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EDUCATIONAL DEGREES AND ADULT MORTALITY RISK IN THE UNITED STATES*

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Abstract

We present the first published estimates of U.S. adult mortality risk by detailed educational degree, including advanced postsecondary degrees. We use the 1997–2002 National Health Interview Survey (NHIS) Linked Mortality Files and Cox proportional hazards models to reveal wide graded differences in mortality by educational degree. Compared to adults who have a professional degree, those with an MA are 5 percent, those with a BA 26 percent, those with an AA 44 percent, those with some college 65 percent, HS graduates 80 percent, and those with a GED or 12 or fewer years of schooling are at least 95 percent more likely to die during the follow-up period, net of sociodemographic controls. These differentials vary by gender and cohort. Advanced educational degrees are not only associated with increased workforce skill level, but also with a reduced risk of death.

Keywords

Education; Mortality

INTRODUCTION

Educational attainment is a principal determinant of health behaviors and health outcomes that works through multiple pathways. These pathways include higher income, better access to healthcare, a greater ability to retrieve and process health information, more extensive social networks, and increased self-efficacy (Lantz et al. 1998; Link and Phelan 1995; Mirowsky and Ross 1998, 2003). Moreover, education is established early in life and can place people on differential health trajectories that have implications for well-being in old age, as well as mortality (Montez and Hayward 2010). Most research in this area, however, does not fully account for the complex and multifaceted nature of educational attainment (Braveman et al. 2005; Hummer and Lariscy 2010; Krieger, Williams, and Moss 1997). Specifically, existing mortality research has used years of education rather than attained degrees. Because education measured in completed years of schooling does not correspond perfectly to obtained degrees, it may not be the best and is certainly not the only measure of educational attainment relevant for health and mortality outcomes. This paper examines the association between the attainment of educational degrees and U.S. adult mortality risk.

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More educated people have greater social psychological resources for dealing with their environment, which may lead to better health and survival. Education is perhaps most important for increasing agency and personal control (Mirowsky and Ross 1998), which leads individuals to believe that they can effectively alter their surroundings and will therefore seek information to guide their lives, know more about health, and adopt a lifestyle that enhances their health outcomes. More highly educated individuals may have access to other highly educated individuals and professionals who can provide advice, and who can effectively and directly intervene in a crisis. Those with higher levels of education may also encounter fewer non-health stressors, such as marital and family problems, conflicts with friends and neighbors, legal hassles, and on-the-job troubles, which result in health benefits and lower mortality risks (House, Landis, and Umberson 1988; Lantz et al. 2005). Compared to those who are less educated, more highly educated individuals tend to engage in stable forms of social support, including friendship networks and marriage, which are associated with better health and lower mortality (House et al. 1988; Lillard and Waite 1995; Mirowsky and Ross 2003). Education is associated with increased productivity and thus higher earnings (Becker 1964), lower unemployment, less financial hardship (Elo and Preston 1996; Hayward and Gorman 2004; Mirowsky and Ross 2003; Rogers, Hummer, and Nam 2000), and more prestigious occupations, which have important implications for mortality (Krueger and Burgard 2010).

In most national surveys, education is measured in completed years of schooling, which researchers either categorize (see Christenson and Johnson 1995; Kitagawa and Hauser 1973; Molla, Madans, and Wagener 2004) or use as a continuous linear predictor of mortality risk (Elo, Martikainen, and Smith 2006; Lynch 2006; Preston and Elo 1995; Zajacova 2006). Some studies suggest that credentials provide little or no information beyond years of schooling for various labor market and health outcomes (e.g., see Ashenfelter and Rouse 2000; Layard and Psacharopoulos 1974; Ross and Mirowsky 1999). Furthermore, a continuous specification of years of education was assumed to fit the data sufficiently well with regard to earnings, and potential nonlinearities in the effects of education were captured using higher-order terms rather than completed degrees (Card 1999). One reason for the focus on years of schooling is the available data. For example, the U.S. Census and the Current Population Survey collected information about education in years of schooling through the 1990s. More recently, however, past the 12th grade, questionnaires have assessed completed degrees rather than years of schooling (Card 1999). Unfortunately, few if any nationally representative public-use data sets simultaneously include continuous measures of years of education and degrees attained, particularly when mortality risk is the outcome variable under study.

There are important drawbacks to measuring educational attainment using years of completed schooling in studies of adult mortality. People who report a given number of years of schooling on a survey may be quite different in terms of credentials. For instance, among those reporting 12 years of education, some may not have a degree, others may have a General Educational Development (GED) degree, whereas most have a high school diploma. Further, it may be faulty to assume that the best functional form for the relationship between education and mortality risk is linear. Backlund, Sorlie, and Johnson (1999) argue that compared to years of education completed, a set of trichotomous dummy variables (less than a HS diploma, at least a HS diploma but no college diploma, and at least a college diploma) provides a better fitting model of the relationship between education and working-aged mortality risk than does a continuous measure of education.

