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Unique contribution of education to behavioral and psychosocial antecedents of health in a national sample of African Americans

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Abstract Education has demonstrated consistent links with many aspects of physical health and is theorized to relate to a variety of behavioral and psychosocial antecedents of health that may ultimately account for these associations. However, many of these associations and the extent to which they manifest specifically for African Americans have not been thoroughly tested. We examined associations of education—distinct from income—with established behavioral and psychosocial antecedents of health in a national sample of African Americans. Education favorably related to many behavioral (e.g., fruit/vegetable intake, lifetime smoking) and psychosocial (e.g., self-efficacy, personality traits, self-esteem, psychological well-being) antecedents of health, but not to all. Some evidence of stronger salutary relations of education for women was found. Results suggest that, for African Americans, education is generally favorably associated with an array of behavioral and psychosocial antecedents of physical health, partially explaining health disparities and providing a point of intervention moving forward.

Keywords Education · African American · Psychosocial resources · Health behaviors · Health beliefs

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Introduction

Educational attainment, a central component of socioeconomic status (SES), significantly and independently predicts life expectancy, morbidity and other indices of physical health (Case & Deaton, 2015; Kaplan et al., 2017; Strand et al., 2010; Viner et al., 2017). Indeed, educational attainment has been described as "an important leverage point that…could help address the problems that give rise to persistent health disparities" (Kaplan et al., 2017, p. 598). Given that the United States has consistently ranked last among developed countries in educational attainment, morbidity, and mortality, it has been argued that "the benefit of education for health and life expectancy is too big to ignore, and the United States must implement evidence-based practices to produce individuals who are 'ready-for-life' (OBSSR, 2014). The notion of educational attainment as a means for promoting public health and reducing health disparities, as well as for improving economic conditions and quality of life for the US population, is gaining traction in many quarters (Olshansky et al., 2012; Thornton et al., 2016; Zajacova & Lawrence, 2018).

While substantial empirical research has demonstrated the education-health link, major gaps remain: Current understanding of the relationship between education and health lacks sophistication (e.g., few studies have disentangled the role of education from that of income) and research has not adequately examined demographic subgroups. Thus, one major gap is the absence of knowledge about the extent to which the education-health link pertains specifically to African Americans: The association between education and health has primarily been demonstrated in large epidemiological studies *controlling* for race rather than examining whether it *pertains* to race or holds for specific ethnic/racial groups (e.g., Kaplan et al., 2017).

This statistical approach precludes examining education's potentially unique effects for subgroups within the general population, even though there is some evidence that effects of education vary by race (e.g., Assari & Mistry, 2018; Johnson-Lawrence et al., 2017).

A second major gap is that studies focusing on race and health rarely identify the unique contribution of education, but rather consider SES in aggregate, failing to distinguish education from income and other aspects of social status (e.g., Assari & Mistry, 2018; Merkin et al., 2009; Signorello et al., 2014). The lack of explicit focus on education as distinct from income is a severe limitation of the research because different aspects of SES may have very different effects on health and/or operate via different mechanisms (Haught et al., 2016; Ruiz et al., 2012), and because, among the components of SES, education appears to have the strongest relationship to health (Lawrence, 2017). For example, a recent investigation of the 2001–2008 National Health and Nutrition Examination Survey (NHANES) data found that lower educational attainment explained the greater inflammatory burden for African Americans and Mexican Americans relative to Whites (Dinwiddie et al., 2016).

Considering specific aspects of SES separately from one another is particularly important for African Americans, given that they are an historically disadvantaged group that has experienced decades of oppression. Studies that compare associations of education and health-relevant outcomes across racial and ethnic groups have shown that education may differentially influence the health of minority groups, given the greater potential lack of opportunities for them to translate education to income due to continued discrimination in hiring and advancement (Assari, 2018a, b; Assari et al., 2018). However, only by examining education separately from income *within* specific racial/ethnic groups can we understand how education alone may influence health for those groups.

A third major knowledge gap pertains to the attribution of well-documented education-related health disparities to a host of behavioral and psychosocial antecedents of health, such as social resources or mastery (Adler et al., 1994; Braveman et al., 2011). Yet with the exception of health behaviors, associations between education and these antecedents have rarely been tested (e.g., Lawrence, 2017; Pampel et al., 2010). In addition, research isolating effects of education while examining psychosocial antecedents of health rarely considers race.

Higher educational attainment is consistently associated with health-promotive behaviors such as healthy eating, regular physical activity, non-smoking, and cancer screenings (Brunello et al., 2016; Mulder et al., 2011). However, studies of health behaviors examining education separately from other aspects of SES do not often examine the data specifically by race but rather either statistically "control" for it (e.g., Documet et al., 2015; Pampel et al., 2010) or ignore it entirely (e.g., Smith et al., 2016).

Further, health behaviors do not fully account for associations between SES and physical health. For example, in an analysis of the nationally-representative sample in NHANES III, education and income each independently predicted nine different physical health indices even after controlling for relevant health behaviors (Seeman et al., 2008). Such findings suggest that education has additional effects on health beyond its influence on health behaviors.

Indeed, education has been hypothesized to be associated with an array of psychosocial antecedents of physical health (e.g., Adler et al., 1994; Braveman et al., 2011). These psychosocial antecedents include (1) health-related beliefs (e.g., locus of control, self-efficacy), (2) health-related psychosocial resources (e.g., personality, self-esteem, social support), and (3) psychological well-being (e.g., depression, affect), each of which, in turn, influences physical health status (e.g., Adler et al., 1994; Braveman et al., 2011; Pampel et al., 2010). As reviewed below, only a few studies have examined how education relates to these psychosocial antecedents of health, with almost none of this work focusing specifically on African Americans.

Health-related beliefs

Education has been proposed to influence health by shaping people's beliefs about control, specifically about their health and more broadly about the extent to which they can influence their life circumstances (Adler et al., 1994), which are, in turn, related to physical health status (Keedy et al., 2014; Williams et al., 2016). Higher levels of education are consistently related to a higher sense of personal control in many countries and cultures (Cutler & Lleras-Muney, 2010). This relationship is not surprising, given that education provides better prospects for employment and income. However, virtually none of this work has linked education to explicitly health-related control beliefs nor been conducted with African Americans.

Health-related psychosocial resources

Education has been associated with higher levels of a broad range of psychosocial resources. For example, education correlates positively with the size of individuals' social networks, which provide essential financial, psychological, and emotional resources that reduce stress exposure and improve health (Cutler & Lleras-Muney, 2010; Mirowsky & Ross, 2003). However, this work has rarely addressed

the unique role of education distinct from income or focused on African Americans.

In addition to social support, other psychosocial resources have also been proposed as pathways linking education to physical health, including personality, perceptions of meaning in life, and self-esteem, all of which are associated with physical health (Czekierda et al., 2018; Hampson et al., 2016; O'Leary et al., 2014). However, little research has examined whether education, independent of income, relates to these psychosocial antecedents of physical health and almost none has focused specifically on African Americans.

