HHS Public Access

Author manuscript

Ann Epidemiol. Author manuscript; available in PMC 2016 May 01.

Published in final edited form as:

Ann Epidemiol. 2015 May ; 25(5): 323–328. doi:10.1016/j.annepidem.2015.01.017.

Educational Attainment and Longevity: Results from the REGARDS US National Cohort Study of Blacks and Whites

Robert M. Kaplan, PhD

National Institutes of Health, Bethesda, Maryland

Virginia J. Howard, PhD, **Monika M. Safford, MD**, and **George Howard, DrPH**

University of Alabama at Birmingham, Birmingham, Alabama

Abstract

Background—Educational attainment may be an important determinant of life expectancy. However, few studies have prospectively evaluated the relationship between educational attainment and life expectancy using adjustments for other social, behavioral, and biological factors.

Method—The data were from the REasons for Geographic and Racial Differences in Stroke (REGARDS) study that enrolled 30,239 black and white adults (45 years of age and older) between 2003 and 2007. Demographic and cardiovascular risk information is collected and participants are followed for health outcomes. Educational attainment was categorized as less than high school education, high school graduate, some college, or college graduate. Proportional hazards analysis was used to characterize survival by level of education.

Results—Educational attainment and follow-up data were available on 29,657 (98%) of the participants. Over 6.3 years of follow up, 3,673 participants died. There was a monotonically increasing risk of death with lower levels of educational attainment. The same monotonic relationship held with adjustments for age, race, sex, cardiovascular risk factors and health behaviors. The unadjusted hazard ratio for those without a high school education in comparison to college graduates was 2.89 (95% CI=2.64–3.18). Although adjustment for income, health behaviors, and cardiovascular risk factors attenuated the relationship, the same consistent pattern was observed after adjustment. The relationship between educational attainment and longevity was similar for black and for white participants. The monotonic relationship between educational attainment and longevity was observed for all age groups, except for those 85 years or older.

Conclusions—Educational attainment is a significant predictor of longevity. Other factors, including age, race, income, health behaviors, and cardiovascular risk factors only partially explain the relationship.

Keywords

Educational Attainment; Life Expectancy; all-cause mortality; Prospective Cohort

A variety of studies suggest that individuals with higher levels of educational attainment have a lower probability of premature disability and death[1–4]. However, the explanation for this relationship remains unclear. Nested within educational attainment are a variety of factors including income, neighborhood effects, race, sex, early life experiences, health

behaviors, and cardiovascular risk factors. There has been relatively little work attempting to disentangle the relationship between educational attainment and other sociodemographic and medical risk factor variables. However, the studies that have been published make a persuasive argument that low levels of education may be the most influential variable[1].

Most of the literature on education and longevity has been produced by demographers who have taken the opportunity to link public surveys, such as the National Health Interview Survey to the National Death Index[1,5–7]. Although the studies are prospective, they have relatively little health information. Other studies, including the Health and Retirement Study (HRS) focus on older cohorts of adults born between 1890 and 1953[8]. It has been suggested that the relationship between education and health may be changing over the course of time because greater numbers of individuals gained entrance to institutes of higher learning in more recent birth cohorts[7]. Further, the impact of cardiovascular risk factors on mortality declines with advancing age[9] and it is unknown whether education interacts with these effects.

In this paper, we report analyses of the relationship between educational attainment and life expectancy using a large heterogeneous cohort created for the national REasons for Geographic and Racial Differences in Stroke (REGARDS) study. This large prospective study allows adjustment for sociodemographic, medical, and behavioral variables.

Methods

The REGARDS study was designed to improve the understanding of racial and geographic differences in stroke mortality[10]. The study focused on contributors to stroke incidence and mortality from both ischemic stroke and intracerebral hemorrhage. Details of the methodology have been reported elsewhere [10].

