Educational Attainment and Mortality in the United States: Effects of Degrees, Years of Schooling, and Certification*

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Abstract

Measuring education either in years or by degree attainment (but not simultaneously), researchers have extensively documented a strong and consistent mortality gradient, with more highly educated individuals living longer than those with less education. Through determining the specific effects of years of education, degree attainment, and nondegree certification on mortality, this study tests human capital and sheepskin theories of the education-mortality gradient. We use data from the mortality-linked restricted-use files of the 1985 Panel Study of Income Dynamics (PSID) sample and Cox proportional hazards models to estimate mortality risk among U.S. adults. In support of sheepskin effects, results indicate that more advanced degrees and additional years of education are associated with reduced mortality risk in separate models, but when included simultaneously, degrees remain influential while years of education are no longer significant. However, among individuals who have earned only a high school diploma, additional years of schooling and vocational school certification (or similar accreditation) are both independently associated with reduced risks of death. Overall, the findings reveal that degrees separate individuals into distinct social groups, a separation that likely has implications for life expectancy. Because degrees, years of education, and certifications each provide unique information about mortality risk, researchers should thoughtfully operationalize educational attainment, and surveys should include multiple measures of educational experiences.

Keywords: mortality, education, degrees, PSID, United States

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Introduction

Social science and public health research has solidly documented a gradient between socioeconomic status (SES) and health and mortality, with those in higher positions enjoying better health and longer lives than those in lower positions. Of the components of SES, among U.S. adults, education shows the most consistent relationship to life expectancy, a relationship that endures across time and place (Elo 2009; Hummer and Hernandez 2013; Hummer and Lariscy 2011). In the United States, the health and mortality gaps between groups of differing educational attainment not only have persisted over time, but appear to be growing, despite medical and technological advancements (Goesling 2007; Masters, Hummer, and Powers 2012; Montez et al. 2011). From 1990 to 2008, the difference in life expectancy between the most and least educated men increased from 13.4 to 14.2 years, and the difference for women went up from 7.7 to 10.3 years (Olshansky et al. 2012).

But we still do not fully understand *how* education influences mortality. Education changes individuals in many ways, and there are a variety of mechanisms for the education-health relationship (Dupre 2008; Hummer and Hernandez 2013). However, studies usually conceptualize educational attainment as a unidimensional construct and operationalize educational attainment as a *single* measure, either years of education or degrees obtained. Using different operationalizations may more accurately capture the complex construct of education and help us to understand how education influences mortality.

Using data from the mortality-linked restricted-use files of the Panel Study of Income Dynamics (PSID), this study examines the relationship between risk of death and years of

education, credentials, and additional measures of training, making two contributions. First, to date, no research has *simultaneously* used these different indicators to elucidate the education-mortality relationship. Second, to our knowledge, no study has examined the effects of specialized training and certification on longevity. Thus, this project (1) determines how different operationalizations of education are associated with longevity, (2) distinguishes mediating effects of other socioeconomic indicators, and (3) adjudicates whether education affects mortality primarily through duration (human capital theory) or credentials (sheepskin effects).

Education and Mortality

Elo and associates (2006) found a graded relationship between education and mortality, with each year of education associated with a 3 to 7% reduced risk of death. However, research has also demonstrated that the influence of education on mortality is nonlinear (Hummer and Lariscy 2011). An additional year of education may mean something different to a person who has already earned a college degree than for someone who has not completed high school. Thus, many studies use a set of categories that indicate important educational milestones for U.S. adults. For example, Hummer and Hernandez (2013) describe the most typical educational attainment categories as less than high school diploma, high school diploma or equivalent, some college, and a college degree or higher. Other studies may include more categories, such as 0–8, 9–11, 12, 13–15, 16, and 17 or more years (Hummer and Lariscy 2011). In exploring different ways to model the education–mortality relationship, Backlund and colleagues (1999) found that it is well described by using three categories: less than high school, high school diploma, and college degree or more.

Further research shows that the most accurate description combines categorical and continuous information. Montez and associates (2012) report that the preferred functional form for the relationship is a linear decline from 0 to 11 years in education, with a step-change reduction at high school diploma and then a steeper linear decline for individuals with more than a high school diploma. Everett and her research team (2013) describe a step-change in the education-mortality relationship that occurs at 9 years, the transition from middle to high school. Additional years of education lower mortality risk, but certain achievements, such as high school graduation, may be more important.

Other studies use degrees to operationalize education. Compared to those who have professional degrees, those with a GED or 12 or fewer years of schooling have the highest mortality risk, followed in order by those with high school diplomas, some college experience, associate's degrees, bachelor's degrees, and master's degrees (Rogers et al. 2010). Similarly, Zajacova, Hummer, and Rogers (2012) find that degrees have a graded relationship with self-rated health status. But the gradient between education and health is imperfect, as those with some college or technical/vocational associate's degrees are at greater risk for some health conditions than those with only a high school diploma (Zajacova, Rogers, and Johnson-Lawrence 2012).

