Education and Health: Exploring Variation in the Gradient by Racial/Ethnic Groups in the United States

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Abstract

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The educational gradient in health is a well-established phenomenon. Despite receiving a great deal of scholarly attention, questions about the universality of the relationship remain. Specifically, there is relatively little research investigating whether the relationship extends to racial/ethnic minority populations. Also, the mechanisms through which education improves health are not well understood. This dissertation adds to our understanding of the educational gradient in health by focusing on two questions. First, does education affect health equally across racial/ethnic groups? And, second, do the intervening variables that connect education to health operate equivalently across groups?

Using data from the National Comorbidity Survey Replication, the National Survey of American Life and the National Latino and Asian American Study, I analyze the health returns of education across racial/ethnic groups in the United States. I conduct analyses at both the pan-ethnic level which includes non-Hispanic whites, non-Hispanic blacks, Hispanics and Asians and at the more specific race/national-origin groups. I employ various methodologies, including logistic regression models and structural equation modeling, to test hypotheses about how and why educational attainment affects health across groups.

Taken together, I find that in general, educational attainment is positively related to better self-rated health. However, interesting racial/ethnic differences emerge, both at the pan-ethnic and at the national-origin level. I also find that while the mechanisms linking education and health are similar across racial/ethnic group, the magnitude of effects varies significantly across groups. I therefore conclude that education does not equally affect health across groups.

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DEDICATION

In memory of Dr. Sarah Pettrone.

Chapter 1: Introduction

1.1 Introduction

The consistently positive association between education and health is a well-established phenomenon that has received much of scholarly attention. In its simplest form, as education increases, health improves and mortality decreases. Better self-assessed health, longer life expectancy, and higher levels of well-being are observed for the highly educated compared to their less educated counterparts (Miroswsky and Ross 2003; Ross and Wu 1995). Those who are more educated are less likely to be diagnosed with chronic diseases, compared to the less educated, and chronic conditions and functional limitations are more likely to happen at older ages for the highly educated compared to the less educated (Mirowsky and Ross 2003; Williams and Collins 1995). In other words, in addition to longer life expectancy in general, those with more education enjoy a longer healthy life expectancy compared to the less educated.

Whether this strong association between education and health is equally strong for racial/ethnic minority populations is less clear. In general, research points to a positive effect of education on health for both blacks and whites in the United States, however, differences between these groups are still evident. For example, some researchers point to larger differences in health between black and whites at lower levels of education than at higher levels (e.g., looking at healthy life expectancy - Crimmins and Sato 2001). This finding suggests that the intercept representing the relationship between education and health is lower for blacks but that the slope is perhaps steeper for blacks compared to whites. Others find the exact opposite. That is, at lower levels of education, black-white differences are smaller and become more pronounced as education increases (e.g., when examining infant mortality – Hummer 1993 or

when looking at chronic health conditions – Hayward et. al. 2000). In these cases, the intercept between education and health might be similar, but the slope representing the health returns to education is steeper for whites than blacks. Whichever the case, the general idea remains; the effect of education on health is not the same for blacks and whites.

Moving beyond the basic, and common, comparison between blacks and whites, investigations into the health returns for education become even more complex. In studies that include Hispanics, some do not report an effect of education on health (Chen et. al. 2006; Gilman et. al. 2008) and others do (Borrell et. al. 2006). And, although investigations of health returns to education that include Asians are rare, the few studies that do are also mixed in their results. Chen and colleagues (2006) conclude that there is no effect of education on health for Asians and Kimbro and colleagues (2008) demonstrate a modest effect for Asians. Although relatively understudied, compared to whites and even blacks, the research for Asians and Hispanics tends to tell a more complicated story. That is, results from studies examining the relationship between education and health for Hispanics and Asians are mixed.

As health disparities move more into the public arena, identifying ways to improve health is becoming more of a priority. A better understanding of what drives health disparities by socioeconomic status and by race/ethnicity are of paramount importance. And, as education is posited to be a strong predictor of health, delving more deeply into the effect of education on health and the mechanisms linking education and health is critical. Furthermore, it is necessary to better understand how education affects health for more specific racial/ethnic minority groups in the United States. In response to this need, my dissertation examines the effect of education on health for racial/ethnic groups at a finer level of race/ethnic specificity than has been previously examined. The core of this dissertation can be summarized by two questions. First,

does education impact education equally across groups? Second, are the intervening variables connecting education and health operating equivalently across groups?

1.2 Background

Those interested in demographic trends have long noted discrepancies in mortality by racial/ethnic group and by socioeconomic class. Around the turn of the 20th century, life expectancy in the United States was short and mortality rates were high. For example, in 1900, life expectancy at birth was 49.2 years. Blacks were especially disadvantaged; their life expectancy at birth in 1900 was only 33.8 years compared to 49.6 years for whites (Arias 2004). Given their markedly shorter life expectancies, it follows that mortality rates would be higher for blacks than for whites. In their book, *The Fatal Years,* which examined child mortality in the late 19th century U.S., Preston and Haines (1991) found that black children, especially those living in cities, experienced higher mortality than white children. They also find that immigrant children suffered from higher mortality rates than native born whites. Preston and Haines argued that the disadvantage for urban blacks and immigrants stemmed from crowded housing conditions, poor sanitation, poor diet and perhaps limited access to medical attention. In addition to racial/ethnic differences in mortality, Preston and Haines documented an association between socioeconomic variables and mortality. Parental literacy, especially maternal literacy, is a significant predictor of lower mortality for the native born population. And although they did not have a measure of income, Preston and Haines roughly approximated wealth by comparing those living on farms that are owned to those living on farms that were rented. They found that living on an owned farm predicts lower mortality compared to living on a rented farm.

Race/Ethnic Disparities in Health and Mortality

While there have been substantial improvements in mortality and life expectancy in the past century, racial and ethnic disparities have remained. For example, life expectancy at birth rose to 70 years for black men in 2006 and to 77 for black women, compared to 76 and 81 for white men and women, respectively (Xu et. al. 2009). Even after controlling for socio-demographic characteristics, blacks experience higher mortality rates than whites (Elo and Preston 1996; Hummer 1993, 1996; Hummer et. al. 1999; LeClere et. al. 1997; Rogers et. al. 2000). Given this mortality disadvantage for blacks, it should come as no surprise that the health status of blacks in the U.S. is considerably worse than that of whites (Adler and Rehkopf 2008; Hayward et. al. 2000; Hummer 1996; Rogers et. al. 2000). For example, blacks are more likely to report fair or poor health, to be obese, to have hypertension or diabetes (Adler and Rehkopf 2008; Hayward et. al. 2000; Singh and Hiatt 2006). Additionally, compared with whites, blacks are more likely to die as a result of injuries, homicide and HIV/AIDS (Hummer 1996; Williams and Collins 1995).

Not all minority groups face the same disadvantage as blacks. One notable example is that of Hispanic Americans. Despite a socioeconomic profile that is relatively disadvantaged, the infant and adult mortality rates for Hispanics, especially Mexican-origin Hispanics, appear to be more similar to non-Hispanic whites than to blacks (Hummer et. al. 1999; Rogers et. al. 2000; Williams and Collins 1995). After controlling for demographic and social conditions, adult mortality rates for foreign-born Hispanics are similar to or significantly lower than for native-born non-Hispanic whites (LeClere et. al. 1997; Hummer et. al. 1999, Goldman et. al. 2006). For example, among the Mexican-origin population in the United States, Mexican-born mothers have lower infant mortality rates than U.S. born non-Hispanic whites and U.S. born mothers of Mexican decent (Hummer et. al. 2007). This phenomenon, where Hispanics enjoy surprisingly

low mortality rates given their disadvantaged socioeconomic profile, is referred to as the "Epidemiologic Paradox" (Markides and Coreil 1986). Not all Hispanics, however, follow this pattern. Mortality rates for Puerto Rican origin Americans, for example, are significantly higher than for non-Hispanic whites before and after controlling for socioeconomic status (Rogers et. al. 2000). Furthermore, the paradox seems to apply to mortality rates and longevity more consistently than other health measures. Hispanics, for example, are disadvantaged compared to non-Hispanic whites in terms of rates of diabetes, infectious and parasitic diseases. Although they experience a longer life expectancy, recent research indicates Hispanics can expect to enjoy fewer disability-free years (Hayward et. al. 2014). Finally, Hispanics are more likely than non-Hispanic whites to die from tuberculosis, diabetes, liver disease and cirrhosis as well as from homicide (Markides and Coreil 1986; Williams and Collins 1995).

Asian Americans appear to enjoy good health and low mortality compared to all groups, even non-Hispanic whites (Rogers et. al. 2000). Asians, both men and women, have the highest life expectancy and the highest disability-free life expectancy of all ethnic groups in the U.S. (Hayward and Heron 1999). Their infant and adult mortality rates are, on average, lower than the non-Hispanic white population (Williams and Collins 1995). The health advantage for Asians, and for many Hispanic groups, is especially pronounced for the foreign born population (Kimbro et. al. 2008; Singh and Hiatt 2006). Also like Hispanics, Asians have subgroups that differ considerably on many health and mortality measures (Williams and Collins 1995).

Unlike the general trends reported for Hispanics and Asians, the health and mortality of Native Americans appears to follow a pattern similar to that of blacks. That is, the health profile for Native Americans is more in line with their disadvantaged economic standing. For example, compared to other groups, blacks and Native Americans spend the largest percentage of their

adult lives (age 20-65) with disabilities (for men, 15.12% for blacks and 19.34% for Native Americans; for women 14.1% for blacks and 17.15% for Native Americans) (Hayward and Heron 1999). Native Americans have higher alcohol and drug use than other racial groups and they also suffer from high mortality rates (Williams and Collins 1995).

Socioeconomic Health Disparities

Until the 1970s research on health disparities in the U.S. primarily focused on race and ethnicity rather than on socioeconomic differences (Elo 2009 p. 554). Kitagawa and Hauser's 1973 examination of mortality rates was one of the first studies to address socioeconomic disparities in health in the U.S. They found a strong inverse relationship between various measures of socioeconomic status and mortality. The relationship between education and mortality was especially pronounced for working age adults and was stronger for women then for men. For example, the life expectancy for women with some college education was 10 years greater than for women with less than five years of education. Men with some college education lived on average 3.2 years longer than men with less than five years of schooling. They also found an inverse relationship between income and mortality. This relationship was more pronounced for men than for women. Overall, they found that both education and income have independent significant effects on health (Kitagawa and Hauser 1973).

Since the 1970s, a great deal of scholarly attention has been dedicated to studying health disparities in various settings and age groups, using different measures of economic status and multiple measure of health and mortality (Adler et. al. 1994; Adler and Rehkopf 2008; Elo 2009; Mirowsky and Ross 2003). Researchers in the U.S. have demonstrated that several measures of socioeconomic status, including income, occupational status, and education, are positively associated with health. Of these socioeconomic indicators, education appears to be the most

consistent predictor of longevity and better health (Elo 2009, p. 557). Researchers argue that education, compared to income or occupation, is also the preferred measure of socioeconomic status because it is established relatively early in life, remains relatively constant over time, and applies to adults who are not in the labor force (e.g. stay-at-home parents, retirees, etc.). Furthermore, education helps determine one's income and occupational standing (Kimbro et. al. 2008; Ross and Mirowsky 1999; Ross and Wu 1995).

As discussed in the introduction to this chapter, the health-related benefits of education are not identical across race and ethnic groups. In general, research finds a strong and robust association between education and health for whites. Blacks, for the most part, also enjoy positive health-returns to education. However, there is evidence that blacks do not enjoy these health benefits at the same rate (slope) or the same magnitude (intercept) as do whites. Finally, results are decidedly mixed for research that explore the education-health association for Hispanics and Asians. That is, some studies demonstrate a positive association and others do not.

1.3 How Education Improves Health

Education is a powerful predictor of health. However, the mechanisms through which education operates to improve health are complex and not well-understood. In general, scholars agree that education likely improves health via three main pathways: economic, psycho-social, and health-related behaviors.

Economic pathways is an important concrete link between education and health. With education comes higher incomes, a higher likelihood of being employed and safer living and working conditions. All of which are associated with better health. The psychosocial pathways

that link education and health are typically divided into personal control and social support. Education is associated with higher levels of personal control, that is, the belief that one is in control of things happening in their life. Education is also related to higher levels of reported social support. Both personal control and social support are associated with better health. Finally, education is associated with adopting a healthier lifestyle. Some lifestyle factors that are linked with the more highly educated include lower rates of smoking, higher rates of exercise and use of preventative healthcare.

1.4 Data

My dissertation explores the health returns to education by racial/ethnic groups in the United States. I use data from the National Institute of Mental Health Collaborative Psychiatric Epidemiology Surveys (NIMH-CPES or CPES). The CPES combines data from three nationally representative sources, the National Comorbidity Survey Replication (NCS-R), the National Survey of American Life (NSAL), and the National Latino and Asian American Study (NLAAS). The NSAL oversamples African-Americans and black Americans of Caribbean descent. The NLAAS population includes only Latino and Asian-Americans. Combining the three surveys allows researchers to make comparisons across many racial/ethnic groups in the U.S. In addition to collecting a wealth of data on social and demographic characteristics, survey respondents were asked a series of in-depth questions about their physical health and, especially, their mental health. All three surveys were conducted between 2001 and 2003. Using the CPES allows me to have enough cases to examine the racial/ethnic differences in health returns to education at the national-origin race/ethnicity group rather than rely on pan-ethnic groupings. I

am also able to explore how the mechanisms via which education improves health operate and to determine if there is variation across racial/ethnic groups.

1.5 Overview

The three empirical chapters that follow are the core of this dissertation. Each chapter focuses on a particular question related to the education-health gradient across racial/ethnic groups in the United States. I use self-rated physical health as my dependent variable in the analyses. I distinguish good, very good or excellent health (self-rated health = 1) from poor or fair health (self-rated health = 0). Table 1.1 provides average rates of reporting good/excellent self-rated health by race/ethnicity in my sample. For each group, the majority report good, very good or excellent health. The group least likely to report good health in my sample is Mexicans. However, more than two-thirds of Mexicans (68%) report good health. Filipinos fall on the other end of the spectrum from Mexicans, with nearly 9 out of 10 (89%) reporting good health.

In Chapter 2, I analyze the health returns to education at two levels of specificity. I start by conducting analyses stratified by the four major U.S. race/ethnic groups: Non-Hispanic Whites, Non-Hispanic Blacks, Hispanics and Asians. Using logistic regression, I estimate models predicting self-rated health, focusing on how race/ethnicity interacts with education. I find that all four racial/ethnic groups exhibit a positive relationship between education and self-rated. Next, I conduct the same analyses, but break down the pan ethnic racial/ethnic groupings into more specific national origin groups. With these newly defined nine groups, I find some interesting differences across groups that were masked by the pan-ethnic groupings.

In Chapter 3, my analysis focuses on the mechanisms linking education and health. Using structural equation modeling, I investigate the pathways between education and self-rated

health for whites, African-Americans and Afro-Caribbeans. I find that education improves self-rated health via several pathways. Increased income and an enhanced sense of personal control are two key mediating variables, for example. Healthy behavior is also a key mechanism linking education and self-rated health. I find no evidence that social support is an intervening mechanism between education and self-rated health for any group. Although the magnitude of the effect varies across groups, I find that the mechanisms linking education and health are the same for all three race/ethnic groups.

The analysis in Chapter 4 revisits the nine racial/ethnic national-origin groups to further investigate health risk factors. Utilizing logistic regression, I estimate the effect of education on self-rated health before and after inclusion of two key health risk factors: obesity and smoking. I find that the addition of these risk factor does not lessen the effect of education on self-rated health for any of the nine racial/ethnic groups. Because the inclusion of smoking and obesity does not significantly alter the effect of education on self-rated health for any of these groups, I do not find that there are racial/ethnic differences in the role that health risk factors play in influencing that relationship. However, interesting and notable differences across racial/ethnic groups are explored and discussed in Chapter 4, and provide some potential insight into future work.

I provide a brief conclusion to the dissertation in Chapter 5. In this chapter, I summarize the findings and discuss the limitations of my research. I also ground my work within the large existing body of research and outline its significance to the ever growing field of health disparities.

Table 1.1: Mean levels of self-rated health by race/ethnic groups and subgroups

	Mean	Standard Deviation	N
White	**.80**	**.40**	**1761**
Black	**.80**	**.40**	**4965**
African American	.78	.41	3588
Afro-Caribbean	.84	.37	1378
Hispanic	**.73**	**.44**	**2808**
Mexican	.68	.47	916
Puerto Rican	.71	.45	494
Cuban	.76	.43	576
Asian	**.83**	**.37**	**2105**
Vietnamese	.77	.42	519
Filipino	.89	.32	507
Chinese	.78	.42	598

Note: The N for Hispanic and Asian is greater than the sum of the Ns of their subgroups. In addition to Mexicans, Puerto Ricans and Cubans, the Hispanic Category includes “Other Hispanics”. This group is not included in the more detailed national origin analysis. Similarly, the Asian category includes “Other Asians.”.

CHAPTER 2: Race, Ethnicity, and the Relationship between Education and Health

2.1 Introduction

Despite dramatic decreases in mortality and improvements in health and life expectancy in the industrialized world over the past one-hundred years, sizable disparities in health across groups remain. Health disparities by race/ethnicity, nativity, socioeconomic status, gender and marital status have all been documented (Adler and Rehkopf 2008; Elo 2009; LeClere et. al. 1997; Rogers 1995; Rogers et. al. 2000). Not surprisingly, a great deal of scholarly attention has been paid to health disparities, particularly those related to socioeconomic status and/or race and ethnicity. Recently, research has begun to reflect that socioeconomic and racial disparities in health are inherently connected. A handful of studies have explored the interactions between race/ethnicity and socioeconomic status on health and mortality finding differential health returns to education for various race/ethnic groups (Borrell et. al. 2006; Chen et. al. 2006; Farmer and Ferraro 2005; Gilman et. al. 2008; and Kimbro et. al. 2008).

In this chapter, I explore group differences in the health returns to education in the United States. I investigate the relationship between education and health for various race/ethnic groups at two levels of specificity.

2.2 Background

Socioeconomic differences in health are well established (Adler et. al. 1994, Adler and Rehkopf 2008; Elo 2009; Kitagawa and Hauser 1973; Mirowsky and Ross 2003). Despite a good deal of concern as well as public and scholarly attention, research shows that health disparities have increased in recent years (Goesling 2007, Liu and Hummer 2008, Williams and

Collins 1995). Although income, wealth, occupational status and education all are important factors in improving health, education is thought to be the key socioeconomic variable at play (Elo 2009; Hammond 2003; Mirowsky and Ross 2003; Ross and Mirowsky 2010; Ross and Wu 1995). This is primarily because education influences many other potential socioeconomic variables.

A large body of research is devoted to the examination of health disparities. Until recently, this research tended to follow one of two patterns. Researchers studied either (a) racial/ethnic disparities in health while controlling for socioeconomic status or (b) socioeconomic disparities in health while controlling for race/ethnicity. Of course, racial/ethnic and socioeconomic differences do not operate separately from one another. Race and ethnicity, in fact, are highly correlated with socioeconomic standing. And, some interesting relationships between race/ethnicity and health/mortality have been reported. For example, socioeconomic conditions, in particular education, accounts for a large proportion of the black-white differences in health. Some research suggests that socioeconomic status is a better predictor of health than is health-related behaviors for blacks (Hayward et. al. 2000).

Early research revealed racial disparities in mortality and health varied by socioeconomic status (Hummer 1993). The majority of these observations within the U.S. have focused on white-black differences. Some studies report that racial differences are smaller at lower levels of education. (For example, Hummer (1993) finds that while overall infant mortality rates are significantly higher for blacks compared to whites, for those with little education, racial differences are quite small.) In other words, at low levels of education, the black-white difference in infant mortality is smaller than at higher levels of education. As education increases, infant mortality rates for blacks and whites diverge such that blacks are

particularly disadvantaged compared with whites. Other research points to a double penalty paid by racial minorities who are less educated. For example, Crimmins and Saito (2001) find that the differences in healthy life expectancy between blacks and whites are greatest at the lower levels of education. That is, blacks with little education suffer both because they are black *and* because they are uneducated.

More recently, research has begun to examine directly how the positive effect of education on health varies by race and ethnicity. Results from these studies have been mixed depending on the populations studied and the health outcomes considered. In one of the first studies to investigate explicitly the relationship between race and socioeconomic status on health, Farmer and Ferraro (2005) find that black adults do not enjoy the same health benefits that accompany higher income and occupational prestige as those enjoyed by whites. In fact, while they find the expected relationship between education and self-rated health for whites, they find no significant relationship between education and self-rated health for blacks (Farmer and Ferraro 2005). Similarly, Borrell and colleagues (2006) find that the likelihood of being diagnosed with diabetes is significantly higher for those with low compared to high levels of education for whites, but not for blacks. Other research supports the education-health gradient for both blacks and whites. Recent studies found that parental education was a significant predictor of several child health outcomes for both blacks and whites (Chen et. al. 2006). Additionally, the education-health gradient appears to hold true for alcohol dependence for both blacks and whites (Gilman et. al. 2008).

The Hispanic population, often the third racial/ethnic group considered in U.S. studies, appears to follow a different pattern. Although Hispanics, on average, are more similar to blacks than to whites in terms of their socioeconomic standing, their health and mortality is more

similar to whites than to blacks. This phenomenon, coined the "Epidemiologic Paradox," by Markides and Coreil (1986), refers primarily to the health and mortality of the Mexican-origin population in the United States. In the handful of studies explicitly exploring the education-health gradient across racial/ethnic groups that include Hispanics, results have been mixed. Although Chen and colleagues (2006) report that parental health is a significant predictor of child health for blacks and whites, they do not find the same holds true for Hispanics. Similarly, Gilman and colleagues (2008) do not find that education predicts alcohol dependence for Hispanics. However, in their study examining diabetes, Borrell and colleagues (2006) report a significant interaction between education and being Hispanic. Compared to those at the highest levels of education, Hispanics with the lowest levels of education are most likely to have a diabetes diagnosis (Borrell et. al. 2006).

Few studies examining the racial/ethnic differences in the relationship between socioeconomic status and health in the United States include Asians. In the handful of studies that do, the results are mixed. Overall, findings suggest the relationship between education and health is less pronounced for Asians compared to whites. This is especially true for foreign-born Asians. In their 2006 study, Chen and colleagues find that parental education is not predictive of child health for Asians. On the other hand, Kimbro and colleagues (2008) find some evidence of an education-health gradient for Asians for several health outcomes. However, the association is consistently weaker (or the gradient is flatter) for foreign-born Asians compared to all U.S. born groups, including U.S. born Asians. The one clear exception is the difference in the odds of smoking between high school and college graduates. Although the difference in the odds of smoking between Asian high school graduates and Asian college graduates is still larger for U.S.-born compared to foreign-born, overall, the gradient for foreign-born Asians is similar to

the differences reported for other U.S.-born groups and larger than foreign-born Hispanics and blacks (Kimbro et. al. 2008). A study that exclusively evaluates the education-health relationship among Asians confirms that the relationship between education and health is not statistically significant after the introduction of certain controls, most notably, English proficiency (Walton et. al. 2009). Additionally, the authors report that foreign place of education rather than foreign-born status drives the weakened relationship between education and health in foreign-born Asians (Walton et. al. 2009).

This chapter builds on the current literature by examining the relationship between education and health for the four major race/ethnic groups in the U.S. Moreover, the data used enable the differentiation of the four major race/ethnic groups (whites, blacks, Hispanics and Asians) into more appropriate categories, namely national-origin groups. This allows for a more detailed analysis of the relationship between education and health for racial/ethnic minorities in the U.S.

2.3 Data and Method

Data

Data for this chapter come from the National Institute of Mental Health Collaborative Psychiatric Epidemiology Surveys (NIMH-CPES or CPES). The CPES combines data from three nationally representative sources, the National Comorbidity Survey Replication (NCS-R), the National Survey of American Life (NSAL), and the National Latino and Asian American Study (NLAAS). The NSAL over samples African-Americans and black Americans of Caribbean descent and the NLAAS population includes only Latino and Asian-Americans.

Combining the three surveys allows researchers to make comparisons across many racial/ethnic groups in the U.S. In addition to collecting a wealth of data on social and demographic characteristics, survey respondents were asked a series of in-depth questions about their physical health and, especially, their mental health. All three surveys were conducted between 2001 and 2003.

Dependent Variable. Self-rated physical health is the dependent variable used in the analysis. Self-rated health (SRH) is a commonly used health indicator and is a robust predictor of mortality, even in multiethnic populations (Idler and Benyamini 1997; McGee et. al. 1999; Schnittker and Bacak 2014). Survey respondents were asked to describe their overall physical health as excellent, very good, good, fair or poor. For the bulk of the analysis, self-rated health is collapsed into a dichotomous variable that distinguishes fair or poor health (SRH=0) from excellent, very good or good health (SRH=1). Transformation of self-rated health into a dichotomized version is common. Collapsing self-rated health into a dichotomous variable yields similar results to maintaining the ordinal nature of the variable with only a small reduction in the statistical power (Manor et. al. 2000). This analysis follows this convention to be consistent with similar research and to simplify the presentation of findings.[1]

Independent Variables. Education is the key independent variable. Highest year of educational attainment is divided into four categories: less than high school, high school graduate, more than high school, and college graduate. Race/ethnicity is measured at two levels of specificity in this analysis. First, in line with the majority of research examining racial/ethnic differences, respondents are grouped into four categories: non-Hispanic White, non-Hispanic Black, Hispanic and non-Hispanic Asian. Second, respondents are divided into nine more

[1] Descriptive statistics presented in Figure 2.1 and in Table 2.A1 in the appendix provide a more detailed look at the distribution of self-rated health as an ordinal measure across the race/ethnic groups in the analysis.

specific racial/ethnic subgroups. The subgroups are: non-Hispanic White, African-American, Afro-Caribbean, Mexican, Puerto Rican, Cuban, Vietnamese, Filipino, and Chinese. Both levels of specificity are used for conducting analysis and reporting findings.

