DOES EDUCATION EQUALIZE OR REPRODUCE INEQUALITY? EFFECTS OF COLLEGE DEGREES ON HEALTH BEHAVIORS

By

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This dissertation entitled:

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The final copy of this thesis has been examined by the signatories, and we

Find that both the content and the form meet acceptable presentation standards

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ABSTRACT

Lawrence, Elizabeth M. (Ph.D., Sociology)

Does Education Equalize or Reproduce Inequality? Effects of College Degrees on Health Behaviors

Dissertation directed by Professors Stefanie Mollborn and Fred Pampel

Among U.S. adults, college degree earners live much healthier lives than those with less education, but we know little about why. This dissertation examines how, why, and for whom college degrees influence health behaviors, such as smoking, diet, exercising, maintaining of healthy weight status, and drinking. Theories posit that college degrees may exhibit: "transformative" effects if college degrees influence health behaviors independent of selection, "sorting" effects if health behavior advantages are due to selection, "conditional reproduction" if groups of historical advantage receive the greatest benefits, or "conditional equalizing" if groups of historical disadvantage have greater benefits. Three research questions characterize the study's objectives: (1) Does education improve health behaviors or is the association spurious? (2) Does education have the same benefits for the health behaviors of all social groups? (3) If education does improve health behaviors, how does it do so? The National Longitudinal Study of Adolescent to Adult Health (Add Health) provides longitudinal data on education and health behaviors across adolescence and young adulthood for a cohort of individuals born 1977-1984. The methods include propensity score approaches to estimate causal effects and test for heterogeneity. This study affirms multiple functions of education: it sorts individuals, improves well-being, and stratifies the population into classes. Very little evidence supports the assertion

that benefits of college degrees are conditional. College degrees improve health behaviors for all college graduates, leaving those without degrees lagging behind. A sociological understanding of why social groups engage in different behaviors can contribute to efforts in reducing social inequality and improving population health.

For my parents

ACKNOWLEDGEMENTS

I can only begin to express the gratitude I have for my advisors, Stefanie Mollborn and Fred Pampel. Their guidance has been invaluable, and I will carry it with me for the rest of my life. I am also forever grateful for the amazing mentorship of Rick Rogers. Liam Downey, Fernando Riosmena, and Ryan Masters have been incredibly supportive, helpful, and a joy to work with. Despite not being on my committee, I have still managed to get great advice and counseling from Jason Boardman, Lori Hunter, Jane Menken, and Sanyu Mojola. It is because of all these faculty that I have had had a wonderful graduate experience. Steve Graham and Judith McCabe also played no small part in supporting my endeavors, and made going to work enjoyable. I hope all of these people know that their time, attention, and thoughtfulness changed my life. A lot.

I am thankful for all the advantages that my parents have given me, but even more thankful that they gave me the freedom to exploit these advantages in whatever way I saw fit. I am grateful for the support of the many members of my large family, including my sister, aunts, uncles, cousins, and those family members who are no longer with us.

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To my other grad school (and grad school partner) homies, you know who you are! I am so lucky to have a great community and each of you has been essential to my success* in the past six years. *success=fun

My college degree has made me healthier, but only because of the influence of my amazing Lyons ladies! Love you all!

It takes a village to raise a Ph.D. There have been so many people instrumental to seeing me through graduate school, and I do not know where I would be without them. I am confident that the path not taken is much less desirable than my current course.

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The deepest problems of modern life derive from the claim of the individual to preserve the autonomy and individuality of his existence in the face of overwhelming social forces, of historical heritage, of external culture, and of the technique of life.
-George Simmel, *The Metropolis and Modern Life*

Why is everything that's supposed to be bad make me feel so good?
-Kanye West, "Addiction"

This dissertation examines in detail the relationship between college degrees and health behaviors such as smoking, diet, and physical activity. We know little about why more educated individuals live more healthfully, and this study breaks new empirical ground on this topic. This dissertation seeks to contribute to the understanding of social determinants of health with the ultimate goals of improving population health and reducing social inequality. Through improving health behaviors, we can increase the health and life expectancies of U.S. residents. Furthermore, the health of U.S. residents varies greatly across many social factors and reducing differences can improve the health of those lagging behind.

In this introduction, I communicate the empirical and theoretical contributions of the project to sociological, health, and educational literatures. First, I demonstrate the broad significance of health behaviors as the outcome of interest. Second, I explain the importance of education to health behaviors. Third, I describe why we need to know more about the causal component of this relationship to better understand the production of inequality. Lastly, I present the conceptual and theoretical frameworks for this project that can help fill in gaps in our causal knowledge about inequality and health behaviors.

Health Behaviors and Mortality

Health behaviors have clear practical and policy importance as a topic of study because they contribute so importantly to preventable mortality in the United States. Understanding population health and personal well-being requires understanding of health behaviors. Calculations made by epidemiologists to translate actual causes of death (e.g., heart disease, cancer) into behavioral causes illustrate this point. In 2000, the leading behavioral cause of death was tobacco use (18.1% of total U.S. deaths), followed by poor diet and physical activity (16.6%), and alcohol consumption (3.5%; Mokdad et al. 2004). These percentages translate into hundreds of thousands of deaths every year.

Cigarette smoking is the leading preventable cause of death, accounting for about one out of five deaths each year (U.S. DHHS 2014). Smoking has multiple negative health consequences, including increased risk of cancer (lung, esophageal, laryngeal, oral, kidney, cervical, bladder, pancreatic, and stomach), cardiovascular diseases (abdominal aortic aneurysm, atherosclerosis, cerebrovascular disease, and coronary heart disease), respiratory diseases (chronic obstructive pulmonary disease, pneumonia, poor lung functioning, poor asthma control), cataracts, hip fractures, low bone density, peptic ulcer disease, and diminished health status (U.S. DHHS 2004). Researchers continue to identify health costs of smoking, adding renal failure, intestinal ischemia, hypertensive heart disease, infections, breast cancer, and prostate cancer as causes of excess mortality among smokers (Carter et al. 2015). Light and intermittent smoking have harmful health effects (Schane et al. 2010), as does involuntary exposure, or secondhand smoke (U.S. DHHS 2004).

Behind smoking, the next leading causes are poor diet and inactivity. Physical inactivity leads to increased risk of coronary heart disease, type 2 diabetes, stroke, and cancer (breast and colon; Lee et al. 2012). Poor nutrition -- excessive levels of salt, fat (and trans-fats), sugar, and

calories, and/or insufficient nutrients -- can result in diabetes, heart disease, stroke, and cancer (WHO 2015). Further, poor diet and inactivity can result in obesity and metabolic syndrome, which are associated with type 2 diabetes mellitus, coronary heart disease, cancer, respiratory complications, and osteoarthritis of large and small joints (Kopeman 2000).

Alcohol consumption also has important health consequences. Light alcohol consumption is associated with improved health (Di Castelnuovo et al. 2006), due to improving cholesterol, blood pressure, and inflammation levels (Agarwal 2002). However, heavy alcohol consumption, alcohol dependence or abuse, and heavy episodic drinking (drinking 4 or 5 drinks in one occasion) are harmful (Agarwal 2002). These consumption patterns increase risk of diabetes mellitus, cardiovascular disorders, gastrointestinal diseases, cirrhosis of the liver (Room et al. 2005), and cancer (oral cavity and pharynx, larynx, esophagus, breast and liver), accounting for 3.2 to 3.7% of cancer deaths (Nelson et al. 2013). Excess alcohol consumption can also lead to unintentional and intentional injuries, including alcohol poisoning, fatal motor vehicle accidents, drownings, falls, self-inflicted injuries, and assault (Room et al. 2005). Recent estimates show that alcohol consumption accounts for approximately 88,000 deaths each year, or 9.8% of deaths of working-age adults (Stahre et al. 2014).

Experts predict that these health behaviors will, in decades to come, continue to matter for the health and life expectancy of Americans. Despite declining rates of smoking in the last half century, nearly one in five (or 42.1 million) U.S. adults in 2013 smoked cigarettes (CDC 2013a). Smoking remains the number one cause of preventable death. However, mortality from tobacco use is expected to decline in the future as the younger population (with lower smoking rates) ages. In contrast, mortality due to diet, exercise, and obesity is expected to rise in the coming decades (Preston et al. 2014). Overall, the changes in prevalence and continued health

risks associated with these behaviors will be important factors in U.S. population health and mortality.

Health Behaviors and Inequality

The harmful consequences of unhealthy behaviors tend to be most concentrated among lower socioeconomic (SES) groups, making health behaviors an important component of social inequality. A massive literature has described the disadvantaged health and longevity of low SES groups. The same inequalities apply to health behaviors: Higher SES groups have healthier behaviors in a surprising breadth of domains, including smoking, physical activity, nutrition, and drinking, but also in the use of drugs, seatbelts, health care, and smoke detectors (Cutler and Lleras-Muney 2010; Pampel et al. 2010). Given the strong effect of health behaviors on mortality, the SES disparities in health behaviors contribute to SES disparities in mortality (Mehta et al. 2015).

Although employment, income, wealth, and occupation are important to disparities in health behaviors, studies find that education has the largest influence (Mirowsky and Ross 2003; Reynolds and Ross 1998). Recent estimates show that current smoking, age at initiation, cigarettes per day, years since quitting, and secondhand smoke all show strong negative relationships to education, and each year of additional education is associated with a 3-4% lower probability of smoking (Cutler and Lleras-Muney 2010; Margerison-Zilko and Cubbin 2012). More educated individuals are more likely to engage in physical activity and more likely to have a good diet. Unadjusted estimates using the 2011 Behavioral Risk Factor Surveillance System dataset demonstrate that 27.4% of college graduates met aerobic and muscle-strengthening guidelines in the Physical Activity Guidelines for Americans (U.S. DHHS 2008), compared to

12.0% of persons with less than a high school diploma (CDC 2013b). Adjusted estimates suggest that, compared to college graduates, those with less than high school, high school, or some college education are 2.8, 2.1, and 1.4 times more likely to not exercise (Pampel et al. 2010). There are few studies on educational disparities in nutrition and even fewer conducted in the United States, but one study reports that more educated individuals consume greater amounts of vegetables, fruits, dairy, and breads/cereals (Deshmukh-Taskar et al. 2007). The negative relationship for maintenance of healthy weight status, operationalized through body-mass index (BMI), is not as strong as that of smoking, but indicates that each year of education is associated with a 1.4% lower probability of being obese (Cutler and Lleras-Muney 2010). However, other estimates show a stronger effect such that high school graduates are about 1.5 times as likely as college graduates to be classified as obese (Cohen et al. 2013; Pampel et al. 2010).

Socioeconomic patterns of drinking are more complex. Light drinking, usually defined as about 1-2 drinks per day, is associated with the best health and lowest risk of death, whereas heavy drinking shows the worst outcomes (Agarwal 2002). More highly educated adults drink more on average, but are less likely to be heavy drinkers, with each year of education associated with a 1.8% reduction in the probability of being a heavy drinker (Cutler and Lleras-Muney 2010).

Health behaviors contribute to educational disparities in health and mortality, which have been growing in past decades. The increasing disparities across educational attainment are well documented (Goesling 2007; Goldman and Smith 2011; Hayward et al. 2015; Lynch 2003; Masters et al. 2012; Olshansky et al. 2012), but the contribution of health behaviors to these growing disparities is complex. Smoking has dropped more rapidly among the most educated, resulting in educational disparities in smoking that have grown over time (Meara et al. 2008). At

the same time, however, obesity has risen across all groups with less differentiation across educational levels (Ljungvall and Zimmerman 2012; Zhang and Wang 2004). The research determining the overall contribution of health behaviors to the growth in educational mortality disparities is mixed (Cutler et al. 2011; Meara et al. 2008; Montez and Zajacova 2013; Yu 2012), but certainly health behaviors contribute to differences across education and SES (Lantz et al. 1998; Mehta et al. 2015).

