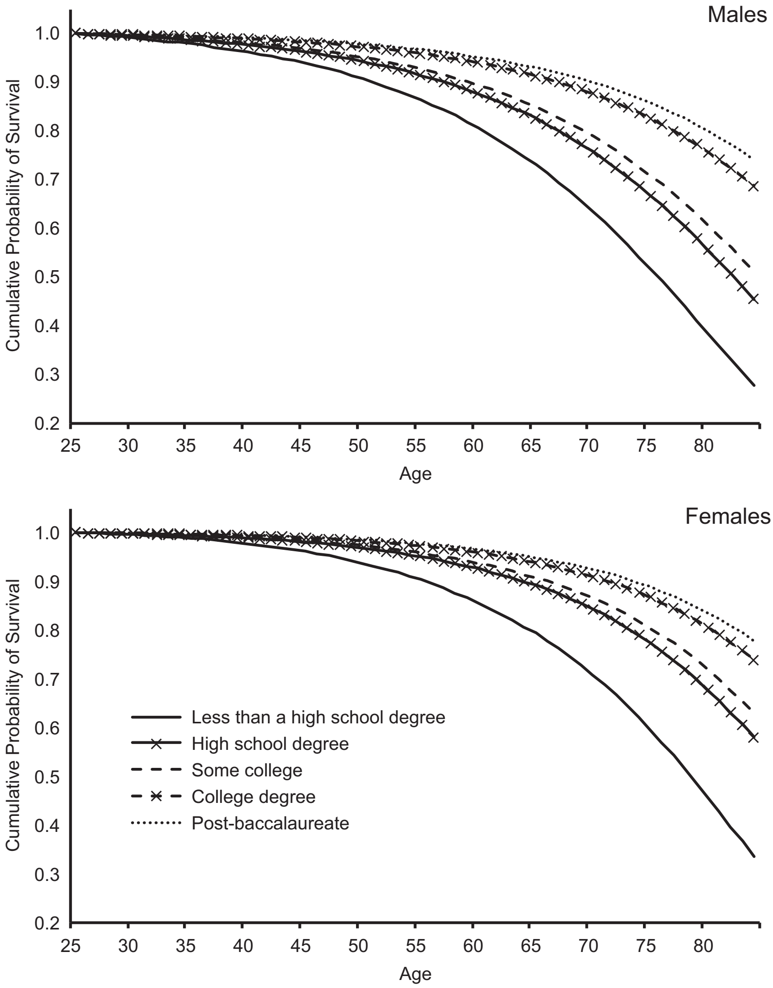
Table 1 shows estimates of the present value of education at age 25 for men (Panel A) and women (Panel B). In each panel, the first row shows the present value of education for earnings; the corresponding interval estimates come from the 25th and 75th centiles of earnings. The second

Table 1. Present Value of Education Compared With Those With Less Than a High School Degree (2015 US Dollars)

	High School Degree	Some College	Baccalaureate Degree	Postbaccalaureate Education
Panel A: Males				
Value of education for earnings, ages 25 to 64[a]	$212,835 ($171,691, $254,452)	$411,271 ($309,253, $526,402)	$841,273 ($580,967, $1,175,951)	$1,260,127 ($859,188, $1,865,883)
Value of education for survival, ages 25 to 84[b]	$449,832 ($253,031, $627,891)	$569,280 ($320,220, $794,620)	$895,866 ($503,925, $1,250,480)	$984,016 ($553,509, $1,373,522)
Value of education for disability-adjusted life, ages 25 to 84[b]	$693,041 ($389,836, $967,370)	$846,785 ($476,317, $1,181,971)	$1,304,174 ($733,598, $1,820,410)	$1,392,081 ($783,046, $1,943,114)
Panel B: Females				
Value of education for earnings, ages 25 to 64[a]	$193,789 ($144,832, $234,082)	$332,291 ($236,556, $430,061)	$652,905 ($482,540, $924,684)	$945,720 ($709,928, $1,331,753)
Value of education for survival, ages 25 to 84[b]	$479,398 ($269,661, $669,160)	$561,999 ($316,125, $784,457)	$726,715 ($408,777, $1,014,372)	$782,332 ($440,062, $1,092,005)
Value of education for disability-adjusted life, ages 25 to 84[b]	$756,738 ($425,665, $1,056,280)	$867,785 ($488,129, $1,211,283)	$1,163,647 ($654,551, $1,624,257)	$1,215,317 ($683,616, $1,696,381)

[a]The interval around the point estimate for lifetime earnings comes from the 25th and 75th centiles of earnings by education, age, and sex.
[b]The intervals around the point estimates for the value of education for survival and for disability-adjusted life represent upper and lower bounds on the value of a statistical life as described by US DOT.