Study Population

Between January 2003 and October 2007, community dwelling adults (N=30, 239) were recruited for participation in the study. Individuals were identified using a commercially available list of community-dwelling residents, and recruited using an initial mailing followed by telephone contact. Adults were oversampled from eight states comprising the geographic region known as the stroke belt. About 56% of the participants resided in these states, including: North Carolina, South Carolina, Georgia, Tennessee, Alabama, Mississippi, Arkansas, and Louisiana. The other 44% were sampled from the other 40 contiguous US states. The sampling design included oversampling of black participants. The final sample comprised 42% black and 55% women. Among those who responded to the telephone inquiry, 49% agreed to participate. Consent was obtained verbally and later in writing. All involved Institutional Review Boards approved the study protocol.

Demographic Assessment

An initial telephone interview was used to obtain information on demographic characteristics, including age, race, sex, household income, and education. Educational attainment was categorized as less than high school education, high school graduate, some college, or college graduate.

Cardiovascular risk assessment

An assessment of cardiovascular risk was based on a telephone interview, self-administered questionnaires, an in-home physical examination (including an electrocardiogram), and the analysis of blood and urine samples collected during the in-home exam. Blood pressure was measured after the participant had been seated for five minutes. The average of two blood pressures was used in the analysis. Hypertension was defined as SBP greater or equal than 140 mmHg, diastolic blood pressure greater or equal than 90 mmHg, or self-reported use of antihypertensive medications.

A fasting blood panel was used to estimate blood glucose, total cholesterol, high – density lipoprotein cholesterol, and triglycerides. All blood samples were sent to a central laboratory. Diabetes mellitus was defined as fasting glucose greater than 126 mg/dl. For cases in which participants failed to fast prior to the examination (14% of those evaluated), the threshold of 200 mg/dl was used. Subjects were also considered to have diabetes if they were using medication to control blood sugar.

Low-density–lipoprotein cholesterol was calculated using the Friedewald formula.[11] Body mass index was defined as weight in kilograms / height in meters^2.

Behavioral Factors

Telephone interviews were used to assess current alcohol use, smoking status and perceived stress as measured by a 4-item version of Cohen Perceived Stress Scale[12].

Vital Status

Following baseline, participants were followed every six months by telephone and when participants could not be reached, contact was made with proxies provided by the participant at enrollment. For participants who reportedly died, the date of death was confirmed through the Social Security Index, death certificates, or the National Death Index. Follow-up for the current analysis was available through March 31, 2013.

The association between educational attainment, risk factors, and all-cause mortality was evaluated using proportional hazards analysis, with the proportional hazards assumption examined by residual plots and testing significance of time-dependent covariates for education terms.

Results

Characteristics of the study population are summarized in Table 1, showing those with lower levels of education to be older, more likely black and female, have lower household income, worse cardiovascular risk profile, to drink and exercise less, and to have a higher level of perceived stress. Over the six years of follow-up, there was a systematic relationship between category of educational attainment and percentage of deaths.

Table 2 summarizes the hazard ratios with 95% confidence intervals for all-cause mortality. The first column displays the crude rate, using college degree or a higher level of education as the reference. The next column considers the effect of educational attainment after

adjustment for demographic variables, including age, race, and sex. The column labeled "adjustment for income categories" represents the effect of education with income category added to the demographic factors. The next column adds cardiovascular risk factors, including hypertension, diabetes, smoking, dyslipidemia. In addition to established risk factors, body mass index was also included. The final column includes adjustment for behavioral factors, including alcohol use, exercise. Perceived stress was included in addition to behavioral factors. The first row in the table summarizes the sample size for the analysis and the number of participants/number of deaths. The trend toward increasing life expectancy with greater levels of educational attainment remained statistically significant with adjustment for demographic, income, cardiovascular risk, and behavioral factors.