Health-related psychological well-being

Not only is psychological well-being a valued quality in itself, but it is also an antecedent of physical health (Brown et al., 2015). For example, depressive symptoms are related to physical health trajectories and mortality (Sin et al., 2015). Further, SES is a well-established predictor of psychological well-being (e.g., González et al., 2016). Thus, psychological well-being has been proposed as a link between education and physical health (Braveman et al., 2011) although little research specific to education has been conducted (cf. Krause, 2018).

The present study

The goal of this study is to explicate the extent to which education—independent of income–relates to behavioral and psychosocial antecedents of health in a national sample of African Americans. These antecedents of health are implicated in a host of physical health conditions. Although all of the behavioral and psychosocial antecedents of physical health examined here have been suggested to function as links between education and physical health, virtually no studies have actually tested their associations with education within an African American sample, especially controlling for income. Collectively, these behavioral and psychosocial antecedents of physical health present an array of potentially valuable intervention targets to help remedy some of the well-documented health disparities related to education.

To date, however, very little research has documented the extent to which education—independent from income—is associated with these health-related resources, and virtually none has examined this issue within African American samples. A specific focus on educational attainment and determinants of health in African Americans is especially warranted given the potentially conflicting roles education may play in African American health (Fuller-Rowell et al., 2015; Gaydosh et al., 2018; Kelley-Moore & Ferraro, 2004; Miller et al., 2016). For African Americans, higher educational attainment may sometimes be a double-edged sword, in that it can provide a valuable set of skills and resources but also lead to exposure to higher levels of discrimination, segregation and other manifestations of racism, causing higher allostatic load and depression (Chen et al., 2015). Further, higher education has been linked to John Henryism, a type of high effort coping that can have deleterious physical health consequences (Hudson et al., 2016). In addition, there is some suggestion that education might influence African Americans' health differentially based on their gender (e.g., Assari et al., 2017a). In particular, among African Americans, education may be more strongly related to physical health for women than for men (e.g., Assari et al., 2017b). However, very little research is available relating education to psychosocial determinants of physical health for African Americans by gender, and issue we examined in an exploratory way in the present study.

Understanding how education relates to behavioral and psychosocial antecedents of health is important not only for advancing our understanding of the pervasive and persistent influences of education on health, but also for identifying the most promising of these antecedents as targets of interventions for alleviating health disparities. Recent calls have argued for attending to "upstream" factors that could be valuable foci for interventions specific to African Americans (e.g., Gilbert et al., 2009). In the broader context of social determinants as intervention targets, it may also be important to examine the role of education (a modifiable health protective factor) in the behavioral and psychosocial antecedents of health.

Method

We conducted a secondary data analysis of data from the Religion and Health in African Americans (RHIAA) initiative (https://sph.umd.edu/department/bch/lab/43501), which involved telephone surveys of African American households across the U.S. The RHIAA baseline sample comprises 2370 participants who completed a 45-min interview.

Procedure

Data collection methods for RHIAA have been reported in detail elsewhere (Debnam et al., 2012). Interviewers from a subcontracted professional sampling firm telephoned potential participants using a probability sampling list of households within the United States and introduced the project. Contacted adults who expressed interest completed a short eligibility screener to determine whether they self-identified as African American and were at least 21 years

old. Individuals with a cancer history were excluded due to assessments of cancer screening in the interview. Those eligible following screening provided verbal assent following an informed consent script. Participants who completed the interview received a $25 gift card. Two additional waves of data were collected over the subsequent 5 years. The present analyses used only baseline data.

Measures

Background demographics

A standard demographic module assessed participant characteristics including sex, age, and household income before taxes. Education was assessed in this module as well, with the question, "What is the highest grade or year of school you completed?", answered as 1 "Never attended school or only attended kindergarten", 2 "Grades 1 through 8 (Elementary)", 3 "Grades 9 through 11 (Some high school)", 4 "Grade 12 or GED (High school graduate)", 5 "College 1 year to 3 years (Some college or technical school)", or 6 "College 4 years or more (College graduate)." As in other research in this area (e.g., Assari & Mistry, 2018), education was operationalized as a continuous measure.

Behavioral antecedents of physical health

Physical activity. The brief version of the International Physical Activity Questionnaire (Craig et al., 2003) was used to measure physical activity. Items assess the number of days in the previous week and amount of time participants engaged in activities reflecting vigorous and moderate activity and walking, producing a total number of minutes/week for moderate and vigorous physical activity. ***Fruit and vegetable consumption***. An adapted National Cancer Institute's 5-A-Day Survey was used to evaluate fruit and vegetable consumption (Block et al., 1986; Kreuter et al., 2005), with seven items assessing fruit consumption and five items targeting vegetables. Number of servings per day are computed by summing the weekly estimates and dividing by seven. ***Cancer screening***. Participants reported on select age-and sex-appropriate cancer screening behaviors (ever had a mammography for women, ever had a PSA test for men) using items based on the Behavioral Risk Factor Surveillance System (BRFSS) modules (CDC, 2018). ***Alcohol and tobacco use***. Alcohol and tobacco use were assessed with BRFSS modules. The alcohol consumption module asked whether participants had any alcohol use in the previous 30 days. For those answering "yes," heavy drinking was assessed ("Considering all types of alcoholic beverages, how many times during the past 30 days did you have 4/5 or more drinks on an occasion? [4 for women; 5 for men]." The items had adequate test–retest reliability in a previous sample of African Americans (Stein et al., 1993). Regarding tobacco, participants were asked if they had ever smoked more than 100 cigarettes (yes/no), a reflection of ever having been a smoker.

Psychosocial antecedents of physical health

Beliefs. *Self-efficacy* was assessed using the New General Self-Efficacy Scale eight-item scale (e.g., "I will be able to achieve most of the goals that I have set for myself."), which has demonstrated good psychometrics (Chen et al., 2001) and had high internal reliability ($\alpha = .86$ in the present sample). Participants responded to items using a 5-point response format from 1 (strongly disagree) to 5 (strongly agree). *Beliefs about illness* as punishment. Illness beliefs were assessed with the Illness as Punishment for Sin scale, consisting of 8 items (e.g., "God sometimes uses physical illnesses to punish people.") with response options of 1 (strongly disagree) to 4 (strongly agree) (Holt et al., 2009). The scale has a possible range of 8–32, with higher scores indicating higher levels of these beliefs. Internal consistency in the present sample was good ($\alpha = .89$) and the scale has demonstrated good psychometrics in previous research (Holt et al., 2009). *Health locus of control beliefs*. The Spiritual Health Locus of Control (SHLOC) scale is a 13-item measure that has two dimensions. Active SHLOC (11 items) involves the belief that God empowers the individual to be proactive about health behaviors or the notion that the individual should work in partnership with God to maintain good health ($\alpha = .91$ in the present sample). Passive SHLOC (2 items) measures the belief that because God has control over one's health, the individual does not have to engage in health protective behaviors ($r = .57$ in the present sample). While the Passive SHLOC scale has only two items, both reliability and predictive validity have been confirmed in previous research (e.g., Debnam et al., 2012; Holt et al., 2003). Participants responded to these items on a 5-point Likert-type format (strongly disagree, disagree, neutral, agree, strongly agree). The two-factor structure and predictive validity have been demonstrated (Debnam et al., 2012; Holt et al., 2003). Scores can range from 11 to 55 for active SHLOC and 2 to 10 for passive SHLOC, with higher scores indicating stronger beliefs.