Years of schooling may impart increasingly less information about the outcome of the educational pathway because of trends toward greater variability in time to attain degrees and higher college dropout rates. Many postsecondary students take classes part-time, move in and out of school, or for other reasons take longer than the normative number of years to complete their degrees. Since 1970, the time to complete college degrees has increased substantially (Bound, Lovenheim, and Turner 2007). Students at four-year institutions who do not drop out now take about four and one-half rather than four years on average to earn a BA degree (NCES 2003). Students who transfer from a two-year college take almost six years on average. In 2006, 12 percent of adults aged 25–29 were still enrolled in school (NCES 2007). Moreover, the conventional category "four or more years of college" does not correspond to a specific degree and cannot distinguish individuals who obtained no degree from those who obtained a bachelor's (BA or BS), master's (MA or MS), doctoral (PhD), Juris Doctor (JD), or Doctor of Medicine (MD) degree. In light of these trends, education may increasingly need to be conceptualized in terms of credentials attained rather than years completed (Faia 1981; Krieger et al. 1997).

A growing number of studies find additional effects of educational credentials on employment and earnings beyond years of schooling (Belman and Heywood 1991, 1997; Frazis 2002). Park (1999) found that a HS diploma was associated with 9 percent higher earnings than 12 years without a diploma; an associate's (AA) degree with 11 percent higher earnings compared to 14 years of education; and a BA/BS degree with 21 percent higher earnings than 16 years of education. There are also dramatic differences in expected lifetime earnings by educational degree. In 1992, individuals with an AA degree could expect to earn over $1.1 million in their lifetime; those with a BA, $1.4 million; those with an MA, $1.6 million; those with a PhD, $2.1 million; and those with a professional degree, $3.0 million (Kominski and Adams 1994). More recently, Heckman, Lochner, and Todd (2003) concluded that the returns to education on income are strongly nonlinear, with pronounced increases in wages at 12 and 16 years.

The credentialing hypothesis posits that educational degrees serve as a signal for an individual's ability and productivity to a potential employer (Arrow 1973; Spence 1973). These have been referred to variously as sheepskin, credentials, or signaling effects. Proponents of credentialism argue that individuals who complete all requirements to earn their diplomas also have abilities that increase their productivity, and that the completion of a specific degree directs employer decisions about screening, hiring, and advancement (Collins 1979; Hungerford and Solon 1987). The comparison of mortality levels for HS graduates against those with 12 years of schooling without a diploma and GED recipients may provide unique insight into the impact of number of years of schooling versus credentials. The GED degree was established in 1942 as a credential alternative and equivalent to a high school diploma to enable World War II veterans to attend college. Later, these degrees were provided as an option to everyone, but they may be more common among those who have experienced disruption in their educational careers, including health problems, pregnancy, family dissolution, financial hardship, drug and alcohol addiction, or incarceration. Many individuals acquire a GED degree through night school (Kominski and Adams 1994) and other alternative options, including, among the incarcerated, classes in prison (Harlow 2003). GED recipients enjoy higher wages (Murnane, Willett, and Boudett 1995; Tyler, Murnane, and Willet 2000) and are more likely to receive company training as well as go on to post-secondary education (Murnane et al. 1997) than high school dropouts who do not complete their GED, but fare worse economically than those with traditional high school diplomas (Cameron and Heckman 1993). Thus, among those who report 12 years of school, there may be mortality differences among those who have obtained a HS diploma, those who have completed a GED degree, and those who dropped out prior to completing a degree.

It is increasingly common to require specific degrees for specific jobs. Traditionally, an AA degree, which can be completed in one to two years, was considered a step toward a more advanced degree, but in the 1970s and 1980s, it became recognized as a terminal degree for many occupations. Not only are the practices of law and medicine in general restricted to people with JDs and MDs, but also, people with MA/MS degrees are more likely to engage in applied work, while PhDs are more likely to engage in teaching and research.

For the purpose of examining the relationship between educational degrees and mortality risk, we can extend the signaling hypothesis from a credential as a signal for a potential employer to broader signals concerning lifestyles, social networks, and potential partners (see Backlund et al. 1999). Thus, it may be that individuals with more education are better integrated into social networks, such as marriage (Mare, 1991), that support health behaviors and provide access to healthcare (Umberson 2002).

It is crucial to study the association between educational degrees and mortality risk within specific contexts because population subgroups may vary in their ‘health returns’ to education. We focus on birth cohort and gender, both of which are considered in existing literature to be important factors that moderate the education-mortality association and that contribute to differences in the educational distribution of the population. Carlson (2008) shows that among multiple birth cohorts—including Generation X (born 1965–1982), Baby Boomers (born 1946–1964), the Lucky Few (born 1929–1945), and the Good Warriors (born 1909–1928)—each successive generation has obtained higher levels of education than the preceding generation, spurred on in the early part of the twentieth century by laws to prevent child labor and to require compulsory school attendance, and later by increasing job requirements and expectations. For example, about half of the Good Warrior cohort, but fewer than 15 percent of the adult Baby Boom and Generation X cohorts, never finished high school (Carlson 2008). Educational credentials have also become more important for securing high quality jobs in the labor market. AA degrees emerged over the past few decades as community colleges proliferated. Because of the increased emphasis in educational accomplishments, some employers who used to hire individuals with AA degrees are now hiring individuals with BA degrees.