Table 3 summarizes the hazard ratios for death between categories of educational attainment. The table breaks down the hazard by race following adjustments for age, race, and sex. The second portion of the table includes adjustment for cardiovascular risk factors, including hypertension, diabetes, smoking, dyslipidemia, and body mass index. The final section of the table includes adjustment for behavioral risk factors, including alcohol use, exercise, and perceived stress. The test for interaction for the top panel of the table is a 3 degree of freedom test for any differences. The test for interaction on the bottom sections of the table evaluates the slope estimated for the linear trend for both black and white participants. All tests for interaction were non-significant, suggesting that the trends for black participants were the same as the trends for White participants. Examination of residual plots supported the reasonableness of the assumption of proportional hazards, as did the lack of evidence for time dependent effects of education after adjustment for age and sex ($X^2 = 1.78$; df = 3; p = 0.62).

Table 4 summarizes the effect of educational attainment on all-cause mortality within different age strata. Within each age category, there was a consistent pattern in the relationship between educational attainment and all-cause mortality in which less educational attainment was associated with higher risk of mortality. These relationships were statistically significant for all age categories except for the oldest old (85 years or older). Adjustment for biological and behavioral variables attenuated the relationship but did not eliminate it (data not shown.)

Discussion

The profound effects of social determinants of health are now documented in a significant number of studies[13–15]. Among the many factors associated with shorter life expectancy, years of formal education has emerged as one of the most important correlates[6]. Low education is likely to influence a variety of downstream factors, including less income, suboptimal neighborhood of residence with attendant health effects, adverse life experiences, and poor access to medical care[14]; however, understanding the contributions of the correlates of educational attainment has remained challenging. Data from the REGARDS study help clarify this picture. Adjustment for race and sex did not substantially affect the relationship between education and mortality, suggesting that these characteristics were not major explanatory factors. Further, the effect of education was similar for both blacks and whites, as shown in the stratified analysis. Although annual household income

substantially attenuated the relationships, less education was still significantly associated with mortality after adjustment for income. The impact of low levels of education was weaker for older participants, but remained consistent within each age stratum. Further, adjustment for cardiovascular risk factors and behavioral variables further attenuated the relationship, but the trend remained significant after all adjustments.

The REGARDS findings are consistent with a variety of other studies from the demography literature. For example, Lantz and colleagues have reported systematic relationships between education and life expectancy using the Americans Changing Lives Study [16–18] while other demographers have found similar results using the National Health Interview Survey linked to the National Death Index[6,7,19]. However, Lantz and colleagues suggested that the effect of education was mediated by income. Our results show that income adjustment attenuates the effect, but a graded relationship between educational attainment and longevity remains after adjusting for income. Since education and income are highly correlated, separating the unique effects is difficult. In addition, income is likely to be measured with error, so any adjustment will only partially remove its influence. Montez and Hayward[20] have also reported similar findings based on the Health and Retirement Survey. The Montez and Hayward study also used detailed adjustments for a variety of factors, including childhood adversity.

The finding that the impact of education is stronger for younger cohorts is important for several reasons. A recent set of analyses from the National Academies of Sciences suggests that the United States is falling behind other wealthy countries in the rate of life expectancy increases[21]. Of particular interest was the observation that deaths early in the life cycle, particularly before age 50, explain an important part of the variance in this relative decline in American health. The declines correspond to relative reductions in the proportion of American children attending preschool and the proportion graduating from college. Kindig and Cheng[22] evaluated changes in life expectancy in U.S. counties between 1992 and 2006. Over the last century, life expectancy in American communities has consistently increased. However, the Kindig-Cheng analysis suggested that, for women, life expectancy declined in 42% of the counties during the study interval. Proportion of residents with a college education was among the best predictors of life expectancy increases for both men and women[22].