Figure 1. Probability of Survival by Educational Attainment



and third rows show the present value of education for survival and the present value of education for disability-adjusted life, respectively; the corresponding interval estimates come from the upper- and lower-bound estimates of the VSL.

Figure 2. Proportion Disabled by Educational Attainment

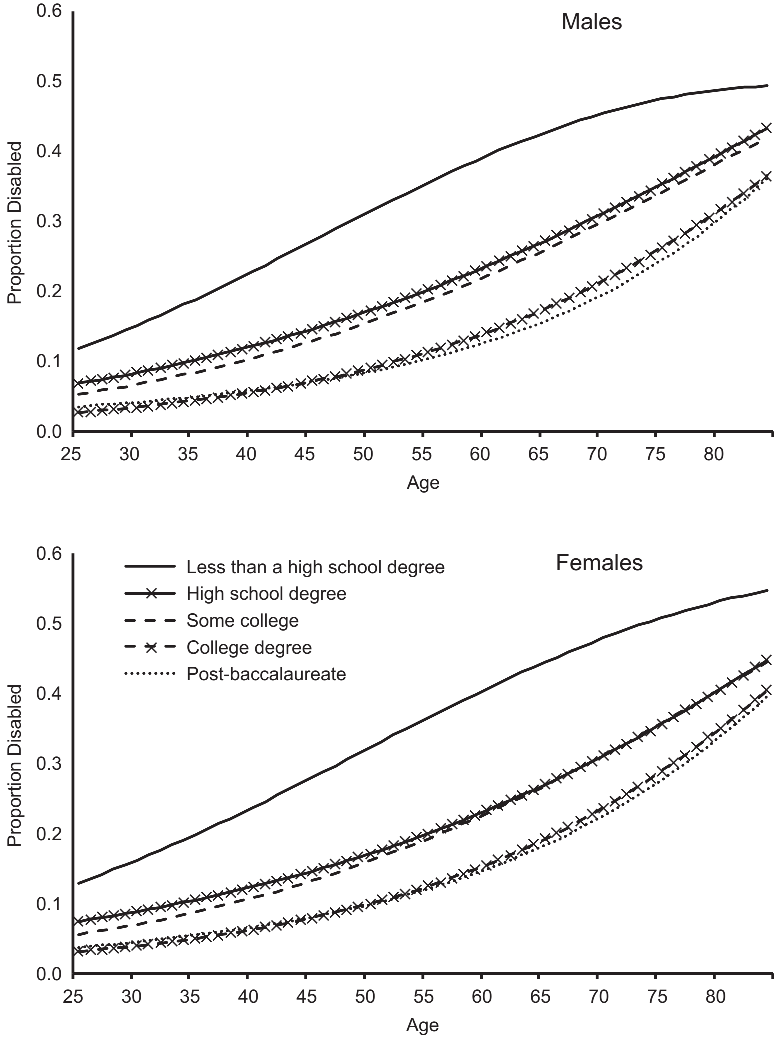
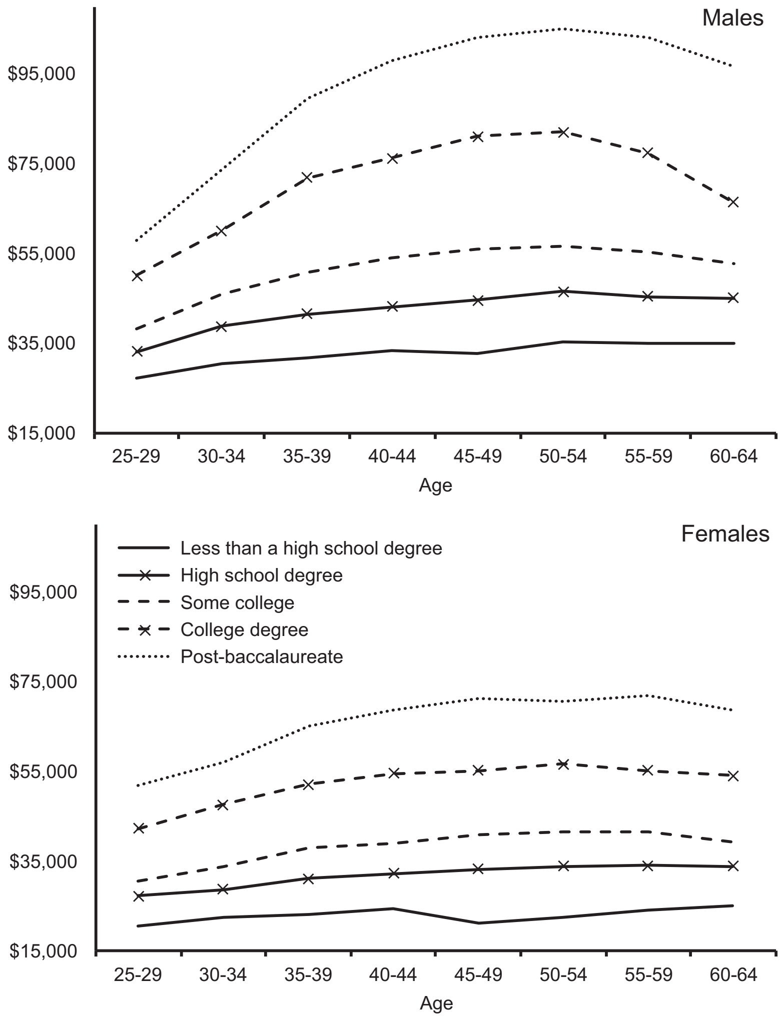