In addition to the key independent variables mentioned above, several control variables are included in the analyses to prevent drawing conclusions based on compositional differences among the groups. Both age and age-squared are included in the analysis. Including this functional form of age captures the possible nonlinear function of age on health. Additionally, dichotomous variables reflecting the respondents marital status (married or cohabitating versus never married or formally married), nativity (US versus foreign born) and sex are all included. Finally, a continuous measure of income rounds out the list of independent variables. Income is another consistent socioeconomic predictor of health and inclusion is necessary to help clarify the role of education net of income differentials.

Method

The analysis in this chapter is divided into two sections. To begin, the bivariate relationship between education and health is presented separately by race/ethnicity. This descriptive piece provides the framework for the multivariate analysis to follow. The bivariate analysis details the health returns to education for the four pan-ethnic groups and additionally for the national origin sub-groups. The bivariate analysis offers a glimpse into the education-health relationship under investigation.

In the second part of the analysis, the core of the investigation, results from the multivariate analysis are presented. This section takes into account the role that key socio-demographic variables play in explaining educational differences in health. In this chapter,

controls for income, age, marital status, birthplace and sex are included in the analysis. Each of these variables are theorized to be related to health and also education. Including each of them in the analysis helps provide a more accurate picture of the role that education plays in improving health. That is, the results reveal the effect of education on health, net of these other factors. I use Stata/MP 13.1 to estimate logistic regression models predicting self-rated health separately by race/ethnicity group[2] (StataCorp 2013). Using the same methods, models are estimated for the four pan-ethnic race/ethnicity groups and then for the eight more detailed national origin race/ethnic groups.

2. 4 Findings

2.4.1 Descriptive Statistics and Bivariate Relationships

The bivariate relationship between education and health by race/ethnicity is displayed in the four panels of Figure 2.1.[3] The x-axis for each panel represents the four educational categories utilized in the analysis: less than high school, high school graduate, some college and college graduate or higher. Scores on the 5-point self-rated health scale are represented on the y-axis. The scale starts at 1 for poor health and ranges up to 5 for excellent health. The average scores on self-rated health range from around 1.8 to almost 3 across the panels. Therefore, the scale is truncated to display the information more clearly. Panel A describes the relationship between education and health for the four main racial/ethnic groups. Panels B, C and D describe the relationship between education and health by race/ethnic subgroups.

[2] All models include a sampling weight provided by CPES and utilizes robust standard errors.
[3] Table 2.A1 in the appendix further describes the information presented in Figure 2.1.

Panel A shows the bivariate relationship between education and health for whites, blacks, Hispanics and Asians by displaying the health means for each educational category. In the absence of any social or economic controls, each of the four groups enjoys a positive health return to additional schooling. The average self-rated health for whites who do not complete high school is 1.92 compared to 2.71 for college graduates. The average self-rated health score rises from 2.13 for blacks with less than a high school degree to 2.65 for black college graduates. The same pattern holds for Hispanics and Asians who also exhibit beneficial health returns to education in this bivariate description. The average self-rated health score for Hispanics who did not finish high school is 2 and for Hispanic college graduates it is 2.64. Asians with no high school degree report an average self-rated health score of 2.19 compared to 2.63 for college graduates. In addition to a sizable increase in health between the lowest and the highest education categories, each group displayed in Panel A enjoys modest improvements in health scores for each educational category increase. For whites, blacks and Hispanics, health returns are greatest for high school graduates compared to those with no high school diploma. The health returns to education for a college degree compared to a high school degree is also high (there is a considerable change in health) for Whites and Hispanics. For blacks, the health returns beyond a high school diploma are clear, but less marked than is seen for whites and Hispanics. The trend for Asians is also positive but less pronounced. That is, although increased education improves average self-rated health scores, the health returns are minimal which can be seen by the comparatively flatter slope. However, Asians with less than a high school degree have higher average self-rated health compared to the other groups. So, although Asians experience lower returns to education, their average levels of health at higher education levels are comparable to the other three groups.

Panel B describes the bivariate relationship between education and self-rated health for blacks. Blacks in this sample are divided into two groups: African Americans (n=3588) and Afro-Caribbeans (n=1378). As evident from this figure, the relationship between education and self-rated health differs quite a bit between these two. In general, African Americans enjoy a modest health return to increased education at each level of education. Afro-Caribbeans enjoy a sizable increase in self-rated health if they graduate from high school, however, a college degree is associated with lower self-rated health. This finding is puzzling, to say the least. Nonetheless, this panel indicates that disaggregating African Americans from Afro-Caribbeans for analysis may be necessary to truly understanding the health returns to education for each group.

Panel C explores the bivariate relationship between education and health for three Hispanic subgroups: Mexcians (n= 916), Puerto Ricans (n= 494) and Cubans (n=576). All three groups enjoy sizable health returns to education (i.e., steep slopes) for graduating from high school, compared to not finishing high school. This steep slope continues for Puerto Ricans, who enjoy incremental improvements in self-rated health for each education step. For Mexicans and Cubans, additional schooling beyond high school that does not culminate in a college degree does not significantly improve health. Completing college is associated with better health for all groups, especially Puerto Ricans and Cubans. For Mexicans, attaining a college degree provides only a slight increase to self-rated health. Again, the disaggregation of Hispanic into sub-groups reveals intragroup heterogeneity that is meaningful.

Finally, Panel D examines the bivariate relationship between education and health for Asians. Again, exploring subgroups reveals substantive intra-group heterogeneity. Chinese have lower reported health at the low and high ends of education but their health returns to education is relatively constant. A high school diploma improves health for Filipinos, but education

beyond that improves health only minimally. However, Filipinos at all levels of education have higher average health scores than Vietnamese and Chinese. The slope for Vietnamese is rather flat at low levels of education. That is, a high school degree does not appear to be associated with better self-rated health compared to those with no high school degree. However, graduating from college markedly improves the self rated health of Vietnamese.

Although merely descriptive, the information gleaned from Figure 2.1 points to the necessity to move beyond pan-ethnic race or ethnicity categories, at least as it relates to education and health. Panel A describes a generally similar relationship between education and self-rated health that is positive for each of the four major race/ethnic groups in the U.S. When racial/ethnic subgroups are considered, as seen in panels B through D, differences within the groups emerge. Given this information, it would be difficult to proceed with analyses of pan-ethnic groups without consideration for subgroup membership.

2.4.2 Multivariate Relationships

The bivariate analysis reported above provides a framework as we move into the full multivariate analysis. In the multivariate analysis, the effect of education on health is considered while controlling for socio-demographic differences. The results from the multivariate analyses are broken into two sections. First, an examination of the four racial/ethnic groups is presented. Next, a more detailed analysis is offered that breaks the non-white sample into eight different race/ethnic subgroups.

Pan-ethnic Race/ethnic Groups

To investigate the health returns to education in the U.S, logistic regression models are estimated to predict good health for each race/ethnic group separately. The results from the multivariate logistic regression models are presented as predicted probabilities in Figure 2.2.[4] For each of the four education categories a point estimate is represented by a dot, and the 95% confidence interval for the point estimate is represented with bars. Panel A describes the relationship between education level and health for whites. A clear upward trend is visible. Whites with higher educational attainment enjoy a greater likelihood of rating their health as good compared to those with less education. Whites who did not graduate from high school are the least likely to report good health. The probability of reporting good health is .67 for those who did not graduate from high school. The probability of reporting good health jumps to .79 for high school graduates. This is a statistically significant difference (t=2.91). There is also a significant increase in the likelihood of reporting good health for college graduates compared to high school graduates (.91 versus .79, t=4.19) and compared to those with some education beyond high school(.91 versus .82, t=3.20). While the probability of reporting good health for those with some education beyond high school (.82) falls in-between the probabilities for high school graduates and college graduates, there is no significant difference between the likelihood of reporting good health for high school graduates and those with some education beyond high school. That is, education beyond high school that does not culminate in a college degree does not significantly improve health for whites.

[4] For ease of interpreting results, I convert the log-odds from the logistic regression output into a predicted probability for the four education groups under investigation. To do this, I need to multiply the coefficients for my control variables by their mean value and get their sum. Additionally, I add the value of the coefficient for the intercept. To differentiate across education levels, I use the summed values from the coefficients times their means plus the intercept and for each education level, I add the appropriate coefficient value. (My reference group is high school graduates. No additional coefficient needs to be added for this group). This creates four numbers, one for each education level. The sum for each education level represents the log odds of reporting good health for that education level. I convert the log odds into the odds for each of my four educational categories. Finally, I convert the odds into a probability.

Panel B of Figure 2.2 describes the relationship between education and self-rated health for blacks. The probability of reporting good health for blacks with no high school degree or equivalency is .76. Graduating from high school significantly improves the probability of reporting good health for blacks to .83 (t=3.99). Blacks who obtain some education beyond high school enjoy a modest, yet significant, increase in the probability of reporting good health (predicted probability increases to .85, t=2.29). Despite a slight increase, blacks who complete college, do not significantly improve their likelihood of reporting good health compared to those who have any education beyond high school (.88 versus .85, t=1.46). However, college graduation is consistent with a significant increase in reported health compared to those with no schooling after graduating from high school (.88 versus .83, t=3.14).

Predicted probabilities of reporting good health for Hispanics are displayed in Panel C of Figure 2.2. Again, a general positive relationship is apparent. With each jump in education category, the probability of reporting good health rises. For Hispanics non-high school graduates, the point estimate of the probability of reporting good health is .64. Hispanics who graduate from high school are significantly more likely to report good health compared to those who did not (.75 versus .64, t=3.69). Some education beyond high school increases self-rated health for Hispanics to .82. This increase in predicted probabilities for high school graduates versus those whose education continues after high school is statistically significant (t=2.14). Moreover, graduating from college compared to graduating from high school greatly increases the probability of reporting good self-rated health for Hispanics to .85 (t=2.48). There is no significant difference between the self-rated health of those with some education beyond high school (.82) and those with a college degree (.85) for Hispanics (t=.95).

The fourth group, Asians, also have predicted probabilities of good health that increase for each education group, although not always significantly. Panel D of Figure 2.2 describes the relationship between education and health for Asians. Asians with who have not completed high school enjoy a relatively high likelihood of reporting good health, .80. Asians with a high school degree increase their probability of reporting good health to .83, which is not a significant improvement over the lowest education category (t=.88). The addition of some schooling beyond a high school diploma or equivalency again increases the probability of reporting good health for Asians to .87. The difference in the probability of reporting good health between those who have some education beyond high school and those whose education ends at high school is not significant. However, Asians with some education beyond high school enjoy significantly higher probabilities of good self-rated health compared with Asians who did not graduate from high school (t=2.28). The slight increase in the probability of reporting good health that accompanies a college degree for Asians (.89) is not a significant improvement compared to those with education beyond high school, but it does represent a significant health advantage when compared to both Asians who did not graduate from high school (t=3.39) and those whose highest level of educational attainment was completing high school (t=2.39).

In general, the results indicate a positive relationship between higher levels of education and better self-rated health for each of the four groups. This positive relationship is often, but not always, significant. In particular, I find relatively minor improvements in self-rated health for those who attain some education beyond high school, but do not complete college, compared with those with no schooling after high school. The difference in the predicted probability of reporting good health between those with a high school degree and those with some education beyond high school is statistically significant only for Hispanics (Figure 2.2 Panel C). For

whites and blacks, especially, it appears those who achieve some education beyond high school are a similar group to high school graduates. For Hispanics, some education beyond high school provides a modest bump in self-rated health. In fact, for Hispanics and Asians, the increased probability between these two education categories is greater than is the difference in the probability of reporting good health between some education beyond high school and college graduates. However, the difference is not great enough to reach statistical significance. Instead, the main difference for all four racial/ethnic groups appears to be the significant and substantial health difference between graduating from high school and graduating from college with those with some education beyond high school falling, predictably, somewhere in-between.

The achievement of graduating from high school significantly improves the likelihood of reporting good health for whites, blacks and Hispanics, but not Asians. However, the predicted probability of reporting good health for Asians with no high school degree or equivalency is relatively high compared to the other three race/ethnic groups. Rather than stating that a high school diploma does not improve the health of Asians, compared to those with no high school diploma, it may be more accurate to state that not graduating from high school does not appear to disadvantage health for Asians in this sample.

In summary, Figure 2.2 confirms, consistent with the educational gradient in health, that whites, blacks, Hispanics and Asians enjoy improved self-rated health as education increases. For all four groups, the achievement of a college degree is associated with significantly improved health compared to high school graduates and those who did not complete high school. In the following section, we will further divide the four pan-ethnic groups into more detailed national-origin race/ethnicity groups as was done in panels B, C and D of Figure 2.1.[5]

[5] In supplementary analysis that considers education as a continuous variable, the coefficient for education is positive and significant for each of the four pan-ethnic race/ethnic groups. However, the magnitude of the

More Groups

The results discussed above generally point to a positive relationship between education and self-rated health for each race/ethnic group. For example, compared to high school graduates, college graduates in each of the four groups enjoyed significantly higher self-rated health. However, these four race/ethnic groupings are not homogenous. For example, the Hispanic group consists of Mexicans, Puerto Ricans and Cubans. In this section, I describe the health returns to education for Hispanic and Asian subgroups as well as two groups of blacks. Non-Hispanic whites in the sample are not broken into any subgroups. Therefore, they will not be discussed in this section as their results are unchanged.

Health returns for blacks in general as reported in the previous section are positive, indicating that additional schooling, especially schooling that results in a high school or college degree significantly improves self-reported health for blacks. Figure 2.3 reveals a very different relationship between education and self-rated health for African Americans (the blue line) compared to blacks of Caribbean descent (the red line). The pattern observed in this figure is remarkably similar in shape to the bivariate relationship presented in Panel B of Figure 2.1. African Americans enjoy a steady increase in predicted self-rated health scores for each education milestone (including some education beyond high school without completing college). This upward trending slope is anticipated as a good deal of research points to the positive relationship between education and self-rated health. Compared to those who do not complete high school, African-American high school graduates are significantly more likely to report good

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coefficients varies froma low of .25 for Asians to a high of .48 for whites. In tests for differences across groups, I find that the effect of education on health is significantly greater for whites compared to blacks, Hispanics and Asians. Although blacks enjoy a significantly smaller health returns to education compared to whites, the effect of education on health for blacks is significantly larger than both Hispanics and Asians.

health (predicted probability of .82 versus .76, t=3.44). The predicted probability of reporting good health is also significantly better for African American college graduates compared to their counterparts whose schooling ended at high school graduation (.88 versus .82, t=2.53). The relationship between education and self-rated health for African Americans is consistent with the positive gradient reported in the literature.[6]

Similar to the findings reported from the bivariate analysis (red line in Figure 2.1, Panel B), the relationship between education and self-rated health for Afro-Caribbeans is complex. Results from the multivariate logistic regression transformed into predicted probabilities are represented in Figure 2.3 with the red line. To begin, Afro-Caribeans with no high school diploma are less likely to report good health than Afro-Caribbeans with more education. In fact, obtaining a high school degree improves self-rated health considerably. The predicted probability of reporting good health for Afro-Caribbeans with a high school degree versus not having a high school degree jumps to .90 from .72. (t=3.33). However, education beyond a high school diploma is not associated with any increase in health. In fact, Afro-Caribbeans who complete college are less likely to report good health than high school graduates (predicted probability of .83 versus .90, not significant (t=1.61)).

Figure 2.4 details the health returns to education for Hispanics. All three Hispanic groups exhibit a positive relationship between education and health. However, Mexicans enjoy a less steep health return to education beyond high school than do Cubans and, especially, Puerto Ricans. For each of the three groups, the predicted probability of reporting good health for those who did not complete high school is lower than their counterparts with more education. For Mexicans and Puerto Ricans, the probability of reporting good health for respondents with less

[6] Table 2.A2 in the Appendix provides the point estimates and the 95% confidence intervals around the predicted probabilities reported in Figures 2.3, 2.4 and 2.5.

than a high school degree is similar (.63 for Mexicans and .65 for Puerto Ricans). Both groups enjoy better self-rated health with additional schooling. Obtaining a high school education is meaningful for Mexicans and significantly improves self-rated health (.63 to .75, t=2.65). For Puerto Ricans, the increase in predicted probability of good self-rated health associated with a high school degree is more modest (.65 to .72, t=1.09) and not statistically significant. Additional schooling beyond high school is not associated with improved self-rated health for Mexicans. However, Puerto Ricans who complete college enjoy a significant boost in their self-rated health (predicted probability of .92). This is a significant difference in the probability of reporting good heath for Puerto Ricans with only a high school education (t=2.95). At the lowest levels of education, Mexicans and Puerto Ricans are very similar in their probability of reporting good health (.63 and .65 respectively), there is quite a health discrepancy between these two Hispanic groups in the highest educational category, college educated (.79 for Mexicans and .92 for Puerto Ricans). While both groups enjoy a significant improvement in health as education increases, the gains for Puerto Ricans are much more striking than they are for Mexican.

Hispanics of Cuban descent also enjoy health benefits to education. At the lowest levels of education, the probability of reporting good health for Cubans is higher than the other two Hispanic groups (.74). Completing high school is associated with a significant increase in self-rated health (probability of reporting good health jumps to .85, t=1.95). Although there is a dip for Cubans who have some education beyond high school (.80), the difference between high school graduates and additional schooling beyond high school is not significant (t=.98). The probability of reporting good health jumps back up for Cubans who complete college to .92. However, the difference in health between high school graduates and college graduates is not significant (t= 1.52). The advantage that Cubans enjoyed over Puerto Ricans at the lowest levels

of education disappear at the highest levels of education, when their predicted probability of reporting good health is equal.

The three Asian-ancestry groups that comprise Asians in this analysis are Vietnamese, Filipinos and Chinese. The general trend detailed in Panel D of Figure 2.1, was improved self-rated health associated with increases in education for all three Asian groups. Figure 2.5 better evaluates differences among the Asian subgroups by controlling for various socio-demographic characteristics. Vietnamese, as depicted by the blue line in Figure 2.5, enjoy no improved self-rated health as education increases. However, the likelihood of reporting good health for Vietnamese with no high school degree, .83, is quite high compared to the other Asian subgroups. Although the line slopes downward as education increases through high school and beyond high school, the relationship is not significant. The slight upward bump in the predicted probability of good health between more than high school and college education for Vietnamese is not significant (t=.27). Overall, there is no apparent relationship between education and health for Vietnamese.

The red line in Figure 2.5 depicts the relationship between education and health for Filipinos. As is evident by the steep jump between those with no high school degree and those with a high school degree, earning a high school diploma improves the self-rated health of Filipinos (t= 1.77). The probability of reporting good health for Filipinos without a high school diploma is .79 compared to .91 for those who completed high school. However, additional schooling beyond high school has no sizable or significant effect on health for Filipinos.

Chinese, represented by the green line in Figure 2.5, enjoy a steady increase in self-rated health as education increases. The predicted probability of reporting good health for Chinese with no high school degree is .73. Predicted probability of reporting good health increases to .78

for those who complete high school and to .82 for those with some education beyond high school. Finally, the predicted probability of reporting good health for Chinese with a college degree is .85. The line for Chinese is virtually identical to the line for all Asians (not shown) which is significant. However, the smaller sample size for the Chinese subgroup compared to the Asian pan-ethnic group results in mostly non-significant findings. The one exception is the difference between the lowest education group and the highest (less than high school versus college) is significant at the .05 level (.73 versus .85, t=1.97). Nonetheless, the positive trend is apparent.[7]

Each of the three Asian groups examined in Figure 2.5 exhibit very different patterns from the others. Chinese present the traditional and expected positive (but in this case, not significant) relationship between education and self-rated health. Vietnamese have good overall health. At the lowest point, those with some education beyond high school, the predicted probability of good health is still .75. However, they do not enjoy any health advantage to increased education. Finally, Filipinos enjoy sizable health returns to education for obtaining a high school diploma but no improved self-rated health from advanced education beyond high school. Clearly, the three Asian groups display different health returns to education from one other. When we grouped all of the Asians in one pan-ethnic group as was done in Panel D of Figure 2.2, there was no way to know that the relationship between education and self-rated health operated so very differently between these three subgroups. Supplementary analysis that is not shown uses a continuous education variable to test for differences in the effect of education on health for the three groups. Both Chinese and Filipinos enjoy a modest and significant slope between education and self-rated health. The relationship for Vietnamese is not significant.

[7] In supplementary analysis not shown here, education is treated as a continuous variable. The coefficient for education for Chinese is significant and positive (t=1.96).

2.5 Conclusion

Scholars argue that education is a key to reducing race/ethnic health disparities. From a policy perspective, this is an attractive proposition. Increase education levels for racial and ethnic minorities and health gaps will begin to narrow. This chapter, however, illustrates that not all groups enjoy health benefits with increased education. While education may be important for improving health for some, and could very possibly lead to healthier behaviors and higher quality medical care, it may not be *the* solution to health disparities. Education, does, however, improve health for many and should likely be pushed as a policy initiative to reduce disparities and improve health across the board.

The analysis above illustrates that using broad pan-ethnic categories masks the clear heterogeneity within these groups. By separating pan-ethnic groups into smaller, national-origin groups, patterns of differential returns to education emerge. While data are not always available at this level of specificity and small sample sizes can inhibit identifying different sub-groups in analysis, an effort should be made to avoid large pan-ethnic groups when possible. At the very least, heterogeneity within these groups should be acknowledged.

2.6 Summary

The positive relationship between education and health is well established. This chapter explored racial/ethnic differences in the health returns to education for various race/ethnic groups, at two levels of specificity, in the United States. Each of four major groups, Whites, Blacks, Hispanics and Asians, exhibit a positive and significant relationship between education and self-rated health. However, the national-origin subgroups that comprise these four larger

groups do not enjoy equal health returns to education. That is, the education-health gradient that is confirmed at the pan-ethnic level does not accurately represent the association between education and self-rated health for national-origin subgroups.

In the chapter that follows, I delve into the mechanisms that link education and health, using a structural equations modeling approach. In particular, I examine the role that a strong sense of personal control, higher levels of social support and the engagement in healthy behaviors plays in improving self-rated health. Models are run separately by racial/ethnic groups and differences across groups are explored.