The crude relationship between education and life expectancy is very strong in comparison to other risk factors. For example, the crude relationship between elevated versus normal LDL cholesterol is about 0.67 quality-adjusted years of life [23]. In contrast, several studies suggest that the crude relationship between having a college degree versus less than a high school education is about 10 quality-adjusted life years[6,20]. Among social determinants of health, educational attainment is attractive because it is potentially modifiable. A variety of international studies suggest that countries that increase the proportion of college graduates have also experienced increases in disability-adjusted life expectancy[24,25]. Older studies from the United Kingdom indicate that laws requiring mandatory school attendance were followed by increases in wealth and health in comparison to regions that did not have the mandatory requirement for high school graduation[26]. Although our observational study

cannot prove causality, the analysis supports a possible pathway for improving life expectancy through education.

Our study has a number of limitations. Inferences are limited to the study volunteers and we cannot assure that the participants are representative of the U.S. the population. However, the participation rate in the REGARDS study is comparable to that in other major epidemiologic investigations. Another limitation is that some of the variables were measured with error. As a result, statistical models may under adjust. For example, an alternative explanation for income not removing the effect of education might be that the imperfection in the income measure attenuated the statistical adjustment. Using a prospective cohort design, our analysis is unable to test the causal relationship between educational attainment and longevity. Despite these limitations, the REGARDS study has some important strengths that contribute to our understanding of this issue. The large prospective investigation offers a substantial ethnically diverse study population and a greater range of social, behavioral, and biological measures than have been used in previous investigations of the relationship between education and longevity.

In summary, we do not know why education and life expectancy are correlated. Our analysis suggests that the relationship is partially explained by low income, more CVD risk factor burden and, to a lesser extent, poor health behaviors. After all of the adjustments, about 15% of the effect remains as a unique effect of education. Given our findings and those reported by others, we believe this relationship deserves continuing research attention.

Acknowledgments

This research was supported by a cooperative agreement U01 NS041588 from the National Institute of Neurological Disorders and Stroke, National Institutes of Health (NIH), Department of Health and Human Services, and also an American Reinvestment and Recovery Act supplement. The content is solely the responsibility of the authors and does not necessarily represent the official views and positions of the National Institute of Neurological Disorders and Stroke or the National Institutes of Health.

References

1. Brown DC, Hayward MD, Montez JK, Hummer RA, Chiu CT, Hidajat MM. The significance of education for mortality compression in the United States. Demography. 2012; 49:819–40. [PubMed: 22556045]
2. Denney JT, Rogers RG, Hummer RA, Pampel FC. Education inequality in mortality: The age and gender specific mediating effects of cigarette smoking. Social science research. 2010; 39:662–73. [PubMed: 20563305]
3. Herd P, Goesling B, House JS. Socioeconomic position and health: the differential effects of education versus income on the onset versus progression of health problems. Journal of health and social behavior. 2007; 48:223–38. [PubMed: 17982865]
4. Zajacova A, Hummer RA, Rogers RG. Education and health among U.S. working-age adults: a detailed portrait across the full educational attainment spectrum. Biodemography and social biology. 2012; 58:40–61. [PubMed: 22582892]
5. Montez JK, Hayward MD, Brown DC, Hummer RA. Why is the educational gradient of mortality steeper for men? The journals of gerontology Series B, Psychological sciences and social sciences. 2009; 64:625–34.
6. Montez JK, Hummer RA, Hayward MD. Educational attainment and adult mortality in the United States: a systematic analysis of functional form. Demography. 2012; 49:315–36. [PubMed: 22246797]