Figure 3. Age-Specific Median Earnings by Educational Attainment (2015 US Dollars)

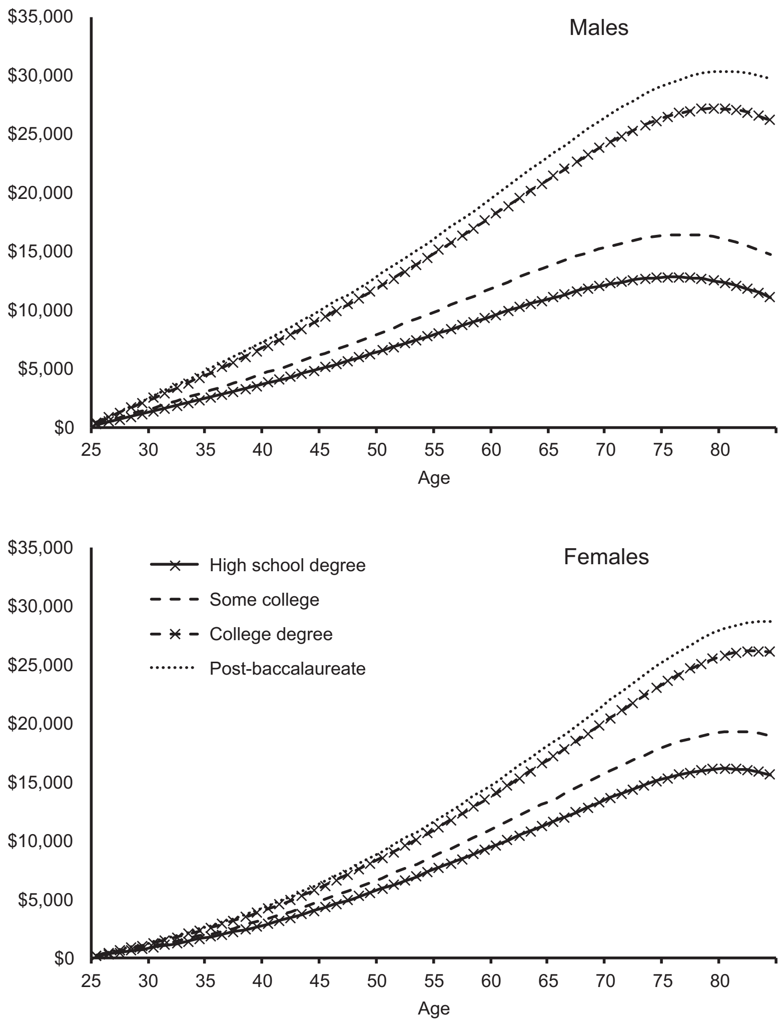


The additional lifetime earnings among those with a high school degree, rather than less than a high school degree, are \$213,000 for males and \$194,000 for females. The estimated value of the longer, healthier lives associated with a high school degree is somewhat greater than the value of earnings. Compared with those with less than a high school degree, the longer lives among those with a high school degree are worth an additional \$450,000 for males and \$479,000 for females, and the additional disability-adjusted life for those with a high school degree is worth \$693,000 for males and \$757,000 for females.