Psychosocial resources. *Personality*. The NEO Five-Factor Inventory–Form S was used to assess the five factor model (Big Five) of personality dimensions (Costa & McCrae, 2004). Conscientiousness was defined as being

organized, reliable, hard-working, self-disciplined, punctual, scrupulous, neat, ambitious, and persevering. Extraversion was characterized by being sociable, active, talkative, person-oriented, optimistic, fun-loving, and affectionate. Openness to experience was described as being curious, having broad interests, creative, original, imaginative, and untraditional. Agreeableness was considered as being soft-hearted, good-natured, trusting, helpful, forgiving, gullible, and straight-forward. Neuroticism was characterized as worrying, nervous, emotional, insecure, inadequate, and hypochondrial (Costa et al., 1986). The scales assessed Conscientiousness (e.g., "Make plans and stick to them"), Extraversion (e.g., "Make friends easily"), Openness to Experience (e.g., "Enjoy hearing new ideas"), Agreeableness (e.g., "Accept people as they are"), and Neuroticism (e.g., "Have frequent mood swings"). Each of these personality traits was measured by five items. Participants responded on a Likert-type scale from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate more of the trait. Both convergent and discriminant validity have been established (Piedmont & Weinstein, 1994). This is a widely used instrument based on the NEO Personality Inventory with high internal consistency (α = .76–.90). Internal consistencies for the current sample were reasonably good: Conscientiousness α = .77, Extraversion α = .75, Openness to Experience α = .67, Neuroticism α = .79, and Agreeableness α = .75. *Self-esteem*. Self-esteem was assessed with the Rosenberg Self-Esteem Scale (Rosenberg, 1965), 10 items (e.g., "I feel that I have a number of good qualities.") rated by participants from 1 (strongly disagree) to 4 (strongly agree). The instrument demonstrated good psychometrics in previous research (e.g., McCarthy & Hoge, 1982). Internal consistency reliability in the present sample was .86. *Sense of meaning*. Sense of meaning was assessed using a 14-item instrument (Krause, 2004). Participants rate each item (e.g., "I have a philosophy of life that helps me understand who I am."; "I feel good when I think of what I have done in the past.") using a 4-point Likert-type scale regarding how much they agree with each item from 1 (not at all) to 4 (a great deal). The instrument evidenced reliability and validity in previous work (Krause, 2004). In the present sample, internal consistency reliability was .90. *Social support*. The Interpersonal Support Evaluation List (ISEL-12) assessed general social support (Cohen et al., 1985). This 12-item instrument includes appraisal (e.g., 'I feel there is someone I can share my most private worries and fears with.'), belonging (e.g., 'If I wanted to have lunch with someone, I could easily find someone to join me.'), and tangible (e.g., 'If I were sick, I could easily find someone to help me with my daily chores.') support, using a 4-point Likert-type scale from 1 (definitely false) to 4 (definitely true). Higher scores reflect greater support. Internal consistency reliability in the present sample was good (α = .89). *Social influence on health behaviors*. Participants' perceptions of the role of others in making health behavior decisions was assessed with the Social Influence on Health Behaviors Scale (Holt et al., 2010), 10 items (e.g., "I rarely engage in health behaviors until I am sure my friends approve of them.", "I frequently gather information from friends and family before I engage in a health behavior") that participants rate on a five point scale from 1 (Strongly disagree) to 5 (Strongly agree). Internal consistency reliability in the present sample was quite high (α = .91).

Psychological well-being. *Positive and negative affect*. Positive and negative affect were assessed with the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988). The widely-used PANAS consists of 20 adjectives [10 positive (e.g., interested, excited) and 10 negative (e.g., distressed, upset)]. Participants indicate the extent to which they have felt that way in the past week from 1 ("very slightly or not at") to 5 ("extremely"). The scale has demonstrated factorial, convergent, and discriminant validity in previous research (Watson et al., 1988). Internal reliability was high in the present study (α = .85 for negative affect and .88 for positive affect). *Depressive symptoms*. Depressive symptoms were assessed with the Center for Epidemiological Studies-Depression Scale (CES-D) (Radloff, 1977). Participants rated how frequently they experienced each of 20 symptoms (e.g., "I had crying spells.", "I felt that everything I did was an effort.") in the previous week from 1 (rarely/less than 1 day) to 4 (all of the time/5–7 days). High internal consistency has been reported in both normal and patient populations (Radloff, 1977), as well as in the present sample (α = .90). The CES-D has been shown to be valid in African American samples (Makambi et al., 2009; Roth et al., 2008).

Results

Sample description

The present sample comprised 2370 people (65.5% women and 34.5% men). Mean age of participants was 57.18 (SD = 13.45); 11.7% had less than a high school diploma, 31.5% had a high school diploma or equivalent, 28.7% had some college, and 28.2% had 4 or more years of college. In terms of relationship status, 11.9% were never married, 16.3% were single, 18.4% were separated/divorced, 37.3% were married, and 16.1% were widowed. In terms of employment status, 33.3% were employed full time, 12.1% were employed part-time, 22.8% were disabled or not working, and 31.7% were retired. Household income ranged from less than $5000/year (6.7%) to over $60,000 (20.8%).Relative to the U.S. black population at the time of

the survey, the current sample was older than the U.S. median age of 32.7 years (current median = 54.0); contains fewer men (current = 38.2%; U.S. = 47.7% male); and was more educated (current% attended 4 + years of college = 26%; U.S. = 18.4%) (U.S. Census Bureau, 2011).

Correlations among study variables

Bivariate correlation analysis was conducted between demographics (gender, age, income and education) with behavioral and psychosocial antecedents of health (see Table 1). Age was significantly and inversely related to both education and income, while gender was unrelated to education but men reported higher household incomes than did women. Education and income were moderately strongly correlated, suggesting they overlap substantially but also represent distinct constructs.

Compared to men, women had lower income and less physical activity, ate more servings of fruits and vegetables, consumed less alcohol and binged less on alcohol,

Table 1 Bivariate correlations of demographics and behavioral and psychosocial antecedents of health overall and by gender