The relationship between education and mortality risk has been repeatedly shown to be stronger for younger compared to older adults (House, Kessler, and Herzog 1990; Mustard, et al. 1997). Some researchers suggest that a weaker relationship between education and mortality risk among older cohorts is causal—that is, a result of either government support to older generations in the form of Social Security and Medicare that decrease inequalities in income and access to health, or increasing biological frailty with age that supersedes socioeconomic inequalities among the elderly (House et al. 1994; Markides and Black 1996). Others argue that this pattern is a result of mortality selection that biases the population average results for the education-mortality linkage downward among older cohorts (Lauderdale 2001; Lynch 2003).

Gender is another demographic factor that received attention in previous studies of the education-mortality relationship. Compared to men, women have made tremendous gains in educational attainment, especially among recent cohorts (Everett et al. 2007). Many researchers describe stronger education gradients in mortality for men than for women (Elo et al. 2006; Koskinen and Martelin 1994; Molla et al. 2004), although most of these studies were conducted with European rather than U.S. data and the gender difference was not tested for statistical significance. In contrast, others find a stronger effect of education on mortality for women (Deaton and Paxson 1999; Kitagawa and Hauser 1973) or no gender differentials (Elo and Preston 1996; McDonough et al. 1999; Zajacova 2006). We are aware of only two studies that explicitly compare men and women in terms of the effects of pre- and post-secondary education on U.S. adult mortality risk (Christenson and Johnson 1995; Zajacova and Hummer 2009). Their findings suggest that the relationship between education and U.S. adult mortality risk may be somewhat stronger at the lower levels for women, but postsecondary degrees may have a stronger effect on mortality for men.

AIMS

This paper has two central goals. First, we present the first published estimates of U.S. adult mortality risk by detailed educational degree, including advanced postsecondary degrees. Second, to determine whether the association between educational degree and mortality risk differs across demographic subgroups, we examine these relationships both for the overall population as well as for specific cohort and gender subpopulations.

DATA AND METHODS

To analyze the relationship between educational degrees and U.S. adult mortality risk, we employ the public-use National Health Interview Survey Linked Mortality Files (NHIS-LMF). The NHIS-LMF links the 1997 through 2000 cross-sectional waves of NHIS (National Center for Health Statistics [NCHS] various years) to the 1997 through 2002 Linked Mortality Files using the National Death Index (NCHS 2005NCHS 2007). This prospective linked data set is ideal for the study of education degrees and mortality risk because of its large size, nationally representative character, detailed information on highest education degree obtained, and mortality/survival during the follow-up period. To provide a public-use version of these data, NCHS perturbed the dates and causes of death for a small number of records to ensure that individuals could not be identified. Lochner et al. (2008) demonstrate that the public-use and restricted data sets produce equivalent results for overall mortality, which perfectly suits our analysis. Our sample is restricted to 185,351 NHIS participants who were 25 years of age and over at the time of survey, met the NDI matching criteria (NCHS 2005), and were U.S. born.[1] We exclude 852 (0.5 percent) additional people, 41 of whom died during follow-up, because of missing information on the variables included in the analyses, which results in a final sample size of 184,499 individuals and 8,994 deaths.

Until 1997, NHIS asked individuals to report the highest completed year of formal schooling. Beginning in 1997, NHIS instead asked for the highest educational degree obtained, in part to be consistent with U.S. Census data. The fact that NHIS and death records are linked so that individuals self-report their educational attainment is a considerable advantage over related work that uses education reported from U.S. death certificates, which relies on third-party reports. Indeed, educational reports on death certificates are widely known to be both overestimated and heaped on selected years (Christenson and Johnson 1995; Molla et al. 2004). We code the following educational degree categories: less than 12 years of schooling with no degree; 12 years but no degree; GED degree; HS diploma; some college but no degree; AA technical, vocational, or academic degree; BA (or BS); MA (or MS); PhD; and professional degrees (MD, DDS, DVM, or JD).[2] We combine MA/MS, PhD, and professional degrees for the sex/cohort-specific analyses because of the small number of deaths in the data set among persons with the highest educational degrees. We use HS diploma as the referent category in all our regression analyses because it includes a large proportion of the sample and thus provides stable estimates. Although it would be useful to contrast findings based on years of

[1]We restrict our analyses to the native-born population to avoid potential confounding between nativity and educational degrees. Nativity can affect the conversion of educational credentials into jobs and income. Immigrants who completed their degrees in another country may have experienced different teaching practices and standards. Further, because of language barriers and discrimination, some immigrants may be prevented from fully using their skills in the United States. Certification may also be a factor; for instance, immigrant MDs may be prohibited from medical practice unless they have successfully passed the U.S. medical boards.
[2]NHIS combines MD, DDS, DVM, and JD into a single "Professional Degree" category.

schooling with those from our results based on educational degree, NHIS does not include both measures concurrently in its data.[3] Our lowest education category, less than 12 years of schooling, is not disaggregated into more detailed categories because there are no degrees associated with lower levels of education, and a dwindling proportion of the population fails to complete HS education, in part because of compulsory education laws. U.S. compulsory education varies by state but generally ends at age 17; and 90 percent of 17 year olds are enrolled in formal education (Sen, Partelow, and Miller 2005).