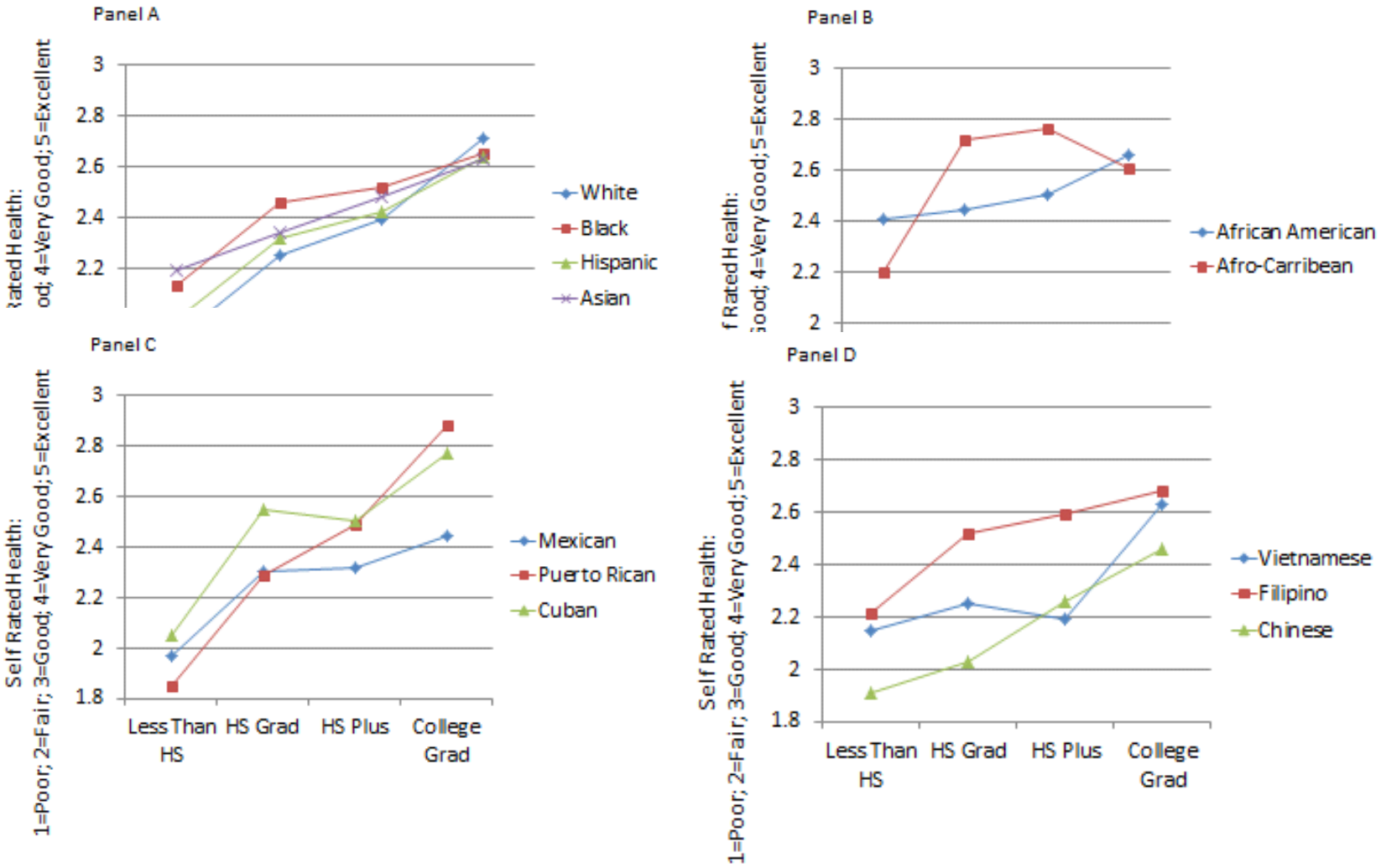


Figure 2.1. Bivariate relationship between education and health by Racial/Ethnic Groups

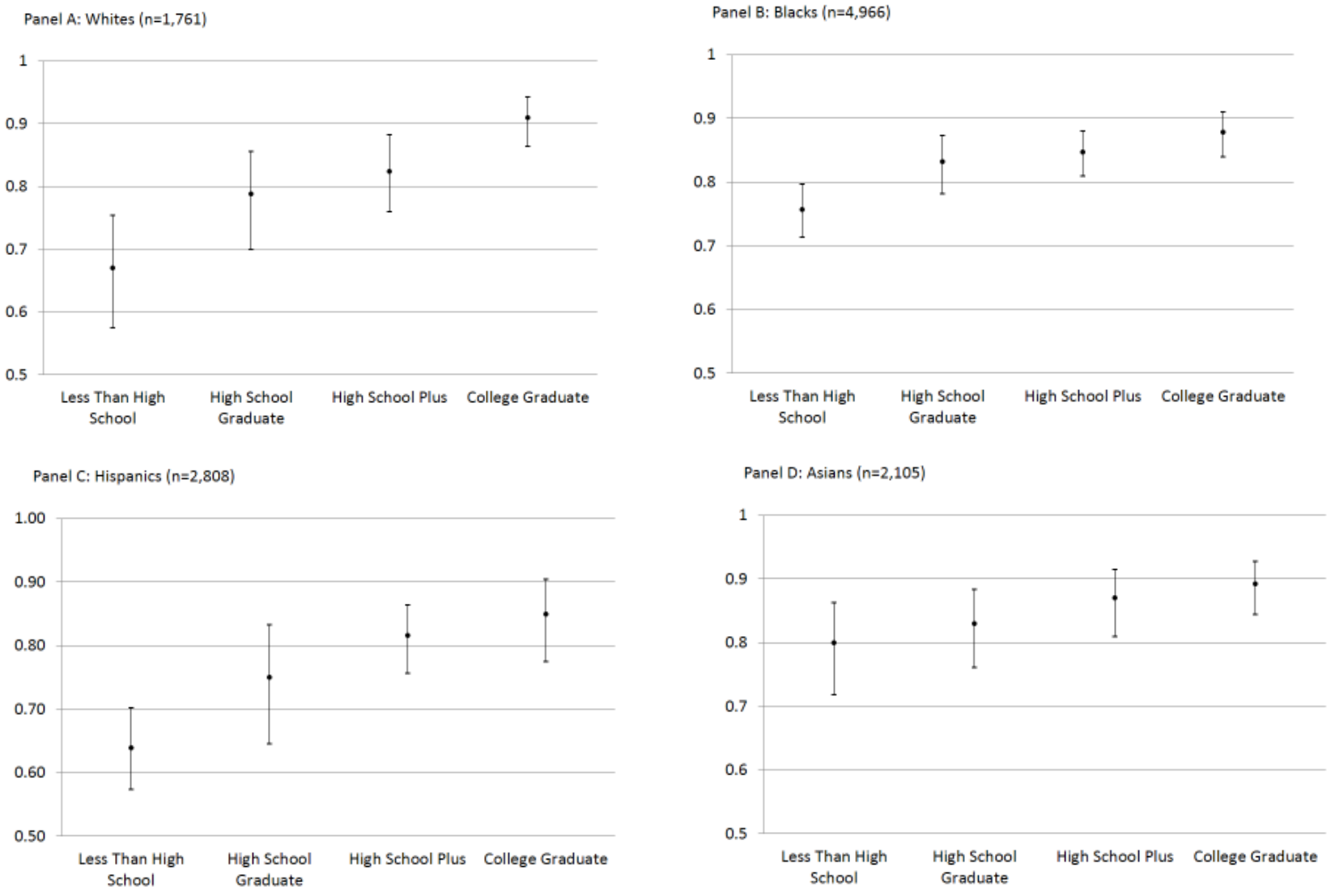


Figure 2.2: Predicted Probabilities of Reporting Good Health by Education Attainment, with 95% confidence intervals.

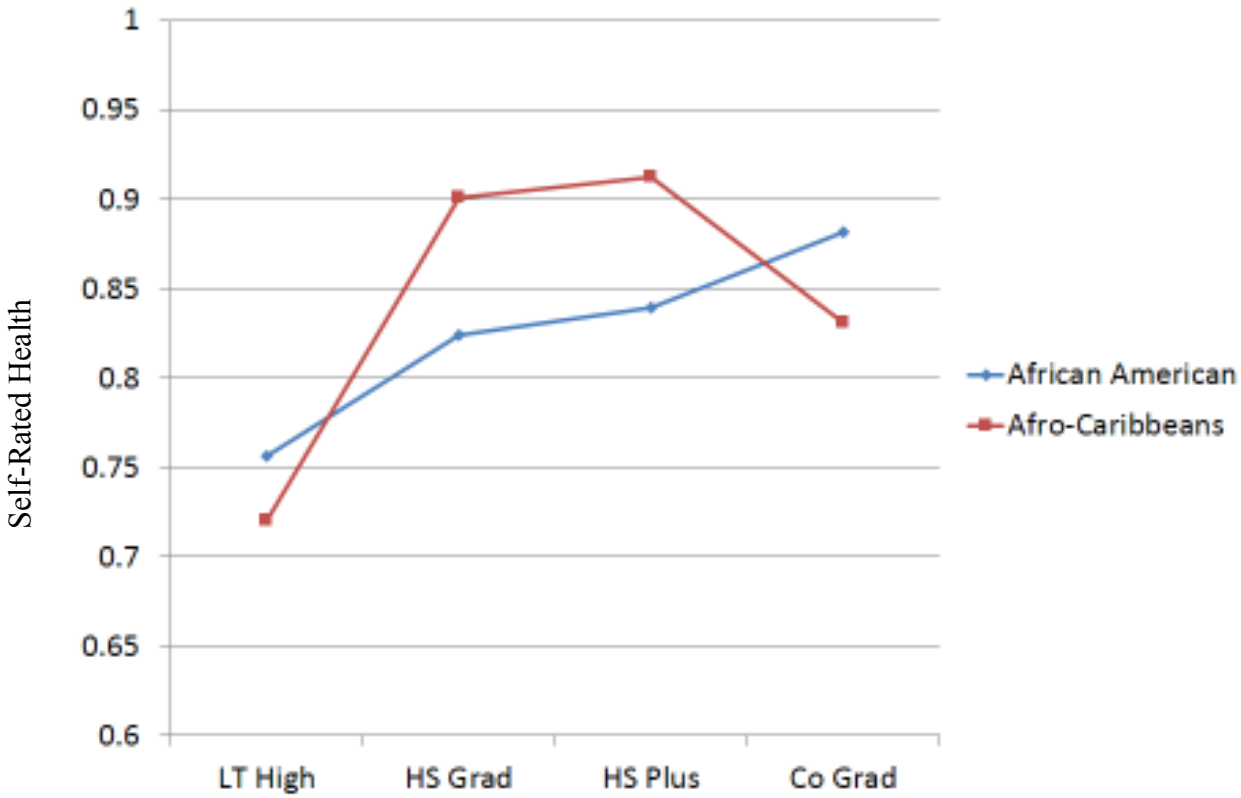


Figure 2.3: Predicted Probabilities of Reporting Good Health by Educational Attainment, Blacks

Note: Models run separately by race/ethnic group and include controls for gender, age, age2, nativity, marital status and income.

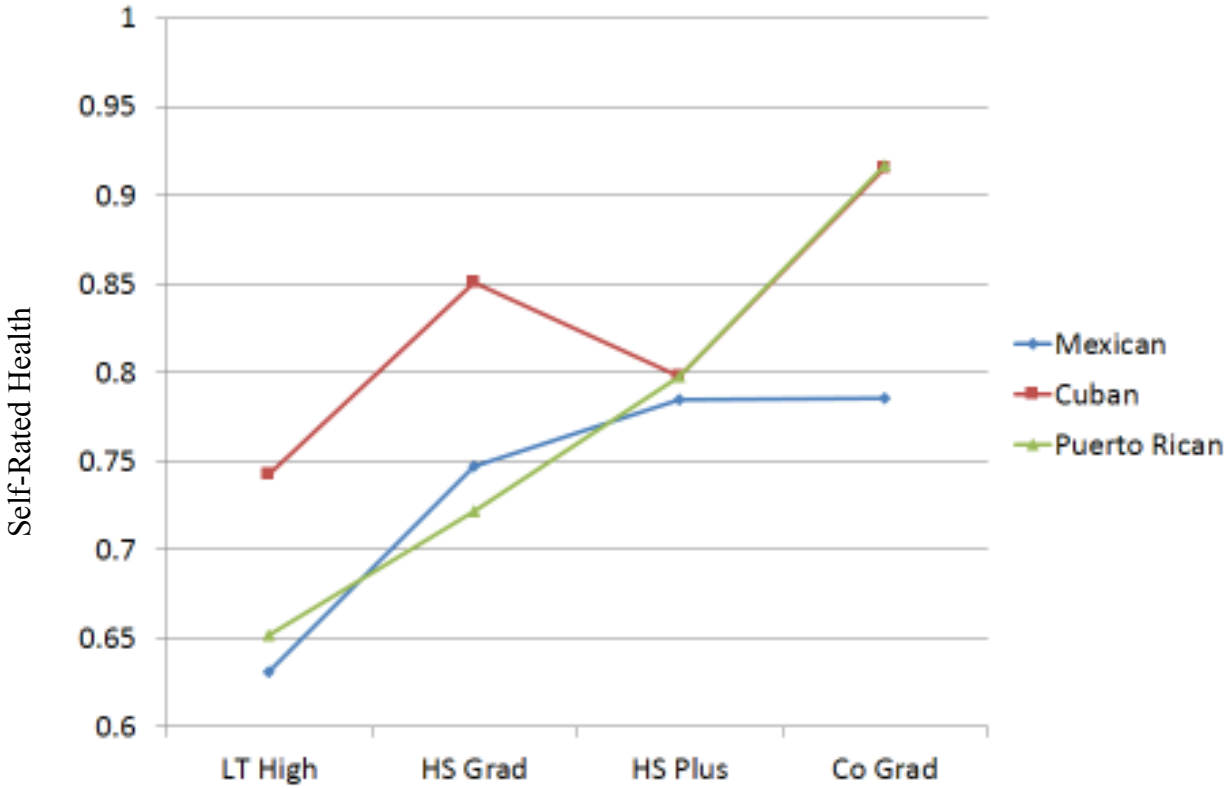


Figure 2.4: Predicted Probabilities of Reporting Good Health by Educational Attainment, Hispanic Subgroups

Note: Models run separately by race/ethnic group and include controls for gender, age, age2, nativity, marital status and income.

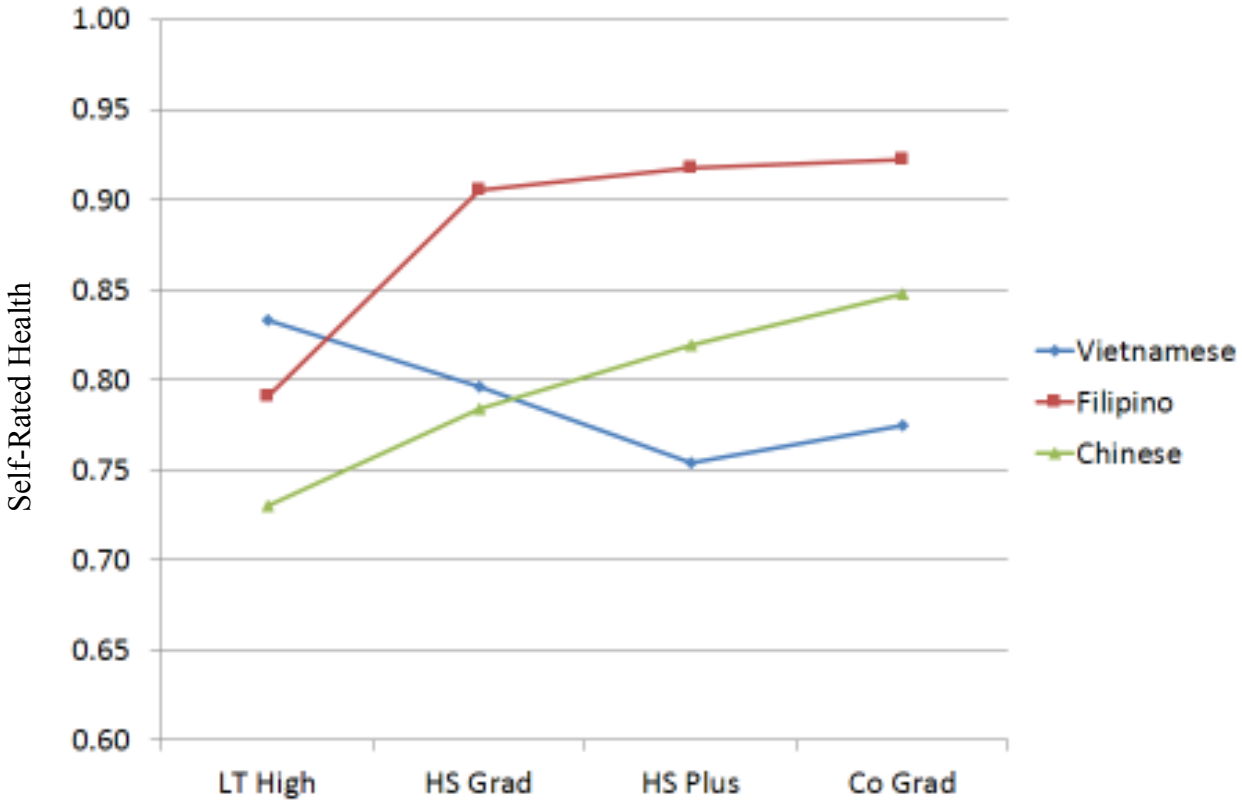


Figure 2.5: Predicted Probabilities of Reporting Good Health by Educational Attainment, Asian Subgroups

Note: Models run separately by race/ethnic group and include controls for gender, age, age2, nativity, marital status and income.

Chapter 3: Exploring Racial/Ethnic Differences in the Relationship between Education and Health in the United States for Black and White Americans

3.1 Introduction

Education is associated with a long list of physical and mental health advantages. The socioeconomic status-health gradient has received a great deal of scholarly attention as it is one of the more consistent findings in the social sciences. Despite this attention, comparatively little research has successfully investigated the mechanisms that operate to improve health for the more educated. Furthermore, the intersection of racial/ethnic and socioeconomic differences has not received a commensurate level of attention given how much effort has been devoted to racial/ethnic differences and SES differences independent of one another. The handful of studies that examine this intersection reveal differential health returns to education across race/ethnic groups. In fact, substantial differences in the relationship between education and health have been noted by race/ethnicity. This paper aims to more clearly define the mechanisms between education and health and to explore whether these pathways vary by racial/ethnic groups in the United States.

3.2 Background

Socioeconomic position is well established as a strong predictor of health and longevity (Adler et. al. 1994; Adler and Rehkopf 2008; Elo 2009; Mirowsky and Ross 2003). Research in the U.S. demonstrates that income, occupational status and education are all associated with better health. Of the various measures of socioeconomic status, education is arguably the most consistent predictor of health. (Elo 2009, p. 557). Education, compared to income or occupation,

is established relatively early in life, remains fairly constant over time after the age of 25, and is applicable to adults whether or not they are currently in the labor force. Furthermore, education helps determine one's income and occupational standing (Kimbro et. al. 2008; Ross and Mirowsky 1999; Ross and Wu 1995).

Those with higher levels of educational attainment enjoy a longer life expectancy, suffer from fewer physical impairments, report higher levels of well-being and better self-assessed health compared to their less educated counterparts (Freedman and Martin 1999; Mirowsky and Ross 2003; Ross and Wu 1995). The more educated also experience delayed onsets of chronic conditions and functional limitations compared to the less educated (Herd et. al. 2007). Additionally, education improves mental health and reduces the likelihood of feeling depressed or experiencing anxiety (Mirowsky and Ross 2003; Williams and Collins 1995). Despite an effort to reduce health disparities in recent years, studies indicate that educational differences in health and mortality are increasing (Masters et. al. 2012 and Montex et. al. 2011).

While the relationship between education and health is robust, there are interesting racial/ethnic differences that have emerged (see Chapter 1 for a review). The inconsistent and unequal findings for an education-health gradient for non-whites beg the question, what is different about the relationship between education and health for various groups? Is there something different about the way in which education improves health?

Despite the plethora of research in this field, the mechanisms through which education operates to improve health are not particularly well understood. To be certain, these mechanisms are complex and difficult to study. Higher income, fewer economic hardships, safer work conditions, better neighborhoods, better access to healthcare, higher levels of social capital, stronger social networks, higher self-esteem, and a better sense of control are all suggested as

links between education and health. These various explanations can be distilled into three main mechanisms through which education influences health. Education improves health via (1) improved economic conditions, through (2) psychosocial pathways, particularly by increasing a sense of control over one's fate and having stronger social support, and by (3) increasing health-promoting behaviors.

Economic Factors. Improved economic and work conditions are often cited as the primary pathway between education and improved health. On average, those with higher levels of education earn higher incomes (Elo 2009; Mirowsky and Ross 2003). Those with higher incomes are less likely to experience financial hardships. They also enjoy living in healthier and safer communities. That is, they live in neighborhoods with lower levels of crime and with fewer hazards and pollutants. These communities often include better access to quality food and healthcare. All of these factors are also associated with better health and reduced mortality (Mirowsky and Ross 2003; Rogers et. al. 2000; Williams and Collins 1995). In addition to being compensated with higher salaries, the educated are more like to have better and more comprehensive medical insurance which may lead to better health through preventative health maintenance (Rogers et. al. 2000). The well-educated also enjoy greater job satisfaction which may be associated with better health although the research is not overly convincing (Ross and Wu 1995). Finally, simply being employed improves health and lowers mortality, and the more educated are more likely to be employed (Ross and Wu 1995).

Psychosocial Mechanisms. The second pathway through which education improves health involves psychosocial mechanisms. Chief among the psychosocial mechanisms is a strong sense of personal control and social support. Higher levels of both personal control and social support are associated with better health (Cornwell and Waite 2012).

Personal control, also referred to as "locus of control", refers to the extent to which someone believes that they have control over his or her life and outcomes. Education increases levels of personal control by enhancing communication, analytic and problem solving skills which lead to a greater sense of confidence and feeling in control of one's life (Ross and Wu 1995). Higher levels of personal control are correlated with improved health due to an increase in health-promoting behaviors (Hammond 2003; Ross and Mirowsky 1999; Ross and Wu 1995). Low levels of personal control, on the other hand, negatively impact health. The feeling that one is unable to control life's outcomes actually suppresses the immune system (Ross and Wu 1995).

Social support is the other psychosocial component that mediates the effect of education. Companionship, emotional support and having people to count on all constitute social support. The presence of supportive interpersonal relationships reduces depression and anxiety, both of which are bad for health (Ross and Wu 1995). For example, it is well established that being married, compared to not being married, reduces mortality (Hughes and Waite 2009; Lillard and Waite 1995; Rogers 1995). It is also demonstrated that social isolation and loneliness is a predictor of functional limitations, reduced self-rated health and increased mortality (Luo et. al. 2012). On average, those with more education report higher levels of social support (Hammond 2003; Mirowsky and Ross 2003). Furthermore, unemployment and economic hardship, both of which disproportionately fall on those with less education, are associated with lower levels of social support (Ross and Wu 1995).

Health-Related Behaviors. The third and final pathway through which education is thought to influence health is through maximizing health promoting behaviors and minimizing risky behaviors. There are several lifestyle factors that have a profound effect on health. Chief among these is smoking. In addition to increasing the odds of developing lung cancer and many

other types of cancer, smoking is a major risk factor for cardiovascular disease, stroke, emphysema and disability (Fenelon and Preston 2012; Mirowsky and Ross 2003; Rogers et. al. 2000; Rogers et. al. 2005). Mehta and Preston (2012) also find that smokers are more likely to binge drink and are less likely to exercise compared with former smokers and non-smokers. Those with higher levels of education are less likely to smoke and are more likely to quit smoking (Mirowsky and Ross 2003: 53-54; Sander 1995).

A second critical health-related behavior is exercise. Those with higher levels of education are more likely to engage in physical activity (Mirowsky and Ross 2003; Pampel et. al. 2010; Ross and Wu 1995). Exercise improves health by increasing strength, endurance, balance, cardiovascular functioning and by reducing the chance of developing diabetes and certain types of cancer (Rogers et. al. 2000; Ross and Wu 1995). Exercise also improves health through stress reduction and improved self-worth (Rogers et. al. 2000).

Additionally, the more educated are more likely to seek medical advice and preventative medical care. Because they have health insurance coverage and better access to health information, those with more education are more likely to get regular physical check ups and screenings as well as immunizations. Furthermore, those with higher levels of education are members of social circles where routine preventative care is normative (Ross and Wu 1995). However, whether physical exams and utilization of health-care services actually improve health is questionable (Elo 2009; Ross and Wu 1995). Finally, being both a perpetrator or violence and the victim of violence is related to race/ethnicity and socioeconomic conditions (Bureau of Justice Statistics 1997; Sampson et. al. 2005).

Although the above mechanisms, through which education affects health, have been studied individually and, occasionally, in concert, there has been little research devoted to racial

or ethnic differences in the effects of education on health through these proposed pathways. Racial and ethnic disparities in health and mortality are well documented (see Adler and Rehkopf 2008 or Williams and Collins 1995 for a review). While socioeconomic status accounts for a good deal of these disparities, meaningful differences in health and mortality remain after controlling for socioeconomic status (Adler and Rehkopf 2008; Hayward et. al. 2000; Hummer 1993; Kimbro et al 2008; Williams and Collins 1995; Williams and Jackson 2005). Investigations into racial/ethnic differences in health that go beyond simply controlling for socioeconomic factors, reveal interesting interactions between race/ethnicity and SES. For example, the benefit of additional schooling does not equally improve health or health behavior across racial/ethnic groups. This was illustrated both in the previous chapter and in prior research (Borell et al 2006; Chen et al 2006; Farmer and Ferarro 2005; Gilman et. al. 2008).

The aim of this chapter is twofold. First, I will define and test the mechanisms through which education improves health. Second, I explore racial/ethnic variation in the relationship between education and health. That is, do the mechanisms that translate education into better health operate equivalently across race/ethnic groups?

3.3 Hypotheses

Based on prior research, we know that education is associated with better health. Figuring out why or how has been a more difficult endeavor. The value in the structural approach to analyzing these data is the ability to tease out the mechanisms through which education improves health. What is it about education that leads to better health and lower mortality? Is it merely an association, or is the relationship causal? This chapter will explore these questions. Additionally, the analysis to follow includes a comparison of the relationship

between education and health across cross race/ethnic groups, which will add to the growing body of literature on racial disparities in health.

To begin, an examination of the direct effect of health-related behaviors on health is explored. Based on findings from prior research, the estimated models assume that healthy behavior is a key mechanism between education and improved self-rated health. The first hypothesis is that health-related behaviors increase the likelihood of good self-rated health:

H1: Health behaviors are directly related to better self-rated health.

The next three hypotheses investigate the role that education plays in promoting health-related behaviors for individuals. First, a direct relationship between education and health-related behavior is explored:

H2: Higher levels of education increase health behaviors - or – there is a direct effect of education on health behaviors

In addition, indirect effects of education on healthy behaviors are also investigated. This analysis focuses on two indirect pathways through which increased education may promote health-related behaviors. Higher levels of education are associated with higher levels of both personal control and social support, which in turn lead to healthier behaviors. The following hypotheses summarize these assumptions:

H3A: Education indirectly increases health behaviors through personal control.

H3B: Education indirectly increases health behaviors through social support.