	Full sample				Men			Women		
	Gender	Age	Income	Education	Age	Income	Education	Age	Income	Education
Demographics										
Age	.03	–	–	–	–	–	–	–	–	–
Household income	− .12***	− .10***	–	–	− .09**	–	–	− .11***	–	–
Highest level of education completed	.00	− .12***	.48***	–	− .12***	.47***	–	− .11***	.49***	–
Behavioral antecedents of physical health										
Moderate PA (mins)	− .19***	− .13***	.06*	.00	− .12***	.02	.00	− .05	.02	− .01
Vigorous PA (mins)	− .15***	− .08***	.04	.00	− .10**	.05	− .01	− .14***	.02	.01
Fruit intake	.06**	.12***	.11***	.10***	.11**	.17***	.07*	.12***	.08**	.13***
Vegetable intake	.06**	.11***	.15***	.16***	.10**	.19***	.10**	.12***	.14***	.19***
Mammogram (ever)	− .01	.14***	.09**	.08**				.14***	.09**	.08**
PSA test (ever)	.02	.16***	.16***	.15***	.16***	.16***	.15***			
Alcohol in past 30 days (Y/N)	− .14***	− .18***	.13***	.09***	.09**	.06	.07*	− .23***	.15***	.11***
Alcohol binges in past month	− .07***	− .06**	.00	− .03	− .03	− .05	− .06	− .09**	.02	− .01
Lifetime smoking (100 + cigarettes)	− .11***	.13***	− .12***	− .13***	.18***	− .18***	− .19***	.12***	− .10***	− .10***
Psychosocial antecedents of physical health										
Self-efficacy	.04*	− .18***	.25***	.23***	− .15***	.27***	.20***	− .21***	.24***	.26***
Illness as punishment	− .05*	.00	− .23***	− .24***	.05	− .20***	− .25***	− .03	− .27***	− .24***
Passive spiritual health locus of control	.01	.06***	− .25***	− .24***	.06*	− .25***	− .24***	.06*	− .26***	− .23***
Active spiritual health locus of control	.06**	.06***	− .13***	− .14***	.08**	− .12***	− .19***	.05	− .13***	− .10***
Openness	.06	− .14***	.13***	.15***	− .10*	.09	.07	− .18***	.19***	.21***
Conscientiousness	.05	− .13***	.08*	.07	− .11*	.07	.02	− .15**	.10*	.10*
Extraversion	.03	− .06	.07	.16***	− .02	.10	.09	− .10*	.07	.22***
Agreeableness	.09*	− .08*	.02	.04	− .07	− .00	− .05	− .09	.06	.12*
Neuroticism	.00	.06	− .25***	− .24***	.07	− .21***	− .22***	.06	− .29***	− .26***
Self-esteem	.02	− .11***	.32***	.36***	− .12***	.31***	.34***	− .11***	.33***	.38***
Sense of meaning	.10***	.15***	.09***	.05*	.13***	.14***	− .00	.14***	.08**	.09**
Social support	.05**	− .02	.20***	.12***	− .02	.20***	.04	− .03	.21***	.18***
Social influences (norms)	− .12***	− .01	− .21***	− .27***	− .04	− .20***	− .22***	.03	− .26***	− .31***
Positive affect	.04	− .03	.22***	.23***	− .05	.23***	.20***	− .02	.23***	.24***
Negative affect	.04	− .13***	− .16***	− .12***	− .11**	− .16***	− .11**	− .15***	− .16***	− .13***
Depressive symptoms	.01	− .12***	− .31***	− .25***	− .09**	− .29***	− .21***	− .13***	− .32***	− .28***

PA physical activity, *mins* minutes, *Y/N* yes/no, *PSA* prostate-specific antigen

*$p < .05$; **$p < .01$; ***$p < .001$

smoked less, had higher self-efficacy and active spiritual health control beliefs and lower illness as punishment beliefs, and were higher in agreeableness, sense of meaning in life, and social support and lower on social influences on health.

Age was related to almost all of the behavioral and psychosocial antecedents of health: older age was related to less physical activity, more servings of fruits and vegetables, higher likelihood of having cancer screening, less consumption of alcohol or binge drinking but higher likelihood of having smoked, and lower self-efficacy, higher spiritual health locus of control (both passive and active), less openness, conscientiousness, and agreeableness, more meaning in life, and less negative affect and depressive symptomatology.

At the bivariate level, both income and education were related to virtually all of the antecedents, and in the same direction. Both were related to consumption of more servings of fruits and vegetables, higher likelihood of cancer screenings, greater likelihood of consuming alcohol, less likelihood of ever being a smoker, higher self-efficacy, lower beliefs in illness as punishment, lower active and passive spiritual health locus of control, higher openness, less neuroticism, higher self-esteem, sense of meaning, social support, positive affect and less social influences on their health behaviors, negative affect and depressive symptomatology. Only income was related to more vigorous physical activity and higher conscientiousness, while only education was related to higher extraversion. When examined by gender, these patterns generally held, but with some minor differences (e.g., education was related to social support for women but not for men).

Education as a unique predictor of behavioral antecedents of health

To determine whether education accounted for unique variance in our set of target behavioral antecedents of health, multiple linear regression analysis was conducted for each behavior in which age, gender, and income were entered as predictors in Step 1 and education was entered in step 2. Results for each behavioral antecedent of health are presented in Table 2. To explore the potential differences in these associations by gender, we also conducted these analyses separately for men and for women (i.e., removing gender from the regression model and splitting the file by gender). These results are reported in Table 2.

Many associations between education and behavioral antecedents were more modest in magnitude once other demographic variables were controlled, and some became statistically non-significant (e.g., mammograms, alcohol use). Although the magnitude of relationships is modest, after controlling for demographics including income, education still demonstrated favorable relationships with diet (related to both higher fruit and vegetable intake). Surprisingly, education was unrelated to moderate-intensity or vigorous-intensity exercise. Education was not related to alcohol consumption variables but was related to lower rates of having ever smoked. Finally, education was not significantly related to lifetime screening of mammograms for women but was related to higher lifetime screening of PSA for men. Examining these associations by gender revealed an interesting pattern in that only for women did education appear to have an advantageous relationship with healthy diet (education was related to intake of both fruits and vegetables only for women).

Education as a unique predictor of psychosocial antecedents of health

To determine whether education accounted for unique variance in our set of target psychosocial antecedents of health, multiple linear regression analysis was conducted for each antecedent in which, age, gender, and income were entered in step 1 and education was entered in step 2. Results for each psychosocial antecedent are presented in Table 3, organized by our three subsets of psychosocial health antecedents, (1) health-related beliefs, (2) health-related psychosocial resources), and (3) psychological well-being. To explore the potential differences in these associations by gender, we also conducted these analyses separately for men and for women (i.e., removing gender from the regression model and splitting the file by gender). These results are reported in Table 3.

Education was uniquely related to all of the beliefs assessed. Specifically, higher education was associated with higher self-efficacy and with lower beliefs in active and passive spiritual health locus of control as well as with beliefs in illness as punishment. Education was related to many, but not all, of the psychosocial resources assessed. In particular, greater education was related to higher scores on the personality traits of openness and extraversion and lower scores on neuroticism but was not significantly related to agreeableness or conscientiousness. Further, greater education was uniquely associated with self-esteem, although not with meaning in life or social support, and was inversely related to perceived social influences on one's health. Finally, education was uniquely and favorably related to all three indices of well-being, higher positive affect and lower negative affect and depressive symptoms.