Methodologically, these studies suggest that different indicators of education may have unique associations with longevity. It is important to test for these distinct associations because of their possible theoretical implications. Conceptually separating some of the components of education may capture different educational mechanisms associated with mortality. While some of the observed education-mortality relationship may not be causal, as there are some confounding characteristics of individuals that shape both educational attainment and mortality,

education does change individuals in ways that affect health and mortality—operating through income, occupation, health behaviors, social psychological resources, access to and utilization of health care, psychosocial attributes, and exposure to and ability to cope with stress (Elo 2009; Hummer and Lariscy 2011), with family income and health behaviors typically the most influential (Rogers, Hummer, and Everett 2012).

But it is unknown whether different educational indicators imply similar or different mechanisms. For example, degrees may be more important for income (which has subsequent effects on life expectancy) than years of education are. This study determines the effects of multiple educational indicators on U.S. adult mortality and explores how these effects are mediated by other socioeconomic factors. To interpret the theoretical implications of these indicators, we draw on two theoretical perspectives: sheepskin effects and human capital.

Human Capital Theory

The theory of human capital describes the rational choice individuals make to invest in their education to secure future returns (Becker 1964). The theory claims that social psychological and cognitive resources increase as a function of time spent in school. These resources influence health outcomes through learned effectiveness, or the ability to acquire, evaluate, and use information, resulting in increased personal control and a greater ability to achieve ends. Learned effectiveness improves and enriches health behaviors, social support, and productive activities. Because the human capital approach to health maintains that learned effectiveness increases in proportion to the quantity of education, this theory predicts that years of education will show a stronger relationship to mortality than degrees or educational quality (Mirowsky and Ross 2003). Using data from the 1995 Aging, Status, and the Sense of Control Survey, Ross and Mirowsky

(1999) found that years of education had larger effects on physical functioning and perceived health than college degrees or college selectivity; however, they looked only at college degrees, rather than at all certifications.

Sheepskin Effects

An alternative approach to human capital emphasizes the signaling functions of degrees or credentials, rather than the skills or knowledge obtained through schooling. There are different applications and versions of this perspective, as it has been used in various fields, including sociology, economics, public health, and medicine. The "screening hypothesis" emphasizes that employers use education to "screen" applicants (Spence 1973). A strict credentialist position contends that the signals degrees provide to employers are symbolic and do not signify that individuals have the specific skills or knowledge necessary for the job (Collins 1979).

An alternative and more flexible version of credentialism does not consider the substantive and symbolic functions of education as mutually exclusive alternatives, but rather focuses on the effect of a degree—the "sheepskin effect"—above and beyond that of the quantity of schooling. This view establishes the importance of degrees, but does not necessarily specify whether the returns to degrees denote symbolic or real information. Regardless of the extent to which they reflect skills or knowledge, degrees have consequences for both socioeconomic and status attainment. Credentials allow individuals to gain more prestigious and higher-paying employment, which increases longevity (Krueger and Burgard 2011). Additionally, degrees stratify individuals into groups. Beyond socioeconomic attainment, degrees can influence the daily lives of individuals, such as where they live, their social networks, and values and beliefs. For example, individuals earning college degrees not only earn more money and have better jobs,

improved health behaviors and health outcomes, and longer lives, they also are happier, with more stable family lives and greater civic engagement (Hout 2012).

The literature on sheepskin effects on earnings has been mixed; some studies uncover evidence that degrees increase earnings more than the quantity of schooling does (Hungerford and Solon 1987; Jaeger and Page 1996), but other studies find no such effect (Silles 2008). The few studies that have looked at sheepskin effects on health and mortality report positive evidence. Using data from the New England Family Study, Liu and colleagues (2011, 2013) found that degree attainment significantly reduced coronary heart disease risk and blood pressure, even with a control for years of schooling. In addition, several studies have found that individuals with GEDs have worse health and survival prospects than those with high school diplomas (Rogers et al. 2010; Zajacova 2012; Zajacova and Everett 2013)—a specific sheepskin effect.

Additional Certifications

Although most studies examine formal degrees, other certifications may also exert positive effects. Individuals often obtain licenses, certificates, or other credentials to indicate their qualifications for a particular job. This type of certification includes a variety of fields such as mechanics, machine operation, computer programming, and cosmetology, and grantors of these certifications include institutions such as trade schools, community colleges, cosmetology schools, and police academies. Professionals may also acquire certification to show areas of specialization or additional expertise, such as medical doctors who obtain board certification in a specialty area. Because of the wording of the survey question used in this study, we focus on

credentials obtained through vocational, training, or apprenticeship programs, likely omitting certification for occupations that require higher education.

Benefits of certifications may reflect processes of socioeconomic attainment similar to sheepskin effects. Certification brings better jobs and higher pay. Some studies have found the income returns to sub-baccalaureate credentials to be mixed depending on the comparisons being made and type of certification, but in general research seems to conclude that these credentials increase income relative to those with high school diplomas but without any additional credential (Grubb 1992; Kerckhoff and Bell 1998; Lewis, Hearn, and Zilbert 1993). Certification may also improve specific skills or knowledge, as employers generally support their current employees in pursuing vocational education, especially when the education program focuses directly on useful skills (Bills and Wacker 2003). However, we know of no study that looks at the effect of nondegree certification on health or mortality.