Putting together the information above, the fourth hypothesis will hold true if support is found for some of the prior hypotheses. That is, if the results indicate that healthy behaviors directly improve health (H1) *and* that there is a direct effect *or* an indirect effect of education on healthy behaviors (H2, H3A or H3B) then it follows that education has an indirect effect on health as stated below:

H4: Education indirectly improves health through various mechanisms.

A heuristic model depicting the first four hypotheses is presented in Figure 3.1. An examination of these hypotheses allows an investigation about each mechanism's role in improving health. Furthermore, it lays the groundwork for a test of racial/ethnic differences which is at the heart of this analysis. Because prior research indicates that education does not offer equivalent health returns for non-whites compared to whites, differences in the estimates for the proposed structural model are expected. The final hypothesis considers whether there are racial/ethnic differences in the pathways between education and health:

H5: There are differences in pathways through which education improves health by race/ethnicity group

If, as anticipated, support for this analysis is found, the results will increase our understanding of why some groups apparently benefit more from education than others. Prior research reveals that education does not improve health equally across different race/ethnic groups. This study aims to identify group differences in the pathways through which education improves health. That is, are the pathways similar across groups but operating at different magnitudes or do the key pathways between education and health by race/ethnicity differ?

3.4 Data and Methods

Data for this paper come from the National Survey of American Life (NSAL) which was conducted between 2001 and 2003. The NSAL population consists of English-speaking, non-institutionalized black and white adults, aged 18-99, residing in similar neighborhoods within the 48 contiguous United States. All respondents live in census tracts or blocks where African Americans comprise at least 10% of the population. Black respondents are divided into two groups depending on whether or not they self-identified as having Caribbean ancestry (African Americans versus Afro-Caribbeans). White respondents are limited to those who do not report Hispanic heritage. The total sample size for the analysis is 5,300. Of this total, 3,181 are African American, 1,294 are Afro-Caribbean and 825 are white.

Variables

Health. Health is the outcome of interest in the analysis. It is a single-indicator construct that relies on the respondent's self-report of their physical health. Self-rated health (SRH) is a commonly used health indicator and is a robust predictor of mortality, even in multiethnic

populations (DeSalvo et. al. 2006; Idler and Benyamini 1997; McGee et. al. 1999). For this item, survey respondents were asked to describe their overall physical health as excellent, very good, good, fair or poor. Self-rated health is collapsed into a dichotomous variable that distinguishes excellent, very good or good health (SRH=1) from fair or poor health (SRH=0). The standard practice of collapsing SRH from an ordinal or categorical variable into a dichotomous variable is commonplace in the health literature. Although some information is lost during the transformation into a dichotomous variable, research indicates that this convention yields very similar results when compared to analysis that utilizes SRH in its original form (Manor et. al. 2000).

Education. Education is also a single-indicator construct. Education is a continuous variable that corresponds to the respondent's years of completed schooling ranging from 4 to 17. This variable is both bottom and top-coded such that responses range from 4 or fewer years of completed schooling to 17 or more years of completed schooling.

Race/Ethnicity. The three race/ethnic groups in this paper are non-Hispanic white, African-American, and Afro-Caribbean. The analyses are conducted separately by race/ethnic group to allow for the examination of group differences in the pathways explored.

Income. Income is a major pathway through which education is hypothesized to improve health. A continuous measure of income is included as a single-indicator construct. Income is top-coded at $200,000 in the NSAL. For the analysis, income is transformed by dividing it by 1000. Transformed values range from 0 to 200.

Personal Control. Personal Control is a latent construct that is composed of seven indicator variables. Personal control is the degree to which individuals believe they have control over their own lives and their life outcomes. Those with high levels of personal control are

believed to have better health compared to those with lower levels of personal control. The proposed mechanism through which personal control improves health is through increasing health-promoting behaviors. In this paper, the Pearlin Mastery Scale (Pearlin et.al. 1981) is used to measure personal control. Respondents are asked how much they agree or disagree with the following statements: (1) There is no way to solve some of my problems; (2) I feel pushed around in life; (3) I have little control over what happens to me, (4) I can do just about anything that I set my mind to, (5) I feel helpless dealing with life's problems, (6) What happens to me in the future depends on me, and (7) There is little I can do to change things that are important in life. All items are coded so that higher values reflect higher levels of personal control. Scores on each item range from 1-4.

Social Support. Social support is a latent construct with four indicator variables. Social support is measured using two items that reflect closeness to others: *closeness I feel towards family*; and closeness *I feel towards friends*; and two items that reflect frequency of asking for help from others: *how often I ask family for help*; and *how often I ask friends for help*. Scores range from 1-4 with higher values representing higher levels of support. That is, for the two closeness measures, 1 represents not close at all and 4 represents very close. For the two items that inquire as to frequency of getting help from family or friends, values range from 1 to 4 where a 1 represents never and 4 represents frequently.[1]

[1] Of the 5300 in the sample, 275 reported not asking for help from family and 323 reported not asking for help from friends. Supplementary analysis not shown reveals that those respondents who report not asking for help still report closeness to friends and or families. For example, 80% of those reporting not asking family for help report being very close to family and 50% of those reporting not asking friends for help report being very close to friends. For respondents who report not asking their family for help, their corresponding value for the closeness they feel towards their family was imputed. For respondents who report not asking friends for help, their corresponding value for the closeness they feel towards their friend was imputed. This imputation allowed these individuals to remain in the analysis without inadvertently downward biasing the social support construct. That is, if one does not need help and does not ask, it might appear that they lack social support.

Health Behaviors. The final latent variable in the analysis is Health Behaviors. Healthy Behaviors is a proposed mechanism through which all of the other variables operate to influence health. In this paper, three items are used to measure healthy behaviors: smoking, frequency of walks, and frequency of exercise. Smoking is measured as a dichotomous variable where a score of 1 indicates the respondent currently smokes[2]. To measure the frequency of physical activity, subjects were asked to report how often they take walks and how often they play sports or exercise. Values for both physical activity variables range from 1 to 4 where 1 represents never and 4 represents often.

Control Variables. In addition to the constructs mentioned above, several single-indicator control variables are included in the analyses to prevent drawing conclusions based on compositional differences among the groups. Age of respondent is included as a control variable. As age increases, self rated health declines. Age also contributes to other factors that influence health, including income, personal control, social support and healthy behaviors. A dichotomous control for marital status is included in the model. Respondents who are married or cohabitating are distinguished from those who are widowed, divorced or never married. Married and cohabitating couples are likely to have higher incomes, higher levels of personal control and report greater social support. All of these factors are believed to contribute to better health outcomes. Finally, a dichotomous measure of sex (female = 1) is included. Women and men tend to differ in both their health behavior and their outcomes.

[2] The NSAL did not collect smoking behavior for whites. Because smoking is a key component for the health behavior construct, smoking values for whites were imputed. A single imputation method, similar to that described by Allison (2001), was employed. The added random error was normally distributed with mean and variance defined by the observed residuals from a regression equation that predicts smoking behavior based on sex, self-rated health, age, frequency of physical activity.

Table 3.1 provides descriptive information on the data used in the analysis. The mean value and the standard deviation for each variable are reported. The sample is divided into the three race/ethnicity categories: White, African American and Afro-Caribbean. The majority of respondents report good or excellent health. For African Americans, 79% report good health compared to 82% of Whites and 85% of Afro-Caribbeans. Average education levels are relatively similar across the three groups. Average years of completed schooling is 13.2 for whites, 13.1 for Afro-Caribbeans and 12.4 for African Americans. Although many of the values on the various variables are quite similar, there are a few notable differences. For example, almost half (48%) of the whites in this sample are married or cohabitating compared to only about a third (35%) of African American respondents. Afro-Caribbeans fall between the two with 43% reporting being married. Also, only one-fifth (19%) of whites report never being married compared to about one-third of both African Americans and Afro-Caribbeans (33 and 35%, respectively). Average income for Whites and Afro-Caribbeans is similar ($42,853 and $42,045) but for African Americans, income is considerably lower ($32,068). The average age of whites (47) in this sample is a bit higher than African Americans (43) and Afro-Caribbeans (41). Finally, Afro-Caribbeans are about half as likely to smoke (13%) as are whites (27%) or African-Americans (27%).

Method

This paper uses Structural Equations Modeling (SEM) to examine how the various pathways between education and improved health operate in the NSAL sample. Estimations are derived using EQS 6.1 (Bentler 1989). To better understand the mechanisms between education and health, it is necessary to estimate the impact of several latent constructs: personal control,

social support, and health promoting behaviors. Employing SEM allows the examination of the relationships among the variables, both the single indicator constructs and these three critical latent constructs.

Identification. To begin, confirmation of model identification is needed. If a model is identified, then there is a solution and the model can be estimated. There are several ways to confirm a model identification. To begin, the t-rule is a particularly useful test. While the t-rule is not sufficient, it is necessary; making it a good first step. That is, if the model does not meet the t-rule, then the model is *not* identified. In this model, there are 29 estimations to make (t) compared to 3 exogenous variables and 6 endogenous variables. These specifications meet the t-rule which is necessary[3]. Despite meeting the t-rule, the model may still not be identified. Therefore, an additional test of identification must be conducted. In this model, the conditions of the recursive rule, which is sufficient for identification, is met, affirming that the model is identified.[4]

3.5 Findings

To begin, I perform a confirmatory factor analysis. This provides an overview of how the indicators and constructs work together by allowing all latent factors to co-vary. Additionally, the results illustrate how well the indicator variables work in concert to define each

[3] In order for a structural equations model to be identified, the t-rule must be met. The proposed model meets the t-rule. The equation is as follows: $t \leq \frac{1}{2}(p+q)(p+q+1)$ where t = the total number of parameters the model is estimating, p = the total number of endogenous variables and q = the total number of exogenous variables. In this case, t = 29, (there are 6 elements in the Φ matrix; 6 elements in the Ψ matrix; 9 elements in the Γ matrix and 8 elements in the B matrix.), p = 6 and q = 3. Plugging into the equation above, $29 \leq \frac{1}{2}(6+3)(6+3+1)$ or $29 \leq 45$, which it is.

[4] The recursive rule states that all elements of the Ψ matrix are on the diagonal (that there is no correlation between the errors of the endogenous variables. In this case, the Ψ matrix is composed of $\psi_{4,4}$ $\psi_{5,5}$, $\psi_{6,6}$, $\psi_{7,7}$, $\psi_{8,8}$, and $\psi_{9,9}$, which meets this requirement. Additionally, the B matrix must be arranged such that all elements are in the lower, left right triangle. This indicates that the direction of the relationships being estimated between the endogenous variables all run in the same direction. In this model, that is the case and therefore the recursive rule is satisfied.

latent construct. The LaGrange multiplier statement in EQS provides suggestions of additional covariances between various error terms to estimate in order to improve the model fit. For this paper, 16 additional covariances are estimated based on the results of the LaGrange multiplier statement.[5] Inclusion of these additional covariances improves the fit of the model by reducing the chi-squared from 2418 with 140 degrees of freedom to 838 with 124 degrees of freedom[6].

The results from the confirmatory factor analysis combining the three race/ethnic groups are presented in Tables 3.2A and 3.2B. Table 3.2A details the pathways between indicator variables and the latent construct (the lambda pathways). Each of the indicator variables that comprise a latent construct is listed under the construct name. For each latent construct, one indicator variable serves as the reference. Coefficients and standard errors are presented for each of the non-referent indicator variables. The first latent construct is personal control and *I can do anything I set my mind to* is the reference. All of the responses were coded such that positive values corresponded to higher levels of personal control. Coefficient values are all positive and significant, indicating that each of these indicators work well together to define the personal control construct. For social support, again, responses are coded such that higher values for each indicator reflect greater social support. The reference for this construct is *how close you feel towards friends*. The coefficients for the three other social support indicators are all positive and statistically significant, indicating that they work well together to define the construct, social support. Finally, the healthy behaviors construct is listed with its three indicator variables. In this instance, *frequency of playing sports or exercising* serves as the reference. Coefficients for each of the remaining indicator variables, *frequency of walking* and *smoking* are significant.

[5] The LaGrange multiplier test in EQS provided suggestions for additional covariances between error terms to estimate to improve model fit. Covariances that made substantive sense were estimated in the final model.
[6] This reduction in X^2 refers to the model presented in Table 3.2A which combines all three race/ethnicity groups.

Since walking is associated with better health, the positive value of the coefficient is expected. Likewise, the negative coefficient representing smoking is expected as smoking should be negatively related to health behaviors. All in all, these three behaviors work well together to inform the final latent construct, health behaviors.

In addition to examining the relationships between latent constructs and their indicators, confirmatory analysis results also provide information about the relationships between the endogenous latent variables and between these constructs and the outcome of interest, self rated health. The variance-covariance matrix that includes the three endogenous latent constructs and self-rated health is displayed in Table 3.2B. The variances for the four constructs, personal control, social support, health behaviors and self-rated health, are reported along the diagonal of the table. The covariances between pairs of constructs are displayed below the diagonal. All of the covariances are positive and significant (at the .05 level), indicating that each pair of constructs co-vary in the same direction. For example, as personal control increases, social support also increases. This is true for each pair of constructs.

Tables 3.3 A and B summarize the measurement model separately by the three race/ethnic groups. In general, my findings are similar across groups. However, there are some subtle differences revealed in this race/ethnicity specific measurement model. Foremost among them is the coefficient for smoking is not significant for whites. For whites, it appears that smoking behavior does not work well with the other same-construct items to define health behaviors.[7] Additionally, while significant for both groups, the coefficient for smoking for African Americans is more than twice as large as for Afro-Caribbeans (-.148 versus -.067).

[7] Given that smoking values were imputed for whites, further investigation seems warranted. In supplementary models that exclude smoking as a component of the healthy behaviors construct, results are virtually identical to the models presented in this paper that utilize imputed values for smoking behavior.

Also of interest, while Table 3.1 revealed no major differences between the average values for personal control items for whites versus non-whites, the coefficient values for the lambda pathways described in Table 3.3A are, across all personal control indicators, smaller for whites than the coefficients for African Americans and Afro-Caribbeans.

The three panels of Table 3.3B present the variance/covariance matrix, separately by race/ethnicity, for the three latent constructs (personal control, social support, and health behaviors) and self-rated health. Similar to Table 3.2B, the variances are displayed along the diagonal and the covariances appear below the diagonal. All of the covariances are significant and positive, indicating that each pair of these four variables covary in the same direction. Nonetheless, there are some differences across the racial/ethnic groups that emerge. For example, the covariance of personal control and health behaviors is the same for African Americans and Afro-Caribbeans (.042) but considerably higher for whites (.077). The covariance between personal control and self-rated health is .035 for whites but only two-thirds that for African Americans (.022) and about one-half as large for Afro-Caribbeans (.017). Similarly, the covariance between social support and self-rated health for whites (.035) is about twice the covariance for African Americans (.017) and three times the covariance for Afro-Caribbeans (.011). These covariances point to a potential difference in the magnitude of the effect of certain mechanisms in the model which will be further explored in the analysis to follow.

The next part of the analysis introduces specific pathways through which variables operate as outlined in the hypotheses. The structural model is run separately for each of the three race/ethnic groups. Table 3.4 presents the unstandardized beta coefficients from these models. The same information is also presented in the three panels of Figure 3.2. Tests evaluating

whether pathways are significantly different across groups are implemented and reported in Table 3.4. The coefficients that are significantly different between race/ethnic groups are indicated by bolded and italicized font. For the most part, Table 3.4 describes, and Figure 3.2 illustrates, similar structural relationships between education and health for the three race/ethnic groups under investigation. All coefficients (pathways) presented are statistically significant at the .05 level unless otherwise noted.

Turning first to the results from the very last pathway described in Table 3.4, we see that healthy behaviors are associated with better self-rated health for all three groups. The coefficients for the pathway between health behaviors and good or excellent self-rated health range from .36 for Afro-Caribbeans to .42 for whites and .47 for African Americans. These findings confirm the first hypothesis, H1, that healthy behaviors are positively and significantly related to better self-rated health and suggest little difference in the effects by race/ethnicity.

The findings presented in Table 3.4 and Figure 3.2 also indicate that several factors indirectly impact self-rated health through their effects on health behaviors. For example, personal control is a strong predictor of health promoting lifestyle choices. The direct effect of personal control on healthy lifestyle is positive and significant for all three groups. In fact, an examination of the standardized total parameter coefficients reveals that personal control is, far and away, the best predictor of healthy behaviors and has the largest indirect effect on self-rated health when compared to Social Support, Education and Income (Table 3.A2, in the appendix).

Direct Effect of Education on Health Behavior. Education is the key indicator variable in this investigation. It is proposed to have a direct effect on healthy behavior as well as an indirect effect via several mechanisms. Turning first to the examination of a direct effect of education on health behavior, Table 3.4 illustrates that both whites and African Americans enjoy a direct

impact of healthier behavior from additional years of schooling (.066 for whites and .039 for African Americans). However, there is no evidence to support a direct relationship between education and healthier behaviors for Afro-Caribbeans (.019, not significant). Additionally, while both whites and African Americans enjoy this direct effect, the magnitude of the effect is considerably greater for whites (.066) compared to African Americans (.039).[8] This evidence points to potential inequality in the influence of education on self-rated health that is at the core of this chapter. Overall, the test of the hypothesis (H2) that education has a direct effect on healthy behaviors resulted in mixed findings. That is, for whites and African Americans, there is very clearly evidence to support a direct relationship between education and health-promoting behavior. For Afro-Caribbeans, on the other hand, the results indicate that there is no direct relationship between education and health behavior.

Indirect Effect of Education on Health Behavior. It is theorized that education will indirectly increase healthy behaviors through two main mechanisms: personal control and social support. The indirect effect of education through personal control is clear and consistent across all three race/ethnic groups. Higher levels of education significantly increase the reported personal control values, which in turn leads to higher rates of health promoting behavior. This is true for whites, African Americans and Afro-Caribbeans. Additional years of schooling also increases income, which has a positive impact on personal control, and therefore healthy behaviors. These clear and consistent results provide support for the first part of the third hypothesis (H3A), that education has an indirect effect on healthy behaviors through personal control.

[8] The difference between the coefficient for whites (.066) and the coefficient for African Americans (.039) is statistically significantly different at the .10 level.

The evidence presented in Table 3.4 and Figure 3.2 illustrates that social support is less predictive of health promoting behaviors than is personal control. There is a significant and positive direct effect for whites and Afro Caribbeans (.168 and .109, respectively), but not for African Americans. An exploration of the standardized results (Table 3.A3) reveals that the impact of social support on healthy behaviors is about one-third that of the effect of personal control for Whites and Afro Caribbeans and about 1/8 the effect for African Americans. Although education increases social support levels for African Americans, they do not enjoy a significant improvement in health behaviors in response to greater values of social support. And despite the positive and significant effect of social support on healthy behaviors for whites and Afro-Caribbeans, education does not improve social support levels for these groups. Therefore, there is no evidence of an indirect effect of education through social support, as was hypothesized (H3B).

Despite the lack of support for an indirect effect of education on healthy behaviors through social support discussed above, the indirect effect of education on healthy behaviors through personal control is evident. That indirect effect, coupled with the strong and consistent direct effect of healthy behavior on self-rated health confirmed earlier (H1), results in the confirmation of the fourth hypothesis (H4) that education has an indirect effect on health through various mechanisms. This investigation confirmed that this hypothesis holds true for the following pathway: Education → Personal Control →Healthy Behaviors → Self-Rated Health. Additionally, education's significant and positive effect on income contributes to this as follows: Education → Income → Personal Control →Healthy Behaviors → Self-Rated Health.

A handful of studies have demonstrated that there is a residual direct impact of education on health. In this study, however, there was no direct effect of education on health for any of the

three race/ethnic groups after including a control for healthy behaviors. Models that include a direct effect of education on health, therefore, are not included for the sake of parsimony.

Racial/Ethnic Differences in Relationship between Education and Health. The fifth and final hypothesis (H5) posits that the analysis will reveal racial/ethnic differences in the relationship between education and self-rated health. Although there are certainly many more similarities than differences in the structural models groups, the results reveal subtle group differences and modest support for the final hypothesis. To begin, despite the confirmed consistent indirect effect of education on self-rated health through personal control and healthy behaviors across groups, several key differences emerged in the analysis. Chief among them is the lack of a direct effect of education on health behaviors for Afro-Caribbeans. For some reason, additional schooling does not directly impact healthier behaviors for this group. Additionally, while both whites and African Americans enjoy a positive and significant direct effect of education on healthy behaviors, the coefficient is substantially larger for whites (.066 versus .039). This difference is statistically significant at the .10 level.

There are also substantive differences in the magnitude of the effect of education on self-rated health across groups. Table 3.5 summarizes key unstandardized coefficients that represent the total parameter effects for the model by race/ethnicity. The total effect of education on self-rated health is .035 for whites and .030 for African Americans. However, the total effect for Afro-Caribbeans is only .015. This is half the total effect for African Americans and less than half the effect of education for whites. So, despite enjoying a significant health returns to education, Afro-Caribbeans enjoy roughly half the health returns to education compared to whites and African Americans. This is likely in part due to the lack of a direct effect of education on health behaviors for Afro-Caribbeans reported earlier.

3.6 Conclusion

This investigation focuses on a series of hypotheses exploring how education improves health and whether that effect varies by race/ethnicity. The analysis illustrates that for all groups, education is significantly related to better health. Analysis confirmed the first hypothesis (H1) that healthy behavior results in better self-rated health. This hypothesis is universally supported by the results. Adopting healthy behaviors is by far the largest predictor of better self-rated health for all three race/ethnic groups. The findings also indentify an indirect effect of education on healthy behaviors through personal control (H3A) for all groups. Putting together the information gleaned from these two hypotheses, the indirect relationship between education and self-rated health (H4) is confirmed for all three race/ethnic groups. To summarize, the analysis confirms that more years of schooling improves health by increasing an individual's personal control which in turn leads to increases in healthier behaviors, and subsequently self-rated health. This was true for whites, African Americans and Afro-Caribbeans in this study.

Despite these similarities, a handful of group differences emerged, lending modest support to the final hypothesis (H5) that proposes racial/ethnic differences in the way education improves health. The direct effect of more years of schooling on healthy behaviors (H2) is not consistent across groups. Both whites and African Americans enjoy a significant boost in healthy behaviors with each additional year of schooling. However, Afro-Caribbeans do not. Furthermore, the difference in the magnitude of the direct effect of education on health behavior for whites and African Americans is considerable; the coefficient for African Americans is just 60% that of whites. This difference between whites and African Americans in the magnitude of the effect of education on health behaviors is significant at the .10 level.

There are also notable differences across races/ethnicities in the relationship between education and social support and social support and self-rated health. Higher levels of social support are associated with healthier behaviors for whites and Afro-Caribbeans. However, extra years of schooling do not increase levels of social support for either of these groups. On the other hand, education increases levels of social support for African Americans, but social support does not increase the likelihood of adopting healthy behaviors. While these nuanced group differences are important to note, the overall outcome is that education does not operate through social support to improve health behaviors, and therefore health, for any of the three groups.

The results presented in this paper in regards to social support are somewhat counterintuitive. That is, married respondents report lower levels of social support, as defined by the latent structure in this model. Because social support is comprised of four variables that measure closeness to friends and family and the extent to which friends and family help you out, it seems quite possible that it is biased against married persons. While married partners potentially have the same closeness to family and friends, they may be less likely in need of help from those outside their home. Additionally, it is possible that those who are unwell, married or not, may rely on friends and family for help more so than those who are healthy. Therefore, this measure may not be a very good indicator of true social support. In fact, the empirical measurement of social support is a difficult and rather inconsistent endeavor. Accurate measurements that meaningfully capture the concept of social support and are universally used are lacking (Bloom 1990).

Although the evidence that education impacts self-rated health is convincing, the relationship is not necessarily unidirectional. For example, although this paper attempts to include important factors that influence health and education, it fails to account for the recursive

nature of the relationship between education and health. Healthy people are more likely to continue their education while the infirm may have prematurely truncated their schooling. It is possible that the relationship between education and health is spurious. That is, there are factors that may influence both education and health. Childhood economic situation could help determine both educational outcomes and health outcomes. Controlling for family background could potentially get at this in future research. This paper fails to address the potential reciprocal relationship between health and health-related behaviors. That is, engaging in health-related behaviors promotes better health. However, being in a state of good health very likely facilitates one's ability to participate in health-related behaviors, particularly exercise and walking.

A related limitation is a product of the type of data used. The NSAL is a cross-sectional dataset which offers a single snapshot of the respondent's life. This type of data is often used to assess causality, however, it is not ideal. Longitudinal data that examines respondents at two or more time points would offer a richer and likely more thorough story.

Finally, a non-linear treatment of education might best capture the education gradient with health. Recent research indicates that the relationship between education and health is more or less linear, until 11 years of schooling. There appears to be a slight jump or step in health associated with obtaining a high school diploma. After twelve years, the linear relationship, where each year of school results in a similar increase in health as the year prior appears to re-emerge. Although, there is some evidence that the post-high school gradient is steeper than the gradient observed for 11 and fewer years of schooling (Montez, Hummer and Hayward 2012).