When examining these associations by gender, interesting patterns again emerged: the significant associations of education with openness to experience, extraversion, and negative affect noted in the full sample were present only for women only while education was associated with

Table 2 Regression analyses by gender of the unique contributions of education in predicting behavioral antecedents of physical health, controlling for age and income (and, for overall sample, controlling for gender)

	Overall sample			Men			Women		
	B	SEB	β	B	SEB	β	B	SEB	β
Moderate PA (mins)	− .92	1.32	− .02	− 2.08	2.27	− .04	− .20	1.60	− .00
Vigorous PA (mins)	− 2.48	1.41	− .05	− 4.42	2.45	− .08	− 1.25	1.70	− .02
Fruit intake	.70	.23	.08**	.15	.36	.02	1.09	.30	.12***
Vegetable intake	.76	.16	.12***	.37	.26	.06	1.02	.21	.16***
Mammogram (ever)	.02	.01	.07				.02	.01	.07
PSA test (ever)	.05	.021	.10*	.05	.02	.10*			
Alcohol in past 30 days (Y/N)	− .01	.01	− .01	.02	.02	.05	− .01	.02	− .01
Binges in past month	− .02	.06	− .01	− .01	.11	− .01	− .03	.08	− .01
Lifetime smoking (100 + cigarettes)	− .05	.01	− .10***	− .06	.02	− .13***	− .04	.02	− .08*

PA physical activity, *mins* minutes, *Y/N* yes/no, *PSA* prostate-specific antigen

*$p < .05$; **$p < .01$; ***$p < .001$

Table 3 Regression analyses by gender of the unique contributions of education as predictors of psychosocial antecedents of physical health, controlling for age and income (and, for overall sample, controlling for gender)

	Overall sample			Men			Women		
	B	SEB	β	B	SEB	β	B	SEB	β
Health-related beliefs									
Self-efficacy	.61	.10	.14***	.48	.16	.11**	.70	.13	.17***
Illness as punishment	− .58	.12	− .13***	− .76	.18	− .17***	− .47	.15	− .10***
Passive spiritual health locus of control	− .21	.03	− .13***	− .26	.06	− .16***	− .17	.04	− .11***
Active spiritual health locus of control	− .65	.16	− .09***	− .22	.09	− .08*	− .01	.06	− .00
Psychosocial resources									
Openness	.30	.13	.10*	.12	.19	.04	.45	.18	.15**
Conscientiousness	.05	.14	.02	.03	.20	.01	.06	.19	.02
Extraversion	.37	.12	.14**	.14	.18	.05	.58	.17	.21***
Agreeableness	.07	.11	.03	− .15	.17	− .06	.26	.15	.10
Neuroticism	− .61	.15	− .18***	− .55	.21	− .16**	− .66	.21	− .19***
Self-esteem	1.10	.10	.26***	1.07	.16	.26***	1.11	.13	.26***
Meaning in life	.17	.14	.03	− .24	.24	− .04	.44	.17	.08**
Social support	.12	.14	.02	− .55	.23	− .08*	.60	.19	.09***
Social influences (norms)	− 1.13	.15	− .19***	− 1.01	.25	− .16***	− 1.21	.18	− .21***
Psychological well-being									
Positive affect	1.3	.22	.15***	1.06	.34	.12**	1.44	.28	.16***
Negative affect	− .43	.16	− .07**	− .28	.23	− .05	− .52	.21	− .08**
Depressive symptoms	− 1.5	.20	− .15***	− .90	.29	− .10**	− 1.82	.27	− .18***

*$p < .05$; **$p < .01$; ***$p < .001$

active spiritual locus of control only for men. Further, significant associations appeared for meaning in life such that for women only, higher education was related to a higher sense of meaning. Finally, education had opposite valences of association with social support: for women, having more education was associated with higher levels of social support, but for men, it was associated with lower levels of social support.

Discussion

Overall, these results support the notion that, for African Americans, education has salutary associations with an array of behavioral and psychosocial antecedents of physical health, potentially helping to explain some health disparities and providing a point of intervention moving forward. Education and income are clearly linked: the more

education an individual has, the more likely he or she will make more money across his or her lifespan. Yet education may provide individuals with health-protective resources apart from money, an idea supported by our findings. Although effect sizes were modest in magnitude once income and other demographics were taken into account, many of the hypothesized behavioral and psychosocial antecedents of health were indeed uniquely linked to education for African Americans.

Regarding behavioral antecedents of health, consistent with previous research, we found that higher education was related to better diet in terms of fruit and vegetable consumption (e.g., Hiza et al., 2013), although this effect was only found for women. Diet quality of Americans differs by age, sex, race/ethnicity, income, and education level, effects independent of income. Perhaps African American women who are more educated are also more inclined to seek out and/or be exposed to information about healthy foods (Hiza et al., 2013). Education was not related to physical activity, counter to some previous research (e.g., Parks et al., 2003) but consistent with other research that has concluded education is a correlate rather than a causal factor in physical activity (e.g., Bauman et al., 2012). Also consistent with other research, education was favorably related to never having been a smoker (e.g., Pampel et al., 2010); importantly, even when controlling for income, education showed an additional protective effect.

Regarding cancer screening, education was related to likelihood of having ever received a PSA test but not for having had a mammogram; this lack of relationship may be due to the lack of variance in receipt of a mammogram in our sample (93.4% of women endorsed having received one compared to 72.0% of men having had a PSA test). Education was not associated with either recent alcohol use or binge drinking. Moderate alcohol use is not necessarily considered unhealthy and some have even argued that it has protective effects (e.g., O'Keefe et al., 2014), and research on the general U.S. population typically finds education is positively correlated with alcohol consumption (e.g., Hiza et al., 2013). However, binge drinking is considered unhealthy, yet only 14.4% of our sample endorsed any binge drinking in the past month, which limits the variance we can predict.

The many associations of education with psychosocial antecedents of health provide an opportunity to consider how attaining an education may have meaningful and lasting effects on diverse psychosocial aspects of individuals with potentially long-term physical health consequences (Hahn & Truman, 2015; Braveman et al., 2011). Education was associated with a higher sense of self-efficacy, along with lower beliefs in illness as a punishment from God or beliefs in a spiritual health locus of control (both active and passive). Collectively, these results suggest that education is associated with a sense of personal mastery and control over one's own health rather than external forces (Yen & Moss, 1999). Education may encourage thinking of oneself as more autonomous and able to influence the course of one's own life (Braveman et al., 2011), which may be reflected in a higher sense of self-efficacy and more internal beliefs regarding illness and health (Mirowsky & Ross, 2003).

Regarding health-related psychosocial resources, education was related to some aspects of personality that have been linked to health. In particular, research has shown that low levels of neuroticism and high levels of conscientiousness are robustly related to physical health, while results for higher extraversion and openness are suggestive but mixed, and agreeableness appears unrelated to physical health (Murray & Booth, 2015). In our sample, education was related to higher extraversion and openness (only for women) and lower neuroticism, but unrelated to agreeableness or conscientiousness. This latter finding is somewhat surprising, in that conscientiousness is also generally shown to be related to academic success (e.g., Ivcevic & Brackett, 2014).

Controlling for income and other demographics, the relationship of education with self-esteem appeared to be the largest in all of our analyses, which bodes well for physical health, given the links between self-esteem and health across the lifespan (e.g., Zou et al., 2017). Importantly, this effect was found for both men and women. Contrary to our tentative expectations, in the full sample, education was not independently related to meaning in life or social support, both substantial predictors of physical health (e.g., Czekierda et al., 2018). However, African American women with more education did report higher meaning in life and social support, while African American men with more education reported *lower* levels of social support. Having a higher education was associated with feeling less influenced by the opinions of others regarding their health behaviors (social norms), again reflecting a sense of autonomy.

Finally, greater education was related to better psychological well-being (i.e., more positive affect and less negative affect and depressive symptoms). Psychological well-being is strongly related to physical health outcomes (e.g., Brown et al., 2015; Sin et al., 2015), indicating this set of antecedents to physical health clearly warrants future investigation. Further, these effects appeared more robust for women than for men. Perhaps those with greater education are likely to experience fewer depressive symptoms because they feel accomplished and empowered, have strong self-esteem and agency, and have had greater access to opportunities for personal development.