Although there is an educational gradient in health behaviors, the division between those with and without college degrees appears particularly important. College graduation is qualitatively different from lower levels of attainment. As Stevens et al. (2008) note, college sorts and stratifies individuals, develops social competencies, legitimizes official knowledge, and connects multiple institutional domains. Because of these multiple functions, earning a college degree has multiple social and economic effects. The attainment of a college degree opens employment and social opportunities, with reverberating effects that separate those with and without degrees. In addition to better health outcomes, individuals who have college degrees display increased likelihood of marriage, more tolerant social values, improved income and employment, higher levels of happiness, and greater civic engagement (Hout 2012). Generally, a college degree confers prestige and respect in social life.

Gaps in Understanding

Despite the importance of health behaviors for health and longevity and the crucial role of education in stratification by health behaviors and health, the field has made little progress in understanding the sources in disparities of health behaviors. Indeed, the topic raises more general

questions about how education in general and college in particular translate into social and health advantages.

Educational disparities in health behaviors require a complex explanation. An adequate explanation needs to answer the following important questions:

(1) Does education improve health behaviors or is the association spurious?

(2) Does education have the same benefits for the health behaviors of all social groups?

(3) If education does improve health behaviors, how does it do so?

These research questions will be the foundation of this project and I will address each of them in this dissertation.

First, the strong, consistent associations demonstrating that more educated individuals behave more healthfully could emerge because more educated people are the kind of people who also behave healthfully. In other words, there could be "selection bias," since a select group of individuals attain higher education. For instance, individuals who come from the highest quartile of household income are eight times more likely to attain a college degree than those in the lowest quartile (Cahalan and Perna 2015), and household income may also shape health behaviors in young adulthood. On the other hand, education may change individuals in a way that reduces smoking, obesity, and other behaviors. Studies testing whether education selects or changes individuals have been limited and reflect considerable disagreement (Conti and Heckman 2010; de Walque 2007; Gilman et al. 2008; Webbink, Martin, and Visscher 2010). Yet, knowing the extent to which education transforms health behaviors is crucial to understanding how education produces health inequality.

Second, we do not yet know whether education shapes the health behaviors for some social groups more than others. A positive relationship between educational attainment and

healthy behaviors averaged across all adults does not capture variation in the effects. Education may differentially shape health behaviors based on class background, race/ethnicity, nativity, or sex. Recent research suggests that experiences in educational institutions vary widely across social groups (Armstrong and Hamilton 2013; Stuber 2011). For example, college students from low-income families are more likely to have a job, while college attendees from wealthy families spend more time socializing. These different experiences may affect later health behaviors.

Prior research has also reported differences in health behaviors and college degree attainment across race and gender. Blacks and Hispanics are more likely to be classified as obese but less likely to smoke or drink heavily than Whites[1-1], whereas women show slightly lower rates of smoking and obesity than men (Flegal et al. 2012; CDC 2013a; Chartier and Caetano 2010). Asians have the highest rates of college completion, followed by Whites, Blacks, and Hispanics. Black, Hispanic, and White women now finish college at greater rates than their male counterparts, though Asian males still outpace Asian females (NCES 2013). Despite these different patterns, we know little about whether the effect of education on health behaviors differs across these subgroups.

Third, if there is a causal influence, we know little about how education might transform individuals. Scholars have established a number of mechanisms for the influence of education on health behaviors, including financial resources, occupational characteristics, subjective status, cognitive abilities, psychological resources, and social capital (Cutler and Lleras-Muney 2010; Marmot 2004; Mirowsky and Ross 2003; Pampel et al. 2010).

Perhaps the most obvious explanation is that financial resources can support a healthy lifestyle. Individuals with higher educational attainment, and college degrees in particular, have higher personal earnings and total family income (Hout 2012). College degrees allow access to

higher-paying employment. Additionally, higher education improves one's likelihood of marrying an individual of higher SES (Schwartz and Mare 2005), and can enhance one's financial literacy and skills. These economic assets can be used to attain better health behaviors. For example, gym memberships, smoking cessation aids, and weight loss programs can be purchased to improve one's habits. As Pampel et al. (2010) note, education enables other economic benefits beyond income that may improve health behaviors. For example, some jobs may offer health insurance (or better health insurance) that promotes healthier behaviors, such as treatment for tobacco dependency (Manley et al. 2003). However, financial resources cannot fully account for differences, since less educated individuals with fewer financial resources are more likely to engage in smoking, a costly behavior.

Employment and occupation may also facilitate healthier behaviors. College graduates are more likely to be employed and be employed in professional and managerial jobs (Hout 2012). Educational attainment is important for occupation beyond employment status and income. The status attainment literature established the importance of education for occupational prestige (Blau et al. 1967). Occupational status may capture norms and "class" in a way that financial resources cannot. Additionally, having different *types* of jobs may confer advantages of disadvantages for health behaviors. For example, there may be workplace rules for when and where employees can smoke, and designated areas for smoking may be far from an office desk, whereas workers can smoke frequently on construction sites. Jobs also may require differential demands and effort while offering differential control and rewards for workers, which have important consequences for health (Krueger and Burgard 2011; Mirowsky and Ross 2003). Moreover, occupation-based value systems may emerge in ways that differentiate and stratify

workers (Weeden and Grusky 2012).These different characteristics may shape health behaviors through stress, which can inhibit healthy efforts.

Relative social status may influence health behaviors. Higher education leads to higher social standing, which in turn can lead to healthier behaviors through distinction of this standing and effects of the social hierarchy. First, individuals may set themselves apart from others through the adoption of health behaviors (Cockerham 2005). For instance, being a smoker has become a stigmatized status, and to a greater extent by those more educated (Stuber et al. 2008). Just as consumption patterns signal to others one's social status (Veblen 1899), health behaviors can also communicate such signals. As examples, listening to classical music is associated with lower levels of smoking (Pampel 2006), and participation in cultural activities is associated with lower body weight (Pampel 2012). Second, social status also reflects one's relative position in the social hierarchy. This position has shown a health gradient in both humans and monkeys, suggesting that there may be an independent, direct effect of low status on health operating through stress (Marmot 2004; Wilkinson 2005). This stress may also promote unhealthy behaviors.

Education increases cognitive resources that can aid in acquiring health-related knowledge and in making healthy decisions. Cognitive resources can include health knowledge, or awareness of health benefits and risks, as well as the ability to translate information and technology to improve health. Knowledge of the health consequences of different behaviors has historically been an important contributor to educational disparities in health behaviors. After the Surgeon General's report came out in 1964, more educated individuals initially realized the health consequences of smoking, followed by those less educated (Link 2008). However, in today's society, awareness of the consequences of smoking and obesity are near universal (Link

2008; Winston et al. 2014), and thus, this type of knowledge appears inadequate to account for educational differences in these behaviors. Information and access to technology about ways to maintain health or become healthy may be more relevant for today's health disparities. For example, weight loss programs incorporating technology appear effective (Coons et al. 2012).

Other skills, which can be called noncognitive traits or psychological resources, are developed through education and can help individuals in healthier behaviors. These qualities include conscientiousness, self-efficacy, and other competencies that help one in identifying and achieving goals. For instance, Mirowsky and Ross (2003) describe the "learned effectiveness that enables self-direction toward any and all values sought, including health." Individuals who are more educated view outcomes as contingent on their choices and action, which encourages and enables healthier behaviors.

Social capital, the benefits one gets through relationships with others in one's family or community, also provides a mechanism for education to shape health behaviors. Social relationships shape health behaviors in multiple ways. First, education can improve behaviors through social support. Having social ties can reduce stress, improve mental health, and increase personal control, all of which may lead to healthier behaviors (Umberson, Crosnoe, and Reczek 2010). For instance, married men and women have healthier habits than those that are never married, divorced/separated, or widowed (Waite and Gallagher 2002). Second, behaviors spread through social networks, and a healthy social network can have positive effects on one's health behaviors (or conversely, an unhealthy network can result in negative effects) (Christakis and Fowler 2007, 2008). The norms and behaviors of an individual's friends and family influence that individual's behaviors (Gaughan 2006; Smith and Christakis 2008). College graduates are more likely to get and stay married, have social ties through civic life, and connect with other

highly educated individuals (Hout 2012; McPherson et al. 2001). The resources that allow other educated individuals to engage in healthier behaviors may thus "spillover" and support healthier behaviors throughout a network (Freese and Lutfey 2010).

Despite the number of likely mechanisms for education's influence on health behaviors, research has not definitely established their existence or their relative contributions. Cutler and Lleras-Muney (2010) provide the best study to date on the subject, reporting that income, health insurance, and family background account for 30% of the relationship between educational attainment and health behaviors, knowledge and cognitive abilities account for 30%, and social networks 10%. However, because of the breadth of mechanisms and health behaviors examined, the authors use multiple datasets (with different ages and cohorts) and limit their sample to White adults. Further, Conti and Hansman (2013) dispute some of their findings, arguing that the study's use of mechanisms from different life course stages biases results. They run their own analyses and find that personality, or noncognitive traits such as efficacy, have approximately the same effect as cognition. Lastly, Cutler and Lleras-Muney do not examine occupation or subjective social status.

Further, these theorized mechanisms may be insufficient to capture the ways in which college degrees shape health behaviors. Research has not yet established the extent to which these mechanisms mediate the college degree-health behavior relationships or their overall effectiveness. There may be additional factors that the literature has not yet considered or specific operationalizations may not reflect their broader categories (e.g. standardized test for general cognition). Thus, research on mechanisms for the education-health behavior relationship is preliminary and has never been tested systematically for a recent U.S. cohort.

Limitations of Existing Research

The gaps in understanding about the sources of disparities in health behavior result in good part from methodological limitations of existing studies. Most studies on the topic tend to be descriptive and associational, and the few focused on understanding causes face obstacles relating to data, methods, and the complexity of the disparities and the ongoing changes that have occurred.

First, reliance on cross-sectional datasets has constrained conclusions as to the complex sources of disparities in health disparities. Cross-sectional studies show associations between factors, but help little in determining which factors temporally precede other factors. For instance, Barbeau, Krieger, and Soobader (2004) examine smoking prevalence across educational attainment, income, and occupation using the cross-sectional National Health Interview Survey (NHIS), finding that those who are more educated, have higher income, and are in more prestigious occupations smoke less. However, because the information for these SES components and smoking were collected at the same time, the authors cannot evaluate selection and causal arguments.

In contrast, longitudinal data (and corresponding methods) can look at changes in outcomes and track causes and mechanisms over time. Specifically, to determine education's effects on health behaviors, one needs detailed information on education and health behaviors prior and subsequent to educational attainment. Although health behaviors have strong influences on adult health and mortality, the development of these behaviors occurs across adolescence and the transition to adulthood. Substance use, including smoking and drinking, increases across adolescence into young adulthood, but then improves in adulthood (Chen and Jacobson 2012; Frech 2012). Conversely, BMI, on average, increases across adolescence into

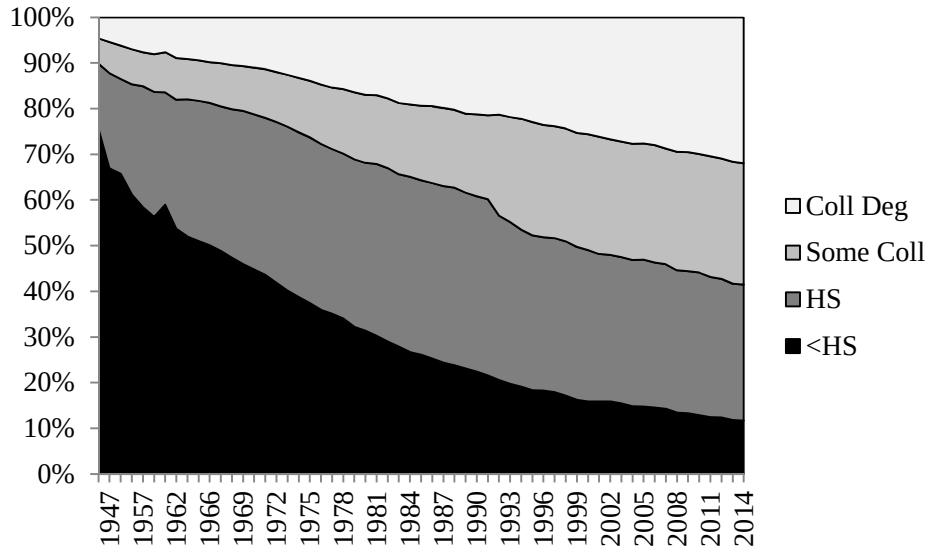
adulthood (Clarke et al. 2009). This period from adolescence to young adulthood therefore captures the critical stage of the life course when individuals establish their health behavior patterns. Longitudinal datasets following individuals across these life course stages are needed to identify effects of education on health behaviors.