The value of having a baccalaureate degree over a high school degree is substantial as well. The additional lifetime earnings for those with a baccalaureate degree rather than a high school degree is \$628,000 (= \$841,273 – \$212,835) for men and \$459,000 (= \$652,905 – \$193,789) for women. The value of the longer life associated with having a baccalaureate degree is somewhat less than the value of earnings. The longer life associated with having a baccalaureate degree rather than a high school degree is worth \$446,000 (= \$895,866 – \$449,832) for men and \$247,000 (= \$726,715 – \$479,398) for women. The value of the additional disability-adjusted life associated with having a baccalaureate degree, however, is comparable to the value of earnings. The value of the additional disability-adjusted life for those with a baccalaureate degree rather than a high school degree is \$611,000 (= \$1,304,174 – \$693,041) for men and \$407,000 (= \$1,163,647 – \$756,738) for women.

Figure 4 shows, by single year of age, the present value of the additional life associated with having a high school degree or more education compared with those with less than a high school degree. The sum of these values for each education group yields the corresponding values in the second rows of Table 1, Panels A and B, respectively. The value of additional education for longer lives is relatively modest in early life, when deaths are rare in all educational groups. Educational disparities in mortality widen in midlife, resulting in an increasing value of education for survival. The value of education for longer lives reaches a zenith in the mid- to late 70s for males and in the early 80s for females. These values begin to plateau or decline in the mid-80s because the proportion surviving to those ages drops for all education groups.

Figure 4. Age-Specific Present Value of Education for Longer Lives, by Educational Attainment (2015 US Dollars)



Discussion

The United States has substantial room to improve high school and college completion rates, especially for students who are nonwhite, are nonwealthy, or grow up in urban areas.[14,15] Increasing the share of the population with high school or college degrees will take time. Our findings suggest that it will take decades to realize most of the economic value of the associated improvements in health and survival, although the benefits to wages and productivity come earlier. Despite the long lag-time, promoting education may improve the health of the US population more than focusing on more targeted behavioral interventions.[43,44] Indeed, medical and behavioral interventions alone may do little to improve the health of the least educated in our population. Educational disparities in survival continue to widen[4] because the benefits of new drugs, medical treatments, and behavioral interventions largely go to the most educated, who are already among the most healthy.[45,46]

Existing research shows that education is associated with longer, healthier lives through such diverse mechanisms as healthier behaviors, higher earnings and social status, stronger cognitive skills, greater knowledge about how to avoid health risks, better adherence to medical treatments, and more salubrious social connections.[27,47-49] Findings from cohort studies that adjust for various confounders (eg, early-life conditions, intelligence) and natural experiments are consistent with a causal association between education and survival, with the strongest evidence at the lower end of the educational distribution.[27-29] Furthermore, a stronger inverse association between education and mortality emerges after accounting for the nonrandom selection of individuals into educational statuses,[29] suggesting that those who are least likely to pursue additional education may reap the greatest survival benefits if they do so.

Despite the growing evidence supporting a causal association between education and survival, policymakers treat education primarily as a mechanism for improving labor force outcomes, rather than as a lever for improving population health.[1,2] Increasing spending on education, however, may yield greater improvements in population health than increasing spending on health care.[5,6] The United States already spends a greater share of its gross domestic product on health care than do other high-income countries,[50] and yet it has experienced falling life expectancies for two consecutive years.[51] Our results clarify the economic value of education as a strategy for improving population health.

Our first aim was to consider the value of education for longer lives. Compared with adults with less than a high school degree, the longer lives associated with having a high school degree are worth an additional $450,000 for men and $479,000 for women. Moreover, compared with adults with a high school degree, the longer lives of those with a baccalaureate degree are worth an additional $446,000 for men and $247,000 for women.

Our second aim examined the value of education for disability-adjusted life.[26] Compared with those with less than a high school degree, the value of the additional disability-adjusted life for those with a high school degree is $693,000 for males and $757,000 for females. And compared with those with a high school degree, the additional disability-adjusted life for those with a baccalaureate degree is worth an additional $611,000 for men and $407,000 for women.