While results of this study are intriguing and suggest directions for future research, limitations must be noted.

The study relied on a cross-sectional design, and while participants' educational attainment likely occurred many years prior to their reports of current behavioral and psychosocial antecedents of health, directionality cannot be inferred. Further, many of the relationships reported here between education and these health antecedents likely operate in complex ways and influences likely operate in many directions. For example, having more education may lead individuals to behave in more healthful ways, but behaving in more healthful ways may boost psychosocial resources and psychological well-being and a sense of self-esteem or self-efficacy. In addition, some of our measures were suboptimal brief reports (e.g., physical activity, diet), necessary for our telephone survey methodology but lacking detail. Our study design did not permit the testing of mediation on actual physical health outcomes; thus, while suggestive, such tests await future research.

Our study complements the body of research that takes a comparative approach to understanding health-relevant associations of education across groups (e.g., Johnson-Lawrence et al., 2017) by taking a more detailed look at how education relates to determinants of health within a specific group with well-known health disparities. For our sample of African Americans, many of the constructs tapped by these measures may belie a complexity that is rarely considered in health research. Education may have a different meaning for African Americans than for the majority race; some have argued that education may not automatically translate to income for minorities, in part due to continued structural racism (e.g., lower pay, more limited opportunities) (Assari & Mistry, 2018). These differences in the meaning of education may have important implications for the health antecedents studied here. Recent research confirms the continued importance of schools and education to African American adults, especially parents. A qualitative study of Black parents' perceptions of schools in Chicago found that both working class and middle class parents were engaged with their children's schools and wanted their children to receive a high quality education. These parents sought quality education for their children despite differences in type of schools the children attended, their perceptions of school quality, and their orientation towards the school (i.e., maintaining high quality of education vs. pushing for reform) (Diamond & Gomez, 2004). In addition, our results are consistent with other recent research suggesting that SES more broadly and education specifically may have differential effects on the health and well-being of African Americans by gender (e.g., Assari et al., 2017a). Indeed, the inverse relationship of education and social support for African American men was unexpected and may reflect the double-edged nature of higher education for African American men in particular. Complex interrelationships between education and behavioral and psychosocial antecedents of health warrant investigation in future work.

Future research should use longitudinal and prospective study designs to provide more insight into temporal directions of associations among variables (e.g., does education increase self-efficacy or are those high in self-efficacy more likely to achieve more education, or both?). Prospective studies that include actual health outcomes would allow for testing models of moderating factors (e.g., is education particularly strongly associated with health antecedents for some subgroups) and mediating processes (e.g., does education exert its salutary effects on health through specific health behaviors or psychosocial factors), and even moderated mediation (e.g., does the education-physical health link operate through different health behaviors and psychosocial factors at different strengths based on gender?) Including additional variables associated with both education and physical health, such as literacy, would be important in further explicating the role of education in health. We have demonstrated the utility of considering education as distinct from income to better understand the unique influence of education (Ruiz et al., 2012). While separating the effects of education and income is important to understand their unique effects, education likely leads to higher income, as suggested by their close association in our sample and many others (e.g., Abdullah et al., 2015). Thus, education likely exerts effects on physical health through employment and health care access as well as through the antecedents identified here; larger samples followed prospectively could provide opportunities to statistically model these complex effects.

Focusing on education's role in health separate from income and other aspects of SES is nascent, and empirical tests of education's associations with antecedents of health even more so. Yet the linkages identified here provide some clues for translation of this work. More emphasis might fruitfully be placed on intervention programs encouraging people to achieve more education, whether in brick-and-mortar schools or online programs or community education/continuing education programs. Our sample comprises middle-aged African Americans, but these findings may be especially important in promoting intervention programs for African American youth to encourage them (via parents, family, media school teachers and counselors, etc.) to continue their education beyond high school. Programs run by churches and community centers, such as the Rites of Passage Program, may also promote the value of post-high school education among African American youth (e.g., Gilbert et al., 2009).

In conclusion, our results demonstrate—for the first time—that education, distinct from income, is related to a host of health-relevant variables for African Americans, including not only health behaviors but also many health-

relevant psychosocial antecedents of health. Although the links between education and physical health outcomes such as mortality are often attributed to health behaviors (e.g., Pampel et al., 2010), we found that education accounted for only modest amounts of variance in health behaviors. In fact, for several health behaviors, education was not significantly related (e.g., physical activity). These results support the notion that education's documented effects on physical health may be, at least in part, due to its associations with other health-relevant psychosocial antecedents that may be as or even more important in determining education-related health disparities in African Americans.

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Compliance with ethical standards

Conflict of interest Crystal L. Park, Eddie M. Clark, Emily Schulz, Beverly Rosa Williams, Randi M. Williams, and Cheryl L. Holt declare that they have no conflict of interest.

Human and animal rights and Informed consent All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

References

Abdullah, A., Doucouliagos, H., & Manning, E. (2015). Does education reduce income inequality? A meta-regression analysis. *Journal of Economic Surveys, 29,* 301–316.

Adler, N. E., Boyce, T., Chesney, M. A., Cohen, S., Folkman, S., Kahn, R. L., et al. (1994). Socioeconomic status and health: The challenge of the gradient. *American Psychologist, 49,* 15–24.

Assari, S. (2018a). Health disparities due to diminished return among Black Americans: Public policy solutions. *Social Issues and Policy Review, 12,* 112–145.

Assari, S. (2018b). Unequal gain of equal resources across racial groups. *International Journal of Health Policy and Management, 7,* 1.

Assari, S., & Mistry, R. (2018). Educational attainment and smoking status in a national sample of American adults; Evidence for the Black's diminished return. *International Journal of Environmental Research and Public Health, 15,* 763. https://doi.org/10.3390/ijerph15040763

Assari, S., Moghani Lankarani, M., Piette, J. D., & Aikens, J. E. (2017a). Socioeconomic status and glycemic control in type 2 diabetes; Race by gender differences. *Healthcare, 5,* 83.

Assari, S., Nikahd, A., Malekahmadi, M. R., Lankarani, M. M., & Zamanian, H. (2017b). Race by gender group differences in the protective effects of socioeconomic factors against sustained health problems across five domains. *Journal of Racial and Ethnic Health Disparities, 4,* 884–894.

Assari, S., Preiser, B., & Kelly, M. (2018). Education and income predict future emotional well-being of whites but not blacks: A ten-year cohort. *Brain Sciences, 8,* 122.

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., Martin, B. W., et al. (2012). Correlates of physical activity: Why are some people physically active and others not? *The Lancet, 380,* 258–271.

Block, G., Hartman, A. M., Dresser, C. M., Carroll, M. D., Gannon, J., & Gardner, L. A. (1986). A data-based approach to diet questionnaire design and testing. *American Journal of Epidemiology, 124,* 453–469.

Braveman, P., Egerter, S., & Williams, D. R. (2011). The social determinants of health: Coming of age. *Annual Review of Public Health, 32,* 381–398.