Second, research using datasets that are not representative of the national population or examine older cohorts/periods have limited generalizability. Non-representative samples may differ from the broader population; atypical racial/ethnic or socioeconomic compositions or restricted geography can result in unrepresentative education-health behavior relationships. For instance, Webbink and colleagues (2010) estimate causal effects of education on the probability of being overweight using data from Australian identical twins. While the internal validity of this study is likely high, it is difficult to determine how the results from these twin sets relate to broader society.

Similarly, studies that examine the education-health behavior relationship in the early 20th century have limited applicability to today's society, since educational attainment and health behaviors have changed dramatically over the last decades. Figure 1-1 demonstrates the rise in educational attainment over the last 70 years, as more people graduated high school and college. Figure 1-2 displays levels of health behaviors over the last several decades. The declines in smoking and rises in obesity demonstrate the dramatic shifts in the health environment. Importantly, the current health environment reflects social and structural changes that have occurred in the last 50 years. The Surgeon General's Report on Smoking, environmental health crises, and increasing government health and safety regulations have spurred concerns about "lifestyle hazards" and "at-risk behaviors." Health is now a personal responsibility or something that individuals accomplish or achieve (Cockerham 2005; Crawford 2006). Since levels of both

education and health behaviors have changed, one cannot conclude that a relationship for one cohort or one time period can be extrapolated to other cohorts or times. Yet, empirical studies of education and health behaviors, especially those going beyond associational conclusions, often use older data because they are more easily attained. For example, de Walque (2007) uses an instrumental variables approach to estimate the causal effect of education on smoking, but limits his study to those eligible for the draft in the Vietnam War (males born between 1937 and 1956).

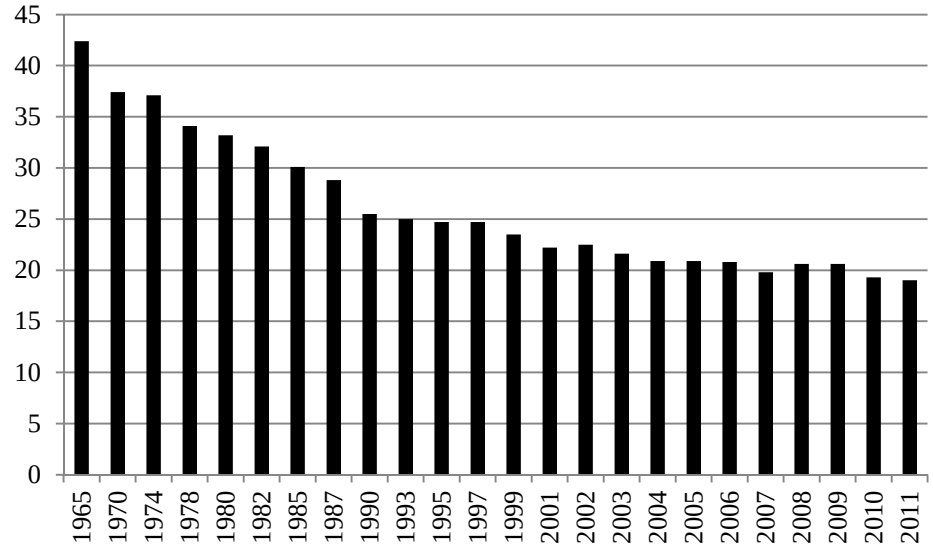
Figure 1-1. Educational attainment in the United States, 1940 - 2014



Source: U.S. Census,
http://www.census.gov/hhes/socdemo/education/data/cps/historical/index.html

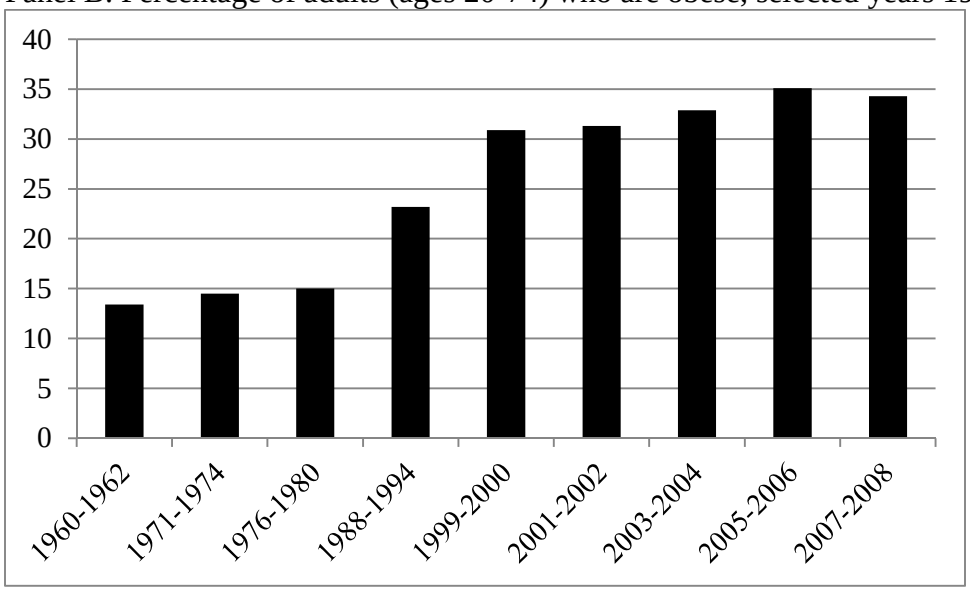
Figure 1-2. Health behaviors over time

Panel A. Percentage of adults who are current smokers, selected years 1965-2011



Source: CDC data from NHIS 1965-2011
http://www.cdc.gov/tobacco/data_statistics/tables/trends/cig_smoking/index.htm

Panel B. Percentage of adults (ages 20-74) who are obese, selected years 1960-2008



Source: Ogden & Carroll, 2010

Third, research has focused on identifying the overall effects of education and health behaviors using homogenous models. For instance, Gilman and colleagues (2008) use sibling fixed effects models to determine that much of the association between educational attainment and smoking was due to factors shared by siblings. However, the authors report only overall associations in the small, mostly White sample without testing for heterogeneity. Testing for heterogeneity requires a sample large enough that one can examine subgroups, as well as methods that explicitly test for differences.

Fourth, a lack of measures of potential mechanisms has constrained studies of education and health behaviors. Datasets with information on health behaviors (such as the National Health and Nutrition Examination Survey) often do not ask questions on social relations, cognitive and non-cognitive traits, or wealth. Without such information, researchers cannot determine which resources resulting from education influence health behaviors. For example, Saint Onge and Krueger (2011) examine educational differences in physical activity using the National Health Interview Survey (NHIS), which does not include measures on cognitive skills, attitudes, or beliefs that would allow for the authors to test their theories on the education-activity link.

Objectives

This study seeks to address the limitations of prior research and fill in the gaps in understanding of the college degree-health behavior relationship. This project addresses the four methodological limitations through the use of: (1) longitudinal data and methods, (2) a recent, nationally representative sample, (3) analyses examining heterogeneity, and (4) information on mechanisms. To fill in gaps in understanding, this study seeks to:

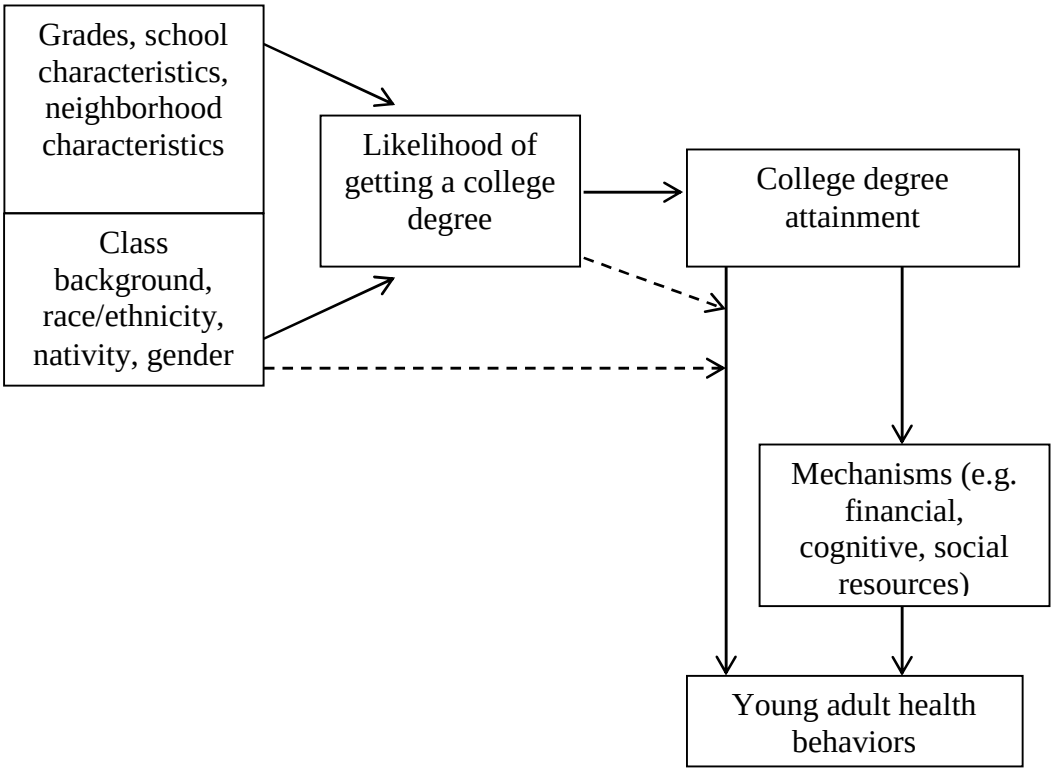
(1) adjudicate between selection and causal explanations of the positive associations between college degrees and health behaviors,

(2) identify the means by which college degrees benefit some individuals more than others, and

(3) determine how college degrees transform health behaviors (if they do).

Figure 1-3 illustrates the relationships between background characteristics, college degree attainment, and health behaviors that I examine in this study. The top part of the figure represents selection: the processes that determine college degree attainment. A number of background characteristics shape one's likelihood of obtaining a college degree, which in turn influences college degree attainment. The right part of the figure depicts the effect of college degrees on health behaviors. College degree attainment produces mechanisms that influence young adult health behaviors. The dotted lines reflect moderating relationships. One's likelihood of getting a college degree and one's ascribed characteristics may change the effect of college degrees on young adult health behaviors.

Figure 1-3. Conceptual Framework



This study focuses on young adult health behaviors. As such, these outcomes should be considered within the broader context of the life course. The ways in which education shapes health changes across age (Lynch 2003). For example, education may influence access to and use of health care, which can become more important at older ages. Young adult health behaviors may therefore be considered outcomes that do not necessarily reflect patterns across middle adulthood and later ages.

Theoretical Framework

To guide the study aims, I put forth new theoretical perspectives that draw broadly from literature on social inequality and can be extended to questions about college and health behaviors. Much of the research on education's effects (usually examining income and labor

market outcomes) has taken a dualistic theoretical approach that positions education as either reducing or exacerbating inequality. This dualism lacks nuance and may obscure substantial diversity in education's effects. I first describe existing educational stratification theories and then propose new extensions of these theories.