Aims

This study determines the unique effects of years of education, degree attainment, and nondegree certification on U.S. adult mortality and tests human capital and sheepskin theories of the education-mortality gradient. Additionally, the study controls for age, gender, race/ethnicity, and early life conditions, and determines the mediating effects of other SES components.

Data and Methods

Data

The Panel Study of Income Dynamics (PSID) prospective dataset is ideal for our study because it provides detailed information on years of education completed and degrees obtained, and it can

be linked to mortality data provided by the National Death Index (NDI; PSID 2013). The PSID is a nationally representative household panel survey that has collected data annually from 1968 to 1997, and biannually since then. We merge the PSID individual files for 1968–2009 with restricted-use NDI information on mortality status and age at death. We use the 1985 PSID sample, as this survey asked all individuals about their educational attainment, even if those individuals had been asked about education in prior years. It allows for a 24-year follow-up. For 7,032 families interviewed in 1985, 11,061 heads of household and their spouses were asked detailed questions about their education.

Education. The number of years of schooling reported by the respondent ranges from 0 to 17. The number of years is equivalent to the number of school grades the respondent reported finishing plus the highest number of years of college he or she completed. The survey did not ask respondents who had received a high school diploma (or more) how many school grades they had finished, so it was assumed to be 12. The maximum number of years of college a respondent could report was five, resulting in a top-code of 17 for this indicator. From this continuous measure, we also categorize individual years of education into 0–11, 12, 13, 14, 15, 16, and 17 or more years (for similar coding, see Hummer and Hernandez 2013). The categorical measure uses 12 years as the referent, the most commonly reported category.

For highest degree attained, individuals are classified into the following mutually exclusive categories: no degree, GED, high school diploma, associate's degree (AA), bachelor's degree (BA/BS), master's degree (MA/MS), and medical degree (MD)/juris doctor (JD) law degree/doctorate of philosophy (PhD).[1] The indicator is computed from three questions: (1) whether the individual had graduated from high school, obtained a GED, or neither, (2) whether

the individual had received a college degree, and (3) the highest college degree received. Again, high school diploma, the modal category, is the referent.

Training and certification is measured dichotomously by the following question: "Did you (HEAD) receive any other degree or a certificate through a vocational school, a training school, or an apprenticeship program?" (PSID 1988).

Covariates. To account for confounders, we control for sociodemographic factors, social origins, achieved SES, and self-rated health status. The Cox proportional hazards approach (described below) implicitly controls for age at the 1985 interview, which ranges from 18 to 96. Models control for sex, race, marital status, and region. Sex is coded 1 for males and 0 for females. Race/ethnicity compares non-Hispanic whites (referent) to non-Hispanic blacks, Hispanics, and all other non-Hispanic individuals. Because of the small numbers of Asian/Pacific Islanders, American Indian/Alaska Natives, and multiracial individuals, we group these cases together with those reporting "other" race. Marital status categorizes individuals as married (referent), single, widowed, or divorced. Region categorizes individuals into the Northeast (referent), North Central, South, and West (including Alaska and Hawaii) regions, with individuals residing outside the United States coded in a separate category.

Two variables capture social origins: whether the individual's parents were poor when he or she grew up and the highest educational attainment of the individual's father. Respondents were asked the following question: "Were your parents poor when you were growing up, pretty well off, or what?"(PSID 1988). Those reporting "poor" were coded 1, and those reporting "average/it varied," "pretty well off," "don't know," or "did not live with parents" were coded 0. The reported highest educational attainment of the father was categorized into less than a high

school diploma, a high school diploma or more, and missing. Fathers who respondents reported could not read or write were included in the less than a high school diploma category.

Other components of SES include income-to-needs ratio, home ownership, and employment status. Income-to-needs ratio is a continuous measure taken from a PSID-created variable representing the ratio of total family income to the poverty threshold for that year, adjusted for household size and for farmers. Home ownership is represented with a dichotomous measure, with those owning a home coded 1 and those renting or neither owning nor renting coded 0. Employment status compares those working to those temporarily not working, looking for work, retired, disabled, keeping house, attending school, and other.

Mortality. The restricted-use mortality file provides information on approximately 6,000 deaths occurring between 1968 and 2009. For 2,425 deaths in the sample of 1985 respondents, year of death was taken from information provided by the NDI.[2] For an additional 83 individuals that the NDI did not match, year of death was obtained from PSID information, through either archival sources or a death certificate. Individuals not included in the mortality file were assumed to be alive. We dropped from all analyses one individual who would have been 118 in 2009, leaving a 109-year-old as the oldest individual in the sample.

Methods

Frequencies provide information on the distributions of years of education, degrees, and certifications. Cox proportional hazards determine the effect of education on mortality, with models including years of education, highest degree attained, and certification separately and jointly. Hazard models stratified by educational degree then determine within-group educational effects. Interaction terms were not possible because of collinearity. Variance inflation factor tests

did not indicate multicollinearity issues for any of the models reported in this study, as all tolerance values were above .20.