Brown, D. S., Thompson, W. W., Zack, M. M., Arnold, S. E., & Barile, J. P. (2015). Associations between health-related quality of life and mortality in older adults. *Prevention Science, 16,* 21–30.

Brunello, G., Fort, M., Schneeweis, N., & Winter-Ebmer, R. (2016). The causal effect of education on health: What is the role of health behaviors? *Health Economics, 25,* 314–336.

Case, A., & Deaton, A. (2015). Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century. *Proceedings of the National Academy of Sciences, 112,* 15078–15083.

Center for Disease Control and Prevention. (2018). https://www.cdc.gov/brfss/index.html Accessed September 8, 2018.

Chen, G., Gully, S. M., & Eden, D. (2001). Validation of a new general self-efficacy scale. *Organizational Research Methods, 4,* 62–83.

Chen, E., Miller, G. E., Brody, G. H., & Lei, M. (2015). Neighborhood poverty, college attendance, and diverging profiles of substance use and allostatic load in rural African American youth. *Clinical Psychological Science, 3,* 675–685.

Cohen, S., Mermelstein, R., Kamarck, T., & Hoberman, H. M. (1985). Measuring the functional components of social support. In I. G. Sarason (Ed.), *Social support: Theory, research and applications* (pp. 73–94). Dordrecht: Springer.

Costa, P. T., Jr., Busch, C. M., Zonderman, A. B., & McCrae, R. R. (1986). Correlations of MMPI factor scales with measures of the five factor model of personality. *Journal of Personality Assessment, 50,* 640.

Costa, P. T., Jr., & McCrae, R. R. (2004). *NEO Personality Inventory—Form S*. Lutz: Psychological Assessment Resources, Inc.

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., et al. (2003). International Physical Activity Questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise, 35,* 1381–1395.

Cutler, D. M., & Lleras-Muney, A. (2010). Understanding differences in health behaviour by education. *Journal of Health Economics, 29,* 1–28.

Czekierda, K., Gancarczyk, A., Park, C. L, & Luszczynska, A. (2018). Meaning in life and physical health: Systematic review and meta-analysis. *Psychology & Health Review, 11*, 387–418.

Debnam, K. J., Holt, C. L., Clark, E. M., Roth, D. L., Foushee, H. R., Crowther, M., et al. (2012). Spiritual health locus of control and health behaviors in African Americans. *American Journal of Health Behavior, 36,* 360–372.

Diamond, J. B., & Gomez, K. (2004). African American parents' educational orientations: The importance of social class and parents' perceptions of schools. *Education and Urban Society, 36,* 383–427.

Dinwiddie, G. Y., Zambrana, R. E., Doamekpor, L. A., & Lopez, L. (2016). The impact of educational attainment on observed race/ethnic disparities in inflammatory risk in the 2001–2008 National Health and Nutrition Examination Survey. *International Journal of Environmental Resources and Public Health, 13,* 42.

Documet, P., Bear, T. M., Flatt, J. D., Macia, L., Trauth, J., & Ricci, E. M. (2015). The association of social support and education with breast and cervical cancer screening. *Health Education & Behavior, 42,* 55–64.

Fuller-Rowell, T. E., Curtis, D. S., Doan, S. N., & Coe, C. L. (2015). Racial disparities in the health benefits of educational attainment: A study of inflammatory trajectories among African American and white adults. *Psychosomatic Medicine, 77,* 33–40.

Gaydosh, L., Schorpp, K. M., Chen, E., Miller, G. E., & Harris, K. M. (2018). College completion predicts lower depression but higher metabolic syndrome among disadvantaged minorities in young adulthood. *Proceedings of the National Academy of Sciences, 115,* 109–114.

Gilbert, D. J., Harvey, A. R., & Belgrave, F. Z. (2009). Advancing the Africentric paradigm shift discourse: Building towards evidence-based Africentric interventions in social work practice with African Americans. *Social Work, 54,* 243–252.

González, M. G., Swanson, D. P., Lynch, M., & Williams, G. C. (2016). Testing satisfaction of basic psychological needs as a mediator of the relationship between socioeconomic status and physical and mental health. *Journal of Health Psychology, 21,* 972–982.

Hahn, R. A., & Truman, B. I. (2015). Education improves public health and promotes health equity. *International Journal of Health Services, 45,* 657–678.

Hampson, S. E., Edmonds, G. W., Barckley, M., Goldberg, L. R., Dubanoski, J. P., & Hillier, T. A. (2016). A Big Five approach to self-regulation: Personality traits and health trajectories in the Hawaii longitudinal study of personality and health. *Psychology, Health & Medicine, 21,* 152–162.

Haught, H. M., Rose, J. P., & Brown, J. A. (2016). Social-class indicators differentially predict engagement in prevention vs. detection behaviors. *Psychology & Health, 31,* 21–39.

Hiza, H. A., Casavale, K. O., Guenther, P. M., & Davis, C. A. (2013). Diet quality of Americans differs by age, sex, race/ethnicity, income, and education level. *Journal of the Academy of Nutrition and Dietetics, 113,* 297–306.

Holt, C. L., Clark, E. M., Kreuter, M. W., & Rubio, D. M. (2003). Spiritual health locus of control and breast cancer beliefs among urban African American women. *Health Psychology, 22,* 294–299.

Holt, C. L., Clark, E. M., Roth, D. L., Crowther, M., Cohler, C., Fouad, M., et al. (2009). Development and validation of instruments to assess potential religion-health mechanisms in an African American population. *Journal of Black Psychology, 35,* 271–288.

Holt, C. L., Clark, E. M., Roth, D. L., Crowther, M., Kohler, C., Fouad, M., et al. (2010). Development and validation of an instrument to assess perceived social influence on health behaviors. *Journal of Health Psychology, 15,* 1225–1235.

Hudson, D. L., Neighbors, H. W., Geronimus, A. T., & Jackson, J. S. (2016). Racial discrimination, John Henryism, and depression among African Americans. *Journal of Black Psychology, 42,* 221–243.

Ivcevic, Z., & Brackett, M. (2014). Predicting school success: Comparing conscientiousness, grit, and emotion regulation ability. *Journal of Research in Personality, 52,* 29–36.

Johnson-Lawrence, V., Zajacova, A., & Sneed, R. (2017). Education, race/ethnicity, and multimorbidity among adults aged 30–64 in the National Health Interview Survey. *SSM-Population Health, 3,* 366–372.

Kaplan, R. M., Fang, Z., & Kirby, J. (2017). Educational attainment and health outcomes: Data from the Medical Expenditures Panel Survey. *Health Psychology, 36,* 598–608.

Keedy, N. H., Keffala, V. J., Altmaier, E. M., & Chen, J. J. (2014). Health locus of control and self-efficacy predict back pain rehabilitation outcomes. *The Iowa Orthopaedic Journal, 34,* 158–165.

Kelley-Moore, J. A., & Ferraro, K. F. (2004). The black/white disability gap: Persistent inequality in later life? *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 59,* S34–S43.

Krause, N. (2004). Stressors arising in highly valued roles, meaning in life, and the physical health status of older adults. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 59*(5), S287–S297.

Krause, N. (2018). Assessing the relationships among stress, God-mediated control, and psychological distress/well-being: Does the level of education matter? *The Journal of Social Psychology*. https://doi.org/10.1080/00224545.2018.1431604.