We examine ages 25 and above to capture individuals who have most likely completed their education and to adults born in one of the following cohorts from 1909 to 1982 (see Carlson 2008): Generation X (born 1965–1982), Baby Boomers (born 1946–1964), the Lucky Few (born 1929–1945), and the Good Warriors (born 1909–1928). Gender is coded as a dummy variable with female as the referent. To control for population heterogeneity, we include race/ethnicity in our models categorized as Hispanic, non-Hispanic white (referent), non-Hispanic black, and other; mortality risk has been shown to vary across these race/ethnic categories (Elo and Preston 1997; Hummer et al. 1999; Rogers Hummer and Nam 2000). Note there are fewer Hispanics in the analysis than what might be expected because of our exclusion of foreign-born respondents. Because marital status is associated with both education and mortality risk (Lillard and Waite 1995; Martin and Bumpass 1989), it is included in the models as married (referent), widowed, divorced or separated, or never married.

We use Cox proportional hazards modeling, the most common choice for modeling event history data. Proportional hazards models are flexible, require few assumptions, and allow us to take into account both the binary outcome variable (die versus survive) and the timing of death during the follow-up period (Allison 1984; Powers and Xie 1999). Our models use age at interview plus time since interview as the time scale, as recommended by Kom, Graubard, and Midthune (1997). This measure ranges from 25.25 to 90.875 years of age and increases by increments of 0.125, or by eighths of a year. Persons enter the model at age at interview and are followed through the times since interview. This effectively controls for both age and time since interview. Cohorts are controlled for in the model to capture generational and contextual differences in the returns to education that a person may receive. Table 3 disaggregates the analyses by cohort and gender to take into account differing relationships between education and adult mortality risk by cohort and gender, as well as to accommodate proportionality assumptions.

Proportional hazards parameter estimates are expressed in their exponentiated form, called hazard ratios. A hazard ratio of one implies that there is no relationship between the covariate and mortality risk. Hazard ratios above one indicate an increase in mortality risk compared to the referent category. For example, a hazard ratio of 1.20 would imply that the specific covariate is associated with a 20 percent increase in the risk of dying over the follow-up period compared to the referent category. Conversely, a hazard ratio below one may be interpreted as a reduced mortality risk compared to the referent group. We present the standard errors of the estimates in our analysis, which can be used to calculate confidence intervals.[4] All our analyses incorporate population weights, clustering, and strata to account for the complex sampling design frame (StataCorp. 2007).

[3]Some national vital statistics registration areas began including the educational credential item on their death certificates beginning in 2003. But because most states have not yet adopted the revised educational item, NCHS currently reports mortality by years of education only (see Kung et al., 2008).

[4]A 95 percent confidence interval may be calculated as the hazard ratio ± (standard error*1.96).

RESULTS

Table 1 shows percentage distributions of the variables included in the analysis for the total study population and by gender and cohort. The educational distributions for both genders exhibit similar patterns, with HS diploma as the modal category, followed by some college but no degree and BA degree. The table shows that over 26 percent of men have completed a BA degree or higher and almost 22 percent of women have completed similar degrees. This difference is more pronounced among those earning professional degrees: 3.5 percent of males but only 1.4 percent of females have earned a PhD or professional degree.

Table 1 also shows substantial cohort shifts in education: compared to the oldest cohort, younger cohorts enjoy increasingly greater concentrations of individuals with higher levels of education. This shift is most dramatic between the Good Warriors (born 1909–1928), where 32.8 percent of the population has less than a twelfth grade education, and the Lucky Few (born 1929–1945), where only 18.3 percent of the population has less than a grade 12 education. Furthermore, the Lucky Few include the greatest percentage of individuals with PhDs and professional degrees. It is important to note that such percentage distributions are influenced by selective survival, particularly among the older cohorts.

Table 2 presents results for the relationship between educational degrees and adult mortality risk for the total sample. The estimates reveal a largely graded relationship between educational degrees and adult mortality risk within a multivariate model that controls for demographic factors.[5] Model 1 shows that, compared to individuals with a HS diploma, those with less than 12 years of education and no diploma have a hazard ratio of 1.21, which can be interpreted as a 21 percent higher risk of death over the follow-up period. In contrast, those with a postsecondary degree experience a substantially lower mortality risk compared to individuals with a high school diploma: 20 percent lower for those with an AA, 30 percent lower for those with a BA, 40 percent lower for those with an MA/MS or PhD, and 45 percent lower for those with a professional degree.

Model 1 also shows that individuals with some college but without any postsecondary degrees show an 8 percent lower mortality hazard relative to HS diploma holders, whereas persons with an AA degree have a 20 percent lower mortality hazard compared to those with a HS degree. Thus, compared to individuals with a HS diploma, persons with some college education have a small survival advantage, and an AA degree provides even more of a survival advantage. Although not statistically significant, GED recipients show an 11 percent higher mortality hazard compared to HS diploma holders. Model 2 shows that marital status has a strong independent effect on mortality risk net of education and other demographic covariates. However, controlling for marital status in Model 2 only slightly attenuates the relationship between educational degrees and mortality risk. Indeed, the hazard ratios remain largely the same for all education levels in Model 2 when compared to Model 1.