Age at the 1985 interview is included in the models as age at entry, and duration is set to the time until death or 2009 for those who survived the follow-up period. Failure is defined as having died during the study period. Although the PSID top-codes age at 98, the oldest individual at the 1985 interview included in the analyses was 96.[3] Although the full models failed a global test of proportionality, all of the variables of interest (all education variables) met the assumption of proportional hazards, which is most important for our analyses. The categories black, other race, single, father with high school diploma, retired, and disabled violated proportionality, but controlling for these indicators is preferable to excluding them. Because household heads and their spouses are not independent observations, we adjust the standard errors to account for clustering at the couple level.[4]

Results

Table 1 displays descriptive statistics for education and independent variables by highest degree attained. As the bottom row indicates, those with a high school diploma are the largest group, followed by no degree, college degree, GED, master's, associate's, J.D. or M.D., and Ph.D. The overall average years of education completed is 12.1. Predictably, individuals with more advanced degrees have been in school longer, but the educational indicators are not collinear. However, as respondents could not report more than five years of college, it appears that most individuals attaining degrees beyond a bachelor's reported the maximum amount, as the averages for these categories are nearly 17 years. Because of the restricted range and small sample sizes, other analyses group together those with advanced degrees. A sizable percentage, about a quarter

of the overall sample, obtained additional certification, with 38.2% of GED-earners and nearly a third of high school completers and associate's degree holders earning these credentials.

Table 1 about here

Other descriptive results confirm racial and socioeconomic stratification patterns in the United States. Non-Hispanic whites show a greater percentage of professional degrees and a smaller percentage of lower educational categories, whereas non-Hispanic blacks display the reverse pattern, with greater percentages of no degree and GED and smaller percentages of college or professional degrees. Father's education and growing up poor indicate intergenerational transmission of SES, as evidenced by the decreasing gradient of higher degree achievement among individuals of disadvantaged origin. For achieved SES characteristics, higher income, home ownership, and currently working are increasingly common among individuals with more advanced degrees. Among those with a Ph.D., J.D., or M.D., none have a household income-to-needs ratio of less than 300%. Those with no degree or a GED are less likely to be married, whereas those with degrees beyond college are more likely. The Northeast has higher percentages of higher degrees, while the South is overrepresented in the lower categories.

Table 2 presents the effects of different educational measures on mortality as computed with multivariate Cox hazards models. The first set of models (Panel A) uses years of education as a continuous measure; each year of education reduces mortality risk over the follow-up period by 3% (HR=0.97), net of sex, race/ethnicity, marital status, region, and social origins (Model 1). Adding in the dichotomous indicator for additional certification (Model 2) does not change the effect of education, and the measure itself is not significant. Once we control for other

components of achieved SES (income, home ownership, and employment status), duration of education is no longer significantly associated with mortality (compare Models 2 and 3).

Table 2 about here

The next set of models (Panel B) replicates the first set, but uses categorical rather than continuous measures of years of education. The hazard ratios display a mostly linear education-mortality relationship. Compared to individuals with 12 years of education, those with less than 12 years experience an increased mortality risk, and those with more than 12 years have lower mortality risk over the follow-up period. An exception is those with 15 years, but this relationship is not statistically significant. The addition of other achieved SES indicators attenuates slightly the effects of the educational categories, but the general pattern persists. Though the continuous indicator for years of education was not significant after SES was taken into account, the reduced risk for categories of further education remains significant even after we control for all other covariates. Interestingly, the categorical operationalization appears to capture something slightly different from the continuous measure, as income is not significant in any model that uses the categorical indicators. As in the previous set of models, certification is not itself significantly associated with mortality and does not seem to affect the association between mortality and any of the categories of years of education.

The next set of models (Panel C) uses educational degrees in place of years of education. These categories demonstrate a graded relationship with mortality risk. Compared to those earning a high school diploma, those without a diploma have a 19% increased mortality risk over the follow-up period (Model 7). Although other studies have indicated differential mortality risk for those with GEDs and high school diplomas, there is no significant difference in these results, but the trend is similar to that in previous research. Those with associate's, bachelor's, or further

advanced degrees show lower mortality risk than those with only a high school diploma. Certification is not influential in these models, as the measure is not significant and does not change the coefficients of other variables. However, when income, home ownership, and employment status are controlled for, non–high school diploma holders and associate's degree attainers no longer differ significantly in mortality from high school diploma holders, but those with bachelor's or higher degrees remain less likely to die over the follow-up period (Model 9).

The last set of models (Panel D) in Table 2 includes both continuous years of education and degrees attained. Interestingly, degrees attained show similar or stronger ratios as in the previous set of models, indicating that degrees are capturing an influence independent from years of education.[5] In contrast, years of education are not significant in Models 10 or 11, but then are *positively* associated with mortality risk in the last model, which controls for other measures of achieved SES.[6] The marginally significant increased mortality risk of 2% for each year of school may suggest that the models are overspecified or a selection effect for those in school longer. For example, exceeding the normative number of 16 years to obtain a college degree may indicate other characteristics that are also associated with greater mortality risk. Lastly, the certification measure shows similar ratios to those in the previous models and is nonsignificant. To further examine the complex relationship between years of education and mortality, we stratify the models by degree.