Despite these limitations, there are several important contributions this chapter makes to the growing literature examining the education-health gradient. The analysis confirms a positive and significant relationship between education and health for each of the three race/ethnic groups

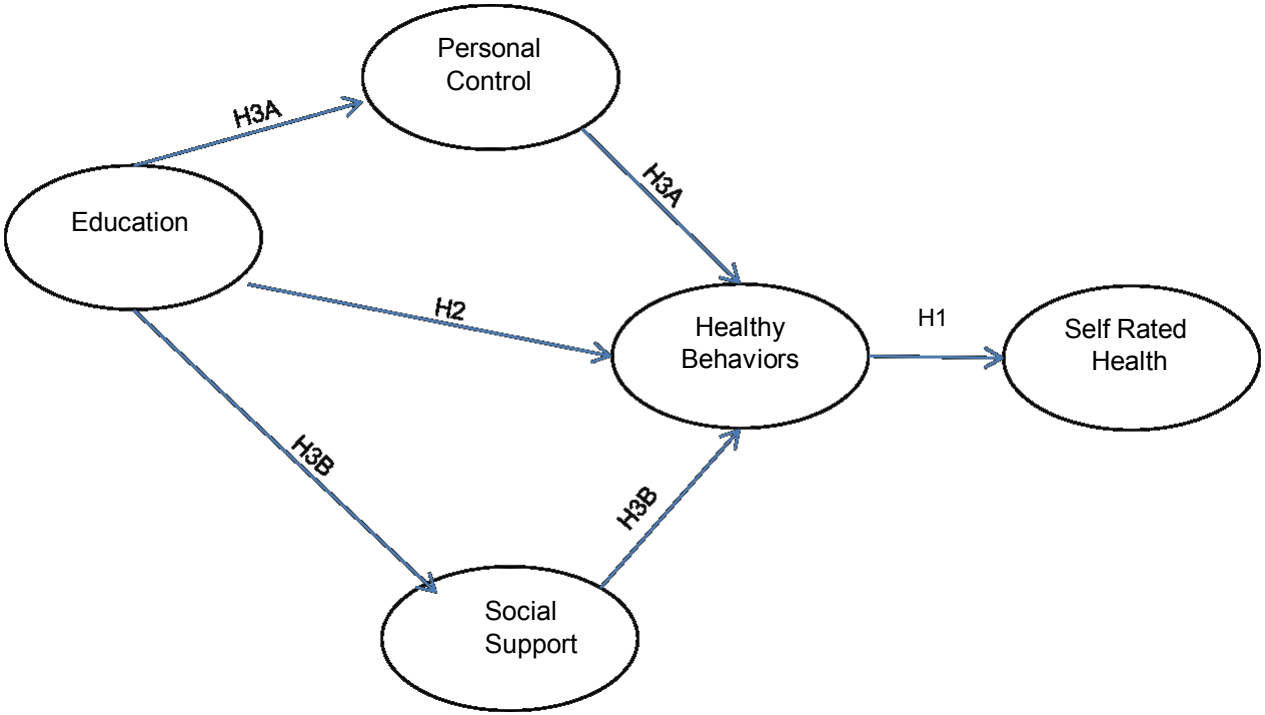
under investigation. Nevertheless, there are large differences in the magnitude of the effect of education on health. The total effect of education on health for Afro-Caribbeans is only half what it is for African American and less than half the total effect for whites. Furthermore, the pathways through which education operates to impact health vary across groups. Health behaviors are a key predictor of health for all groups. But, only whites and African Americans enjoy a direct effect of education on higher rates of health behaviors. Increases in health behaviors associated with higher levels of education for Afro-Caribbeans result from the indirect effects funneled through higher rates of personal control. And, despite finding a direct effect of education on health behaviors for both whites and African Americans, the difference in magnitude is, again, striking.

3.7 Summary

In this chapter, I utilized structural equations modeling to investigate the relationship between education and health for whites, African Americans and Afro-Caribbeans. I find an indirect effect of education on self-rated health via health behaviors for all three groups. Education directly increases health behaviors and indirectly increases health behaviors via higher incomes and higher levels of personal control. For whites and African Americans, there is a direct effect of education on health behavior. This is not the case for Afro-Caribbeans. The effect of education on health behaviors for Afro-Carribeans operates through the mediating variables, income and personal control. Overall, these findings suggest that health behaviors is a key mediating factor linking education and health.

Building on the results presented here, Chapter 4 takes a closer look at the role that health behaviors play in mediating the effect of education on health. I return to the full dataset that

includes nine racial/ethnic groups and estimate logistic regression models that predict good self-rated health focuses on the role that risk factors plays in mediating the effect of education on health across racial/ethnic groups.



H1: Healthy behavior is directly related to better self-rated health.
H2: Higher levels of education results in higher levels of health promoting behaviors.
H3A: Education indirectly increases healthy behaviors through personal control.
H3B: Education indirectly increases healthy behaviors through social support.
H4: Education indirectly improves health through various mechanisms (entire model).

Figure 3.1: Basic Structural Model describing Hypotheses 1-4.

Table 3.1: Descriptive Statistics by Race/Ethnicity for Variables Used in Analysis

	White		African American		Afro-Caribbean	
	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Self-Rated Health						
Proportion Reporting Good or Excellent Health	0.82	0.38	0.79	0.41	0.85	0.36
Healthy Behaviors						
Proportion who Smoke	0.27	0.45	0.27	0.44	0.13	0.33
How often do you play sports or exercise[1]	2.75	1.12	2.70	1.15	2.80	1.10
How often do you take walks[1]	3.07	1.03	3.13	1.02	3.34	0.91
Personal Control Items[2]						
I can do anything I set mind to	3.57	0.71	3.72	0.63	3.69	0.65
There is no way to solve some of my problems	3.05	1.06	3.10	1.08	3.05	1.06
I feel pushed around in life	3.06	1.04	3.05	1.10	2.91	1.10
I have little control over what happens to me	3.30	0.92	3.32	0.98	3.13	1.02
I feel helpless in dealing with life's problems	3.19	0.96	3.24	0.99	3.16	0.99
What happens to me depends on me	3.62	0.71	3.70	0.68	3.61	0.73
Little I can do to change important things in life	3.24	0.99	3.17	1.09	3.09	1.06
Social Support Items[3]						
How close do you feel to family members	3.59	0.68	3.64	0.65	3.62	0.63
Frequency family helps you out	2.85	1.01	2.85	1.02	2.81	1.03
How close do you feel towards friends	3.35	0.72	3.30	0.77	3.27	0.74
Frequency friends help you out	2.71	0.93	2.57	1.00	2.58	0.96
Other Variables						
Proportion Female	0.57	0.50	0.64	0.48	0.60	0.49
Education, Average Years	13.23	2.54	12.39	2.46	13.08	2.78
Proportion Married/Cohabitating	0.48	0.50	0.35	0.48	0.43	0.50
Proportion Divorced or Widowed	0.32	0.47	0.32	0.47	0.23	0.42
Proportion Never Married	0.19	0.40	0.33	0.47	0.35	0.48
Income, Average	$42,853	$34,080	$32,068	$28,780	$42,045	$33,840
Age, Average	47.40	16.80	42.69	16.10	40.66	15.30
N	825		3181		1294	

[1] For both the exercise and walk items, frequency of the activity is measured where 1 = never, 2=rarely, 3=sometimes and 4=often.

Table 3.1 Notes, Continued.

[2] For personal control items, all responses are coded such that a lower value reflects lower level of personal control. That is, for positive items, like, "I can do anything I set my mind to" a value of 1 represents strongly disagrees and a 4 represents strongly agrees. For negative items, like "There is no way to solve some of my problems" a value of 1 represents strongly agrees (lower personal control) and a 4 represents strongly disagrees (higher personal control).

[3] For social support items, all responses are coded such that a lower value reflects lower levels of social support. For the two items that reflect closeness to families and friends, a value of 1 represents not close at all and a value of 4 represents very close. For the two items that inquire as to frequency that family and friends help the respondent, a value of 1 represents never and a value of 4 represents often.

Table 3.2A: Summary of Results from Confirmatory Factor Analysis

	Coefficient	Standard Error
Personal Control Items (F6)		
There is no way to solve some of my problems	3.48	0.20
I feel pushed around in life	3.19	0.19
I have little control over what happens to me	3.41	0.19
I feel helpless in dealing with life's problems	3.41	0.19
What happens to me depends on me	0.79	0.06
Little I can do to change important things in life	3.62	0.20
I can do anything I set mind to (reference)	--	--
Social Support Items (F7)		
Frequency family helps you out	0.31	0.03
How close do you feel to family members	0.21	0.02
Frequency friends help you out	0.84	0.06
How close do you feel towards friends (reference)	--	--
Healthy Behaviors (F8)		
Currently Smoke	-0.13	0.02
How often do you take walks	0.26	0.03
How often do you play sports or exercise (reference)	--	--

X^2 = 837.82 Degrees of Freedom = 124
Bentler-Bonett Normed Fit Index = 0.95
Bentler-Bonett Non-Normed Fit Index = 0.93
Comparative Fit Index = 0.95

Table 3.2B. Variance-Covariance Matrix for Endogenous Latent Constructs and Self-Rated Health, all Race/Ethnicity Groups

	Personal Control	Social Support	Health Behaviors	Self-Rated Health
Personal Control	.035			
Social Support	.024	.443		
Health Behaviors	.044	.083	.237	
Self-Rated Health	.022	.019	.111	.154

Note: The numbers along the diagonal represent the variance. All variances and co-variances are significant at the .05 level.

Table 3.3A: Summary of Results from Confirmatory Factor Analysis, by Race/Ethnicity

	White		African American		Afro-Caribbean	
	Coef	St. Dev	Coef	St. Dev	Coef	St. Dev
Personal Control Items (F6)						
There is no way to solve some of my problems	2.69	0.31	3.82	0.29	3.21	0.38
I feel pushed around in life	1.95	0.26	3.49	0.28	3.36	0.41
I have little control over what happens to me	2.21	0.26	3.76	0.28	3.42	0.39
I feel helpless in dealing with life's problems	2.39	0.28	3.69	0.28	3.48	0.40
What happens to me depends on me	0.75	0.12	0.75	0.09	0.86	0.13
Little I can do to change important things in life	2.64	0.31	3.90	0.30	3.65	0.42
I can do anything I set mind to (reference)	--	--	--	--	--	--
Social Support Items (F7)						
Frequency family helps you out	0.34	0.09	0.26	0.03	0.40	0.08
How close do you feel to family members	0.34	0.06	0.17	0.02	0.22	0.04
Frequency friends help you out	1.12	0.13	0.68	0.07	1.08	0.13
How close do you feel towards friends (reference)	--	--	--	--	--	--
Healthy Behaviors (F8)						
Currently Smoke	-0.03	0.04	-0.15	0.02	-0.07	0.03
How often do you take walks	0.34	0.09	0.24	0.04	0.30	0.07
How often do you play sports or exercise (reference)	--	--	--	--	--	--

X^2 = 915.719 Degrees of Freedom = 124
Bentler-Bonett Normed Fit Index = .940
Bentler-Bonett Non-Normed Fit Index=.921
Comparative Fit Index=.928

Table 3.3B: Variance-Covariance Matrix for Endogenous Latent Constructs and Self-Rated Health, by Race/Ethnic Group

Panel A: Whites

	Personal Control	Social Support	Health Behaviors	Self-Rated Health
Personal Control	.064			
Social Support	.035	.302		
Health Behaviors	.077	.125	.555	
Self-Rated Health	.035	.035	.125	.145

Panel B: African Americans

	Personal Control	Social Support	Health Behaviors	Self-Rated Health
Personal Control	.030			
Social Support	.024	.574		
Health Behaviors	.042	.071	.234	
Self-Rated Health	.022	.017	.118	.165

Panel C: Afro-Caribbeans

	Personal Control	Social Support	Health Behaviors	Self-Rated Health
Personal Control	.035			
Social Support	.019	.333		
Health Behaviors	.042	.107	.327	
Self-Rated Health	.017	.011	.077	.130

Note: The numbers along the diagonal represent the variance. All variances and co-variances are significant at the .05 level.

Table 3.4: Summary of Results from a Constrained Pathways Model, by Race/Ethnicity

	White N = 825	African American N = 3,181	Afro-Caribbean N = 1,294
Pathways between Exogenous and Endogenous Variables			
Female → Education	.085^{NS}	.083^{NS}	.350
Female → Social Support	.147	.096	.029^{NS}
Female → Income	-7.059	-8.035	-7.842
Age → Personal Control	-.003	-.001	-.002
Age → Social Support	-.000	.003	-.000^{NS}
Age → Income	-.033^{NS}	.085	.025^{NS}
Age → Healthy Behaviors	-.003	-.008	-.009
Married → Income	25.454	18.359	18.049
Married → Social Support	-.112	-.072	-.058^{NS}
Pathways between Endogenous Variables			
Education → Income	4.391	4.471	4.725
Education → Personal Control	.010	.015	.016
Education → Social Support	.009^{NS}	.026	.011^{NS}
Education → Healthy Behaviors	***.066***	.039	***.019^{NS}***
Income → Personal Control	.001	.001	.001
Personal Control → Healthy Behaviors	1.059	1.205	1.023
Social Support → Healthy Behaviors	***.168***	***.030^{NS}***	.109
Healthy Behaviors → Good Health	.420	.471	.361

Note: ^{NS} denotes that this particular coefficient is not significant at the .05 level

Note: Bold and italicized coefficients for the same pathways are significantly different from each other at the .05 level

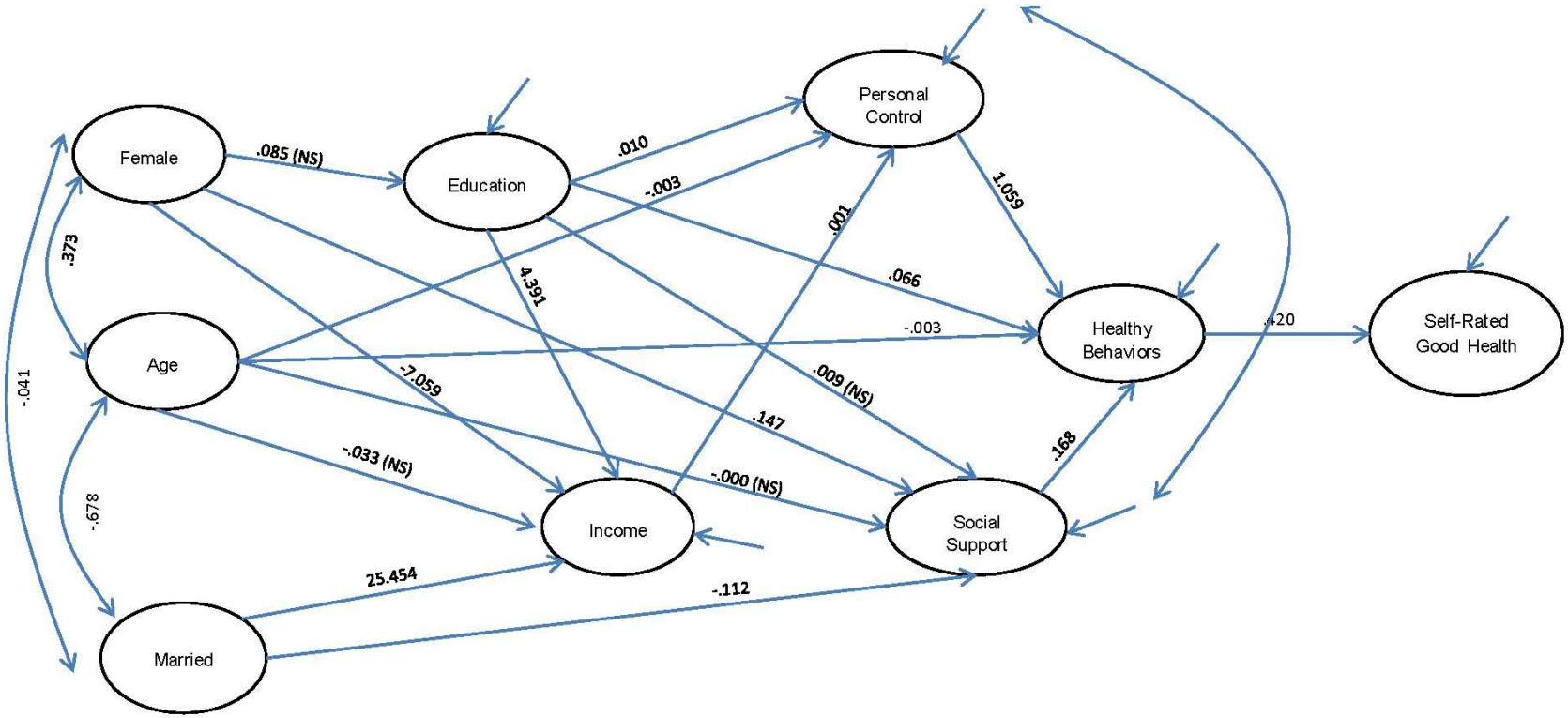


Figure 3.2A: Structural Model Depicting the Relationship between Education and Health for Whites.

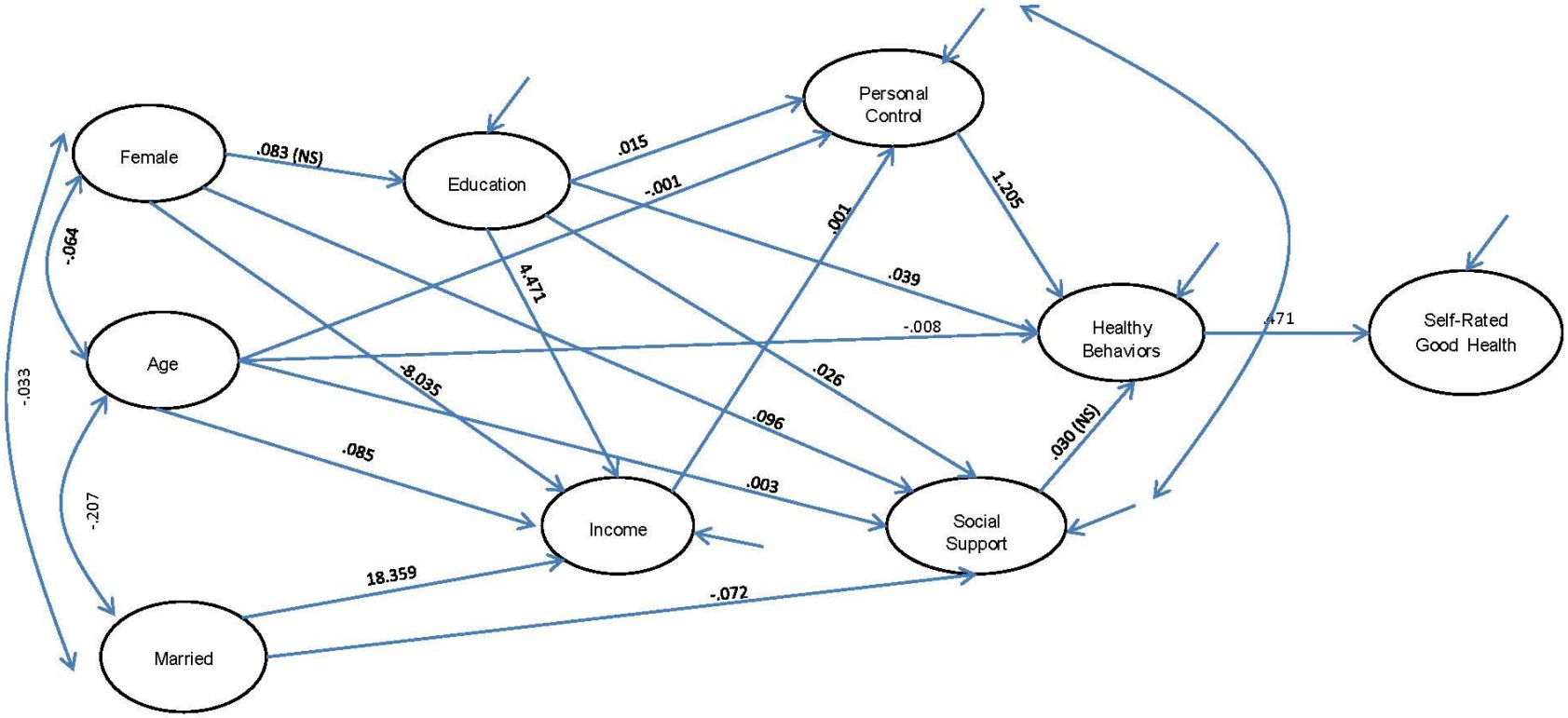


Figure 3.2B: Structural Model Depicting the Relationship between Education and Health for African Americans.

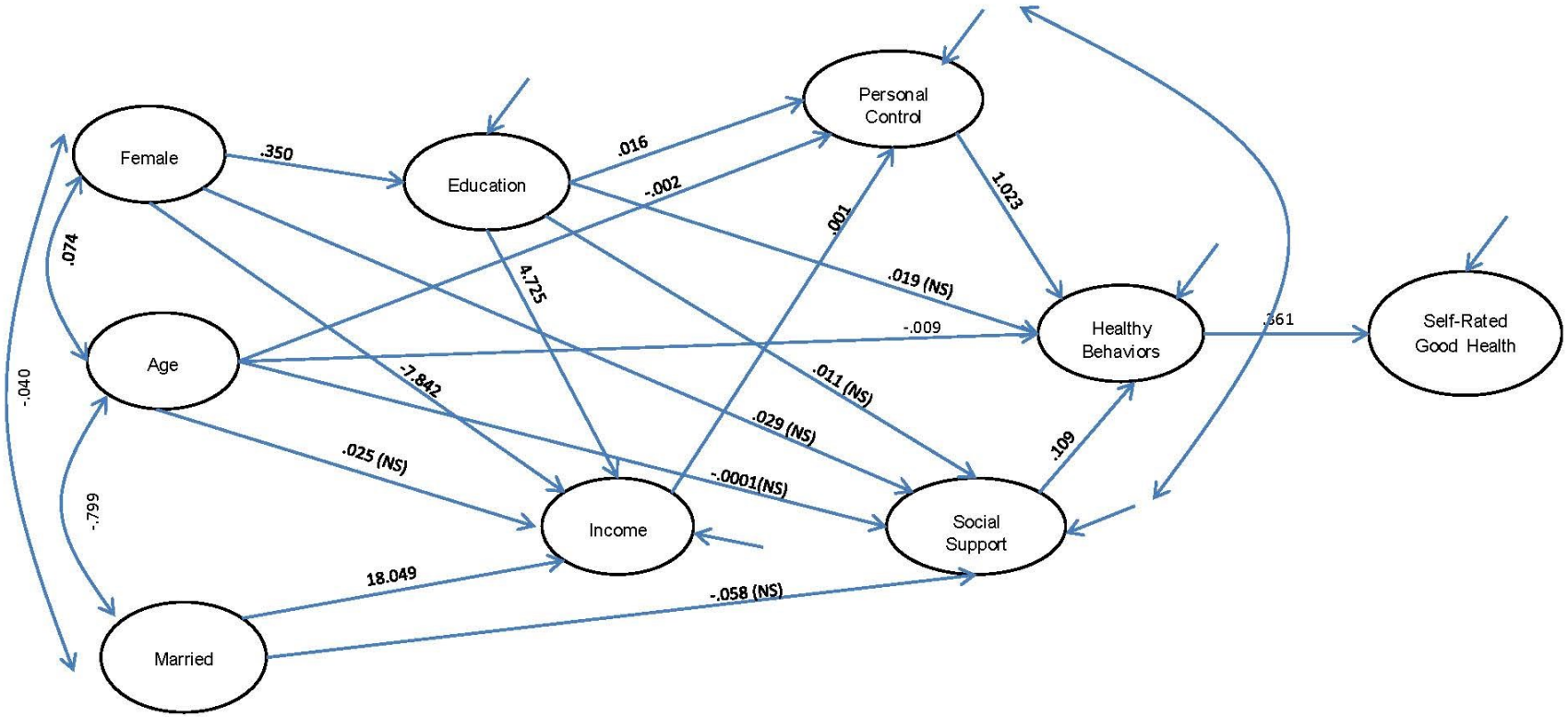


Figure 3.2C: Structural Model Depicting the Relationship between Education and Health for Afro-Caribbeans.

Table 3.5: Summary of Unstandardized Total Parameter Effects, by Race/Ethnicity

Personal Control	** Education*	** Income*			
White	.015	.001			
African American	.019	.001			
Afro-Caribbean	.020	.001			
Social Support	** Education*				
White	.009				
African American	.026				
Afro-Caribbean	.011[NS]				
Healthy Behaviors	** Education*	** Income*	** Personal Control*	** Social Support*	
White	.083	.001	1.059	.168	
African American	.063	.001	1.205	.030[NS]	
Afro-Caribbean	.041	.001	1.023	.109	
SR Health	** Education*	** Income*	** Personal Control*	** Social Support*	** Healthy Behaviors*
White	.035	.001	.445	.071	.420
African American	.030	.001	.568	.014	.471
Afro-Caribbean	.015	.000	.369	.039	.361

Note: All coefficients are statistically significant at the .05 level except where denoted by NS.