7. Montez JK, Hummer RA, Hayward MD, Woo H, Rogers RG. Trends in the Educational Gradient of U.S. Adult Mortality from 1986 to 2006 by Race, Gender, and Age Group. Research on aging. 2011; 33:145–71. [PubMed: 21897495]
8. Van Nostrand, JF.; Furner, SE.; Suzman, R. Vital & health statistics Series 3, Analytical and epidemiological studies / [US Dept of Health and Human Services, Public Health Service, National Center for Health Statistics]. 1993. Health data on older Americans: United States, 1992. Introduction. Background; p. 1-5.
9. Howard G, Manolio TA, Burke GL, Wolfson SK, O'Leary DH. Does the association of risk factors and atherosclerosis change with age? An analysis of the combined ARIC and CHS cohorts. The Atherosclerosis Risk in Communities (ARIC) and Cardiovascular Health Study (CHS) investigators. Stroke; a journal of cerebral circulation. 1997; 28:1693–701. [PubMed: 9303011]
10. Howard VJ, Cushman M, Pulley L, et al. The reasons for geographic and racial differences in stroke study: objectives and design. Neuroepidemiology. 2005; 25:135–43. [PubMed: 15990444]
11. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clinical chemistry. 1972; 18:499–502. [PubMed: 4337382]
12. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. Journal of health and social behavior. 1983; 24:385–96. [PubMed: 6668417]
13. Vandenheede H, Vikhireva O, Pikhart H, et al. Socioeconomic inequalities in all-cause mortality in the Czech Republic, Russia, Poland and Lithuania in the 2000s: findings from the HAPIEE Study. Journal of epidemiology and community health. 2013
14. Marmot M, Bell R, Goldblatt P. Action on the social determinants of health. Revue d'epidemiologie et de sante publique. 2013; 61(Suppl 3):S127–32.
15. Di Cesare M, Khang YH, Asaria P, et al. Inequalities in non-communicable diseases and effective responses. Lancet. 2013; 381:585–97. [PubMed: 23410608]
16. Lantz PM, Golberstein E, House JS, Morenoff J. Socioeconomic and behavioral risk factors for mortality in a national 19-year prospective study of U.S. adults. Social science & medicine. 2010; 70:1558–66. [PubMed: 20226579]
17. House JS, Lepkowski JM, Williams DR, et al. Excess mortality among urban residents: how much, for whom, and why? American journal of public health. 2000; 90:1898–904. [PubMed: 11111263]
18. Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen J. Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. JAMA: the journal of the American Medical Association. 1998; 279:1703–8. [PubMed: 9624022]
19. Rogers RG, Hummer RA, Everett BG. Educational differentials in US adult mortality: An examination of mediating factors. Social science research. 2013; 42:465–81. [PubMed: 23347488]
20. Montez JK, Hayward MD. Cumulative Childhood Adversity, Educational Attainment, and Active Life Expectancy among U.S. Adults. Demography. 2014 in press.
21. Woolf SH, Aron LY. The US health disadvantage relative to other high-income countries: findings from a National Research Council/Institute of Medicine report. JAMA: the journal of the American Medical Association. 2013; 309:771–2. [PubMed: 23307023]
22. Kindig DA, Cheng ER. Even as mortality fell in most US counties, female mortality nonetheless rose in 42.8 percent of counties from 1992 to 2006. Health affairs. 2013; 32:451–8. [PubMed: 23459723]
23. Clarke R, Emberson J, Fletcher A, Breeze E, Marmot M, Shipley MJ. Life expectancy in relation to cardiovascular risk factors: 38 year follow-up of 19,000 men in the Whitehall study. Bmj. 2009; 339:b3513. [PubMed: 19762417]
24. Mathers CD, Murray CJ, Salomon JA, et al. Healthy life expectancy: comparison of OECD countries in 2001. Australian and New Zealand journal of public health. 2003; 27:5–11. [PubMed: 14705260]
25. Mathers CD, Sadana R, Salomon JA, Murray CJ, Lopez AD. Healthy life expectancy in 191 countries, 1999. Lancet. 2001; 357:1685–91. [PubMed: 11425392]
26. Oreopoulos P. Do dropouts drop out too soon? Wealth, health and happiness from compulsory schooling. Journal of Public Economics. 2007; 91:213–2229.