Table 3 displays results from the same sequence of models used in Table 2, but stratified by degree. Surprisingly, years of education are significant only among those with a high school diploma (Model 1). When we control for all covariates including income, home ownership, and employment, each year reduces their risk of death over the follow-up period by 8%. Among those without a high school diploma and for those with the highest degrees, more education

appears to be unimportant, as the years of education hazard ratios are very close to one. While the coefficient is not significantly different from one, duration of education has a positive relationship to mortality for those with a GED or an AA degree.[7]

Table 3 about here

Certification is also salient for high school diploma attainers, as this group shows a 15% reduction in mortality risk over the follow-up period for those who have vocational or similar training certification (Model 2). This significant effect, combined with the nonsignificant ratios above one in the other groups in this table, support the conclusion that the general models in Table 2 may have obscured heterogeneity. Because vocational or similar training certification may improve employment options for those with a high school diploma, but confer negligible employment advantage on individuals with higher degrees, it is reasonable that this indicator would specifically benefit the high school group in life expectancy as well. This effect remains marginally significant after the inclusion of other SES covariates; the influence of certification may be somewhat mediated by income, home ownership, and employment.

Discussion

Our results underscore that education is complex and multidimensional, but point to degrees as the dominant educational influence on longevity among U.S. adults. Like Liu and associates (2011, 2013), we found "sheepskin effects" on mortality; degree attainment remains significant beyond years of education. The different trends and findings from the stratified models in Table 3 and the descriptive statistics in Table 1 suggest that degrees separate individuals into distinct social groups, a separation that likely has implications for life expectancy. Moreover, the significance of training certification for high school diploma earners beyond years of schooling

points to the importance of mechanisms associated with status attainment.

These results do not imply that human capital approaches emphasizing social psychological and cognitive benefits are inaccurate, as education likely embeds important resources in individuals that influence health and mortality. But for this sample, duration of education appears to operate through other indicators of SES, as its effect does not persist once we control for income, home ownership, and employment. On the other hand, when we control for SES in models looking within educational groups, longer schooling is valuable among those with a high school diploma. It may be that, within this group, those who attended school longer improve cognitive and noncognitive resources that then increase longevity. The nonsignificant relationships between years of education and mortality within other groups may be due to a selection effect whereby students are in school longer because of difficulty in finishing their degrees, to data limitations (discussed below), or to the nonexistence of the relationship.

Interestingly, the effect of additional certification for high school diploma holders was also significant and not completely mediated by income, employment, and home ownership. These certifications usually increase economic returns relative to the high school diploma but not the bachelor's degree (Kerckhoff and Bell 1998). Asking about vocational school or similar certifications is uncommon, yet about a quarter of the overall sample and nearly a third of high school completers earned such a certification. Further, these certifications influence degree attainment (Ainsworth and Roscigno 2005) and individuals' careers (Kerckhoff and Bell 1998; Lewis, Hearn, and Zilbert 1993). Health research should look further at certifications, an education dimension distinct from other indicators.

The results also shed light on the findings of other studies looking at the functional form of the education-mortality relationship. The inflection point that indicates a step reduction in

mortality risk at 12 years of education (Everett et al. 2013; Montez et al. 2012) likely captures the effect of a high school diploma, but may overlook differences within the high school diploma group, which our results suggest are important for mortality. Studies that use a single educational measure—either years of schooling or degrees—may obscure important heterogeneity.

These findings diverge from those of Ross and Mirowsky (1999), who found that years of education had a stronger effect on health status and physical functioning than degrees. There may be three reasons for this. First, the mechanisms for mortality may differ from those for health status and physical functioning. Second, the different data resulted in different coding schemes. We use more detailed indicators of degrees, while they included a dichotomous measure of college degree. Finally, as Ross and Mirowsky's college degree variable interacted with college selectivity, its coefficient captures the effect of a degree from a college lacking selectivity, rather than the average effect of all college degrees.

This study also did not find a significant mortality difference for GED earners as others have (Rogers et al. 2010), perhaps because of the small number of GED earners in the older data that we used. The GED was introduced in 1942 to target World War II veterans who joined the military before completing high school, and GED earners did not exceed even 8% of high school credentials until the 1970s (Heckman, Humphries, and Mader 2010). Because PSID respondents averaged 40.9 years of age in 1985, the GED was unavailable or uncommon for much of this study's sample.

Even though this study controls for a number of possible confounders, it cannot definitively conclude that the reported associations are causal. It may be that the characteristics of individuals that lead them to attain certain degrees also influence mortality. For example, individuals who complete college may be more ambitious, organized, and motivated, qualities

that may also extend their longevity. However, the findings appear robust and fit with previous findings that education affects mortality (Lleras-Muney 2005).