Kreuter, M. W., Skinner, C. S., Holt, C. L., Clark, E. M., Haire-Joshu, D., Fu, Q., et al. (2005). Cultural tailoring for mammography and fruit and vegetable consumption among low-income African American women in urban public health centers. *Preventive Medicine, 41,* 53–62.

Lawrence, E. M. (2017). Why do college graduates behave more healthfully than those who are less educated? *Journal of Health and Social Behavior, 58,* 291–306.

Makambi, K. H., Williams, C. D., Taylor, T. R., Rosenberg, L., & Adams-Campbell, L. L. (2009). An assessment of the CES-D scale factor structure in black women: The Black Women's Health Study. *Psychiatry Research, 168,* 163–170.

McCarthy, J. D., & Hoge, D. R. (1982). Analysis of age effects in longitudinal studies of adolescent self-esteem. *Developmental Psychology, 18,* 372–379.

Merkin, S. S., Karlamangla, A., Crimmins, E., Charette, S. L., Hayward, M., Kim, J. K., et al. (2009). Education differentials by race and ethnicity in the diagnosis and management of hypercholesterolemia: A national sample of US adults (NHANES 1999–2002). *International Journal of Public Health, 54,* 166–174.

Miller, G. E., Cohen, S., Janicki-Deverts, D., Brody, G. H., & Chen, E. (2016). Viral challenge reveals further evidence of skin-deep resilience in African Americans from disadvantaged backgrounds. *Health Psychology, 35,* 1225–1234.

Mirowsky, J., & Ross, C. E. (2003). *Education, social status, and health*. Hawthorne, NY: Aldine de Gruyter.

Mulder, B. C., de Bruin, M., Schreurs, H., van Ameijden, E. J., & van Woerkum, C. M. (2011). Stressors and resources mediate the association of socioeconomic position with health behaviours. *BMC Public Health, 11,* 798.

Murray, A. L., & Booth, T. (2015). Personality and physical health. *Current Opinion in Psychology, 5,* 50–55.

O'Keefe, J. H., Bhatti, S. K., Bajwa, A., DiNicolantonio, J. J., & Lavie, C. J. (2014). Alcohol and cardiovascular health: The dose makes the poison… or the remedy. *Mayo Clinic Proceedings, 89,* 382–393.

O'Leary, A. O., Jemmott, J. B., III, Stevens, R., Rutledge, S. E., & Icard, L. D. (2014). Optimism and education buffer the effects of syndemic conditions on HIV status among African American men who have sex with men. *AIDS Behavior, 18,* 2080–2088.

OBSSR. (2014). Education and health: New frontiers. Meeting summary. https://obssr.od.nih.gov/wp-content/uploads/2016/07/OBSSR_Education_and_Health_REV_8-22-2014_FINAL_RLA.pdf. Accessed July 26, 2018.

Olshansky, S. J., Antonucci, T., Berkman, L., Binstock, R. H., Boersch-Supan, A., Cacioppo, J. T., et al. (2012). Differences in life expectancy due to race and educational differences are widening, and many may not catch up. *Health Affairs, 31,* 1803–1813.

Pampel, F. C., Krueger, P. M., & Denney, J. T. (2010). Socioeconomic disparities in health behaviors. *Annual Review of Sociology, 36,* 349–370.

Parks, S. E., Housemann, R. A., & Brownson, R. C. (2003). Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States. *Journal of Epidemiology and Community Health, 57,* 29–35.

Piedmont, R. L., & Weinstein, H. P. (1994). Predicting supervisor ratings of job performance using the NEO Personality Inventory. *Journal of Psychology, 128,* 255–265.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1,* 385–401.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University.

Roth, D. L., Ackerman, M. L., Okonkwo, O. C., & Burgio, L. D. (2008). The four-factor model of depressive symptoms in dementia caregivers: A structural equation model of ethnic differences. *Psychology and Aging, 23,* 567–576.

Ruiz, J. M., Steffen, P., & Prather, C. C. (2012). Socioeconomic status and health. In A. Baum, T. A. Revenson, & J. E. Singer (Eds.), *Handbook of health psychology*. Mahwah, NJ: Lawrence Erlbaum Associates.

Seeman, T., Merkin, S. S., Crimmins, E., Koretz, B., Charette, S., & Karlamangla, A. (2008). Education, income and ethnic differences in cumulative biological risk profiles in a national sample of US adults: NHANES III (1988–1994). *Social Science and Medicine, 66,* 72–87.

Signorello, L. B., Cohen, S. S., Williams, D. R., Munro, H. M., Hargreaves, M. K., & Blot, W. J. (2014). Socioeconomic status, race, and mortality: A prospective cohort study. *American Journal of Public Health, 104,* e98–e107.

Sin, N. L., Yaffe, K., & Whooley, M. A. (2015). Depressive symptoms, cardiovascular disease severity, and functional status in older adults with coronary heart disease: The heart and soul study. *Journal of the American Geriatrics Society, 63,* 8–15.

Smith, S. G., McGregor, L. M., Raine, R., Wardle, J., Wagner, C., & Robb, K. A. (2016). Inequalities in cancer screening participation: Examining differences in perceived benefits and barriers. *Psycho-Oncology, 25,* 1168–1174.

Stein, A. D., Lederman, R. I., & Shea, S. (1993). The Behavioral Risk Factor Surveillance System questionnaire: Its reliability in a statewide sample. *American Journal of Public Health, 83,* 1768–1772.

Strand, B. H., Grøholt, E. K., Steingrímsdóttir, Ó. A., Blakely, T., Graff-Iversen, S., & Næss, Ø. (2010). Educational inequalities in mortality over four decades in Norway. *BMJ, 340,* c654.

Thornton, R. L., Glover, C. M., Cené, C. W., Glik, D. C., Henderson, J. A., & Williams, D. R. (2016). Evaluating strategies for reducing health disparities by addressing the social determinants of health. *Health Affairs, 35,* 1416–1423.

US Census Bureau. (2011). 2011 American Community Survey 1-year estimates. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml. Accessed 5/8/2018.

Viner, R. M., Hargreaves, D. S., Ward, J., Bonell, C., Mokdad, A. H., & Patton, G. (2017). The health benefits of secondary education in adolescents and young adults. *SSM-Population Health, 3,* 162–171.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070.

Williams, J. S., Lynch, C. P., Voronca, D., & Egede, L. E. (2016). Health locus of control and cardiovascular risk factors in veterans with type 2 diabetes. *Endocrine, 51,* 83–90.

Yen, I. H., & Moss, N. (1999). Unbundling education: A critical discussion of what education confers and how it lowers risk for disease and death. *Annals of the New York Academy of Sciences, 896,* 350–351.

Zajacova, A., & Lawrence, E. M. (2018). The relationship between education and health: Reducing disparities through a contextual approach. *Annual Review of Public Health, 39,* 273–289.

Zou, H., Tian, Q., Chen, Y., Cheng, C., & Fan, X. (2017). Coping styles mediate the relationship between self-esteem, health locus of control, and health-promoting behavior in Chinese patients with coronary heart disease. *Journal of Cardiovascular Nursing, 32,* 331–338.

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