Two opposing perspectives lie at the core of educational stratification theory. One focuses on education as the key to upward mobility ("transformative theory") and the other highlights the role of education in reproducing inequality across generations ("sorting theory"). The "transformative theory" considers the important and positive functions of education in society. Rooted in a functionalist paradigm, this view uses a meritocratic rationale to explain social inequality, arguing that the social hierarchy results from variations in individual skills and qualifications (e.g. Davis and Moore 1945). The abilities, knowledge, and resources acquired through education allow individuals to enter more prestigious occupations and achieve higher incomes. In asserting education as a solution to the negative consequences of inequality, this perspective does not perceive education to be zero-sum (i.e. acquiring benefits through more education does not reduce the benefits of others' education) and supports higher educational attainment for all.

This approach has a number of applications. One of the most influential is human capital theory, which argues that education allows individuals to embed resources in themselves that then influence real future incomes (Becker 1964). Human capital therefore refers to those skills and abilities that, through education, are embodied resources. Mirowsky and Ross (2003) apply human capital to the case of health and describe how education imparts skills that are particularly important for health, such as a sense of mastery and personal control. Mirowsky and Ross (2003:204) further assert that there are no drawbacks to higher education, since each individual

can improve him or herself without harming others and because “each person who adopts healthy ways makes it easier for others to do the same.”

In contrast, “sorting theory” takes a more critical view. This approach emphasizes how education allows individuals from high status families to maintain their position. The illusion of meritocracy may justify social inequality, as employers use educational attainment to exclude individuals because of their social class, not because the attainment reflects skills critical for employment (Berg 1971; Collins 1979). The social strata resulting from educational differences do not reflect meaningful differences in abilities. Further, from this point of view, higher educational attainment does not reduce inequality. If educational attainment rises universally, then new criteria for distinction will emerge, through either increasing or changing requirements and their accessibility. For example, graduate degrees may become the new threshold, or “horizontal dimensions” such as college type, college selectivity, or field of specialization may become more salient.

Social reproductionism is one of the most prominent theories of the “sorting theory” perspective. Reproductionists argue that schooling rewards children of higher status, essentially sorting children into levels of educational attainment based on their background. Teachers, staff, and administrators identify students from families with higher SES and offer them better grades and opportunities (Bourdieu and Passeron 1977[1970]). Students with working class backgrounds receive education that prepares them for working class jobs, whereas those from middle or upper class backgrounds are prepared for college and professional occupations (Bowles and Gintis 1976, 2002; Willis 1977). Thus, individuals of higher social status continue in school, receiving credentials that, rather than reflecting important skills learned in school, signify social class membership.

These broad theories can be tested through causal analysis. If education "sorts," then it does not change individuals. The effects of education reflect prior characteristics that shape the sorting. In contrast, if education "transforms," then the effects of education are due to these changes. A strong, positive average causal effect of college degrees on health behaviors would indicate that health behaviors improve because of education, supporting the meritocratic arguments of the transformative perspective. Conversely, a weak or near zero average causal effect would demonstrate that observed associations merely signal prior differences (captured through adjustments for selection into college degrees) and are not caused by education, supporting the sorting argument.

Specific applications of these broad perspectives on educational stratification vary, but generally follow the underlying reasoning described here. Studies usually test one view or the other, but the oppositional nature of these two theories is limiting, as each precludes the existence of the other. A more nuanced approach would allow education to simultaneously serve multiple purposes. Education may both provide resources important for employment and help advantaged individuals maintain their advantage. Further, education may have multiple functions because individuals experience schooling differently. Both of the approaches described above assume that education has a homogenous effect. But education may change some individuals and not others. For example, an individual born into wealth and elite status may continue in the footsteps of his or her parents regardless of educational attainment, whereas for an individual growing up in a low-income home who meets new people and has new experiences in college, a college degree may be transformative. On the other hand, perhaps the individual from a low-income background is unable to fully participate in and take advantage of all that college degrees

offer, but the wealthy individual is able to use college to translate his or her background into later success. It is important to go beyond average effects to distinguish heterogeneity.

I extend these approaches to develop new theoretical positions on heterogeneity in education's effects. Determining whether college degrees primarily help those who are disadvantaged or advantaged, or benefit everyone equally, will yield insight into whether education serves to equalize or reproduce inequality. By identifying for whom education is most important, this study will move beyond, but also incorporate the insights of the two opposing theoretical perspectives: (1) transformative theory and (2) sorting theory.

Conditional Equalizing Effects

As described above, "transformative theory" emphasizes the important skills and resources learned through education. However, some may be able to acquire resources elsewhere. Those born into privilege may obtain money, social networks, habits, tastes, and dispositions from their family members and upbringing, whereas those growing up in families without such resources can only acquire them through higher educational attainment. Thus, a "conditional equalizing effects" approach argues that education is more influential for those from less advantaged individuals, since these individuals can only obtain higher social status through educational opportunities.

This theory is similar to Mirowsky and Ross's resource substitution theory that argues that education is more important for the health of those who are otherwise disadvantaged because education provides individuals with learned effectiveness, cognitive skills, and a sense of control that can mitigate the effects of not having other resources (Mirowsky and Ross 2003; Ross and Mirowsky 2011). Education serves as a resource that can "substitute" for other resources, such as

a lack of finances. Similarly, the "conditional equalizing effects" approach argues that education can help individuals overcome disadvantage. However, the theories differ: resource substitution theory is about lessening the consequences of concurrent resource deprivation, while conditional equalizing is about lessening the consequences of background disadvantage through education's benefits, including resources in multiple domains. For example, resource substitution theory contends that low income is less harmful for the health of educated individuals, whereas conditional equalizing argues that growing up in a low income family is less harmful for those who attain more education and subsequently achieve higher income in adulthood. While both theories argue that education is more beneficial for disadvantaged individuals, they are conceptually distinct as to the development and source of the benefits.

Empirical evidence suggests that education results in some equalization. Schools equalize the human capital of young students, as lower SES kindergarten and first grade students gain ground in reading and math achievement scores over the school year compared to their higher SES counterparts, but then lose ground over the summer (Downey et al. 2004; findings also show that schools exacerbated differences across race, which are discussed in the next subsection). Increases in financial capital from education are also larger among the disadvantaged, because those who are least likely to attain a college degree receive higher increases in income than those who are most likely (Brand and Xie 2010). Education improves health (physical functioning, self-rated health status, and physical impairment) most for those with the least educated parents (Mirowsky and Ross 2003; Ross and Mirowsky 2011).

Despite general evidence supporting this equalizing perspective, whether college degrees have greater effects on the health behaviors of those least advantaged is as yet unknown. Individuals with college degrees may have improved health behaviors because they have a

higher sense of mastery, greater financial resources, and stronger social support, which some may get through education, but others may obtain from other sources. It may be that college degrees offer to all the opportunity to gain resources that those from privileged backgrounds already have, resulting in greater benefits from degrees among those less likely to attain them.

Also unknown is whether college degrees serve to equalize outcomes from those of marginalized race/ethnic and gender groups. Similar to socioeconomic disadvantage, disadvantages associated with being Black, Hispanic, or a woman may be surmounted through higher education. Compared to White males, White women have received higher returns from college completion for personal earnings, family standard of living, and avoiding income deprivation since the 1960s, and a similar female advantage exists among Blacks (DiPrete and Buchmann 2006). Using data on individuals graduating high school in 1992 from the National Educational Longitudinal Study (NELS:92/20), Perna (2005) reported greater benefits among women than men for several outcomes, including income, health insurance, and non-smoking. She also found that Blacks had larger returns than Whites for health insurance coverage, job satisfaction, and perceived employment benefits. The differential returns may similarly benefit health behaviors of women and minorities.

Conditional Reproduction Effects

An alternative view, "conditional reproduction effects," focuses on how education reproduces inequality through providing the greatest benefits to the most advantaged. This view is based on the differential schooling experiences described by social reproductionists, who assert that the education system best serves the privileged. Bourdieu and Passeron's (1977[1970]) characterization emphasizes the rewards students receive in school based on the cultural signals

they display. Since performance in school leads to greater status attainment, schools operate to reproduce the status quo through an unequal distribution of educational opportunities. In the United States, students of lower SES attend schools that have fewer financial resources (Kozol 1991; Condron and Roscigno 2003), and schools disproportionately place students of lower class and racial minority background in lower curricular tracks with little opportunity for mobility (Condron 2007; Oakes 1995).

Generalizing from the core argument of differential schooling experiences, this perspective would argue that college degrees offer fewer benefits to less advantaged students. Empirical evidence suggests that students experience college differently based on background. Class background exerts a strong influence on the level of a student's involvement, integration in the institutional culture, and sense of belonging (Armstrong and Hamilton 2013; Martin 2012; Ostrove 2007; Stuber 2011). Compared to peers from higher socioeconomic backgrounds, students from a low SES background engage in fewer extracurricular activities, work more, study less, and have lower GPAs (Walpole 2003). College's advantages influencing health behaviors, such as improvements in personal control or social networks, may be concentrated among certain populations on campus. Thus, college degrees may have a greater effect on the health behaviors of more advantaged students. For students from disadvantaged backgrounds to benefit in the same way, they would have to make changes to conform to middle- or upper-class norms (Lehmann 2014). It may be harder for disadvantaged students to change their health behaviors than it is for advantaged students to have their lifestyle habits reinforced.

Women and individuals of minority background may also have diminished effects of college degrees. Black and Hispanic students are disadvantaged by their lower SES, since they are more likely to be first generation students, of lower socioeconomic status, and dependent on

financial aid, but racial dynamics unrelated to SES may also be important, especially since most Black and Hispanic college students attend predominantly White institutions (Fischer 2007). Discrimination and stereotypes could operate to further disadvantage women and people of color socially and in the classroom (Feagin et al. 1996). Overall satisfaction in college and perceptions of campus racial climate differ across race/ethnic groups, with important effects on social integration and academic engagement (Fischer 2007). For example, the identity strategies used by White males in high school transferred well to a predominantly White four-year college, but expectations for Black males were much narrower, resulting in more difficult social integration for Black men (Wilkins 2014). Female and minority students may participate in college differently than White male peers, resulting in different effects of college degrees.

In support of these arguments, some research suggests that education has fewer benefits for disadvantaged groups. Looking at the impact of schools on student achievement, Downey and colleagues (2004) find that schools exacerbate differences between Black and White students (while equalizing across SES). White students make greater cognitive gains in 4-year institutions than their Black counterparts (Flowers and Pascarella 2003). Further, the education-health behavior relationship shows differences across race and gender. Conti and Heckman (2010) find that education has a stronger causal influence on obesity for males than females, but find similar causal relationships for smoking. Stronger education-smoking relationships have been reported for White, rather than Black or Hispanic individuals (Margerison-Zilko and Cubbin 2012).

However, it may be that college degrees have homogenous effects on health behaviors. If there is no heterogeneity, then one of the broad stratification perspectives ("transformative theory" or "sorting theory") may accurately describe the effects of college degrees. However, effects may also appear homogenous because of heterogeneous processes working in opposition.

Different mechanisms may operate for different groups, resulting in relatively equal effects of college degrees across the population. For example, those least advantaged may make important financial gains, while those most advantaged improve cognitively, leading to overall similar outcomes.

Hypotheses

Below are the hypotheses that will test these theoretical perspectives. First, I will evaluate whether the healthier behaviors of college graduates is due to college degrees or selection into these degrees.

Hypothesis 1a (Transformative theory): College degrees have positive effects on healthy behaviors.

Hypothesis 1b (Sorting theory): Selection into degree attainment accounts for the healthier behaviors of college graduates.

If after controlling for selection, college degrees have a positive, statistically significant effect on multiple health behavior outcomes, Hypothesis 1a will be supported. If, in contrast, college degrees do not maintain a positive, statistically significant effect, Hypothesis 1b will be supported.

Second, I will determine whether college degrees benefit the health behaviors of advantaged or disadvantaged social groups.

Hypothesis 2a (Conditional equalizing): College degrees benefit the health behaviors of individuals from disadvantaged (or historically disadvantaged) social statuses more than those of their advantaged counterparts.