Further, this study illustrates a pathway of education's effect through socioeconomic mediators. Degrees and educational duration categories may better account for the signaling characteristics of education that are important for socioeconomic attainment, since income was nonsignificant in models with those variables, but significant with the continuous years of education measure. Nondegree certification also appears to operate at least partly through socioeconomic status, as the addition of the indicators reduced the influence of certification to marginal significance. These certifications likely have a direct effect on income and employment, but they may have other broader benefits as well. Overall, education's influence persists beyond the other socioeconomic components.[8]

To our knowledge, the restricted-use PSID is the only nationally representative dataset that asks separate questions on years of schooling and degrees attained and also has mortality follow-up. But the data are limited. Respondents could report a maximum of five or more years of college, so the survey likely misses important years of education among those achieving degrees beyond a bachelor's. In addition, those with a high school diploma or higher were not asked for the number of years they spent in grade school, which may differ from 12 if they skipped or repeated grades. Auxiliary analyses further restricting the range of years of education to just 8 to 16 years show results similar to those presented here, with years of education nonsignificant and degrees remaining influential. We reason that the effect estimations may be conservative because duration of education has a broader range than dichotomous degree indicators. Lastly, as we note in the section on measures, the questions on certification do not capture additional accreditation for those in occupations that require higher education. Future

research should look at effects of certifications for doctors, lawyers, or other professionals. Despite these limitations, the results suggest that the years of education, degree, and certification indicators capture different educational dimensions, and there was no indication of multicollinearity.

Last, we use data from 1985 to allow for a sufficient mortality follow-up period, but the data reflect the experiences of older cohorts.[9] As the mortality gap by education is growing and patterns are changing (Masters et al. 2012; Montez et al. 2011), the importance of degrees or years of schooling for mortality may shift. Supplemental models (not shown) ran the analyses within three cohort groups—individuals born 1887–1928, 1929–1945, 1946–1967—and there were some differences across these groups. Those born more recently (1946–1967) had the strongest results for years of education, whereas those born in the middle group (1929–1945) had the strongest associations with degrees. The effect of the GED also differed across the cohorts, likely because of the timing and changing meaning of the GED, discussed above. GEDs are associated with reduced mortality risk over the study period for the oldest cohort (1887–1928), but increased risk for the other two groups, compared to high school diplomas.

Conclusion

The results of this study indicate that both degrees and years of education are simple operationalizations of educational experiences, and separating them can help us distinguish some of the mechanisms of influence as well as better understand the functional form of the education-mortality relationship. However, more information on both the quantity and quality of education would likely be useful. Because certifications were influential for high school diploma earners, there may be other ways to capture different dimensions of education. For example, looking at

the grantors and fields of degrees and certifications, including but not limited to college degrees, may provide insight into how educational quality influences mortality. Similarly, further insight may be gained by investigating education over the life course and when degrees are obtained, particularly the effects of normative and non-normative timing of educational attainment.

Given the strong associations between education and mortality, it is of paramount importance for U.S. health surveys to include several questions on education that provide detailed values. For example, the National Health Interview Survey (NHIS) changed its education question in 1997 from one measure of the number of years of education to one that captures mostly degrees, asking about years of education only for those not attaining any degree. Asking about both may provide valuable insight into the mechanisms of education that shape health and mortality. Notably, the significance of vocational school and similar certifications for high school diploma earners reveal that other educational experiences also affect health and longevity. We did not have data on other types of certifications, but they may function similarly among other educational groups. For example, among those obtaining professional degrees, those who have medical board certification or pass the state bar exam may gain survival advantages.

We have demonstrated the benefits of simultaneously examining the association among years of education, degree attainment, additional training and certification, and mortality. High school graduates benefit from earning their diploma, but also benefit from gaining further years of education and from non-degree training and certification. Thus, different educational opportunities provide multiple pathways to better health and longer lives.

Endnotes

[1]Accordingly, we use "high school completers" to mean, not all those who have a high school diploma, but those who have a diploma and no further formal degree.

[2]Supplemental analyses suggested that the findings are robust to the matching procedures used to provide the mortality data. The results presented in this study reflect information from all individuals with known year of death. Results from models using only the best NDI matches (from a summary measure provided by PSID) did not differ substantively from the results presented.

[3]Auxiliary models restricted the sample to individuals 65 and under, excluding about 10% of the sample. These models produced similar patterns, but, as other studies have reported (Beckett 2000; Lauderdale 2001), there does appear to be an age effect, as ratios were generally stronger for the younger sample.

[4]Supplemental analyses accounting for complex survey design resulted in no differences in coefficients or standard errors, and thus we do not control for probability weights, strata, or sampling units.

[5]A likelihood ratio test of the full model also indicated significant improvement ($p<.001$) from inclusion of the degree categories compared to the same model without those categories. Similarly, in Panels B and C, models were significantly improved ($p<.01$) by the category groups of years of education and degrees.

[6] Ancillary models combining categorical years of education with degrees attained (not shown) produced very similar results.

[7]Additional models for the GED earners top- and bottom-coded years of education to provide a restricted range for this variable similar to the ranges of the other groups, and the results confirmed those reported in Table 3.

[8]Models with the full set of covariates using self-rated health, rather than mortality, as the outcome variable produced hazard ratios of education that were somewhat attenuated, but very similar to those reported here.

[9]Supplemental models with a 15- rather than 24-year follow-up produced similar but more variable hazard ratios, most likely because of a smaller sample. Some differences between the models were that the shorter follow-up produced weaker and nonsignificant hazard ratios for the category of those without a high school diploma, and that among GED earners, years of education produced a more positive and marginally significant hazard ratio in the full model.