Chapter 4: Health Risk Factors and the Relationship between Education and Health: The Role of Smoking and Obesity

4.1 Introduction

Chapter 2 revealed racial and ethnic variation in the relationship between education and self-rated health. At the pan-ethnic level, a consistent positive relationship between schooling and health was found across four groups: non-Hispanic Whites, Blacks, Hispanics, and Asians. However, there were significant differences across groups both in the strength of the relationship between education and self-rated health and in the absolute levels of self-rated health. At the national-origin subgroup level, group differences that were camouflaged in the pan-ethnic analysis, emerged. No longer was there evidence of a universal health benefit to additional schooling. For example, the positive effect of education on health was less pronounced for Mexicans compared to other Hispanic origin groups. Additionally, there was no apparent relationship between education and self-rated health for Vietnamese-origin respondents. Instead, I found that the likelihood of reporting good self-reported health for Vietnamese health was high at all levels of educational attainment.

Chapter 3 explored the mechanisms linking education and health. Health behaviors emerged as a key conduit through which education affects self-rated health. This chapter further investigates racial and ethnic differences in the relationship between education and health by building on the findings presented in the previous chapter. The present analysis seeks to explain *why* there are differences in the effect of education on self-rated health. Can introducing other explanatory variables help account for the differences across groups in the effect of education on

health? More specifically, does incorporating two key risk factors for disease and illness inform our understanding of the relationship between education and self-rated health?

4.2 Background

Two of the most prominent preventable risk factors for illness and disease in the United States are smoking and obesity (Cutler and Lleras-Muney 2010; Healton et. al. 2006; Jia and Lubetkin 2005; Jamal et. al. 2014). About one-third of all adults in the US are obese and close to one-fifth are current smokers (Solomon and Manson 1997; Jamal et. al. 2014). Both smoking and obesity are large contributors to premature death and general ill health/morbidity. They are strongly associated with increased incidence of many major illnesses, including cardiovascular disease, the most common cause of death in the United States.

Despite declines in smoking rates in the United States in recent years, smoking remains a leading cause of morbidity and premature mortality (Jamal et al 2014). Smoking is one of the leading risk factors for developing heart disease, the most common cause of mortality in the U.S. In fact, smoking doubles the risk of heart disease (Klesges et. al. 1989). Smoking increases the likelihood of developing lung cancer and many other types of malignancies and is a major risk factor for aortic aneurysm, emphysema and disability (Fenelon and Preston 2012; Jacobs et al 1999; Lederle et al 2003; Mirowsky and Ross 2003; Rogers et. al. 2000; Rogers et. al. 2005). Smoking is also associated with other unhealthy behaviors. For example, compared to those who do not smoke, smokers are more likely to binge drink and are less likely to exercise (Mehta and Preston 2012).

There is a strong relationship between education and smoking behavior. Those with higher levels of education are less likely to smoke and are more likely to quit smoking (Cutler

and Lleras-Muney 2010; deWalque 2007; Jamal et al 2014; Mirowsky and Ross 2003: 53-54; Pampel et. al. 2010; Sander 1995). One study estimates that each year of schooling reduces the probability of smoking by 3% (Cutler and Lleras-Muney 2010). Others find that those with lower levels of education are more likely to die from smoking-related cancers than are the more highly educated (Albano et al 2007).

Smoking also appears to be stratified by race/ethnicity. According to a recent report from the Centers for Disease Control (Jamal et al 2014), Asians in the US have the lowest smoking rates, at less than 10%. Hispanics also smoke at relatively low levels. About 12 percent of Hispanics smoked. There were, however, large gender differences in smoking for both Asians and Hispanics. 15% of Asian men smoked compared to only 5% of Asian women. Similarly, 17% of Hispanic men smoked compared to 7% of Hispanic women. Close to one-in-five blacks and non-Latino whites currently smoke (18 and 19 percent, respectively). The gender differences for these groups were less pronounced. The highest smoking rates in the US fell to the multiple race category (29%) and to a combination of indigenous peoples: American Indian/Native Alaskans (28%).

Obesity is a close second to smoking as an avoidable health risk factor in the U.S. Obesity is defined as having a body mass index (BMI), or weight-to-height ratio, that is equal to or greater than 30 kg/m^2. Rising levels of obesity are quickly becoming a global health crisis. This is especially true in the developed world, but extends into developing countries, as well (Dixon 2009). The prevalence of obesity over the last several decades has increased dramatically. It is estimated that more than one-third of the adult population in the US is obese (Dixon 2009; Solomon and Manson 1997).

Obesity is a major risk factor for many serious health problems and increased mortality. Being obese is associated with increased risk of coronary heart disease, high blood pressure, diabetes, stroke, and gastrointestinal disease (Dixon 2009, U.S. Department of Health and Human Services 2012, Solomon and Manson 1997). Obesity is also linked to increased risk for several cancers including endometrial, ovarian, cervical, breast, gallbladder, prostate and colorectal (U.S. Department of Health and Human Services 2012, Solomon and Manson 1997). Furthermore, obesity is associated with osteoarthritis, sleep apnea, obesity hypoventilation syndrome, reproductive problems and gallstones (U.S. Department of Health and Human Services 2012). Both physical and mental quality of life is lower for obese adults compared to non-obese adults (Jia and Lubetkin 2005). Finally, obesity increases the likelihood of suffering from psychological problems like depression, even after controlling for physical health conditions (Dixon 2009).

There is evidence that both socioeconomic status and race/ethnicity are related to the risk of obesity. In developed, high-income countries, higher socioeconomic status is associated with a lower likelihood of being obese (Houle 2013). For example, in the U.S., additional schooling is associated with a reduced likelihood of obesity (Cutler and Lleras-Muney 2010; Pampel et. al. 2010). However, not all of the evidence points to a socioeconomic gradient for obesity. For example, a recent report published from the CDC finds that increases in education and income reduces the likelihood of being obese for women, but not for men (Ogden et. al. 2010).

Racial/ethnic differences in obesity rates are more consistent across studies. There is ample evidence of an increased prevalence of obesity in Hispanic and black populations compared to whites in the U.S. (Buttenheim et al 2010; Center for Disease Control and Prevention: Adult Obesity Facts 2014; Solomon and Manson 1997; Flegal et. al. 2012). For

example, about one-third of non-Hispanic whites are obese (35%) compared to 50% of blacks (Flegal et. al. 2012). Hispanic women have considerably higher rates of obesity (41%) than do non-Latino white women (33%). Asian-Americans have the lowest rates of obesity in the U.S. (Center for Disease Control and Prevention: Adult Obesity Facts 2014).

In this chapter, I re-visit the relationship between education and health for nine racial/ethnic groups in the US to investigate whether the introduction of controls for smoking and obesity can help explain health returns to education. There are two ways to investigate how these risk factors might affect the relationship between education and health. First, it is possible that the inclusion of risk factors mediate the effect of education on health. That is, adding smoking behavior and obesity into the equation might reduce the effect of education on health for various race/ethnic groups. Therefore, the first research hypothesis that I test in this chapter predicts that:

> H1: The addition of risk factors, specifically smoking and obesity, attenuate the effect of education on health for various race/ethnic groups.

If the analysis supports an attenuation of the effect of education on health, then a second possibility to consider is that the introduction of risk factors impacts the effect of education on health differently across groups. That is, perhaps this hypothetical attenuated effect of education on health after controlling for risk factors operates differently by race/ethnicity group. Can risk factors help explain the race/ethnic variation in the effect of education on health? Therefore, the second research hypothesis examined in this chapter predicts that:

H2: Smoking behavior and obesity differentially affect the relationship between education and health by racial/ethnic groups.

Very few studies have examined whether risk factors, like smoking and obesity, help explain the relationship between education and self-rated health. And no studies, to my knowledge, have investigated the role that risk factors play in moderating the education-health relationship in racial and ethnic minority populations in the U.S.

4.3 Data and Method

Data

This chapter utilizes data from the National Institute of Mental Health Collaborative Psychiatric Epidemiology Surveys (CPES).[1] The dependent variable is self-rated physical health (SRH). The original variable is ordinal with respondents scoring their health on a five-item scale. Subjects choose from the following five responses to describe their overall physical health: excellent, very good, good, fair or poor. As is customary in the health literature, self-rated health is collapsed into a dichotomous variable that distinguishes fair or poor health (SRH=0) from excellent, very good or good health (SRH=1). Collapsing self-rated health into a dichotomous variable yields similar results to maintaining the ordinal nature of the variable with only a small reduction in the statistical power (Manor et. al. 2000).

Analyses are conducted separately by nine race/ethnic groups. Respondents identify themselves as belonging to the following nine racial or ethnic origin groups: Chinese,

[1] For a more detailed summary of the data, please refer to the data section of Chapter 2 pages 16-18.

Vietnamese, Filipino, Mexican, Puerto Rican, Cuban, Afro-Caribbean, African American, and non-Hispanic White. Each of these nine groups includes both US born and foreign born respondents.

The key independent variable is education. Education is a continuous measure for which respondents report the highest grade of completed schooling. This variable is bottom coded at 4 and top coded at 17. The mean education level across all groups is 12.6 and the standard deviation is 3.

Smoking and obesity are the two risk factors under investigation. The analysis to follow examines whether the inclusion of these variables mediates the relationship between education and health. Smoking is a dichotomous variable that distinguishes current smokers from non-current smokers, including former smokers.[2] Obesity is a dichotomous variable that distinguishes respondents whose body mass index (BMI) is greater than or equal to 30kg/meter^2. This is a standard obesity threshold. [3]

Many additional socio-demographic control variables are included in the analysis. Income is another key variable that is related to both education and health. Annual income is a continuous variable and ranges from 0-200,000. For ease in interpretation of results, income is divided by 1000 for the analyses. In its transformed form, the mean value of income is 46.7 (median of 32.5) with a standard deviation of 44.8 and a range of 0-200.

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[2] Some respondents from each racial/ethnicity group do not report their smoking status. These respondents are included in the analysis but flagged with a dummy variable indicating that their smoking status is missing. For the variable that indicates whether someone smokes, they are grouped with non-smokers (smoke =0). They are also assigned a 1 for the dichotomous variable indicating that their smoking status was actually missing.

[3] There are some respondents whose body mass index is not reported. Following the same procedures used for those whose smoking status was missing, I retained these individuals in the analysis and included a dummy variable indicating that their weight status was missing. That is, these individuals are grouped with the non-obese group in the obesity variable (obesity =0) and are also assigned a 1 for the dichotomous variable indicating that their BMI is missing.

A dichotomous variable measuring nativity is also included as an independent variable. Controlling for nativity is important given the abundance of research on the immigrant health advantage. In general, immigrants to the U.S. tend to have better health than their U.S.-born race/ethnic group counterparts, and in some cases even better than native-born whites. The health advantage, which is most pronounced for recent immigrants, is primarily attributed to two things. First, those who immigrate are in better health than those they leave in their sending region. In other words, immigrants are positively selected on health. Second, immigrants bring with them cultural practices and habits that are healthier than those they encounter in their destination. For example, the diet of recent immigrants is far healthier than longer term US residents.

There is a huge disparity in the percentage of each race/ethnic group in this sample who were born in the U.S. For example, 97% and 98 % of the White and African American subgroups, respectively, are U.S. born. However, only 3 % of the Vietnamese subgroup is U.S. born.

Age is included as a control variable to account for the effect of age on education. Because this effect of age on health is non-linear, both age and its square are included in the analyses to follow. Including age also allows me to capture, in a sense, some cohort differences. A dichotomous variable indicating sex is included in the analysis. Controlling for sex is important as it relates to risk factors and general health. In general, women enjoy better health and longevity than men. Furthermore, women are less likely than men to smoke. Finally, I include a dichotomous variable to account for marital status (marred or cohabitating versus not currently married or cohabitating). Marriage is generally regarded to be good for health (Hughes

and Waite 2009; Lillard and Waite 1995; Rogers 1995). Furthermore, marriage rates vary considerable by race/ethnicity in the U.S.

Table 4.1 presents the means and standard deviations for each variable used in the analyses by racial/ethnic group. The dependent variable, self-rated health is the first variable. The proportion reporting good or excellent health ranges from .68 for Mexicans to .89 for Filipinos. Years of schooling is reported on the second line. Mexicans, on average, have completed just 10.39 years of school compared to over 14 years for Chinese. Chinese in this sample are the least likely to smoke. The proportion of Chinese who are current smokers is .10. The proportion of African Americans and Puerto Ricans who smoke is more than two and a half times that of the proportion of Chinese (.27 and .28 for African Americans and Puerto Ricans, respectively). The difference between groups in obesity is even more striking. Only 3% of Vietnamese in this sample are obese. On the other end of the spectrum, more than one-in-three (36%) of African-Americans are obese. There is also quite a bit of disparity in income across groups. Filipinos and Chinese enjoy the highest annual incomes (around $82,000 and $77,000, respectfully). African Americans, on average, earn less than half of Filipinos and Chinese in this sample. Their average annual income is around $32,000.

Method

To begin, I investigate the bivariate relationship between the two key risk factors and self-rated health. That is, I calculate mean scores for reporting good or excellent health for each racial/ethnic group by their smoking status and again by their obesity status. I also provide an overview of the relationship between education and the two risk factors by racial/ethnic group.

Next, I delve into the core of the chapter and examine the relationship between education and health for various racial/ethnic groups in the U.S. while controlling for the key risk factors. Logistic regression analyses predicting the likelihood of reporting good, very good or excellent health are conducted. Models are estimated separately by nine racial/ethnic groupings. The first models, the baseline models, estimate the likelihood of reporting good health with the basic social and demographic control variables, including education. I then include a measure of smoking behavior to explore whether the addition of smoking mediates the effect of education on health. Next, I explore whether the addition of a measure of obesity helps explain the relationship between education and health. Finally, I consider the effect of education on health while including both key risk factors: smoking behavior and obesity.

4.4 Findings

To begin, I provide a summary of how the two key risk factors, smoking and obesity, are related to self-rated health for the nine racial/ethnic groups. Table 4.2 presents the bivariate relationship between smoking and self-rated health. The sample is split into two groups according to their current smoking behavior.[4] For each racial/ethnic group, I present the proportion who report good or excellent health for those who smoke and again for non-smokers. I also provide the sample size for both smokers and non-smokers. In this sample, whites, African Americans, Afro-Caribbeans, and Mexicans who do not smoke report better health than their smoking counterparts. However, the same cannot be said for the other groups. Cubans, Puerto Ricans, Chinese and Vietnamese who smoke are about as likely to report good health as their

[4] Table 4.2 includes only those for whom smoking behavior is known. In subsequent analysis later in this chapter, those whose smoking behavior is unknown are included. When included, I control for smoking status unknown to account for that missing information. N's across different tables will not be consistent because of this omission.

non-smoking same ethnicity counterparts. The differences in the proportions who report good health are not statistically significant for these groups. Finally, Filipinos, whether they smoke or not, are the most likely to report good health of any groups. In a strange twist, 88% percent of non-smoking Filipinos report good health compared to 92% of Filipinos who smoke. This difference, however, is not statistically significant.

Table 4.3 presents similar information to Table 4.2, but in this instance, respondents are divided on whether or not they are obese.[5] The relationship between obesity and self-rated health is apparent based on the findings from this bivariate analysis. Without exception, normal weight respondents report good or excellent health at higher rates than do the obese. This is true for all nine race/ethnic groups under investigation. The difference in proportion reporting good health is smallest for Chinese (.78 versus .74 and not statistically significant). But, recall that only 6% of the Chinese sample fall into the obese category. Because of this, it is difficult to draw conclusions on the relationship between obesity and health for Chinese. This is also the case for the Vietnamese sample, who have an extremely low incidence of obesity in these data. Again, the difference in the proportion of obese reporting good health and the non-obese reporting good health for Vietnamese is not significant. For all other race/ethnicity groups under investigation, the proportion reporting good health who are not obese is significantly higher than the proportion the corresponding proportion of obese respondents. The largest difference in proportion reporting good health by obesity status is found for Mexicans. Only 56% of Mexicans who are obese report good or excellent health. However 74% of Mexicans who are not obese report good or excellent health.

[5] Table 4.3 includes only those for whom BMI is known. In subsequent analysis later in this chapter, those whose obesity status is unknown are included. When those individuals are incorporated in the analysis, I include a dichotomous variable that indicates whether BMI information is missing. Sample sizes across different tables will not be consistent because of this omission.

Table 4.2 and 4.3 highlight the importance of including smoking and obesity in the analysis to follow. Table 4.2 reveals a differential effect of smoking behavior on health by racial/ethnic group. Perhaps the inclusion of smoking behavior might help explain the differences uncovered in the effect of education on health by race/ethnic groups. The results presented in Table 4.3 illustrate that including obesity may also help explain differences in the relationship between education and health by racial ethnic group. Although obesity was related to worse health for each racial/ethnic group, the incidence of obesity varied widely by group. The group-difference in rates of obesity coupled with the strong relationship between obesity and health make the inclusion of obesity important for exploring differential effects of education on health by race/ethnicity.

In addition to exploring how risk factors are related to health, it is also important to establish the connection between education and presence of risk factors. Table 4.4 provides an abbreviated look at multivariate logistic regression models that predict smoking and obesity, separately. This table presents only the coefficient for education for each racial/ethnicity group and for each risk factor. Each model also controls for age, age2, marital status, sex, income and birthplace. All coefficients are significant at the $p < .001$ level. Based on prior research, the negative and significant relationship between education and smoking is expected. I find that, without exception, for each racial/ethnic group, education is associated with significant reduction in the likelihood of being a smoker. The results for obesity are less straightforward. Despite a general trend toward lower obesity at higher levels of socioeconomic status in the United States, the analysis finds that the effect of education on obesity varies considerably across groups. As education increases for whites, African-Americans and Cubans, the likelihood of obesity decreases significantly. On the other hand, higher levels of education significantly increase the

likelihood of obesity for Afro-Caribbeans, Puerto Ricans, Mexicans, Vietnamese, Filipinos and Chinese. For both Vietnamese and Chinese, the very low numbers of respondents who are obese make these results less compelling. However, this finding in the four other groups requires some speculation. One consideration is the recency of immigration. In less developed countries, higher socioeconomic status is associated with higher levels of obesity (Houle 2013). It is possible that some of these respondents follow patterns more closely associated with their sending countries.

Turning now to the multivariate findings that use self-rated health as the outcome of interest, I am able to directly address the possibility that smoking and obesity mediate the effect of education on health. For each racial/ethnic group, I estimate four models. The first model estimates the effect of education on health net of the socio-demographic controls described in the variables section above. This provides a baseline model to examine how the effects of education on health change when risk factors are added. The second model adds information about smoking behavior. The third model estimates the effect of education on health net of the socio-demographic controls from model 1 and a measure of obesity. By adding smoking and obesity information to the base model (model 1) separately, as is done in models 2 and 3, I am able to easily compare the effects of each risk factor on the education-health relationship and compare across racial/ethnic groups. Finally, the fourth model, takes into account all of the socio-demographic controls from model 1, as well as both key risk factors: smoking behavior and obesity. The full regression results for the four models for each of the nine racial/ethnicity group can be found in Appendix Table 4.A1. Abbreviated results are presented in Table 4.5.

Table 4.5 describes the relationship between education and health across four models by nine racial/ethnic groups. Logistic regression coefficients for education, smoking and obesity are

all included, as is an indication of whether that coefficient is statistically different from zero at the .05 level. Education is positively and significantly related to better self-rated health for all groups for all models, except for Vietnamese. Turning first the results for whites, I find that the education coefficient is relatively high across models, ranging from .18 for model 1 to .16 for model 4. In other words, for every year of education, there is a significant increase in the likelihood of reporting good health. The logistic regression coefficients for both smoking and being obese are significantly and negative, indicating that each risk factor reduces the likelihood of reporting good or excellent health for whites. Similar patterns are found for both African Americans and Afro-Caribbeans. Education is associated with an increased likelihood of reporting good health (with coefficients for both groups at about half the magnitude of whites). Also similar to whites, smoking and obesity are independently related to a reduced likelihood of reporting good health for African Americans and Afro-Caribbeans.

Vietnamese in this sample follow a different pattern. The coefficient for education for Vietnamese is not significant in any of the four models. That is, there is no relationship between education and self-rated health for Vietnamese. Smoking is moderately associated with a lower probability of reporting good health. In Model 2, which adds smoking to the sociodemographic model, the coefficient for smoking is negative and reaches statistical significance. However, obesity is not related to self-rated health for Vietnamese. It is difficult to draw conclusions about obesity in the Vietnamese sample, however, since the number of respondents who are considered obese is very low (less than 3%). In Model 4, which includes controls for obesity and smoking, the smoking coefficient reduces slightly (from .64 to .63 with the standard error holding steady at .35).

The other two Asian-ancestry groups, Chinese and Filipinos, enjoy a significant and positive effect of education on health across all four models at roughly the same magnitude. The logistic regression coefficients for education for Chinese and Filipinos range from .10 to .11. Smoking is not associated with worse self-rated health for either of these groups (the coefficients representing smoking are not statistically significant). For Filipinos, being obese significantly reduces the likelihood of reporting good health. This is true for both models that include smoking behavior and those that do not. Obesity is not associated with self-rated health for the Chinese subgroup.

The three Latino groups consistently enjoy significant health returns to education. The coefficients for education are significant and positive across all four models for each group. For Mexicans and Cubans, both smoking *and* obesity are associated with a lower likelihood or reporting good health. This is true in models where each risk factor is considered independent of the other (Models 2 and 3) and where both risk factors are included (Model 4). Like Mexicans and Cubans, Puerto Ricans who are obese are significantly less likely to report good health. However, smoking, is not related to a lower likelihood of reporting good health for Puerto Ricans. The non-relationship between smoking and health for Puerto Ricans represents a deviation from the other two Latino groups under investigation.

In summary, the results presented in Table 4.5 point to a consistent relationship between education and health before and after the introduction of risk factors. This is true for all groups, whether or not the effect of education is significant. This is also true whether or not the effect of smoking or obesity is significantly related to health. While risk factors are important predictors of health and are statistically significant in many instances, they do nothing to attenuate, or to strengthen, the relationship between education and health for any group. Therefore, I find no

evidence in support for the first hypothesis (H1) that controlling for two key risk factors – smoking and obesity – will reduce the impact of education on self-rated health.

The effect of education on health is remarkably consistent across models before and after the inclusion of risk factors. Therefore, there is no support for the second hypothesis (H2) that risk factors differentially impact the effect of education on health across racial/ethnic groups. That is, there is no notable effect of smoking and/or obesity on the effect of education on health for any group.

4.5 Conclusion

Results indicate that including risk factors does not substantially reduce the relationship between education and health for any race/ethnic group under investigation. This examination, that includes smoking and obesity in the models, however, provides a fuller picture of relationship between education and self-rated health. Although the risk factors do not mediate the relationship between education and self-rated health, they are related to both education and health and their prevalence varies quite a bit across groups. Therefore, for many groups, models in this chapter that include measures of these risk factors better estimate the effect of education on health.

Many groups enjoy a significant improvement in model fit between the base socio-demographic model (Model 1 in Table 4.A1) and the full risk factors model (Model 4 in Table 4.A1). Comparing model fit across models for whites, for example, results in a likelihood ratio of 59.15 with 4 degrees of freedom, which is significant at the .001 level. African-Americans, Afro-Caribbeans, Mexicans and Cubans also enjoy significant (at the .001 level) model fit improvement when comparing log likelihood.

However, the addition of these particular risk factors did not significantly improve model fit for several groups. Neither the Chinese nor the Vietnamese enjoy improved model fit by inclusion of smoking and obesity information. Given that the effect of obesity on self-rated health is not significant for either of these national-origin groups and that the effect of smoking is not significant for Chinese and is only borderline significant for Vietnamese (at the .10 level), this finding is not significant. [6] Finally, the inclusion of smoking and obesity only slightly improves model fit for Puerto Ricans and Filipinos. The log likelihood ratios for these groups are significant at the .10 level.

The main findings that health risk factors, while often significant predictors of self-rated health, do not attenuate the relationship between education and health for any race/ethnicity groups under investigation is in line with prior research in this arena. For example, Lantz and colleagues (1998) report that risk factors do not explain the SES-mortality gradient for blacks and non-blacks in the U.S. However, this analysis moves beyond a simple comparison between two groups. For all nine groups under investigation, I consistently find that including smoking behavior and obesity does little to impact the effect of education on health. The story does not end here, however. There were interesting differences across groups in the effect of education on risk factors and the effect of risk factors on health. For example, education is negatively associated with the likelihood of smoking for all racial/ethnic groups. However, education reduces the likelihood of being obese for some groups and increases it for others. Furthermore, the effect of these risk factors on health varied across groups.

Of course, like all studies, this one has limitations that need to be acknowledged. First, obesity measures are being reevaluated. While BMI is the commonly used indicator of obesity,

[6] The likelihood ratio, which compares the 2 log likelihood values for the base model (Model 1) and the full model (Model 4) does not reach statistical significance for either of these groups.

and its use in this analysis allows for comparability across studies, it may not be the best indicator of obesity. Central obesity, a measurement based on waist circumference, is likely a better measure of obesity and predictor of health (Solomon and Manson 1997). However, data on waist circumference is not, yet, often collected and therefore is not widely used in analyses to date.