We can change the educational degree referent (HS diploma) to, say, a professional degree, by dividing each hazard ratio by 0.557, the hazard ratio for a professional degree in Model 2, to offer another picture of the full gradient (transformations not shown). Compared to individuals who have a professional degree, the mortality risk over the follow-up period is 26 percent higher for those with a BA, 44 percent higher for those with an AA, 65 percent higher for those with some college, 80 percent higher for HS graduates, 95 percent higher for those with a GED, 96 percent higher for individuals who completed 12 years of

[5]All models control for race/ethnicity in Tables 2 and 3 and marriage is controlled for in Table 3, but these controls have little or no effect on the relationship between educational degrees and mortality risk.

schooling with no degree, and over twice as high for those with less than 12 years of schooling. We can also determine which degree differentials are associated with significant survival differences. We already described that there are significant survival advantages for those earning a HS diploma compared to attending school for less than 12 years, and for those attending some college compared to persons with a HS diploma. There are also significant survival advantages associated with earning an AA degree over attending college,[6] earning a Bachelor's over an AA degree, and earning a Master's over a Bachelor's degree.

Table 3 disaggregates the total sample into six cohort/gender subgroups.[7] In each subgroup, individuals with lower educational attainment experience higher mortality risk. Among males (Panel A) and females (Panel B), relative educational disparities are generally smaller for older cohorts. For example, compared to high school graduates, men born between 1946 and 1982 (Baby Boomers and Generation X) with less than 12 years of schooling experience 51 percent higher risk of death compared to HS graduates, whereas men born between 1929 and 1945 (The Lucky Few) experience 40 percent higher risk, and men born between 1909 and 1928 (The Good Warriors) experience only an 18 percent higher mortality risk over the follow-up period when making the same educational comparisons.

There are several reasons for the higher relative mortality risk for persons with lower levels of education among more recent birth cohorts. First, as larger proportions of the population receive advanced degrees, it becomes increasingly difficult for persons without college or high school degrees to find employment. Second, health and risk behaviors are not evenly distributed across socioeconomic statuses. Indeed, research has shown that innovations in ideas and health-related knowledge are adapted by persons of higher socioeconomic status first, and then diffuse to the rest of the population (Lopez 1995; Lopez Collinshaw and Piha 1994; Rogers 2003). In particular, differences in smoking behaviors by education level may be a major force for the larger mortality risk disparity by educational degree among younger cohorts, particularly among males (Denney et al. 2010).

Among males in all cohort groups, there are gradients by educational degree in the risk of death. Compared to males in the most recent cohorts with an MA/PhD/professional degree, those with an AA experience over twice the mortality risk, those with a GED experience 4.5-fold higher, and those with less than 12 years of education, 4.8-fold higher mortality risk over the follow-up period. Among males in all cohorts, those who have attended some college have statistically comparable mortality risks to those with a HS diploma. For younger males, even attaining an AA degree is not associated with a significantly decreased mortality risk compared to HS graduates. In contrast, males in the Good Warriors cohort with an AA degree have statistically lower mortality risk (20 percent lower) than those who earned a HS diploma. Among more recent cohorts of males, there is no statistically significant difference between HS graduates and those with 12 years but no diploma, although GED recipients have a markedly increased mortality risk. Among the Lucky Few cohort of males, there is a 34 percent higher risk of dying among those with a GED, 35 percent higher risk of dying for those with 12 years but no diploma, and 40 percent higher risk for those with less than 12 years of education compared to HS graduates.

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[6]To determine whether there are significant differences for this comparison, we calculate $(0.918/0.801)/\sqrt{0.033^2+0.042^2}=21.5$ which is significant at $p \le 0.001$.

[7]Although Table 2 provides a summary of the overall relationship between educational degrees and U.S. adult mortality risk, it does not pass the proportionality assumption. In contrast, all six gender- and cohort-specific models in Table 3 pass global proportionality assumption tests based upon Shoenfeld residuals using the "estat phtest" commands in Stata 10.

The patterns are somewhat different for women (Panel B). The overall educational degree gradient is evident in all cohorts of women, although the mortality advantages for those with postsecondary degrees are generally not as pronounced among women as among men. Among women born after 1945, those who have not completed a GED or high school degree exhibit 43 to 55 percent higher mortality than high school graduates, while those who have completed a BA exhibit 34 percent lower mortality than high school graduates. Women in this most recent cohort who have completed an MA/MS or higher degree show exceptionally low mortality risk: 44.4 percent lower than high school graduates. For women born between 1909 and 1928 (Good Warriors), the mortality gradient is flatter, whereby women with less than 12 years of education have only a 10 percent higher risk of dying during the follow-up period compared to HS graduates, and those in the highest educational category have only an 18 percent (non-significant) lower risk of death. Interestingly, there is no statistically significant difference between the older female HS graduates, those with some college, and those with AA, BA, or advanced degrees. Further, there are no statistically significant mortality differences in the older cohorts of women with HS diplomas versus those with 12 years of schooling but no diploma, although there appears to be a benefit to acquiring a GED for the oldest cohort that is absent in any of the other female cohorts.

The pronounced education gradient among women in the most recent cohorts is an interesting phenomenon and points to changing labor markets and gender norms. Among women in older cohorts, there were few career opportunities for women with advanced degrees. Thus, higher levels of education were less likely to translate to better incomes or healthcare access. Recent cohorts of women, however, are receiving similar and in some populations higher levels of education compared to males (Diprete and Buchman 2006; Everett et al. 2007). The increase in female educational attainment suggests that those persons who do not graduate high school or college in recent cohorts may find themselves further economically disadvantaged than previous cohorts of women with low levels of education, and therefore at an increased mortality risk.