Hypothesis 2b (Conditional reproduction): College degrees benefit the health behaviors of individuals from advantaged (or historically advantaged) social statuses more than those of their advantaged counterparts.

To test Hypotheses 2a and 2b, I will first evaluate whether the effects of college degrees differ across social groups. If the effects differ, I will then determine whether the size of effects is greater for advantaged or disadvantaged groups. If effects are greater for disadvantaged groups, Hypothesis 2a will be supported; greater effects for advantaged groups would support Hypothesis 2b. If, however, effects do not differ (and Hypotheses 2a and 2b are excluded), then I will turn back to Hypotheses 1a and 1b. The relative contributions of degree attainment and social group membership to health behaviors will suggest whether an unconditional equalizing or reproduction approach best describes effects of college degrees.

Lastly, if Hypothesis 1a is supported (college degrees have positive effects on healthy behaviors), I will determine what kinds of resources (if any) account for or mediate the relationship.

Hypothesis 3a: College degrees produce financial, occupational, status, social, cognitive, and psychological resources that improve health behaviors.

Hypothesis 3b: College degrees shape health behaviors independently of financial, occupational, status, social, cognitive, and psychological resources.

To test these hypotheses, I will evaluate whether the different resources mediate the college degree-health behavior relationship. I will examine mediation for each group of resources and for the full set of resources. If the resources fully or partially mediate the effects, Hypothesis 3a will be supported; if there is no or only partial mediation, Hypothesis 3b will be

supported. Partial mediation will support both Hypotheses 3a and 3b and interpretation will consider the extent to which the resources mediate the relationships.

Each of the sets of hypotheses reflect two oppositional extremes. However, results may fall somewhere in between these two extremes, in which case the relative contributions will be examined. If the effects of college degrees on health behaviors may be due to both selection and causality, I will then examine how much of the relationship is selection and how much is causal. Similarly, there may be both heterogeneous and homogeneous effects of college degrees, and thus, I will determine how much and in which relationships there is heterogeneity. Lastly, mechanisms may mediate some but not all of the college degree-health behavior relationships. I will then identify how much the relationships are mediated and how much is left unexplained.

Contributions

This project makes several theoretical, methodological, and empirical contributions to sociological literature in the areas of health and education. Theoretically, I bring forth new theoretical perspectives: conditional equalizing and conditional reproduction theories. These theories are innovative because they: apply educational stratification perspectives to health, explicitly theorize as to whether the effects of education are conditional, and allow for education to serve dual functions (stratify and serve as source of mobility) simultaneously. Methodologically, this study is the first (to my knowledge) to bring together several types of propensity score approaches to estimate both causality and heterogeneity. Empirically, this study contributes to our understanding of the sources of differences in health behaviors and of the broad benefits of education. To my knowledge, no study has produced estimates of the effects of college degrees on health behaviors, examined differences in these effects by likelihood of

attaining a college degree, class background, gender, race/ethnicity, or immigrant status. The few studies that have examined mechanisms in the college degree-health behavior relationships have been limited (as described earlier in this chapter). Through documenting the college degree-health behavior relationships in detail, the empirical findings of this study contribute to a deeper understanding of how social factors create inequality with important consequences for individuals.

Endnotes

[1-1]I capitalize White and Black to differentiate these racial categories from the colors.

Chapter 2: Data and Methods

In this chapter, I detail the data and methods used to test the hypotheses outlined in Chapter 1. I describe the dataset, measures, and analytic approaches used in the upcoming chapters, as well as additional methodological considerations.

Data

This project uses The National Longitudinal Study of Adolescent to Adult Health (Add Health), a longitudinal, nationally representative dataset that is well-respected and widely used in social science research. The dataset was developed in response to a mandate from U.S. Congress to study adolescent health. The first wave of data (1994-1995) selected 132 high schools and their feeder middle schools in 80 communities using a primary sampling frame derived from the Quality Education Database. In each of these schools, an in-school questionnaire was administered to all students in grades 7-12 (ages 11-17) in these 132 schools, resulting in a sample of more than 90,000 students. From the rosters of students in the Add Health schools, a core sample was selected to complete an in-home interview, with approximately 200 adolescents from each community participating. Supplemental samples targeted individuals based on ethnicity, genetic relatedness to siblings, adoption status, and disability, as well as black adolescents with highly educated parents. The in-home interview had a 79% response rate, and with weights, is representative of the national population of adolescents in grades 7 to 12. A parent of the core sample also completed a parent in-home interview (85% response rate) at Wave I. In 1996, an in-home interview was administered to a subsample of the Wave I core sample. This Wave II sample (N=14,738) consisted of adolescents in grades 7 to 11 in Wave I, as

well as those in the 12th grade but were part of either the genetic or adoption oversamples (Harris 2013).

Wave III of Add Health re-interviewed Wave I respondents in 2001-2002, when they were ages 18-26. In addition to those participating in Wave I, Wave III surveyed about 1500 romantic partners of Add Health respondents. Approximately 76% of the sample, or 15,170 individuals, completed the in-home interview. In addition to the interview data, biomarker data and high school transcripts were also collected. Add Health conducted Wave IV of data collection in 2008, when respondents were 24-32 years old. All Wave I respondents were eligible for this wave, and 80% completed the Wave IV in-home interview, or 15,701 respondents (Harris 2013). Add Health is currently working to administer Wave V when individuals will be 31-42 years old. For more information on Wave V or other aspects of Add Health study design, see the website: http://www.cpc.unc.edu/projects/addhealth.

This study will take advantage of in-home interviews at each wave and Wave I parent and school administrator interviews for the full sample provided by the restricted-use dataset. Add Health is well suited for this project because it offers detail on both the educational experiences and health behaviors of individuals across adolescence to adulthood. The Add Health cohort is uniquely positioned to offer insight into current educational stratification. Reaching 18 years of age around the turn of the 21st century, the Add Health participants reflect recent increases in educational attainment, and college degree attainment in particular. Importantly, detailed information collected during adolescence will capture well selection into degree attainment. The data cover the ideal age range, since the data capture background factors influencing college degree attainment and health behaviors in young adulthood, when these behaviors are more consistent than younger ages (the transition to adulthood).

Measures

College degree attainment

Whether or not the individual attained a college degree is the main independent variable of interest. This measure is collected from Wave IV when individuals are young adults, or ages 24-32. An Add Health constructed variable taken from the interview question asking about highest educational attainment indicates whether individuals earned a four-year college degree. As participants are ages 24-32 in this last wave of data, most should have completed schooling. Sensitivity analyses tested this assumption through replicating the results for older subsets (ages 26-32 and 28-32), as well as for a sample excluding those enrolled in school during the interview.

Outcomes

All health behavior outcomes are taken from Wave IV. The outcomes include measures of smoking, maintenance of weight status, alcohol consumption, physical activity, and nutrition. I focus on these outcomes as they contribute the most to mortality and morbidity (Mokdad et al. 2004). There are many other health behaviors available in the survey, such as the use of sunscreen, seatbelts, or smoke detectors, but these behaviors have smaller effects on overall health. Mean, standard deviations, ranges of the health behavior outcomes, and means across college degree attainment are displayed in Table 2-1.

Table 2-1. Descriptive statistics for health behavior outcomes, U.S. young adults ages 24-32

	Mean	SD	Min	Max	No degree	College degree
Smoking						
Current smoker	0.35	0.48	0	1	0.43	0.19
Daily smoker	0.21	0.41	0	1	0.28	0.07
Weight Status						
BMI	29.12	7.56	14	97	29.89	27.45
Obese	0.37	0.48	0	1	0.41	0.27
Obese II	0.18	0.39	0	1	0.22	0.12
Obese III	0.09	0.29	0	1	0.11	0.05
Physical Activity						
No phys activities	0.15	0.36	0	1	0.18	0.11
# physical activities	6.32	5.99	0	49	6.11	6.76
Nutrition						
Sugary beverages	11.01	10.87	0	40	12.73	7.38
Fast food	2.37	2.74	0	21	2.65	1.78
Drinking status						
Abstainer	0.28	0.45	0	1	0.32	0.19
Light drinker, no HED	0.25	0.43	0	1	0.23	0.30
Light drinker, HED	0.37	0.48	0	1	0.35	0.43
Heavy drinker	0.10	0.30	0	1	0.10	0.09

Source: National Longitudinal Study of Adolescent Health, Wave IV

Smoking is operationalized with two dichotomous variables: current smoking (having smoked at all in the last 30 days) and daily smoking (having smoked every day in the last 30 days). Maintenance of weight status is operationalized through the continuous measure of BMI and dichotomous indicators of obesity ($\geq$ 30 BMI), class II obesity ($\geq$35 BMI), and class III obesity ($\geq$40 BMI). Field interviewers measured height and weight used to calculate BMI (BMI=kg/m^2). Obesity statuses are taken from the Add Health constructed variable on obesity, which omits pregnant women. BMI also excluded these individuals.

Drinking is categorized based on consumption patterns. Respondents reported how often and how much they usually drink and how often they exhibit heavy episodic drinking (HED; 5 [males] or 4 [females] or more drinks in one occasion). These questions were combined to

create a categorical measure of those who do not drink, light drinkers who reported no HED, light drinkers who reported HED, and heavy drinkers. Based on CDC drinking status categorizations (Schoenborn et al. 2013), light drinking is defined as drinking more than zero, but less than eight (women) or fifteen drinks (men) per week and heavy drinking is more than eight (women) or fifteen (men) drinks per week.

Physical activity is operationalized through the sum total of physical activity reported in response to the following questions asking the number of times (from zero to seven or more times) in the last seven days individuals participated in the following activities: (1) bicycle, skateboard, dance, hike, hunt, or do yard work; (2) roller blade, roller skate, downhill ski, snow board, play racquet sports, or do aerobics; (3) participate in strenuous team sports such as football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey; (4) participate in individual sports such as running, wrestling, swimming, cross-country skiing, cycle racing, or martial arts; (5) participate in gymnastics, weight lifting, or strength training; (6) play golf, go fishing or bowling, or play softball or baseball; (7) walk for exercise. A continuous measure of activity sums the number of times for each activity over the week, for a range of 0 to 49. A dichotomous measure of physical inactivity contrasts those reporting zero for all activities to individuals who engaged in any of the activities at least once.

Sugar-sweetened beverage and fast food consumption represent nutrition. Sugar-sweetened beverage consumption is represented with the number of sweetened drinks (regular soda, juice drinks, sweetened tea or coffee, energy drinks, flavored water, or other sweetened drinks) the respondent had in the last seven days. Add Health allowed respondents to report up to 99 drinks, and I recode the measure to top-code at 40 drinks, since less than 5% of the sample reported more than 40 drinks. The number of times the respondent ate at a fast food restaurant

(such as McDonald's, Burger King, Wendy's, Arby's, Pizza Hut, Taco Bell, Kentucky Fried Chicken, or a local fast food restaurant) in the last seven days. Respondents reported up to 99 times, and I top-code the measure at 21 times (<1% of the sample).

Likelihood of college completion

Parent, school, and respondent information from Wave I will inform a measure of likelihood of college completion. (The importance of this measure will be made clear in the analytic approach section below.) Individuals were adolescents during Wave I (ages 11-17), and a broad range of information from this time will be used to create the likelihood: family background (e.g., family structure, nativity, household income, parent education, parent smoking status, parents' educational expectations), educational experiences (e.g., repeating a grade, having been suspended or expelled, grades in English, math, social studies, and science, paying attention to school, finishing homework, feelings toward school, teachers, and classmates), academic potential (e.g., self-efficacy, cognitive test scores), characteristics of high school attended, health considerations (e.g., disability, depression, school absences due to illness), health behaviors, future expectations (perceived likelihood of going to college, living to age 35, married by age 25, killed by age 21), delinquent behaviors, religiosity, and environment (reports of neighborhood safety). Details on these variables are provided in Table 2-2. Except age at Wave IV, all variables are taken from Wave I, though some time-invariant characteristics such as race or gender were corrected at later waves.