Additionally, despite using a very ethnically diverse sample, this analysis only controls for whether or not a respondent was born in the U.S. There are clear differences between the first, second, and higher generations of immigrants that we are unable to explore here. For example, research points to a decline in the immigrant health advantage as length of residence in the U.S. increases. This is especially true as you move into the second and third generation of immigrants. After spending time in the U.S., immigrants, and their children, begin to adapt to U.S. diet and activities which worsens health. This acculturation process is especially evident around incidence of obesity (Cunningham et al 2008). Also, some immigrant groups experience a downward assimilation into disadvantaged segments of American society (Acevedo-Garcia et al 2010; Cunningham et al 2008). This negatively impacts health as well as other outcomes. Future research might delve more deeply into the role of immigrant generation, or length of residence, on the mediating effects (or lack of effects) of health risk factors.

It is also imperative to acknowledge the complicated relationship between the two risk factors under investigation. Both smoking and obesity are bad for health. However, those who smoke are less likely to be obese. In general, smokers tend to weigh less than non-smokers. People who initiate smoking tend to lose weight and people who cease smoking tend to gain weight (Klesges et at 1989). Although this observation does not limit the work presented, it does leave space for future research aimed at reducing risk factors for illness and disease.

Prior chapters in this dissertation showed that the relationship between education and health varies across racial/ethnic groups. The goal of the current chapter is to investigate *why* these differences occur. On the whole, the findings reported here do little to explain why the relationship between education and health varies across groups. The introduction of two key risk factors, smoking and obesity, help explain the variation in health within groups. In fact, their inclusion significantly improve model fit for many groups. However, the introduction of these risk factors fails to affect the effect of education on health for any racial group (as was proposed by the first hypothesis). Across the board, there was no change in the effect of education on health after the introduction of smoking and/or obesity. As such, there was no difference in the effect of these risk factors on the education-health relationship across groups to explore. Nonetheless, the findings in this chapter add to the growing body of literature on both socioeconomic and racial/ethnic health disparities.

This chapter begins by recounting that the relationship between education and health varies across racial/ethnic groups. Overall, I consistently find that including health risk factors does not appreciatively change the relationship between education and self-rated health for any group. And, although I do not find a differential effect of obesity or smoking on the relationship between education and health across groups, the results clearly indicate that the presence of these risk factors impacts groups differently.

4.6 Summary

In this chapter, I investigated the role that two major health risk factors, obesity and smoking, play in the complicated relationship between education and health. I consider whether smoking, obesity or both alter the relationship between education and health for any race/ethnic

group. I also consider whether smoking behavior, obesity or both risk factors differentially effect the relationship between education and health across groups.

Using logistic regression to predict self-rated health, I find that including risk factors does not impact the relationship between education and health. This was a consistent finding for all groups under investigation. Therefore, these risk factors do not differentially impact the relationship between education and health across groups. Despite this consistent finding of no-effects, ample variation emerged. Education is significantly associated with a lower likelihood of smoking for all groups. However, smoking is only associated with worse health for some groups. Furthermore, education reduces the likelihood of obesity for some, but reduces it for others. And, obesity is associated with worse self-rated health for some but not all groups. These findings point to a complicated relationship between education, risk factors and health that varies considerably across racial/ethnic groups.

Table 4.1. Mean values (and standard errors in parentheses) for variables used in analysis, by race/ethnic group.

	White		African American		Afro-Caribbean		Cuban		Puerto Rican	
Proportion in Good Health	.80	(.40)	.78	(.41)	.84	(.37)	.76	(.43)	.71	(.45)
Years of Schooling	13.23	(2.51)	12.35	(2.50)	13.06	(2.79)	12.16	(3.69)	11.76	(3.04)
Proportion who Smoke	.16	(.36)	.27	(.45)	.13	(.33)	.20	(.40)	.28	(.45)
Proportion Obese	.25	(.43)	.36	(.48)	.24	(.43)	.22	(.41)	.30	(.46)
Age	47.22	(17.68)	42.76	(16.32)	40.91	(15.43)	48.83	(16.89)	41.01	(15.42)
Proportion Female	.60	(.49)	.65	(.48)	.61	(.49)	.52	(.50)	.57	(.50)
Income (Divided by 1000)	52.33	(43.15)	32.01	(29.53)	41.66	(33.88)	51.20	(53.22)	50.15	(48.80)
Proportion Married	.53	(.50)	.35	(.48)	.43	(.49)	.61	(.49)	.55	(.50)
Proportion US Born	.97	(.18)	.98	(.14)	.27	(.44)	.13	(.34)	.56	(.50)
N	1761		3588		1378		576		494	

	Mexican		Vietnamese		Filipino		Chinese	
Proportion in Good Health	.68	(.47)	.77	(.42)	.89	(.32)	.78	(.42)
Years of Schooling	10.39	(3.55)	12.17	(3.74)	13.79	(2.80)	14.06	(3.14)
Proportion who Smoke	.17	(.38)	.15	(.36)	.15	(.36)	.10	(.31)
Proportion Obese	.31	(.46)	.03	(.16)	.14	(.35)	.06	(.23)
Age	36.54	(13.65)	43.01	(14.72)	41.93	(16.11)	41.62	(14.03)
Proportion Female	.55	(.50)	.53	(.50)	.54	(.50)	.53	(.50)
Income (Divided by 1000)	38.94	(39.04)	53.11	(51.37)	81.58	(57.52)	76.83	(63.09)
Proportion Married	.70	(.46)	.74	(.44)	.68	(.47)	.69	(.46)
Proportion US Born	.46	(.50)	.03	(.18)	.31	(.46)	.21	(.41)
N	916		519		507		598	

Table 4.2: Values of self –rated health for smokers versus non-smokers, by race/ethnicity group

	Non-Smokers			Current Smokers		
	N	Mean	St. Dev	N	Mean	St Dev
White	622	.82	.38	273	.71	.46
African American	2603	.81	.39	980	.71	.45
Afro-Caribbean	1201	.85	.36	175	.77	.42
Cuban (NS)	458	.77	.42	118	.75	.44
Puerto Rican (NS)	354	.70	.46	140	.73	.45
Mexican	758	.70	.46	158	.61	.49
Vietnamese (NS)	440	.77	.42	79	.77	.42
Filipino (NS)	431	.88	.33	76	.92	.27
Chinese (NS)	536	.78	.41	62	.77	.42

Note: Differences between proportion reporting good health for non-smokers and smokers are significant at the $p < .05$ level except where indicated by (NS).

Table 4.3: Values of self –rated health for obese versus non-obese, by race/ethnicity group

	Not Obese			Obese		
	N	Mean	St. Dev	N	Mean	St Dev
White	1283	0.84	0.36	439	0.68	0.47
African American	2205	0.81	0.39	1285	0.73	0.44
Afro-Caribbean	1008	0.87	0.34	334	0.75	0.44
Cuban	451	0.79	0.41	124	0.65	0.48
Puerto Rican	341	0.75	0.43	149	0.62	0.49
Mexican	613	0.74	0.44	288	0.56	0.50
Vietnamese (NS)	503	0.78	0.42	13	0.62	0.51
Filipino	426	0.90	0.30	73	0.78	0.42
Chinese (NS)	561	0.78	0.41	35	0.74	0.44

Note: Differences between proportion reporting good health for normal weight and obese are significant at the $p < .05$ level except where indicated by (NS).

Table 4.4: The effect of education on smoking and obesity.

	Predicting Smoking		Predicting Obesity	
	Coefficient	N	Coefficient	N
White	-.243	895	-.059	1722
African American	-.103	3583	-.065	3490
Afro-Caribbean	-.121	1376	.020	1342
Cuban	-.074	916	-.063	901
Puerto Rican	-.110	494	.016	490
Mexican	-.047	576	.018	575
Vietnamese	-.187	519	.193	516
Filipino	-.085	507	.035	499
Chinese	-.101	598	-.048	598

Note: All coefficients are significant at $p < .001$ level. Models include controls for age, age2, marital status, sex, income and U.S. birthplace.

Table 4.5: Abbreviated results from logistic regression models predicting good health by race/ethnic groups.

WHITE	Model 1	Model 2	Model 3	Model 4
Education	0.18*	0.17*	0.17*	0.16*
Current Smoker		-0.40*		-0.48*
Obese			-0.77*	-0.84*
AFRICAN AMERICAN				
Education	0.09*	0.09*	0.09*	0.08*
Current Smoker		-0.40*		-0.46*
Obese			-0.42*	-0.47*
AFRO-CARIBBEANS				
Education	0.08*	0.07*	0.08*	0.08*
Current Smoker		-0.47*		-0.44*
Obese			-0.79*	-0.80*
VIETNAMESE				
Education	-0.03	-0.04	-0.03	-0.04
Current Smoker		-0.64*		-0.62†
Obese			-1.00	-0.95
FILIPINOS				
Education	0.10*	0.11*	0.10*	0.10*
Current Smoker		0.52		0.42
Obese			-1.04*	-1.00*
CHINESE				
Education	0.11*	0.11*	0.11*	0.11*
Current Smoker		-0.27		-0.29
Obese			-0.60	-0.60
MEXICAN				
Education	0.13*	0.13*	0.13*	0.13*
Current Smoker		-0.44*		-0.46*
Obese			-0.74*	-0.75*
CUBAN				
Education	0.14*	0.14*	0.15*	0.15*
Current Smoker		-0.57*		-0.63*
Obese			-0.85*	-0.88*
PUERTO RICAN				
Education	0.18*	0.18*	0.19*	0.19*
Current Smoker		0.04		-0.01
Obese			-0.60*	-0.60*

Note: Coefficients above were selected from the full logistic regression models which include the following controls, not reported here: Age, Age2, Married, Sex, Income, and US Born. See Table A1 in the appendix for full regression results.

* p< .05 ; † p < .10

Chapter 5. Conclusion

5.1 Recap

Socioeconomic differences in health have long captured the attention of scholars. As such, there is a large body of research devoted to the education-health gradient. Surprisingly, relatively few studies have explored racial/ethnic differences in the effect that education has on health. Those that have, describe a murkier relationship than had previously been demonstrated. Results from these studies have been mixed. Nevertheless, taken as a whole, these findings cast doubt on the universality of the education-health gradient. This dissertation enters these murky waters and attempts to provide some clarity into the relationship between education and health for racial/ethnic minority groups in the United States. This conclusion reviews the findings from the previous chapters and describes how this current scholarship contributes to the growing literature devoted to socioeconomic differences in health.

Chapter Two examines the effect of education on health across racial/ethnic groups in the U.S. I begin by asking if there are differences across groups at the pan-ethnic level. Results confirm a positive association between education and health for white, blacks, Hispanics and Asians. I find, for example, a significant difference between the likelihood of reporting excellent or good health for college graduates compared to high school graduates for all group. However, I uncover some interesting differences in health returns to education across groups. Whites, for example, enjoy the largest increase in the probability of reporting good health between the lowest and highest education category. Asians, on the other hand, gain the least. At low levels of education, the likelihood of reporting good health for Asians is relatively high, considerably higher than the other three race/ethnic groups. But, as they move through the education ranks, the likelihood of reporting good health increases only slightly.

After my examination using broad racial/ethnic categories, I investigated the effect of education on health using national-origin groups and revealed substantial sub-group differences. I find that African Americans who complete college enjoy significantly better health compared to their high school graduate counterparts. The likelihood of reporting good health increases slightly as African Americans move through the four education increments in this chapter. The picture for Afro-Caribbeans, however, is quite different. I find a significant increase in the likelihood of reporting good health for Afro-Caribbean high school graduates compared to Afro-Caribbeans who do not complete high school. Education beyond high school does nothing to improve health for this group. These striking differences in the education-health gradient between African Americans and Afro differences were masked in the pan-ethnic analysis.

Using a more detailed definition of race/ethnic groups, I divide Hispanics and Asians into three groups each. In the national-origin analysis Mexicans, Puerto Ricans and Cubans all enjoy positive health returns to education. Puerto Ricans, however, enjoy the largest increase in the probability of reporting good health when moving from the lowest to the highest education category. Perhaps enjoying U.S. citizenship contributes to the stronger association between education and health for Hispanics of Puerto Rican heritage. Mexican high school graduates enjoy a sizable improvement in health compared to those who did not complete high school. The education gradient for Mexicans after high school, however, is relatively flat.

Dividing Asians into three national-origin groups for analysis reveals three different stories. Chinese enjoy modest improvements in health as education increases. The difference between the lowest and highest education categories is statistically significant. The effect of education on health for Filipinos is greatest when comparing those in the lowest educational category to Filipinos with a high school diploma. Additional education beyond high school is not

associated with any increases in health. However, the likelihood of reporting good health for Filipinos with a high school degree is the highest of all national-origin race/ethnic groups. Finally, Vietnamese enjoy no health benefit to education. By studying each national origin groups separately, I demonstrate that the effect of education varies greatly across groups and within the larger pan-ethnic categories typically used by social science researchers. These differences are camouflaged when I relied on the pan-ethnic groupings.

In Chapter Three, I use structural equation modeling to investigate how education improves health for whites, African American and Afro-Caribbeans. I find that health behaviors, as measured by smoking, frequency of walking and frequency of exercise, mediate the relationship between education and health for all groups. For all three groups, education increases income and increases the sense of personal control. Income also increases personal control across groups. Personal control is associated with health behaviors which, in turn, is the final link to improved self-rated health.

I begin by identifying the casual pathways for each group. Then, I ask if there are differences in the relationship between education and health across groups. For the most part, I find that the pathways linking education and health are similar across groups, but some differences do emerge. I report a direct effect of education on health behaviors for whites and for African Americans. I do not find support for a direct effect of education on health behaviors for Afro-Caribbeans, however. I also uncover sizable differences in the magnitude of the effects across groups. For example, the direct effect of education on health behaviors for African Americans is just 60% the effect for whites. When examining total effects, I find the effect of education on health for Afro-Caribbeans is only half of the total effect for African Americans (.15 versus .30) and less than half the total effect for whites (.35). This weaker effect of

education on health for Afro-Caribbeans noted here is consistent with the results presented in the second part of Chapter Two.

After demonstrating that health behaviors serve as key mediators between education and health in Chapter Three, I turn my attention to health risk factors. In Chapter Four I ask if health risk factors help explain the effects of education on health across the national-origin groups identified in Chapter Two. I identify smoking and obesity as two of the most pronounced preventable risk factors for disease and illness in the United States.

I begin by establishing a relationship between education and the two risk factors. I find that as education increases, the likelihood of smoking decreases. This finding is statistically significant without exception across all groups. The same cannot be said for education and obesity. For some groups, I find that education decreases the likelihood of being obese and for others education increases the risk of obesity. I suspect that for members of newer immigrant groups, the association between socioeconomic status and obesity is more in line with trends in their sending countries. Research indicates that in less developed countries, socioeconomic status is associated with higher levels of obesity (Houle 2013).

For the most part my analysis reveals that both smoking and obesity are associated with a lower probability of reporting good health. This finding is consistent with prior research and common sense. The inclusion of smoking and obesity, however, does little to affect change in the relationship between education and health for any group. That is, I find no support of a mediating effect of either smoking or obesity on the relationship between education and health.

As a whole, this project demonstrates that the relationship between education and health is complex. When examined at the pan-ethnic level, as is done by most, the education gradient in health is, for the most part, confirmed. Additional schooling is associated with better health.

My analysis, however, moves beyond pan-ethnic groupings into more appropriate national-origin categories. By breaking down the pan-ethnic categories into more specific groups, I find that there is a fair amount of heterogeneity within the larger groups. This project also identifies health behavior as a key mediating variable between education and health for white, African Americans and Afro-Caribbeans in Chapter Three. I do not find that health risk factors, however, attenuate the effect of education on health for any racial/ethnic group in Chapter Four. The findings from this project provide some important insight into the relationship between education and health and have implications for future research.

5.2 Contributions, Limitations and Future Research

Both the results I presented and the limitations I faced provide opportunities for future research. First, my finding of variation in the effect of education on health revealed in my national-origin level analysis that was camouflaged in the pan-ethnic analysis deserves additional attention. As social scientists, we understand the pitfalls at failing to account for intragroup heterogeneity. Chapter Two demonstrates that moving away from pan-ethnic groupings into more specific national-original race/ethnicity subgroups uncovers substantial variation between the groups comprising the larger categories. However, analyses at the pan-ethnic level are standard practice. What else are we missing by so broadly grouping subjects? Unfortunately, the data set used in this analysis is unique. It is unusual to find datasets with a sufficient sample size for national-origin groups. Collecting data that includes national origin information seems warranted. And, when available, researchers should consider moving beyond pan-ethnic categories in favor of more specific national-origin groupings.

I find some subtle differences in the mechanisms linking education and health across groups in Chapter Three. The lack of a direct effect of education on health behaviors for Afro-Caribbeans differed from my other two groups. Data necessary to conduct this analysis was not available for Hispanic and Asian subgroups and therefore my analysis was limited to whites, African Americans and Afro-Caribbeans. It would be useful to explore the mechanisms across more racial/ethnic groups to see what emerged. Nevertheless, the dataset used in this dissertation is cross-sectional. That is, data are collected at one time point. It is difficult to assess causal assumptions using cross-sectional data. Datasets that collect data at multiple time points and follow people over several years or even decades have the potential to tell a very rich story and to tease apart causal processes. As it relates to the education gradient in health, longitudinal data might capture how early health contributes to educational outcomes. Longitudinal data might also explore changes in the effect of education on health over time.

My finding of no mediating effect of smoking or obesity on health returns to education was consistent across all groups. This is an interesting result given that education is related to health risk factors and that risk factors are, not surprisingly, related to health. However, the addition of health risk factors did not inform the relationship between education and self-rated health. One limitation of this project is my grouping of men and women in the analysis and simply controlling for sex of respondent. The process underlying the education-health gradient may very well operate differently for men and women. However, I am unable to run sex-specific analyses while maintaining my national-origin race/ethnic categories due to sample size limitations. Future research exploring differences in the effect of education on health by sex and across race/ethnicity would add greatly to our understanding of health disparities. Incorporating risk factors in a sex stratified sample might also yield different results than I present in Chapter

Four. Another limitation is my inability to tease out differences among first generation, second generation and third generation and higher immigrants. In this analysis, I focus on racial/ethnic differences and control for U.S. birthplace. An investigation into how the effect of education on health varies across generations of immigrants would be an interesting endeavor. Given our understanding of the acculturation process, I suspect the educational gradient for third and higher generation immigrants would approach the expected positive slope that we saw for whites and African Americans in Chapter Two.

Future research may also consider incorporating a spatial component to the analysis. It would be interesting to consider the influence of the respondents' residential community. Neighborhood conditions and attributes, such as access to quality health care professionals and facilities or access to healthy food, would be an interesting addition to the study of racial/ethnic variation in the education-health gradient.

Finally, this dissertation relies on self-rated health as the dependent variable throughout the analyses. Self-rated health is an item that is commonly used and is a proven predictor of morbidity and mortality (Idler and Benyamini 1997; McGee et al 1999; Schnittker and Bacak 2014). Research indicates that its validity extends across race/ethnic groups (McGee 1999). The abundance of evidence on the efficacy of self-rated health in predicting mortality coupled with the ease with which the measure can be obtained in surveys, resulted in self-rated health becoming a widely used and accepted health indicator. However, there is some evidence that there may be intricacies to the measure that warrant further exploration. For example, one study finds that self-rated health predicts mortality more accurately after longer periods of acculturation in the US for Latino immigrants (Finch et. al. 2002). Also, research into what information a respondent references to rate their health varies across groups (Krause and Jay

1994). For example, older individuals rate their health based on the presence or absence of health problems whereas younger individuals rely on health behaviors to guide their response. Findings from this same study suggest subtle variations by race (whites rely on general physical functioning when non-whites rely on health problems) and by education level (less education tend to rate health based on health behaviors more than other factors) (Krause and Jay 1994). While these findings, especially with regards to education and race, were suggestive and not conclusive, they still present a challenge for future research to explore.

5. 3 Conclusion

In the opening paragraphs of this dissertation, I summarized the project's direction by posing two questions that guided my work. One, does education affect health equally across racial/ethnic groups? And, two, are the intervening variables connecting education and health operating equivalently across groups? This dissertation addressed these questions by utilizing data that allowed an examination of racial/ethnic groups at a more appropriate national origin level. I find that education does not equally affect health across groups. Although the true variation in the health effects of education is masked in the pan-ethnic analysis, my more detailed approach reveals significant and important variation across groups. I find, for the most part, that the mechanisms linking education and health are more similar than they are dissimilar.

After answering these two questions, I am left with a final question: Why does any of this matter? Health disparities have long been of interest to demographers and other social scientists. However, the amount of public attention that disparities in health are starting to receive is

unprecedented. The rising mainstream interest in health disparities comes at a time when income inequality and wealth disparity are also rapidly becoming headline news. Over the past few decades, socioeconomic disparities as well as health disparities have increased. Our society is faced with growing socioeconomic gaps which may serve to continue to accentuate health disparities over time. Gains in socioeconomic standing, for many groups, results in better health. Therefore, restricted opportunities to improving socioeconomic status, through education, for example, will likely contribute to continued health disparities.

This dissertation revealed unequal health returns to education by racial/ethnic groups. For example, some groups enjoy good self-rated health despite low economic standing. This has long been noted for Mexican immigrants to the United States. This paper suggests a similar finding for Vietnamese immigrants, who enjoy good self-rated health regardless of their educational attainment. Identifying how low SES groups obtain favorable health outcomes would inform our understanding of how to reduce health disparities for other low-SES populations. Additionally, investigations into how education improves health for those who enjoy health benefits from additional schooling will contribute to our knowledge of how education improves health. Taken together, information gleaned from both of these cases can help policy makers provide programs and initiatives tailored to underserved populations in an effort to reduce and eventually eliminate socioeconomic and racial/ethnic health disparities.

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APPENDIX Table 2.A1: Bivariate relationship between Education and Health by Race/Ethnic Groups and Subgroups

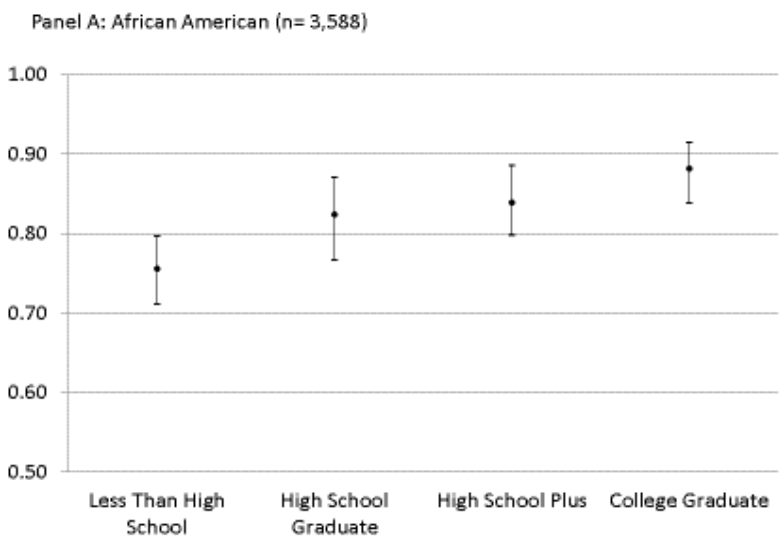
	Less Than High School				High School Graduate			
	SRH	St. Dev	N	%	SRH	St. Dev	N	%
White	**1.92**	**.09**	**279**	**15.8%**	**2.25**	**.05**	**575**	**32.7%**
Black	**2.13**	**.04**	**1182**	**23.8%**	**2.46**	**.03**	**1747**	**35.2%**
African American	2.41	.02	929	25.9%	2.44	.03	1343	37.4%
Afro-Carribean	2.2	.26	254	18.4%	2.72	.05	404	29.3%
Hispanic	**2**	**.05**	**1047**	**37.3%**	**2.32**	**.05**	**717**	**25.5%**
Mexican	1.97	.08	458	50.0%	2.3	.07	232	25.3%
Puerto Rican	1.85	.09	171	34.6%	2.29	.1	140	28.3%
Cuban	2.05	.09	177	30.7%	2.55	.09	136	23.6%
Asian	**2.19**	**.09**	**316**	**15.0%**	**2.34**	**.08**	**371**	**17.6%**
Vietnamese	2.15	.12	152	29.3%	2.25	.1	115	22.2%
Filipino	2.21	.2	53	10.5%	2.52	.08	97	19.1%
Chinese	1.91	.11	85	14.2%	2.03	.14	95	15.9%

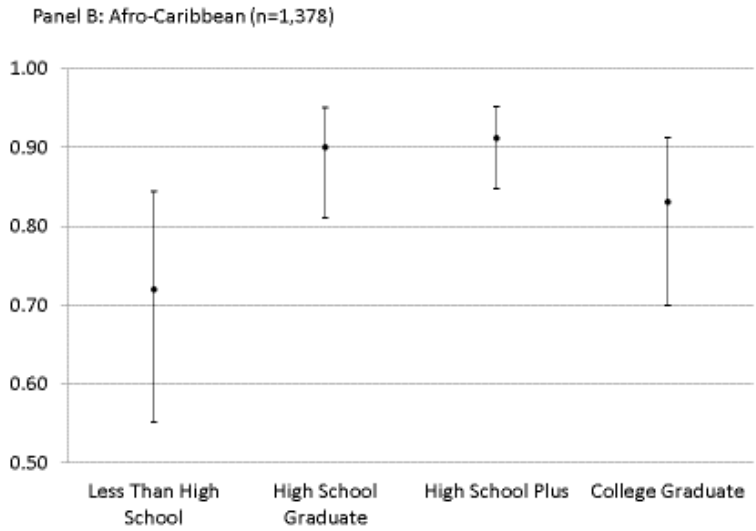
	More than High School				College Graduate or Higher				*Total*
	SRH	St. Dev	N	%	SRH	St. Dev	N	%	*N*
White	**2.39**	**.06**	**454**	**25.8%**	**2.71**	**.05**	**453**	**25.7%**	***1761***
Black	**2.52**	**.03**	**1205**	**24.3%**	**2.65**	**.03**	**831**	**16.7%**	***4965***
African American	2.5	.04	830	23.1%	2.66	.03	486	13.5%	*3588*
Afro-Carribean	2.76	.07	374	27.1%	2.61	.14	346	25.1%	*1378*
Hispanic	**2.42**	**.05**	**643**	**22.9%**	**2.64**	**.06**	**401**	**14.3%**	***2808***
Mexican	2.32	.07	157	17.1%	2.44	.15	69	7.5%	*916*
Puerto Rican	2.49	.1	123	24.9%	2.88	.11	60	12.1%	*494*
Cuban	2.5	.16	120	20.8%	2.77	.11	143	24.8%	*576*
Asian	**2.48**	**.05**	**533**	**25.3%**	**2.63**	**.04**	**885**	**42.0%**	***2105***
Vietnamese	2.19	.1	129	24.9%	2.63	.1	123	23.7%	*519*
Filipino	2.59	.07	168	33.1%	2.68	.08	189	37.3%	*507*
Chinese	2.26	.1	116	19.4%	2.46	.07	302	50.5%	*598*

Note: The N for Hispanic and for Asian is greater than the sum of Ns of their subgroups. In addition to Mexicans, Puerto Ricans and Cubans, the Hispanic category includes 822 "Other Hispanics". This group is not included in the more detailed analysis. Similarly, the Asian category contains 481 "Other Asians".