Importantly, both genders generally show larger education-mortality disparities among more recent cohorts. These disparities are larger for more recent cohorts at all educational levels, including the pre-secondary levels (especially among males), and at the postsecondary levels(especially among females). For instance, relative to females with at least a Master's degree, women with less than 12 years of schooling exhibit 34 percent higher mortality among the Good Warrior cohort, 2.5-fold higher mortality among the Lucky Few cohort, and 2.6-fold higher mortality among the Baby Boom and Generation X cohorts.

CONCLUSION

It is crucial to fully consider different dimensions of education because it is a fundamental cause of health and longevity (Link and Phelan 1995). Our results are the first to describe the relationship between detailed educational degrees and U.S. adult mortality risk. We find a strong mortality gradient such that those with less than 12 years of schooling with no degree exhibit the highest overall risks, and those with the most advanced degrees show the lowest mortality risks. Although the relationship between educational degrees and mortality risk varies by cohort and gender, we find clear indications that educational degrees are related to mortality risk. For example, we find that an AA degree is associated with lower mortality in comparison to persons who attended college but have not earned a diploma. People with AA degrees are often educated in specific occupational skills that may increase their employability and income relative to those with HS diplomas and even to those with some college but no degree (Collins, 1979; Hungerford and Solon, 1987).

Our results directly bear on national concerns regarding education-mortality disparities. The mortality gap between those with a HS diploma and those with less than 12 years of schooling is wider with each successive cohort among males, but shows a less clear-cut pattern among females. On the other hand, the mortality gap between those with a HS diploma and those with at least an MA/MS degree is wider with each successive cohort among females, but is less distinct among males. Our findings suggest that educational disparities in mortality risk may depend in part on cohort effects, with successive cohorts showing greater mortality disparities within the extreme educational categories: higher relative mortality among those with less education and lower relative mortality among those with the most education. The most pronounced shift occurs between the Good Warriors and the Lucky Few, which reinforces the "Lucky Few" label (Carlson 2008). Many individuals in the Lucky Few cohort experienced both great educational opportunities and low relative mortality; on the other hand, individuals in this cohort who failed to realize large educational gains have suffered relatively higher mortality risk compared to individuals in the Good Warriors cohort.

The relative mortality gap between those with a GED and a HS diploma is larger among more recent rather than older cohorts of men. This may indicate that because GED degrees were initially created during WWII to accommodate young soldiers, we would expect men who were in the twenties during the postwar decades did indeed benefit from their GED. But because GED degrees were designed to encourage young men to continue on to college, we can surmise that individuals with *terminal* GED degrees may have stalled their educational progression, thus foreclosing employment and income opportunities and ultimately increasing their mortality risk. This may be especially evident among younger men today. There may be additional differences between a HS diploma and a GED that provide salient signals to employers, potential spouses, and social networks. The effect may also be due to selection, whereby some characteristics that impact individuals' paths toward a GED rather than a HS diploma also affect their ability to reap rewards from credentials. For instance, individuals who obtain a GED may have stopped their education because they served in the military, became pregnant, or were incarcerated (Harlow 2003).

Among women in the most recent cohort we examined, those who complete less than 12 years of schooling experience greater risk of death. These results call for further investigation into what factors are associated with dropping out of school—including, for example, pregnancy, care-giving, marriage, and work. Although it may be the precipitating factors rather than the departure from school that underlies the additional mortality risk, such departures from school may have their own consequences for individuals in this category.

Social policies can focus on keeping everyone, especially young women historically, and young men more recently, in school and on track toward a degree. Moreover, social policies could encourage more individuals to pursue advanced professional degrees. Schoeni et al. (2008) recently made a strong case for the inclusion of educational policy as an important part of U.S. health policy. In an analysis not shown, we examined the mediating impact of insurance coverage, both private and government run programs, on the relationship between education degrees and mortality risk. While insurance coverage is an important independent factor in predicting mortality risk, it does not mediate the relationship between education and mortality risk. These additional results provide further evidence that the nation's investment in improving educational degree pathways is a potential avenue to improve not only labor market and earnings outcomes, but length of life outcomes as well.

Our analyses also point to the large size and significance of educational credentials among more recent cohorts of individuals. While we cannot exclude competing explanations for the stronger relative differences among younger rather than older cohorts, particularly mortality selection (Lynch 2003, Zajacova, Goldman, and Rodriguez 2009), this pattern is also consistent with studies that have found increasing educational mortality disparities in recent decades (Lauderdale 2001). This increase may in part be due to compositional changes in educational attainment in recent years, as there have been large increases in the number of individuals who complete college degrees. Compared to previous cohorts, current generations of adults who do not complete degrees may find themselves particularly disadvantaged. These changes may be more pronounced among women, who have experienced more dramatic increases in educational attainment in recent decades.