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Table 1. Descriptive statistics of education and control variables of U.S. adult respondents, 1985

	All	No degree	GED	HS Dipl	AA	BA	MA	PhD	JD/MD
Education									
Average years of ed	12.1	8.6	10.6	12.5	14.3	16.1	16.97	16.94	16.93
Range of years of ed	0-17	0-16	0-17	12-17	12-17	12-17	14-17	16-17	15-17
Has certification	24.9 %	12.2 %	38.2 %	31.2 %	31.2 %	21.8 %	17.0 %	14.9 %	5.0 %
Controls									
Sociodemographic controls									
Average age	40.9	49.3	36.4	38.0	34.8	37.7	41.8	45.2	40.5
Male	44.3 %	42.5 %	52.6 %	41.2 %	48.8 %	51.6 %	51.3 %	78.7 %	82.7 %
Race/ethnicity									
White	62.5	45.4	54.2	65.2	68.5	82.6	85.9	80.9	86.4
Black	32.8	48.0	39.0	31.1	27.5	14.7	10.5	14.9	3.7
Other	1.5	1.7	1.8	0.9	1.1	1.4	2.1	4.3	3.7
Hispanic	3.3	4.9	4.9	2.9	2.9	1.3	1.6	0.0	6.2
Marital status									
Married	71.9	61.7	66.9	74.8	77.6	77.5	80.1	93.6	86.4
Single	10.6	9.6	12.0	10.7	10.1	12.3	13.1	4.3	9.9
Widowed	6.0	14.2	2.5	3.9	1.6	2.2	1.3	0.0	1.2
Divorced	11.5	14.5	18.6	10.6	10.7	8.0	5.5	2.1	2.5
Geographic controls									
Region									
Northeast	15.4	10.4	11.4	15.8	22.4	21.1	26.0	27.7	18.5
North Central	23.5	20.8	23.9	24.4	18.1	26.6	21.3	19.1	37.0
South	44.5	57.5	50.1	41.5	37.1	32.4	31.0	34.0	29.6
West	16.3	11.1	14.2	17.8	22.4	19.4	20.5	19.2	13.6
Foreign country	0.4	0.1	0.5	0.5	0.0	0.6	1.3	0.0	1.2
Social Origins									
Father's education									
Less than high school	57.3	78.0	67.1	55.2	43.2	31.4	32.7	23.4	16.3
High school degree	35.2	10.2	24.6	38.2	51.5	65.9	65.7	74.5	81.3
Don't know	7.5	11.7	8.3	6.6	5.3	2.7	1.6	2.1	2.5
Poor growing up	38.9	60.2	49.4	33.3	30.9	21.1	28.5	19.2	11.1
Achieved SES									
Income-to-needs ratio									
<100%	2.9	5.2	5.4	2.5	0.8	0.5	0.8	0.0	0.0
100-200%	5.5	12.2	6.3	4.0	2.1	0.2	0.0	0.0	0.0
200-300%	7.5	17.5	8.2	4.4	2.4	1.8	1.0	0.0	0.0
300%+	84.1	65.1	80.1	89.1	94.7	97.5	98.2	100.0	100.0
Owns home	58.1	52.4	46.1	58.7	61.9	65.2	76.4	83.0	75.3
Employment status									
Working	64.1	41.8	68.9	68.1	81.3	80.9	83.8	85.1	88.9
Temporarily not working	1.3	1.3	1.5	1.4	1.6	1.0	1.6	0.0	0.0
Looking for work	5.6	7.6	10.2	5.2	3.5	2.9	1.6	2.1	0.0
Retired	9.3	17.8	4.4	7.3	2.4	4.9	6.0	10.6	6.2
Disabled	2.7	7.6	2.0	1.3	0.5	0.2	0.0	0.0	1.2
Keeping house	15.5	23.0	8.7	15.3	8.3	8.4	6.5	0.0	1.2
Student	1.2	0.6	3.1	1.2	2.4	1.6	0.5	2.1	2.5
Other; prison; jail	0.3	0.4	1.2	0.2	0.0	0.1	0.0	0.0	0.0
N	11084	2838	605	5489	375	1242	382	47	80