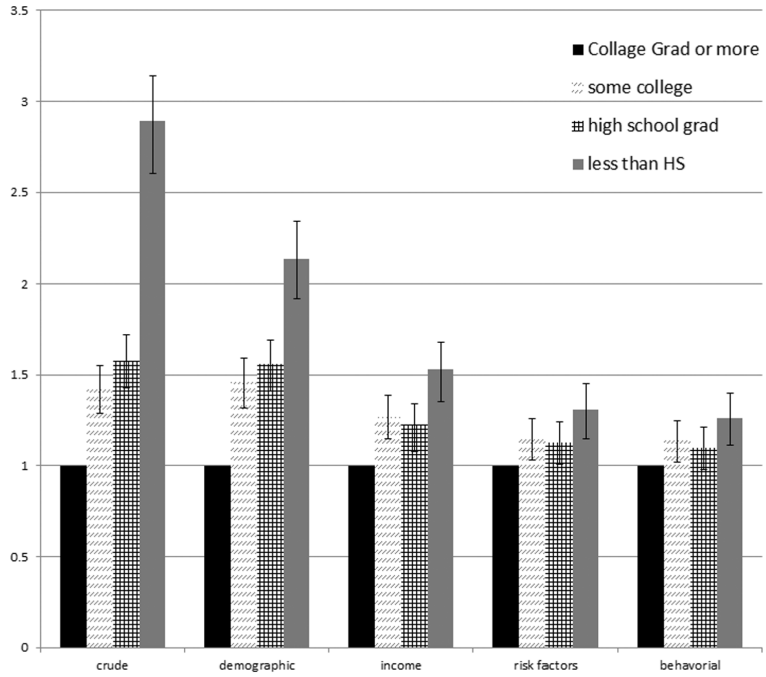

Figure 1.

Hazard ratio for all-cause mortality as a function of educational attainment. The reference case (1.0) was college graduation or greater. The successive column clusters represent: 1) crude ratios, 2) hazards adjusted for demographic factors, 3) hazards adjusted for demographic factors plus income, 4) hazards adjusted for demographic factors, income and biological risk factors, and 5) hazards adjusted for demographic, income, biological risks, and behavioral risk factors. Although successive adjustments attenuate the hazard ratios, the relationship between educational attainment and longevity remains graded and statistically significant.

Table 1

Description of the study population, showing distribution of the demographic, income, cardiovascular risk factor and behavioral factors used in subsequent analyses by level of education.

			< HS Graduation (n = 3,707)	HS Grad (n = 7,666)	Some College (n = 7,948)	College Grad (n = 10,336)
Demographic Factors	Age (mean ± SD)		68.2 ± 9.2	65.1 ± 9.2	64.2 ± 9.4	64.1 ± 9.4
	Black (%)		65.6	44.4	40.7	30.3
	Male (%)		40.9	40.6	42.3	51.7
Income	Income Strata (%)	<$20K	45.1	24.9	15.8	4.8
		$20K - $35K	26.8	31.2	26.7	16.1
		$35K - $75K	8.6	24.9	33.7	37.7
		$75K+	1.7	5.5	12.3	31.3
		Refused	17.8	13.5	11.5	10.1
Cardiovascular Risk Factors	Hypertension (%)		72.4	63.2	58.9	51.8
	Diabetes (%)		34.7	24.1	21.7	16.1
	Smoking (%)		20.7	16.8	16.0	9.3
	Dyslipidemia (%)		63.0	61.1	58.7	57.2
	BMI Classification (%)	Underweight (<18.5)	1.5	1.1	0.9	1.0
		Normal (18.5 – 24.9)	19.8	22.3	22.1	27.4
		Overweight (25.0 – 29.9)	33.9	35.8	36.7	38.9
		Obese (30+)	44.8	40.9	40.3	32.7
Behavioral Factors	NIAAA Alcohol Use Strata (%)	None	80.3	70.6	62.8	50.4
		Moderate (1–7 drinks/wk for women; 1–14 drinks/wk for men)	17.1	26.0	33.1	44.6
		Heavy (8+ drinks/ week for women; 15+ drinks/wk for men)	2.5	3.4	4.1	5.1
	Exercise Category (%)	None	43.8	37.8	34.9	28.2
		1–3 times/wk	28.7	32.9	36.3	40.6
		4+ times/wk	27.5	29.3	28.7	31.2
	Perceived stress (mean ± SD)		4.1 ± 3.4	3.4 ± 3.0	3.1 ± 2.9	2.7 ± 2.6