There are important distinctions among advanced degrees. As more individuals obtain advanced degrees and the concomitant benefits, including increased chances for employment, greater income, and access to such on-the-job benefits as health insurance, we see an even greater need to focus on educational differences among individuals with advanced degrees. Future studies could examine the effects of multiple education measures on mortality risk, including years of formal education completed, and all formal degrees obtained (not just highest degree), in addition to technical vocational training, specialized certifications, and continuing education. There may be additional benefits derived from completing degrees within accelerated or normal rather than prolonged time frames. For example, students who earn their BA degree within 4 years may have characteristics that translate into more favorable labor market and health outcomes than those who graduate in, say, 6 years. It would also be useful to know what degrees individuals obtained in addition to their highest degree. For instance, are there health and mortality differences for individuals who have a BA but previously earned a GED in comparison to a HS diploma? Because education is such a fundamental cause of health and longevity (Link and Phelan 1995), we encourage survey researchers to obtain information on both years of education and educational degrees, and to consider different professional degrees, which vary substantially by training, certification, occupation, and income.

Further research might also examine whether our results are tempered by the particularities of our data set. For example, the NHIS samples the non-institutionalized U.S. population and therefore does not include or represent institutionalized persons. Second, several covariates could further illuminate the confounders and/or pathways by which education is related to reduced mortality risk, such as personal autonomy (Ross and Wu 1995), intelligence (Korten et al. 1999; Whalley and Deary 2001), smoking (Denney et al. 2010; Pampel 2005), and social networks (Link and Phelan 1995), which are not available in our sample. Third, our follow-up period, which is a maximum of five years for persons interviewed in 1997 but only two years for persons interviewed in 2000, may affect our results, especially among the younger cohorts where there are relatively few deaths within the detailed educational degree categories. Finally, our NHIS data does not include other measures of education—such as years of education, certification, or training programs—which could further enrich and expand the analysis of the relationship between education and the risk of death.

Despite these limitations, we find strong evidence that educational degrees are differentially associated with mortality risk. When people make decisions about their education, including the attainment of degrees, they are also making indirect decisions about other life chances, including their survival prospects. Perhaps more important, both educational and health policymakers should encourage and help facilitate more advanced educational degrees in the United States, not only to increase the skill level of our workforce, but also to improve the health of the nation.

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TABLE 1

Percentage Distributions, U.S. Adults Aged 25 and Above, 1997–2002

		Sex		Cohort			
	Total	**Male**	**Female**	**Good Warriors (1909–1928)**	**Lucky Few (1929–1945)**	**Baby Boom (1946–1964)**	**Generation X (1965–1982)**
Education							
Less than 12	14.3 %	14.2 %	14.4 %	32.8 %	18.3 %	8.3 %	8.2 %
Grade 12	2.1	2.0	2.1	2.3	2.1	2.0	2.2
GED	2.6	2.8	2.4	1.4	2.6	2.9	3.0
High School Diploma	30.0	28.4	31.5	32.1	32.5	28.7	26.3
Some college	17.5	17.1	17.9	13.3	16.0	19.1	20.9
AA	9.4	8.8	9.9	4.7	7.0	11.5	11.1
BA	15.4	16.5	14.3	8.2	12.0	17.9	22.1
MA	6.3	6.4	6.1	3.5	6.6	7.0	4.7
Prof. degree (MD, DDS, JD, DVM)	1.4	2.1	0.9	1.0	2.5	1.7	1.2
PhD	0.9	1.4	0.5	0.8	1.4	1.0	0.4
Sociodemographic							
Race/Ethnicity							
Non-Hispanic white	83.7	84.5	83.0	88.9	85.9	82.1	77.4
Non-Hispanic black	10.9	10.0	11.7	7.9	9.8	11.8	13.8
Hispanic	3.0	3.1	3.0	1.6	2.3	3.4	5.4
Other	2.4	2.4	2.3	1.6	2.0	2.6	3.4
Marital Status							
Married	70.8	77.1	65.2	51.1	71.2	69.7	55.7
Widowed	8.8	3.4	13.5	39.2	9.7	1.2	0.2
Divorced/separated	12.0	10.1	13.7	5.6	13.0	13.9	7.4
Never married	8.4	9.4	7.6	3.4	4.1	10.1	7.4
Male	47.5			41.0	47.5	48.9	48.7
Cohort							
Generation X, born 1909–1928	17.9	18.3	17.5				
Baby Boom, born 1929–1945	47.1	48.5	45.8				
Lucky Few, born 1946–1964	21.9	21.9	21.9				
Good Warriors, born 1965–1982	13.2	11.4	14.8				

		Sex		Cohort			
	Total	**Male**	**Female**	**Good Warriors (1909–1928)**	**Lucky Few (1929–1945)**	**Baby Boom (1946–1964)**	**Generation X (1965–1982)**
Sample Size	184,499	86,082	98,417	24,460	40,900	86,483	32,656
Number of Deaths	8,994	4,650	4,344	5,193	2,450	1,190	161

Source: Derived from NHIS-LMF.