Table 2-2. Covariates used to inform likelihood of college degree attainment

	Range	Question (s)
Add Health constructed		
Female	0 - 1	Wave 1 and updated with later waves
Vocabulary score	14 - 146	Add Health Picture Vocabulary Test standardized score
Disabled	0 - 1	
Wave 4 weight	21 - 18472	
Parent Interview		
Household smoker	0 - 1	Are there any cigarette smokers in your household? ; Do you smoke?
Frequency of parent HED	1 - 6	How often in the last month have you had five or more drinks on one occasion?
Parent receiving public assistance	0 - 1	Are you receiving public assistance, such as welfare?
Parent educational attainment	0 - 18	Parent: How far did you go in school?; How far did your current (spouse/ partner) go in school?; Respondent: How far in school did she [residential mother] go?; How far in school did she [residential father go?
Parent smoker	0 - 1	Parent: Do you smoke?; Respondent: Has she [resident mother] ever smoked cigarettes?; Has he ever smoked cigarettes?
In-home interview		
Age at Wave 4	24 - 34	What is your birth date? ; Interview date
Race	1 - 6	Are you of Hispanic or Latino origin?; What is your race? (Updated with later waves)
Born in the U.S.	0 - 1	Were you born in the United States?
Mom is professional	0 - 1	What kind of work does she [residential mother] do?
Dad is professional	0 - 1	What kind of work does he [residential father] do?
Income-to-needs ratio	1 - 5	About how much total income, before taxes did your family receive in 1994? Include your own income, the income of everyone else in your household, and income from welfare benefits, dividends, and all other sources; Household size from household roster
Social control	1 - 5	If a neighbor saw your child getting into trouble, would your neighbor tell you about it?
Parent-child closeness scale	-1.2 - 4.4	Most of the time, your mother is warm and loving toward you; You are satisfied with the way your mother and you communicate with each other; Overall, you are satisfied with your relationship with your mother; Most of the time, your father is warm and loving toward you; You are satisfied with the way your father and you communicate with each other;Overall, you are satisfied with your relationship with your father.
Parent disappointment for child not graduating college	1 - 5	On a scale of 1 to 5, where 1 is low and 5 is high, how disappointed would [your mother/adoptive mother/etc.] be if you did not graduate from college?
Household size	1 - 18	From household roster
Ever repeated grade	0 - 1	Have you ever repeated a grade or been held back a grade?
Ever suspended	0 - 1	Have you ever received an out-of-school suspension from school?
Ever expelled	0 - 1	Have you ever been expelled from school?
Ever truant	0 - 1	During this school year how many times have you skipped/did you skip school for a full day without an excuse?
Standardized scale of grades	-1.7 - 3.8	What was your grade in English or language arts/mathematics/history or social studies/science?
School integration scale	0- 4	You feel close to people at your school; You feel like you are part of your school; Students at your school are prejudiced; You are happy to be at your school; The teachers at your school treat students fairly; You feel safe in your school.
Getting along with teachers scale	0 - 4	Since school started this year, how often have you had trouble: getting along with your teachers?
Problem with attention scale	0 - 4	Since school started this year, how often have you had trouble: paying attention in school?

Table 2-2, continued

Problems with homework scale	0 - 4	Since school started this year, how often have you had trouble: getting your homework done?
Getting along with students scale	0 - 4	Since school started this year, how often have you had trouble: getting along with other students?
College expectations scale	1 - 5	On a scale of 1 to 5, where 1 is low and 5 is high, how likely is it that you will go to college?
Desire for college attendance scale	1 - 5	On a scale of 1 to 5, where 1 is low and 5 is high, how much do you want to go to college?
Expectations to live to 35 scale	1 - 5	What do you think are the chances that each of the following things will happen to you? You will live to age 35
Expectations killed by 21 scale	1 - 5	What do you think are the chances that each of the following things will happen to you? You will be killed by age 21
Protective factors scale	-8.2 - 12.0	How much do you feel that adults care about you?; How much do you feel that your teachers care about you?; How much do you feel that your parents care about you?; How much do you feel that your friends care about you?; How much do you feel that people in your family understand you?; How much do you feel that you want to leave home?; How much do you feel that you and your family have fun together?; How much do you feel that your family pays attention to you?
Depression scale	-1.4 - 6.1	How often was each of the following true during the last week? You were bothered by things that usually don't bother you; You didn't feel like eating, your appetite was poor;You felt that you could not shake off the blues, even with help from your family and your friends; You felt that you were just as good as other people;You had trouble keeping your mind on what you were doing; You felt depressed; You felt that you were too tired to do things; You felt hopeful about the future; You thought your life had been a failure; You felt fearful; You were happy; You talked less than usual; You felt lonely; People were unfriendly to you; You enjoyed life; You felt sad; You felt that people disliked you; It was hard to get started doing things; You felt life was not worth living.
Ever had sex	0 - 1	Have you ever had sexual intercourse?
Self-rated health	1 - 5	In general, how is your health?
How often missed school	0 - 4	In the last month, how often did a health or emotional problem cause you to miss a day of school?
Smoking status	1 - 3	Have you ever tried cigarette smoking, even just 1 or 2 puffs?; During the past 30 days, on how many days did you smoke cigarettes?Have you ever smoked cigarettes regularly, that is, at least 1 cigarette every day for 30 days?
Number of close friends that smoke	0 - 3	Of your 3 best friends, how many smoke at least 1 cigarette a day?
BMI	11.2 - 63.5	What is your height in feet and inches?; What is your weight?
Alcohol consumption	1 - 4	Have you had a drink of beer, wine, or liquor—not just a sip or a taste of someone else's drink—more than 2 or 3 times in your life?; Think of all the times you have had a drink during the past 12 months. How many drinks did you usually have each time?
Days in past year drunk/high	0 - 6	Over the past 12 months, on how many days have you gotten drunk or "very, very high" on alcohol?
Number of close friends that drink	0 - 3	Of your 3 best friends, how many drink alcohol at least once a month?
Physical activities in last week	0 - 15	During the past week, how many times did you: go roller-blading, roller-skating, skate-boarding, or bicycling?; play an active sport, such as baseball, softball, basketball, soccer, swimming, or football?; exercise, such as jogging, walking, karate, jumping rope, gymnastics or dancing?
Visited dentist within last year	0 - 1	When did you last have a dental examination by a dentist or hygienist?
Vegetable consumption	1 -3	How often did you eat vegetables yesterday?
Sweet snack consumption	1 - 3	How often did you eat cookies, doughnuts, pie, or cake yesterday?
How often wears seatbelt	0 - 4	How often do you wear a seatbelt when you are riding in or driving a car?
Usually gets enough sleep	0 - 1	Do you usually get enough sleep?
Hours of screentime	0 - 282	How many hours a week do you watch television?; How many hours a week do you watch videos?; How many hours a week do you play video or computer games?

Table 2-2, continued

Delinquent behaviors scale	-.8 - 8.9	In the past 12 months, how often did you … paint graffiti or signs on someone else's property or in a public place?; deliberately damage property that didn't belong to you?; lie to your parents or guardians about where you had been or whom you were with?; take something from a store without paying for it?; get into a serious physical fight?; hurt someone badly enough to need bandages or care from a doctor or nurse?; run away from home?; drive a car without its owner's permission?; steal something worth more than $50?; go into a house or building to steal something?; use or threaten to use a weapon to get something from someone?; sell marijuana or other drugs?; steal something worth less than $50?; take part in a fight where a group of your friends was against another group?; act loud, rowdy, or unruly in a public place?
Religious attendance scale	0 - 3	In the past 12 months, how often did you attend religious services?
Religious importance scale	0 - 2	How important is religion to you?
Neighborhood quality scale	-5.4 - 6.5	You know most of the people in your neighborhood; In the past month, you have stopped on the street to talk with someone who lives in your neighborhood; People in this neighborhood look out for each other; Do you usually feel safe in your neighborhood?; On the whole, how happy are you with living in your neighborhood?; If, for any reason, you had to move from here to some other neighborhood,how happy or unhappy would you be?

Source: National Longitudinal Study of Adolescent to Adult Health
Notes: All covariates are taken from Wave 1, except where noted.

Class background

Class background is operationalized through the educational attainment of either the mother or father, whichever is higher. The parent completing the Wave IV interview reported his or her education and, in the case of two resident parent families, the educational attainment of the other parent. About 150 parents of the Wave IV sample did not complete the parent interview, but their education was filled in from the adolescent reports of parent education in Wave I or Wave II. The measure of degree attainment categorizes this highest education into those who did not complete high school, hold a high school diploma, attended some college, earned a college degree, and earned a degree beyond a bachelor's.

Race and gender

Chapter 4 examines differences in the effects of college degrees by race and gender. Gender will be represented with a dichotomous indicator of male/female taken from the Wave IV measure, since this includes any corrections or updates since Wave I. Race and ethnicity will be captured

with mutually exclusive categories for non-Hispanic White, non-Hispanic Black, Hispanic, Asian/Pacific Islander (A/PI), American Indian/Alaska Native (AI/AN), and other, with "other" reflecting individuals who responded "other" to the question of race and ethnicity. Information from Wave III reports of race/ethnicity will be used to fill in missing information from Wave I. Persons reporting more than one race are assigned to the one category that they report best describes their racial background. For analyses focused on race/ethnic groups, such as those in Chapter 4, the small sample sizes of AI/AN and other race/ethnicity prevent these groups from inclusion.

Mechanisms

Potential mechanisms for the relationship between college degree attainment and health behaviors, taken from respondent interviews in Wave IV (concurrent with health behavior outcomes), include measures of financial resources, occupational characteristics, social relations, cognitive ability, and psychological traits. Although measured in the same wave as the mechanisms, completion of education likely occurred several years earlier for most of the subjects and temporally precedes current finance, work, social relations, and psychological characteristics.

Household income-to-needs ratio, personal earnings, home ownership, debt-to-assets ratio, number of financial hardships, and health insurance comprise financial resources. Household income-to-needs is calculated as the ratio of the reported total household income to the household size-specific poverty threshold given in 2007 by the U.S. Census. Total household income includes all sources of income from all household members that contribute to the household budget, and was recoded to the midpoint of each of the categories offered (<$5,000;

$5,000-$9,999; $10,000-$14,999; $15,000-$19,999; $20,000-$24,999; $25,000-$29,999; $30,000-$39,999; $40,000-$49,999; $50,000-$74,999; $75,000-$99,999; $100,000-$149,999), except the top-code of $150,000+, which was recoded to 200,000. Personal earnings is a continuous measure that includes all income that the respondent earned before taxes. For those who responded that they did not know how much they earned, a categorical question captured their best guess of personal income. These responses were recoded identically to the household income and were filled in for 586 individuals. Home ownership is a dichotomous variable representing whether the respondent reported "yes" or "no" to "Is your house, apartment, or residence owned or being bought by {YOU AND/OR YOUR SPOUSE/PARTNER}?". A categorical measure indicates whether respondents would have something left over, break even, or be in debt (referent) if they sold all major possessions, cashed in investments and other assets, and paid off all debts. The number of financial hardships is a count of reports of the following hardships in the past 12 months: without phone service; didn't pay full amount rent/mortgage; eviction from not paying rent/mortgage; didn't pay full gas, electric, or oil bill; gas, electric, or oil service turned off from nonpayment; and worried food would run out. Lastly, a dichotomous measure captures whether respondents reported no health insurance (coded 1) or if they reported some type of health insurance coverage (coded 0).

Employment status, job satisfaction, and personal efficacy at work comprise occupational resources. I categorize employment status as professional employment, nonprofessional employment, and unemployed. Unemployed includes those responding that they do not work for pay for at least 10 hours a week and those who are incarcerated during the interview. Professional employment includes individuals working at least 10 hours a week who reported a profession such as managers, engineers, or teachers (prefixes 11-29 using the Standard

Occupational Classification System). Nonprofessional employment includes working individuals reporting professions such as orderlies or machinists (prefixes 31-55 using the Standard Occupational Classification System). Active duty military personnel are categorized as nonprofessional employment. Questions about the respondent's job are asked about the current, primary job, or the most recent job for those not currently working at least 10 hours a week. There is a small number of individuals (N=241) who have never worked 10 hours a week and are missing for these measures. Job satisfaction is represented with a five-point scale of responses (extremely satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, extremely dissatisfied) to the question "How satisfied are you with the job, as a whole?" Personal efficacy at work is the average of three responses: (1) how often the respondent has the freedom to make important decisions about what they do and how they do it; (2) how much of the time the respondent does same things repeatedly; and (3) whether the respondent supervises employees that supervise others, supervises other employees, or does not supervise anyone.