Table 2

Hazard ratio (95% CI) for death between categories of educational attainment, after adjustment for demographic factors (age, race and sex), after further adjustment for income categories, after further adjustment for risk factors (hypertension, diabetes, smoking, dyslipidemia, and BMI), and after further adjustment for behavioral factors (alcohol use, exercise, and perceived stress). Results are shown for each model for (number of participants / number of deaths).

		Crude (29,657 / 3,673)	**Demographic Factor Adjusted (29,657 / 3,673)**	**+ adjustment for income categories (29,657 / 3,673)**	**+ adjustment for risk factors (27,272 / 3,260)**	**+ adjustment for behavioral factors (26,372 / 3,098)**
Educational Strata	College Grad or more	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
	Some college	1.42 (1.29 – 1.55)	1.46 (1.33 – 1.60)	1.27 (1.15 – 1.39)	1.15 (1.04 – 1.27)	1.14 (1.03 – 1.26)
	High School Grad	1.58 (1.44 – 1.73)	1.56 (1.43 – 1.71)	1.23 (1.12 – 1.38)	1.13 (1.02 – 1.25)	1.10 (0.99 – 1.22)
	Less than HS	2.89 (2.64 – 3.18)	2.14 (1.94 – 2.36)	1.53 (1.38 – 1.71)	1.31 (1.17 – 1.47)	1.26 (1.12 – 1.41)
Trend test		1.38 (1.34 – 1.42) <0.0001	1.26 (1.23 – 1.30) <0.0001	1.13 (1.09 – 1.17) <0.0001	1.08 (1.04 – 1.12) <0.0001	1.06 (1.03 – 1.10) 0.0011

Table 3

Hazard ratio (95% CI) for death between categories of educational attainment shown by race, after adjustment for demographic factors (age, race and sex), after further adjustment for income categories, after further adjustment for risk factors (hypertension, diabetes, smoking, dyslipidemia, and BMI), and after further adjustment for behavioral factors (alcohol use, exercise, and perceived stress). Tests of interaction for the top panel is a 3 degree of freedom test for any differences, while the bottom test interaction is a test in the difference in slope estimated for the linear trend for blacks and whites.