APPENDIX Table 2.A2: Confidence Intervals around Estimates of Predicted Probabilities of Reporting Good Health presented in Figures 3-5

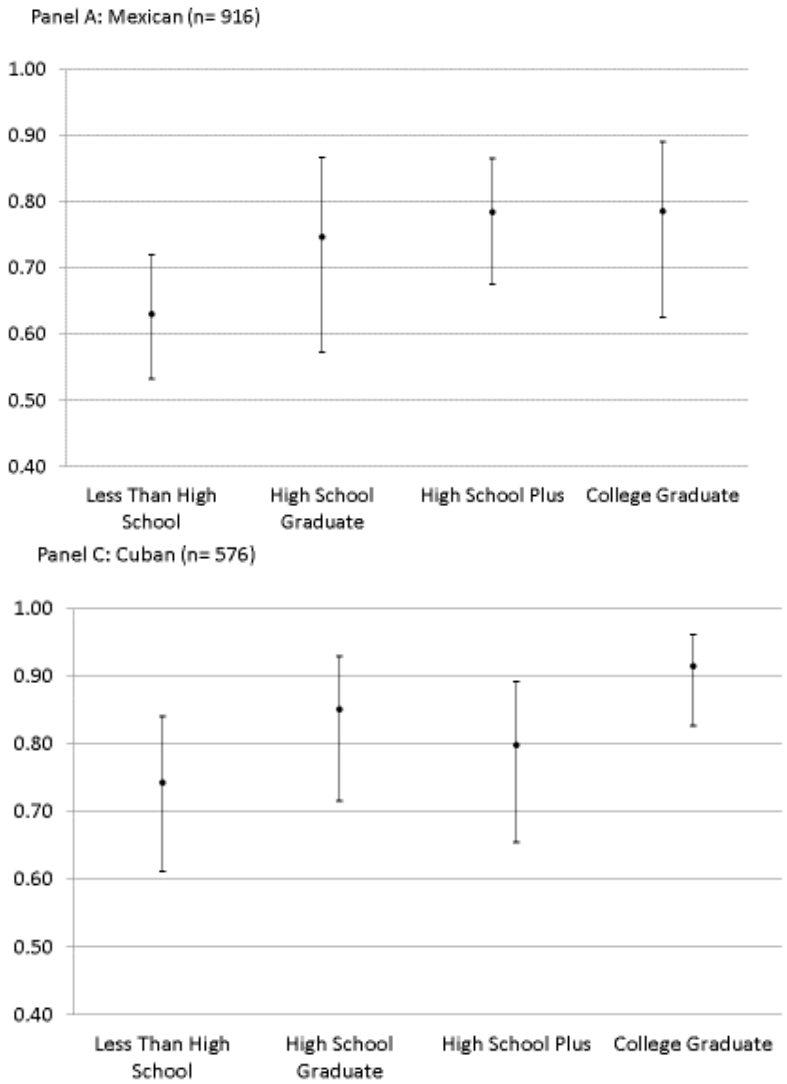
	Less Than High School			High School			High School Plus			College Graduate		
	Lower	*Point Estimate*	*Upper*	*Lower*	*Point Estimate*	*Upper*	*Lower*	*Point Estimate*	*Upper*	*Lower*	*Point Estimate*	*Upper*
Figure 3												
African American	.71	.76	.80	.77	.82	.87	.80	.84	.89	.84	.88	.91
Afro-Caribbean	.55	.72	.84	.81	.90	.95	.85	.91	.95	.70	.83	.91
Figure 4												
Mexican	.53	.63	.72	.57	.75	.87	.67	.78	.86	.62	.79	.89
Puerto Rican	.51	.65	.77	.50	.72	.87	.67	.80	.89	.81	.92	.97
Cuban	.61	.74	.84	.71	.85	.93	.65	.80	.89	.83	.92	.96
Figure 5												
Vietnamese	.71	.83	.91	.60	.80	.91	.59	.75	.87	.57	.77	.90
Filipino	.58	.79	.91	.78	.91	.96	.81	.92	.97	.82	.92	.97
Chinese	.55	.73	.86	.62	.78	.89	.66	.82	.91	.71	.85	.93





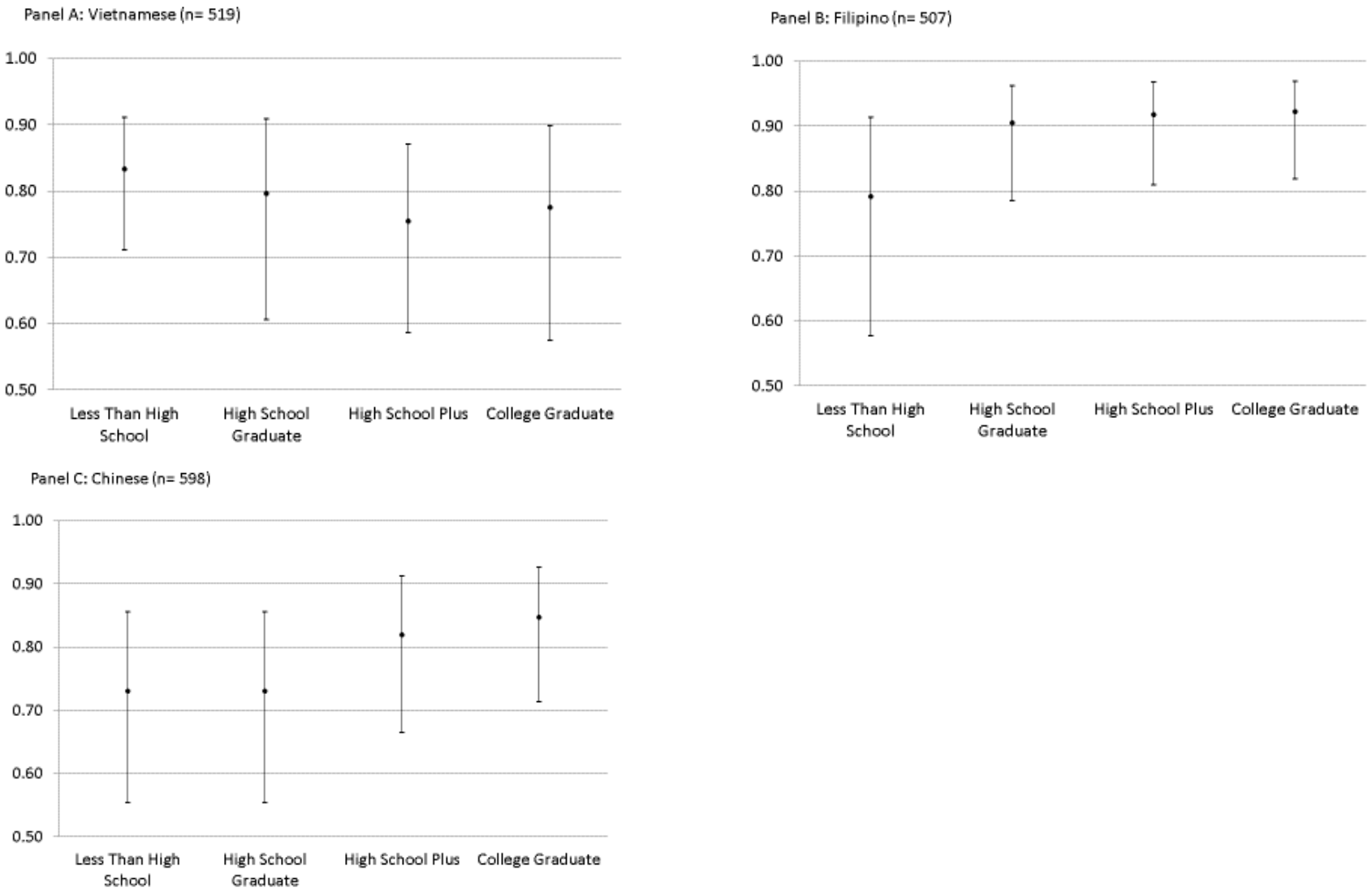
Appendix Figure 2.A1: Predicted Probabilities of Reporting Good Health by Educational Attainment, Blacks, with 95% confidence intervals.

Note: Models run separately by race/ethnic group and includes controls for sex, age, age^2, marital status, income and nativity.



Appendix Figure 2.A2: Predicted Probabilities of Reporting Good Health by Educational Attainment, Hispanics, with 95% confidence intervals.

Note: Models run separately by race/ethnic group and includes controls for sex, age, age^2, marital status, income and nativity.



Appendix Figure 2.A3: Predicted Probabilities of Reporting Good Health by Educational Attainment, Asians, with 95% confidence intervals.

Note: Models run separately by race/ethnic group and includes controls for sex, age, age^2, marital status, income and nativity.

APPENDIX Table 3.A1: Summary of the X^2 Values and Probabilities that the Race/Ethnic pairings are equivalent

	Whites & African Americans	**Whites & Afro-Caribbean**	**African Americans & Afro-Caribbeans**
Gamma pathways			
Female - Education	.00 (.99)	1.24 (.27)	2.18 (.14)
Female - Social Support	.88 (.35)	3.81 (.05)	2.02 (.16)
Female - Income	.18 (.67)	.09 (.77)	.01 (.93)
Age - Personal Control	2.04 (.15)	.60 (.44)	.58 (.45)
Age - Social Support	2.74 (.10)	.08 (.78)	3.22 (.07)
Age - Income	3.19 (.07)	.51 (.47)	.98 (.32)
Age - Healthy Behaviors	6.68 (.01)	7.11 (.01)	.28 (.57)
Married - Income	8.97 (.00)	6.78 (.01)	.01 (.95)
Married - Social Support	.55 (.46)	.80 (.37)	.08 (.78)
Beta Pathways			
Education - Income	.03 (.86)	.42(.52)	.52 (.47)
Education - Personal Control	1.16 (.28)	1.28 (.26)	.05 (.82)
Education - Social Support	2.31 (.13)	.02 (.88)	2.67 (.10)
Education - Healthy Behaviors	3.01 (.08)	6.88 (.01)	2.29 (.13)
Income - Personal Control	.35 (.55)	.15 (.70)	.06 (.81)
Personal Control - Healthy Behaviors	.43 (.51)	.02 (.89)	.62 (.43)
Social Support - Healthy Behaviors	4.53 (.03)	.40 (.53)	2.24 (.13)
Healthy Behaviors - Good Health	.51 (.48)	.57 (.45)	2.42 (.12)

Note: Significant p-values indicate that the hypothesis of equivalent pathway between groups is violated. This hypothesis is tested separately by each race/ethnic pairing for each pathway, with one degree of freedom.

APPENDIX Table 3.A2: Abbreviated Summary of the Standardized Total Parameter Effects, by Race/Ethnicity

Personal Control	* Education	* Income
White	.15	.16
African American	.28	.16
Afro-Caribbean	.31	.19

Social Support	* Education
White	
African American	
Afro-Caribbean	

Healthy Behaviors	* Education	* Income	* Personal Control	* Social Support
White	.40	.08	.50	.18
African American	.32	.07	.41	.05 NS
Afro-Caribbean	.25	.08	.42	.15

SR Health	* Education	* Income	* Personal Control	* Social Support	* Healthy Behaviors
White	.23	.05	.29	.10	.59
African American	.18	.04	.23	.03	.57
Afro-Caribbean	.11	.04	.19	.07	.45

Note: All coefficients are statistically significant at the .05 level except where denoted by NS.

APPENDIX TABLE 4.A1: Full Logistic Regression Results for Models Predicted Good Health, Whites

	Model 1	Model 2	Model 3	Model 4
Education	.18*	.17*	.17*	.16*
	(.03)	(.03)	(.03)	(.03)
Age	-.09*	-.10*	-.08*	-.08*
	(.02)	(.02)	(.02)	(.02)
Age^2	.00*	.00*	.00*	.00*
	(.00)	(.00)	(.00)	(.00)
Married	.22	.22	.23†	.23
	(.14)	(.14)	(.14)	(.14)
Sex (Female)	.07	.07	.11	.10
	(.13)	(.13)	(.13)	(.14)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
US Born	-.32	-.31	-.36	-.36
	(.41)	(.41)	(.42)	(.42)
Current Smoker		-.40*		-.48*
		(.19)		(.19)
Smoking Missing		.38*		.41*
		(.15)		(.15)
Obese			-.77*	-.84*
			(.14)	(.14)
BMI Missing			-.78†	-.87*
			(.40)	(.41)
Intercept	1.27†	1.45*	1.25†	1.45*
	(.71)	(.73)	(.72)	(.73)
Pseudo R^2	.10	.11	.12	.13
Log Likelihood	-790.60	-779.87	-774.40	-761.02
N	1761			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1 (continued) : Full Logistic Regression Results for Models Predicted Good Health, African Americans

	Model 1	Model 2	Model 3	Model 4
Education	.09*	.09*	.09*	.08*
	(.02)	(.02)	(.02)	(.02)
Age	-.08*	-.07*	-.08*	-.06*
	(.01)	(.01)	(.01)	(.01)
Age^2	.00*	.00*	.00*	.00*
	(.00)	(.00)	(.00)	(.00)
Married	-.02	-.01	.00	.01
	(.10)	(.10)	(.10)	(.10)
Sex (Female)	-.09	-.14	-.02	-.07
	(.09)	(.09)	(.10)	(.10)
Income/1000	.02*	.02*	.02*	.02*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	-.97†	-.93†	-.91†	-.85
	(.53)	(.53)	(.53)	(.53)
Current Smoker		-.40*		-.46*
		(.09)		(.10)
Smoking Missing		-.49		-.38
		(.99)		(.97)
Obese			-.42*	-.47*
			(.09)	(.09)
BMI Missing			-.04	-.07
			(.27)	(.27)
Intercept	2.93*	2.93*	2.90*	2.90*
	(.64)	(.64)	(.65)	(.65)
Pseudo R^2	.10	.10	.10	.11
Log Likelihood	-1704.36	-1695.26	-1693.51	-1681.83
N	3588			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1 (continued) : Full Logistic Regression Results for Models Predicted Good Health, Afro-Caribbeans

	Model 1	Model 2	Model 3	Model 4
Education	.08*	.07*	.08*	.08*
	(.03)	(.03)	(.03)	(.03)
Age	-.02	-.02	-.01	-.01
	(.03)	(.03)	(.03)	(.03)
Age^2	.00	.00	.00	.00
	(.00)	(.00)	(.00)	(.00)
Married	-.11	-.11	-.06	-.05
	(.17)	(.17)	(.17)	(.17)
Sex (Female)	-.45*	-.51*	-.31†	-.36*
	(.17)	(.17)	(.17)	(.18)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	-.74*	-.66*	-.65*	-.58*
	(.18)	(.18)	(.18)	(.18)
Current Smoker		-.47*		-.44*
		(.22)		(.22)
Obese			-.79*	-.80*
			(.17)	(.17)
BMI Missing			-.82†	-.77†
			(.42)	(.42)
Intercept	2.14*	2.19*	2.13*	2.19*
	(.69)	(.69)	(.70)	(.70)
Pseudo R^2	.09	.09	.11	.11
Log Likelihood	-559.06	-556.15	-547.61	-544.63
N	1378			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1 (continued) Full Logistic Regression Results for Models Predicted Good Health, Vietnamese

	Model 1	Model 2	Model 3	Model 4
Education	-.03	-.04	-.03	-.04
	(.03)	(.03)	(.03)	(.03)
Age	-.04	-.03	-.02	-.02
	(.04)	(.04)	(.05)	(.05)
Age^2	.00	.00	.00	.00
	(.00)	(.00)	(.00)	(.00)
Married	.62*	.64*	.64*	.66*
	(.28)	(.28)	(.28)	(.28)
Sex (Female)	-.26	-.46†	-.27	-.46†
	(.24)	(.27)	(.24)	(.27)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	-1.38*	-1.40*	-1.34*	-1.37*
	(.61)	(.61)	(.61)	(.62)
Current Smoker		-.64*		-.62†
		(.35)		(.35)
Obese			-1.00	-.95
			(.64)	(.63)
BMI Missing			1.38	1.37
			(1.53)	(1.53)
Intercept	3.08*	3.28*	2.83*	3.02†
	(1.10)	(1.12)	(1.13)	(1.15)
Pseudo R^2	.11	.11	.11	.12
Log Likelihood	-249.02	-247.43	-247.46	-245.97
N	519			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1: Full Logistic Regression Results for Models Predicted Good Health, Filipinos

	Model 1	Model 2	Model 3	Model 4
Education	.10*	.11*	.10*	.10*
	(.05)	(.05)	(.05)	(.05)
Age	-.05	-.05	-.04	-.04
	(.05)	(.05)	(.05)	(.05)
Age^2	.00	.00	.00	.00
	(.00)	(.00)	(.00)	(.00)
Married	-.25	-.25	-.21	-.21
	(.37)	(.37)	(.38)	(.38)
Sex (Female)	.00	.09	-.09	-.02
	(.30)	(.31)	(.30)	(.31)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	-.24	-.26	-.05	-.06
	(.34)	(.34)	(.36)	(.36)
Current Smoker		.52		.42
		(.48)		(.48)
Obese			-1.04*	-1.00*
			(.35)	(.36)
Intercept	1.98	1.77	1.99	1.83
	(1.21)	(1.22)	(1.23)	(1.24)
Pseudo R^2	.07	.07	.09	.10
Log Likelihood	-167.52	-166.87	-162.69	-162.28
N	507			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1 (continued) : Full Logistic Regression Results for Models Predicted Good Health, Chinese

	Model 1	Model 2	Model 3	Model 4
Education	.11*	.11*	.11*	.11*
	(.03)	(.03)	(.03)	(.03)
Age	-.03	-.03	-.03	-.03
	(.04)	(.04)	(.04)	(.04)
Age^2	.00	.00	.00	.00
	(.00)	(.00)	(.00)	(.00)
Married	-.22	-.23	-.19	-.20
	(.27)	(.27)	(.27)	(.27)
Sex (Female)	-.41†	-.45*	-.43†	-.47*
	(.22)	(.22)	(.22)	(.23)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	.60†	.62†	.74*	.77*
	(.32)	(.32)	(.34)	(.34)
Current Smoker		-.27		-.29
		(.35)		(.35)
Obese			-.60	-.60
			(.46)	(.46)
BMI Missing			-1.43	-1.48
			(1.47)	(1.47)
Intercept	.69	.72	.63	.67
	(1.11)	(1.11)	(1.11)	(1.11)
Pseudo R^2	.12	.12	.12	.12
Log Likelihood	-278.31	-278.02	-277.09	-276.77
N	598			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1 (continued) : Full Logistic Regression Results for Models Predicted Good Health, Mexican

	Model 1	Model 2	Model 3	Model 4
Education	.13*	.13*	.13*	.13*
	(.03)	(.03)	(.03)	(.03)
Age	-.08*	-.07*	-.06*	-.05†
	(.03)	(.03)	(.03)	(.03)
Age^2	.00*	.00†	.00	.00
	(.00)	(.00)	(.00)	(.00)
Married	.24	.20	.31†	.27
	(.17)	(.18)	(.18)	(.18)
Sex (Female)	.00*	-.07	.02	-.06
	(.15)	(.16)	(.16)	(.16)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	-.09	-.02	.02	.09
	(.17)	(.18)	(.18)	(.18)
Current Smoker		-.44*		-.46*
		(.20)		(.20)
Obese			-.74*	-.75*
			(.16)	(.16)
BMI Missing			-.13	-.07
			(.58)	(.58)
Intercept	.79	.84	.66	.71
	(.63)	(.63)	(.64)	(.64)
Pseudo R^2	.08	.09	.10	.10
Log Likelihood	-525.90	-523.56	-515.33	-512.80
N	916			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1 (continued) : Full Logistic Regression Results for Models Predicted Good Health, Cuban

	Model 1	Model 2	Model 3	Model 4
Education	.14*	.14*	.15*	.15*
	(.03)	(.03)	(.03)	(.03)
Age	-.13*	-.12*	-.12*	-.12*
	(.04)	(.04)	(.04)	(.04)
Age^2	.00*	.00*	.00*	.00*
	(.00)	(.00)	(.00)	(.00)
Married	.44†	.44†	.50*	.51*
	(.23)	(.23)	(.24)	(.24)
Sex (Female)	-.77*	-.88*	-.76*	-.89*
	(.23)	(.24)	(.23)	(.24)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	-.73†	-.65	-.70	-.59
	(.44)	(.45)	(.44)	(.45)
Current Smoker		-.57*		-.63*
		(.28)		(.29)
Obese			-.85*	-.88*
			(.26)	(.26)
Intercept	3.12*	3.29*	3.16*	3.35*
	(1.20)	(1.22)	(1.20)	(1.23)
Pseudo R^2	.18	.19	.20	.21
Log Likelihood	-257.59	-255.61	-251.75	-249.43
N	576			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

APPENDIX TABLE 4.A1 (continued) : Logistic regression predicted Good Health , Puerto Rican

	Model 1	Model 2	Model 3	Model 4
Education	.18*	.18*	.19*	.19*
	(.04)	(.04)	(.04)	(.04)
Age	-.09*	-.10*	-.09*	-.09*
	(.04)	(.04)	(.04)	(.04)
Age^2	.00†	.00†	.00	.00
	(.00)	(.00)	(.00)	(.00)
Married	.09	.09	.15	.15
	(.23)	(.23)	(.24)	(.24)
Sex (Female)	-.40†	-.39†	-.33	-.33
	(.23)	(.23)	(.23)	(.23)
Income/1000	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
U.S. Born	.21	.20	.16	.16
	(.24)	(.24)	(.24)	(.24)
Current Smoker		.04		-.01
		(.26)		(.26)
Obese			-.60*	-.60*
			(.24)	(.24)
BMI Missing			-1.0	-1.03
			(1.22)	(1.21)
Intercept	1.02	1.01	1.00	1.00
	(.96)	(.97)	(.97)	(.98)
Pseudo R^2	.17	.17	.18	.18
Log Likelihood	-246.57	-246.56	-243.26	-243.26
N	494			

Note: Standard Errors in Parentheses * $p < .05$; † $p < .10$

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EDUCATION

2015 Ph.D., Department of Sociology, University of Washington
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Tolnay, Stewart E. and Suzanne C. Eichenlaub. 2007. "Inequality in the West: Racial and Ethnic Variation in Occupational Status and Returns to Education, 1940 to 2000." *Social Science History,* 31(4): 471-507.

Tolnay, Stewart E. and Suzanne C. Eichenlaub. 2006. "Southerners in the West: The Relative Well-Being of "Direct" and "Onward" Migrants." *Social Forces*, 84(3): 1639-1663.

PRESENTATIONS

Tolnay, Stewart E. and Suzanne C. Eichenlaub. "From Dixie to Chicago: Tracking Participants in the Great Migration, 1910-1930." Pacific Sociological Association Annual Meetings, Seattle, WA. March 2011.

Eichenlaub, Suzanne C. "Income Inequality and Health: A Multilevel Analysis Investigating Interactions with (Non)Metropolitan Status, Sex, Income and Race/Ethnicity." Population Association of America Meetings, New York, NY. March, 2007.

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2007 - 2009 Research Assitant and Project Manager, Department of Sociology, University of Washington. "A New Database for the Study of Southern Lynchings" PI: Stewart Tolnay (NSF funded).

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