A broad measure of subjective social status captures graded social position, which may differ in some ways from income and employment. Respondents are asked to place themselves on a ten-step ladder where the people at the top have the most money, education, and respected jobs and those at the bottom have the least money and education, and least respected or no job.

Social resources include marital status, the number of reported close friends, a scale of religiosity, and a measure of volunteerism. Marital status is a dichotomous indicator of whether the respondent is married or not.[2-1] Respondents reported the number of close friends they had, and the categorical responses were recoded to make a continuous measure. None was coded as 0, 1 or 2 was coded as 1, 3 to 5 was coded as 4, 6 to 9 coded as 7, and 10 or more coded as 10. A scale of religiosity is reflected as the average of responses as to the importance of religious faith

to the respondent (0=no religion/not important at all; 1=somewhat important; 2=very important/more important than anything else) and how often the respondent attends religious services (0=no religion/never; 1=less than once a month; 2=once a more/a few times a month; 3=once a week/a few times a week/once a day/more than once a day). A dichotomous variable indicates if the respondent volunteered or did community service work in the previous 12 months, with incarcerated individuals coded as not having volunteered.[2-3]

For cognitive ability, Wave III includes a picture vocabulary test. Because there is no proxy for cognition available in Wave IV, this Wave III measure is used. A percentile rank score from this test represents individual performance.

Psychological traits[2-2] include scales for mastery, perceived stress, and depression. The mastery scale operationalizes an individual's sense of control. Add Health created a constructed mastery scale based on respondents' reports of how much they agreed with the following five statements: (1) There is little I can do to change the important things in my life; (2) Other people determine most of what I can and cannot do; (3) There are many things that interfere with what I want to do; (4) I have little control over the things that happen to me; (5) There is really no way I can solve the problems I have. Add Health also creates a constructed variable for Cohen's Perceived Stress Scale. The scale combines responses to four questions about how often they felt the following in the last 30 days: (1) unable to control the important things in your life; (2) confident in your ability to handle your personal problems; (3) things were going your way; (4) difficulties piling up so high that you could not overcome them. Lastly, the Center for Epidemiological Studies Depression Scale (CES-D) provides an evaluation of respondents' depression. The Add Health constructed variable combines five responses to questions such as how often the respondent felt sad or could not shake the blues.

Analytic Approach

The analysis will use a combination of descriptive statistics, regression models, and propensity score approaches, described in the sections below. Overall, the methods in this project focus on propensity scores to account for selection into college degree attainment and estimate causal effects. As mentioned in the introduction, those attaining college degrees differ from those who do not in important ways. Traditional regression approaches can adjust for some preexisting differences, but collinearity may prevent adjustment on many factors. Additionally, traditional regression looks at average differences across the population sample, which can produce irrelevant results. If there are individuals who have zero (or near-zero) probability of attaining a college degree, it is meaningless to interpret an effect of this degree. In contrast, propensity scores allow for one to adjust across a large number of factors influencing pretreatment selection and provide a superior comparison through limiting the sample to those who are comparable. A propensity score approach, however, is also limited. Selection into degree attainment is only approximated and the influence of unobservables can never be fully known. A randomized controlled trial is preferable to estimating causality, but randomly assigning college degrees is neither practical nor ethical. Thus, a propensity score approach improves on associational methods and traditional regression in particular. Additionally, the rich dataset allows me to include a large number of pretreatment variables that shape degree attainment.

Hypothesis 1a (Transformative theory): College degrees have positive effects on healthy behaviors.

Hypothesis 1b (Sorting theory): Selection into degree attainment accounts for the healthier behaviors of college graduates.

For the first set of hypotheses about average causal effects, the study will employ a variety of methods. I first use frequencies to ensure that college graduates display healthier behaviors than those with less education and that these differences are statistically significant. Second, growth curve models indicate if and when differences emerge through comparing trajectories of health behaviors from adolescence to adulthood. These models predict health behavior outcomes at each of the four waves using a multilevel approach that nests time points within individuals. The only covariates are age, age squared (if appropriate), college degree attainment, and interaction terms between age/age squared and college degree attainment. The multilevel model is illustrated by Equation 1 (for continuous outcomes, with person *i* at time *t*):

$$S_{ti} = \gamma_{00} + \gamma_{10}(A_{ti}) + \gamma_{20}(A^2_{ti}) + \gamma_{01}D_i + \gamma_{11}(D_i*A_{ti}) + \gamma_{21}(D_i*A^2_{ti}) + u_{0i} + u_{1i}(A_{ti}) + u_{2i}(A^2_{ti}) + r_{ti} \quad (1)$$

In this equation, *A* reflects age for individual i at time t and *D* reflects college degree status for individual i. The left side of the equation (γ_{00}, γ_{10}, γ_{20}, γ_{01}, γ_{11}, and γ_{21}) reflects the fixed effects and the right side (u_{0i}, u_{1i}, u_{2i}, and r_{ti}) reflects the random effects. The interaction terms (γ_{11} and γ_{21}) reveal how health behaviors differ over time for those who do or do not attain a college degree. If differences between the groups are relatively constant over time, then college degree attainment would appear to be a proxy for differences that existed during adolescence. If, in contrast, differences emerge later or continually diverge, further analysis will need to determine the role of selection.

Next, I will estimate causal effects of college degrees on the different health behavior outcomes. As mentioned in the introduction, causality is difficult to estimate because individuals who earn or do not earn college degrees differ in many ways and it may be that these differences influence health behavior outcomes, rather than the educational attainment itself. Traditional

regression models control for observable factors influencing outcomes, but do not explicitly model selection into treatment or endogeneity (the degree to which both college degrees and outcomes are related to other variables). I therefore go beyond these correlational approaches and separate the effect of the treatment (college degrees) from selection effects (the influence of those preexisting differences).

The underlying idea of propensity score matching (PSM) is to approximate a counterfactual in order to compare the actual outcome to what would have happened had the individual not received treatment. To accomplish this, the approach matches each individual who received the treatment (college degree) to a similar individual who did not receive the treatment, with similarity defined based on the propensity score, or the probability of receiving treatment conditional on observables estimated with a probit or logit regression. Given the assumption that treatment is conditional on observables, then matching with propensity scores is equivalent to matching on those observables (Rosenbaum and Rubin 1983). Once individuals have been matched, the difference in their outcomes is equal to the average treatment effect for the treated (Dehejia and Wahba 1999). The first step for PSM is therefore to estimate a propensity score with a logit model predicting college degree attainment, and the predicted probability for each respondent is the propensity score. Second, individuals with college degrees are matched to individuals without degrees who have similar propensity scores. Third, the average treatment effect for the treated is the difference between the mean of the control and treatment groups on the outcomes. Equation 2 illustrates the average treatment effect E(δ) based on the means of these groups:

$$E(\delta)=E(Y_1) - E(Y_0) \qquad (2)$$

To determine the reliability of the propensity score approach, I assess covariate balance on the propensity scores. That is, I compare the treatment and control groups before and after matching to determine whether the matching process has resulted in similar groups. I compare the means of the groups on each of the covariates with a *t*-test to determini1 statistically significant differences. I also compare percent bias, an effect size measure calculated as the difference in means as a percentage of the average pooled standard deviation (Rosenbaum and Rubin 1985). A rule of thumb suggests that bias less than 10% is negligible (Austin 2011).

PSM also assumes that those in the treatment and control groups are similar enough to compare, known as the common support assumption. If, for example, there are individuals with college degrees with very high propensities for attaining the degrees, but there are not any individuals without degrees with equally high propensities, this assumption would be violated. The results presented here do not violate this assumption. Although higher propensities are more common among the treatment and lower score among the control, both the treatment and control groups display a range of overlapping propensity scores and no observations are dropped from any analysis.

For PSM, I use the Stata package *teffects*, which assumes fixed weights and homoscedasticity of the outcome variable within the treated and control groups. As with all PSM, this approach also assumes independent observations. Standard errors for the treatment effects are adjusted for error in the first-stage estimation of propensity scores. Results presented reflect matching using 5 nearest neighbors, but findings from alternative specifications are also presented. While propensity scores have been widely used in causal effects research, they are not without weakness. In addition to the assumption of common support mentioned above, PSM also has a strong ignorability assumption: that treatment status is independent of factors conditional

on observables. That is, there are no unobserved characteristics that shape selection into treatment. While this assumption is difficult to meet, the wide range of data available at Wave I and the larger pool of non-degree earners to match to degree earners minimize concerns.

PSM will produce average treatment effects that will adjudicate between hypotheses 1a and 1b. If the average treatment effect is statistically significant and in the direction such that degree earners are healthier, then hypothesis 1a will be supported. If, in contrast, the average treatment effect is not statistically significantly different from zero or if the direction is such that degree earners are not healthier, then hypothesis 1b will be supported.

Hypothesis 2a (Conditional equalizing): College degrees benefit the health behaviors of individuals from disadvantaged (or historically disadvantaged) social statuses more than those of their advantaged counterparts.

Hypothesis 2b (Conditional reproduction): College degrees benefit the health behaviors of individuals from advantaged (or historically advantaged) social statuses more than those of their advantaged counterparts.

For the second set of hypotheses, this project uses two propensity score approaches that do not employ direct matching of individual cases: heterogeneous treatment effect (HTE) models as outlined by Xie and colleagues (2012) and demonstrated in previous studies (Brand and Xie 2010; Schafer, Wilkinson, and Ferraro 2013) and inverse probability weighted regression models (IPW). I use HTE and IPW to determine how the effects of college degrees differ across groups: HTE for differences across one's likelihood of degree attainment and IPW for differences across class background, race/ethnicity, gender, and immigrant status.

HTE models both account for selection into treatment (college degrees) and allow for heterogeneity in the effects of the dependent variable. Brand and Xie (2010) use this approach to show that those who are least likely to achieve a college degree receive the largest gains in income. Schafer and his associates (2013) report that education improved health (defined as hypertension, heart disease, and mortality) most for those who were least likely to attain a college degree. In essence, HTE uses propensity scores to account for selection into treatment and then allow results to vary according to these propensity scores. The first step in these models is using generalized linear models to estimate individual propensity for the treatment (college degrees).

Two types of HTE models examine heterogeneity across propensity scores: stratification-multilevel method and matching-smoothing method (Xie et al. 2012). The stratification-multilevel method divides the matched sample into strata based on propensity scores and calculates a treatment effect for each stratum. Then, a variance-weighted least squares regression of the strata-specific effects assesses whether there is a linear trend of treatment effects across propensity score strata. Similar to the stratification-multilevel method, the matching-smoothing method identifies trends of treatment effects across propensity scores, but instead of calculating strata-specific effects, the matching-smoothing method calculates the effect for each matched pair. Then, a nonparametric smoothed curve plots the differences across pairs to determine whether there is a pattern of treatment effects across propensity scores.

The stratification-multilevel HTE models will produce a coefficient indicating whether there is a linear trend of effects of college degrees across propensity score strata. For an outcome where a positive value is a healthy behavior, a positive, statistically significant coefficient will indicate that effects are greater for those more likely to attain a college degree (Hypothesis 2b),

and a negative, statistically significant coefficient will indicate that effects are greater for those less likely (Hypothesis 2a). A coefficient that is not statistically different from zero will support neither Hypothesis 2a or 2b, and I will then turn back to Hypotheses 1a and 1b to describe the relationship.

The matching-smoothing HTE models do not produce a single value to evaluate, but provide a visual representation of effects across propensity scores. For an outcome where a positive value is a healthy behavior, a chart that increases (along the y-axis) as propensity score values go up (across the x-axis) would support Hypothesis 2b, whereas one that decreases as propensity score values go down would support Hypothesis 2a. A chart where the effect of college degrees stays relatively level would support Hypothesis 1a or 1b.