		Crude B: 12,197 / 1,632 W: 17,460 / 2,041		**Age-Sex adjusted B: 12,197 / 1,632 W: 17,460 / 2,041**		**+ adjustment for income categories B: 12,197 / 1,632 W: 17,460 / 2,041**		**+ adjustment for risk factors B: 11,030 / 1,408 W: 16,242 / 1,852**		**+ adjustment for behavioral factors B: 10,601 / 1,323 W: 15,771 / 1,775**	
		Estimate	**p-value for interact**	**Estimate**	**p-value for interact**	**Estimate**	**p-value for interact**	**Estimate**	**p-value for interact**	**Estimate**	**p-value for interaction**
College Grad or more	Black	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
	White	1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)		1.00 (ref)	
Some college	Black	1.20 (1.02 – 1.39)		1.26 (1.08 – 1.47)		1.05 (0.89 – 1.23)		0.99 (0.84 – 1.18)		0.99 (0.83 – 1.18)	
	White	1.54 (1.38 – 1.72)		1.56 (1.39 – 1.75)		1.39 (1.24 – 1.56)		1.21 (1.07 – 1.37)		1.19 (1.05 – 1.35)	
High School Grad	Black	1.48 (1.27 – 1.71)	0.062	1.49 (1.29 – 1.73)	0.088	1.11 (0.95 – 1.29)	0.060	1.06 (0.90 – 1.26)	0.20	1.02 (0.86 – 1.21)	0.28
	White	1.60 (1.43 – 1.80)		1.55 (1.39 – 1.75)		1.27 (1.12 – 1.44)		1.13 (0.99 – 1.28)		1.11 (0.97 – 1.26)	
Less than HS	Black	2.68 (2.32 – 3.83)		2.05 (1.78 – 2.37)		1.37 (1.17 – 1.60)		1.25 (1.06 – 1.48)		1.18 (0.99 – 1.41)	
	White	2.89 (2.51 – 3.33)		2.23 (1.94 – 2.58)		1.65 (1.41 – 1.92		1.34 (1.14 – 2.28)		1.32 (1.11 – 1.56)	
Test for Trend	Black	1.39 (1.33 – 1.46) <0.0001	0.28	1.27 (1.21 – 1.32) <0.0001	0.34	1.11 (1.06 – 1.17) <0.0001	0.24	1.08 (1.03 for all cause– 1.14) 0.0035	0.60	1.06 (1.00 – 1.12) 0.041	0.39
	White	1.35 (1.29 – 1.41) <0.0001		1.27 (1.22 – 1.32) <0.0001		1.15 (1.09 – 1.20) <0.0001		1.08 (1.03 – 1.13) 0.0028		1.07 (1.02 – 1.13) 0.0081	

Table 4

Hazard Ratios for All-cause Mortality by Age and Education

	Education			**AGE**		
		45–54 RS: 3,682 / 116	**55–64 RS: 11,307 / 767**	**65–74 RS: 9,570 / 1,274**	**75–84 RS: 4,515 / 1,268**	**85+ RS: 583 / 248**
Adjusted for sex and race	College Grad or more	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
	Some college	2.00 (1.21 – 3.30)	1.67 (1.33 – 1.92)	1.42 (1.21 – 1.66)	1.45 (1.24 – 1.70)	1.15 (0.80 – 1.63)
	High School Grad	1.92 (1.32 – 3.27)	1.94 (1.59 – 2.36)	1.49 (1.28 – 1.73)	1.48 (1.27 – 1.73)	1.17 (0.83 – 1.65)
	Less than HS	3.91 (2.11 – 3.27)	3 33 (1.59 – 2.36)	2.43 (2.06 – 2.86)	1.80 (1.53 – 2.13)	1.35 (0.95 – 1.93)
	Test of trend	1.45 (1.21 – 1.75) <0.0001	1.45 (1.35 – 1.55) <0.0001	1.30 (1.23 – 1.37) <0.0001	1.20 (1.14 – 1.26) <0.0001	1.10 (0.98 – 1.23) 0.11
	p-value for interaction	<0.0001				
Adjusted for sex, age and income	College Grad or more	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
	Some college	1.58 (0.94 – 2.63)	1.32 (1.08 – 1.62)	1.24 (1.06 – 1.46)	1.29 (1.10 – 1.51)	1.11 (0.77 – 1.59)
	High School Grad	1.19 (0.69 – 2.80)	1.38 (1.12 – 1.71)	1.21 (1.03 – 1.42)	1.21 (1.03 – 1.42)	1.09 (0.76 – 1.57)
	Less than HS	1.92 1.00 – 3.68)	1.94 (1.12 – 1.71)	1.76 (1.46 – 2.11)	1.37 (1.15 – 1.64)	1.19 (0.81 – 1.75)
	Test of trend	1.14 (0.94 – 1.40) 0.18	1.21 (1.12 – 1.31) <0.0001	1.17 (1.11 – 1.24) <0.0001	1.09 (1.03 – 1.16) 0.0019	1.05 (0.93 – 1.19) 0.40
	p-value for interaction	<0.0001				