Source: Panel Study of Income Dynamics, 1985

Table 2. Education and the risk of death, U. S. adult respondents, 1985-2009

	Panel A: Years of educ. (continuous)			Panel B: Years of educ.(categorical)			Panel C: Degrees attained			Panel D: Years of educ. and degrees		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Years of education	0.97 ***	0.97 ***	0.99							1.01	1.01	1.02 +
Years of education (12)												
0-11				1.11 *	1.11 +	1.03						
13				0.84	0.85	0.86						
14				0.74 **	0.74 **	0.78 *						
15				0.87	0.88	0.92						
16				0.71 ***	0.71 ***	0.79 *						
17+				0.65 ***	0.65 ***	0.73 **						
Degrees (High School Diploma)												
No degree or diploma							1.19 ***	1.18 **	1.08	1.23 **	1.22 **	1.19 *
GED							1.08	1.09	1.10	1.10	1.11	1.17
AA							0.67 *	0.67 *	0.74	0.66 *	0.67 *	0.71 +
BA							0.74 ***	0.74 ***	0.83 *	0.73 ***	0.72 ***	0.77 **
MA/JD/MD/PhD							0.65 ***	0.65 ***	0.73 **	0.63 ***	0.63 ***	0.66 **
Certification		0.96	0.98		0.95	0.98		0.95	0.97		0.95	0.96
Controls												
Male	1.59 ***	1.60 ***	1.68 ***	1.63 ***	1.64 ***	1.69 ***	1.63 ***	1.63 ***	1.69 ***	1.63 ***	1.64 ***	1.70 ***
Race/ethnicity (non-Hispanic White)												
Non-Hispanic Black	1.12 *	1.11 +	1.08	1.12 *	1.11 +	1.08	1.11 +	1.10 +	1.07	1.12 +	1.11 +	1.08
Non-Hispanic Other	0.89	0.88	0.88	0.93	0.91	0.88	0.91	0.91	0.88	0.92	0.92	0.90
Hispanic	0.67 *	0.67 *	0.65 *	0.68 *	0.68 *	0.65 *	0.67 *	0.67 *	0.64 **	0.68 *	0.68 *	0.66 *
Marital status (Married)												
Single	1.50 ***	1.51 ***	1.44 ***	1.53 ***	1.53 ***	1.48 ***	1.52 ***	1.52 ***	1.47 ***	1.52 ***	1.52 ***	1.46 ***
Widowed	1.62 ***	1.62 ***	1.49 ***	1.62 ***	1.63 ***	1.50 ***	1.61 ***	1.61 ***	1.49 ***	1.61 ***	1.62 ***	1.50 ***
Divorced	1.42 ***	1.43 ***	1.41 ***	1.42 ***	1.43 ***	1.42 ***	1.40 ***	1.41 ***	1.41 ***	1.40 ***	1.41 ***	1.40 ***
Region (Northeast)												
North Central	1.06	1.05	1.04	1.04	1.04	1.03	1.04	1.04	1.03	1.04	1.04	1.03
South	0.97	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
West	0.90	0.90	0.89	0.90	0.90	0.89	0.90	0.89	0.89	0.90	0.89	0.89
Foreign country residence	0.46	0.48	0.47	0.48	0.49	0.48	0.47	0.48	0.47	0.47	0.48	0.47
Social Origins												
Poor growing up	1.06	1.06	1.06	1.06	1.06	1.05	1.06	1.06	1.05	1.07	1.07	1.06
Father Education (less than HS)												
High school degree	0.82 **	0.82 **	0.85 **	0.87 *	0.87 *	0.89 +	0.86 *	0.86 *	0.88 *	0.86 *	0.86 *	0.88 *
Don't know	0.84 *	0.83 *	0.86 +	0.86 +	0.84 *	0.86 +	0.84 +	0.83 *	0.86 +	0.85 +	0.84 *	0.87
Achieved SES												
Income-to-needs ratio			0.99 *			1.00			1.00			0.99
Owns home			0.98			0.98			0.99			0.98
Employment status (working)												
Temporarily not working			1.29			1.27			1.27			1.26
Looking for work			1.54 ***			1.52 ***			1.52 ***			1.50 ***
Retired			1.87 ***			1.86 ***			1.85 ***			1.86 ***
Disabled			2.80 ***			2.74 ***			2.74 ***			2.79 ***
Keeping house			1.66 ***			1.63 ***			1.62 ***			1.63 ***
Student			0.84			0.88			0.84			0.82
Other; prison; jail			0.78			0.76			0.75			0.73
N	11081	11081	11041	11081	11081	11041	11055	11055	11040	11055	11055	11040

Source: Panel Study of Income Dynamics, 1985

Notes: Accounts for clustering between couples. Referent is listed in parentheses.

*** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$; + $p \leq .10$

Table 3. Educational degree, years of education, certification, and the risk of death, U.S. adult respondents, 1985-2009

	Model 1[a]	Model 2[b]	Model 3[c]
	No Degree (N=2,848)		
Years of education	0.99	0.99	1.00
Certification		1.00	1.02
	GED (N=605)		
Years of education	1.07	1.07	1.08
Certification		1.15	1.16
	High School Diploma (N=5,489)		
Years of education	0.91 *	0.92 *	0.92 *
Certification		0.85 *	0.86 +
	AA Degree (N=375)		
Years of education	1.24	1.21	1.16
Certification		1.42	1.55
	BA Degree (N=1,242)		
Years of education	0.87	0.87	0.91
Certification		1.08	1.18
	MA, PhD, JD, MD (N=509)		
Years of education	0.99	0.99	1.00
Certification		1.12	1.13

Source: Panel Study of Income Dynamics, 1985
Notes: Accounts for clustering between couples.
*** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$; + $p \leq .10$

[a]Model 1 controls for sex, race/ethnicity, marital status, region, being poor while growing up, and father's education.

[b]Model 2 controls for Model 1 covariates plus additional certification.

[c]Model 3 controls for Model 2 covariates plus income-to-needs ratio, home ownership, and employment.