The value of education for survival is substantial. Earlier research suggests that the personal (eg, wages) and public (eg, increased tax payments, reduced crime, and decreased utilization of welfare and health care) benefits of having a high school or baccalaureate degree are greater than the costs (eg, tuition, forgone wages while in school) associated with attaining those degrees.[52,53] Those studies, however, fail to consider the value of longer, less disabled lives. Indeed, the economic value of a high school degree for longer lives and lower disability outstrips the value of a high school degree for lifetime earnings. The value of a baccalaureate degree is also substantial. Thus, promoting high school and college completion may be viable targets for policymakers.[35]

The value of the survival benefits associated with education largely accrues after the value of lifetime earnings. The value of the lifetime earnings associated with education accrues by age 65. The value of the longer lives associated with education, however, is modest in early adulthood, grows in midlife, and peaks in the mid- to late 70s for males and in the early 80s for females—well past their prime working ages. Existing evidence suggests that income explains about 30% of the association between education and health[54]; that is, the value of education for longer, healthier lives is substantially but not completely distinct from the value of education for earnings. Thus, investments in education may yield two dividends: higher earnings during the working ages, and the value of longer, healthier lives for older adults.

The existing research offers little insight into how closing educational disparities in survival and disability would affect public or private health care spending. Some evidence suggests that spending may increase if more adults survive to the older ages, during which spending on health care is typically greatest.[55] Other research finds that reduced disability and improved health in those who survive to the older ages could reduce health care spending.[56] Notably, other high-income countries exhibit both longer lives and lower health care expenditures than the United States, suggesting that we can improve both. Per capita health care spending in the United States outpaces spending in other countries largely because we do too little to control health care costs, not because we live too long.[5,57] Moreover, compared with spending on health care, investments in education have the added advantage of largely offsetting their own costs because of greater economic productivity,[12] even when ignoring the economic value of longer, healthier lives.

Strengths and Limitations

The strengths of our analyses include the use of large, nationally representative data. Our estimates of VSL come from the US DOT, whose values are used by policymakers and are derived from expert panel reviews of the published literature.[21] The VSL we used in our analyses is comparable to values from an earlier meta-analysis.[17] We recognize the uncertainty inherent in valuing human life by presenting upper and lower bounds, based on the range of value-of-life estimates identified by the US DOT.[21]

Our analyses also have several limitations. First, although some evidence suggests that education is causally linked to survival,[27-29] we were unable to include a comprehensive set of confounders in our models, so our results may misstate the association between education and disability and survival. Earlier research, however, suggests that the association between education and mortality may be even stronger after accounting for the nonrandom selection of individuals into higher levels of education.[29]

Second, estimates of VSL and VSLY are imprecise,[17,21] although even imperfect estimates may be useful to policymakers who routinely make decisions that have consequences for population health.[16] Third, we assumed values for both our discount rate and the disability weight.

Separate analyses show that the value of education for health and survival declines somewhat faster than the value of education for earnings when using higher discount rates because we discounted over a longer age span and because the value of education for health and survival peaks at later ages. Furthermore, the value of education for disability-adjusted life is smaller when using smaller disability weights, but the values remain larger than the value of education for survival, given substantial educational disparities in disability.[26]

Finally, we used educational disparities in survival specific to the 1955 birth cohort in our analyses. Estimates of educational disparities in mortality from more recent cohorts might be desirable, but the survival outcomes of adults aged 25 in 2015 will not be observed for decades. Period life tables solve that issue by assuming that younger individuals in a given calendar year will eventually experience the same mortality rates as do older adults in that same calendar year.[37] Period life table estimates, however, will provide biased estimates of educational disparities in survival because those disparities are widening across cohorts.[4,37] We used mortality estimates specific to the 1955 birth cohort because the people in that cohort are young enough to be relevant to current survival experiences in the United States but old enough that we could estimate stable survival disparities. To the extent that educational disparities continue to widen in cohorts born more recently than 1955, our results will understate the survival advantages and the consequent economic value associated with greater education. But any bias associated with using educational disparities in survival specific to the 1955 birth cohort will likely be smaller than the bias that would occur if we had used period life tables that ignore the changing educational disparities in survival across cohorts.

Conclusions

Educational attainment is strongly associated with better health and longer lives.[3,4] We found that the economic value of education for longer, healthier lives sometimes outstrips the value of education for earnings. The existing research has seldom estimated the economic value of potential social determinants of population health, making it difficult to prioritize some policies or interventions over others.[58] Our findings support efforts to prioritize interventions that provide the greatest value for population health at the lowest cost. Indeed, policies and interventions that improve rates of high school completion, college enrollment, and college graduation could prove valuable to the health and wealth of the US population.

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