TABLE 2

Hazard Ratios of Educational Degrees and Mortality Risk, U.S. Adults Aged 25 and Above, 1997–2002

	H.R.	S.E.	H.R.	S.E.
	Model 1		Model 2	
Education (High school diploma)				
Less than 12	1.210 ***	(0.035)	1.183 ***	(0.035)
Grade 12	1.070	(0.077)	1.092	(0.078)
GED	1.107	(0.082)	1.088	(0.083)
Some college	0.922 *	(0.033)	0.918 *	(0.033)
AA	0.801 ***	(0.041)	0.801 ***	(0.042)
BA	0.695 ***	(0.030)	0.700 ***	(0.031)
MA	0.592 ***	(0.045)	0.587 ***	(0.045)
Prof. degree (MD, DDS, JD, DVM)	0.551 ***	(0.070)	0.557 ***	(0.072)
PhD	0.602 ***	(0.082)	0.605 ***	(0.084)
Sociodemographic				
Male	1.579 ***	(0.036)	1.686 ***	(0.010)
Cohort (Generation X, Born 1965–1982)				
Baby Boom, born 1946–1964	1.144	(0.309)	1.167	(0.301)
Lucky Few, born 1929–1945	1.105	(0.338)	1.122	(0.328)
Good Warriors, born 1909–1928	1.140	(0.358)	1.161	(0.342)
Race/Ethnicity (Non-Hispanic white)				
Non-Hispanic black	1.343 ***	(0.054)	1.257 ***	(0.049)
Hispanic	0.902	(0.056)	0.887†	(0.057)
Other	1.063	(0.074)	1.046	(0.072)
Marital Status (married)				
Widowed			1.264 ***	(0.037)
Divorced/separated			1.481 ***	(0.056)
Never married			1.642 ***	(0.073)
Log Likelihood	−78030		−77920	

N=184,499, Dead=8,994

† p ≤ .10;

* p ≤ .05;

** p ≤ .01;

*** p ≤ .001.

Note: Referent in parentheses.

Source: Derived from NHIS-LMF.

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TABLE 3

Hazard Ratios of Educational Degrees and Mortality Risk by Cohort and Sex, U.S. Adults Aged 25 and Above, 1997–2002

	Good Warriors (born 1909–1928)		Lucky Few (born 1929–1945)		Baby Boom & Gen X (born 1946–1982)	
	H.R.	S.E.	H.R.	S.E.	H.R.	S.E.
			A. Males			
Education (High school diploma)						
Less than 12	1.178 **	(0.064)	1.395 ***	(0.103)	1.506 ***	(0.185)
Grade 12	1.151	(0.149)	1.346 +	(0.244)	0.970	(0.247)
GED	1.168	(0.173)	1.342 *	(0.175)	1.412 *	(0.247)
Some college	0.952	(0.070)	0.978	(0.090)	0.900	(0.097)
AA	0.799 *	(0.092)	0.959	(0.131)	0.841	(0.119)
BA	0.748 **	(0.069)	0.642 ***	(0.075)	0.460 ***	(0.064)
MA/PhD/Prof. degree	0.691 ***	(0.069)	0.556 ***	(0.099)	0.314 ***	(0.066)
Race/Ethnicity (Non-Hispanic white)						
Non-Hispanic black	0.981	(0.073)	1.204 *	(0.115)	1.534 ***	(0.160)
Hispanic	0.755 *	(0.097)	0.890	(0.163)	1.367 *	(0.188)
Other	0.935	(0.144)	0.931	(0.208)	1.592 *	(0.295)
Marital Status (married)						
Widowed	1.185 ***	(0.064)	1.460 **	(0.172)	3.285 ***	(1.070)
Divorced/separated	1.294 *	(0.139)	1.684 ***	(0.132)	1.903 ***	(0.196)
Never married	1.157	(0.126)	2.013 ***	(0.233)	2.438 ***	(0.247)
Log Likelihood	−18857		−11263		−6722	
N	9,988		19,327		56,767	
Died over follow-up	2,495		1,391		764	
			B. Females			
Education (High school diploma)						
Less than 12	1.100 *	(0.055)	1.468 ***	(0.127)	1.435 *	(0.227)
Grade 12	1.000	(0.126)	0.870	(0.178)	1.548 *	(0.333)

	Good Warriors (born 1909–1928)		Lucky Few (born 1929–1945)		Baby Boom & Gen X (born 1946–1982)	
	H.R.	S.E.	H.R.	S.E.	H.R.	S.E.
GED	0.520 *	(0.149)	1.038	(0.244)	1.029	(0.268)
Some college	0.951	(0.066)	0.787 *	(0.086)	1.000	(0.127)
AA	0.849	(0.087)	0.707 *	(0.107)	0.733 +	(0.134)
BA	0.890	(0.078)	0.906	(0.119)	0.660 **	(0.127)
MA/PhD/Prof. degree	0.819	(0.109)	0.599 **	(0.105)	0.556 **	(0.119)
Race/Ethnicity (Non-Hispanic white)						
Non-Hispanic black	1.137 *	(0.067)	1.474 ***	(0.125)	1.549 ***	(0.169)
Hispanic	0.869	(0.121)	0.562 **	(0.111)	1.021	(0.191)
Other	0.811	(0.159)	1.243	(0.243)	1.094	(0.260)
Marital Status (married)						
Widowed	1.227 ***	(0.057)	1.256 **	(0.102)	1.342	(0.367)
Divorced/separated	1.204 +	(0.116)	1.342 **	(0.124)	1.746 ***	(0.191)
Never married	1.276 *	(0.136)	1.642 ***	(0.231)	1.552 **	(0.215)
Log Likelihood	−21653		−8661		−4977	
N	14,472		21,573		62,372	
Died over follow-up	2,698		1,059		587	

† $p \le .10$;

* $p \le .05$;

** $p \le .01$;

*** $p \le .001$.

Note: Referent in parentheses.

Source: Derived from NHIS-LMF.