IPW regression models will test for differences in college degree effects across social groups. IPW uses propensity scores to account for selection, but uses weighting based on the scores instead of matching. IPW follows the same steps for creating the propensity score: a logit model predicts college degree attainment and the predicted probability for each individual is then the propensity score. However, instead of matching individuals with similar propensity scores, this approach uses regression models and weights individuals according to the inverse probability of the treatment condition that occurred. For example, an individual who did not graduate from college and has a propensity score of .8 would be weighted 5 (IPW=1/[1-.8]), while an individual who did graduate from college and has the same propensity score of .8 would be weighted 1.25 (IPW=1/.8). The result of IPW regression models should be the same as matching, assuming that there are no propensity scores equivalent to zero or one (and that the ignorability assumption is met as in PSM). Studies find that IPW regression models produce unbiased results (Busso, Dinardo, and McCrary 2009; Lunceford and Davidian 2004).

The Stata package *teffects* conducts this IPW approach in one step, combining the propensity score estimation and weighted regression (Statacorp 2013). However, separating the propensity score estimation and the weighted regression allows me to conduct logistic regression on the dichotomous outcomes, multiply impute missing values, and include interaction terms critical for determining differences in degree effects. Coefficients should be identical for the two processes, but standard errors may differ since regression models from the separate step approach do not take into account that propensity scores are estimated. I compare basic results from both processes to determine potential bias, but interpret the findings from the two-step approach.

A base IPW model includes only college degree attainment as a covariate, but includes the weight to account for selection. I then add in interaction terms between college degrees and social groups (class background, race/ethnic and gender categories, and immigrant status) to determine how college degree effects differ across these groups. Equation 3 illustrates these models for a hypothetical social group (GROUP) and a continuous outcome where all coefficients are weighted estimates:

$$Y_i = \alpha + \beta_1 DEG + \beta_2 GROUP + \beta_3 (DEG*GROUP) + \varepsilon \qquad (3)$$

The coefficient β_3 will thus reveal if and how the effects of college degrees vary for different social groups. I will separately test these interaction terms for class background from race/ethnic and gender categories and immigrant status. If the interaction terms are statistically significant, then the effects of college degrees are not the same across those groups and either Hypothesis 2a or 2b will be supported depending on the direction and magnitude of the coefficients. If the interaction terms are not statistically significant, then I will then turn back to Hypotheses 1a and 1b.

Hypothesis 3a: College degrees produce financial, occupational, status, social, cognitive, and psychological resources that improve health behaviors.

Hypothesis 3b: College degrees shape health behaviors independently of financial, occupational, status, social, cognitive, and psychological resources.

The approach for this hypothesis uses the mediation model in regression, as outlined in Baron and Kenny (1986). To determine mediation, four criteria need to be met. The independent variable of interest (college degree attainment) needs to be a significant predictor of the outcome (criterion #1) and the mediator examined (criterion #2). Second, models should compare the effect of the independent variable of interest (college degree attainment) in two models, one excluding and one including the mechanism variable. If the effect of college degrees is reduced in magnitude in the model including the mechanism (criteria #3) and the mechanism variable is significant (criteria #4), then mediation can be concluded.

Regression models evaluate these criteria and also incorporate inverse probability weights (IPW) to account for selection, similar to the previous chapter. First, OLS and logistic regression models determine whether college degree attainment is a significant predictor of each of the mechanisms. A sample OLS model is represented with the following equation:

$$MECH_i = \alpha + \beta_1 DEG + \varepsilon \qquad (4)$$

Thus, β_1 (weighted by the IPW) will indicate, for each mechanism, whether criteria #1 is met.

For the second criteria, base models regressing each outcome on college degree attainment (weighted by the IPW) determines whether there is a significant relationship between

college degree and outcome and provides a base level of college degree effects that can be compared to the later models.

$$BEH_i = \alpha + \beta_1 DEG + \varepsilon \quad (5)$$

Regression models then add in mechanisms separately. Changes in the effect of college degree when mechanisms are included indicate the extent to which these resources mediate the effect of college degrees on the different health behavior outcomes.

$$BEHi = \alpha + \beta_1 DEG + \beta_2 MECH + \varepsilon \quad (6)$$

Thus, changes in β_1 from equation 5 to 6 will show the change in the effect of college degrees due to the mediating mechanisms. β_2 will show whether mechanisms significantly predict each outcome. Additionally, a full model will incorporate all mechanisms as independent variables.

I use IPW rather than matching because the former allows for a flexible regression approach. The IPW regression models can easily add in new variables (i.e. mechanisms), while matching does not easily provide a framework for mediation. However, it should be noted that the selection model considers selection into college degrees, not into the different mechanisms. Because subjects have not been matched on background factors the way college graduates and nongraduates have been matched, one cannot consider the mediators to be "causal" in this framework since there are likely confounders shaping both mediators and outcomes (and that are different than those for college degree attainment). However, since I am concerned with the mediation more than the effects of these mechanisms on the outcome, this is not a critical limitation.

Samples

Samples vary across the analyses in this project due to item missingness, as well as additional exclusion criteria. Women pregnant in Wave IV are excluded from some analyses, because their weight status cannot be examined. Models examining racial/ethnic differences exclude individuals reporting American Indian/Alaska Native or "other" racial background due to small sample sizes. A total of 14,796 respondents participated in the Wave IV data collection, have valid sample weights, and college degree attainment information, and 14,265 respondents meet these criteria and are not pregnant. For the race/ethnicity analyses, 14,097 individuals meet these criteria and are White, Black, Hispanic, or Asian. The samples examined range from 97-100% of these eligible samples; details on samples are given in each of the chapters.

I retain most cases through employing mean and multiple imputation. Multiple imputation is used for IPW regression models used in Chapters 3, 4, and 5, allowing retention of all eligible individuals. Assuming data are missing at random, estimates from multiple imputation should be less biased than omitting individuals missing on any of the relevant covariates (Allison 2002). Details on the multiple imputation specifications are given in each chapter.

Propensity score matching used in Chapter 3, however, does not provide a framework for employing multiple imputation. The *teffects* package (which adjusts standard errors for the estimation of propensity scores) does not allow for multiple imputation (Statacorp 2013). While a logit model creating propensity scores could incorporate multiple imputation, how best to adjust the standard errors in the average treatment effects for both the imputation and the estimation has not yet been determined. Thus, I use mean imputation for the creation of propensity scores and listwise deletion for individuals missing on outcomes. Because there are a large number of variables in the propensity score models, item missingness could reduce the

sample size substantially, even though most individuals are missing on just one or two variables. I therefore use the sample mean for missing values so that each individual's propensity score is based on the valid indicators for that individual. I also include an indicator of the number of items missingness so that balance in the patterns of missingness can also be achieved through matching (Rosenbaum 2010). While this approach allows me to retain nearly the full sample, standard errors are not adjusted and may be slightly underestimated. However, this limitation is outweighed by the advantages of this approach to listwise deletion.

External Validity

The propensity score approach used in this project focuses on internal validity, or the careful estimation of effects for the individuals in the Add Health dataset. However, the external validity or generalizability of the results are also of interest. The use of nationally representative data offers external validity since the results should be generalizable to the cohort (adolescents in grades 7-12 in the United States in 1994-95). However, Add Health recommends that analyses adjust for complex sampling design to deal with different selection probabilities and nonresponse bias and achieve generalizability (Harris 2013). I do not adjust for complex sampling design because there is no consensus on this adjustment in propensity score matching and because IPW models weight by propensity score (rather than survey weights). Table 2-3 presents means of health behaviors across educational attainment without any adjustment for complex sampling design (Panel A) and with adjustments for probability weights, primary sampling units, and strata using the *svyset* commands in Stata 13 (Panel B). The means are similar across Panel A and Panel B, suggesting that the adjustments do not change the results much. Further, the propensity score analyses match or weight on many factors related to differential sample

selection probabilities, including race/ethnicity and the Wave IV weight. By controlling for these factors in the propensity score models, their influence should be minimized. Some evidence suggests that unweighted OLS estimates are "unbiased, consistent, and have smaller standard errors" than weighted estimates, assuming that sample weights are a function of independent variables (Winship and Radbill 1994).

Table 2-3. Health behavior means by educational attainment, U.S. young adults ages 24-32

	Full sample	No HS degree	HS deg	Some college	College degree	Advanced degree
Panel A: Unadjusted						
Population share		0.08	0.26	0.34	0.24	0.08
Current smoker	0.35	0.62	0.45	0.38	0.21	0.13
Daily smoker	0.21	0.44	0.30	0.24	0.08	0.04
BMI	29.12	29.30	30.21	29.78	27.64	26.87
Obese	0.37	0.39	0.43	0.41	0.28	0.23
Obese II	0.18	0.20	0.23	0.21	0.12	0.10
Obese III	0.09	0.09	0.12	0.11	0.06	0.04
No phys activities	0.15	0.20	0.19	0.16	0.12	0.08
# physical activities	6.32	5.95	5.80	6.38	6.74	6.79
Sugary beverages	11.01	16.69	13.18	11.48	7.68	6.46
Fast food	2.37	3.08	2.77	2.47	1.87	1.48
Panel B: Adjusted for survey design						
Population share		0.09	0.27	0.33	0.23	0.07
Current smoker	0.39	0.63	0.46	0.40	0.23	0.18
Daily smoker	0.25	0.46	0.33	0.27	0.09	0.06
BMI	29.04	29.14	29.95	29.74	27.46	27.10
Obese	0.37	0.39	0.42	0.41	0.27	0.23
Obese II	0.18	0.19	0.22	0.21	0.12	0.11
Obese III	0.09	0.09	0.11	0.10	0.05	0.05
No phys activities	0.15	0.19	0.18	0.15	0.11	0.06
# physical activities	6.34	5.90	5.81	6.32	6.96	7.12
Sugary beverages	11.48	17.38	13.55	11.85	7.58	6.66
Fast food	2.36	3.15	2.79	2.41	1.75	1.37

Source: National Longitudinal Study of Adolescent to Adult Health

An additional threat to external validity is attrition and nonresponse bias. Table 2-4 compares means of Wave I factors (used to create the propensity score). Wave IV is related to many of these factors. Wave IV participants are more likely to be female, White, and have higher socioeconomic status. Add Health reports that the Wave IV probability weights reduce the bias to a negligible amount (Harris 2013). However, as I do not use these weights, the generalizability of the results may be somewhat limited.

Table 2-4. Comparison of Wave I characteristics across those included and not included in the Wave IV sample.

	Not in Wave IV	In Wave IV	Sig Diff?	N
Population	0.29	0.71		20783
Wave I covariates				
Female	0.42	0.53	***	20774
White				
Black	0.23	0.22		20767
Hispanic	0.20	0.16	***	20767
A/PI	0.09	0.06	***	20767
AI/AN	0.012	0.007	**	20767
Other race	0.01	0.00	***	20767
Native English	0.84	0.90	***	20741
Born in U.S.	0.86	0.92	***	20740
Household smoker	0.47	0.45	+	19636
Parent smoker	0.63	0.64	+	20667
Parent HED	1.26	1.24		19610
Parent education	12.9	13.15	***	20601
Mom is professional	0.23	0.27	***	20725
Dad is professional	0.66	0.71	***	20731
Income-to-needs ratio				
Below 100%	0.16	0.14	***	20783
100-<200%	0.16	0.18	***	20783
200-<300%	0.13	0.16	***	20783
300-<400%	0.10	0.12	***	20783
400%+				
Missing	0.33	0.24	***	20783
Parent receiving public assistance	0.32	0.28	***	19543
Social control	3.93	3.93		19610
Parent-child closeness scale	0.00	0.00		20570
Parent disappointment for child not graduating college				
Very disappointed				
Somewhat disappointed	0.37	0.4	***	19593
Not disappointed	0.18	0.15	***	19593
Household size	4.62	4.61		20755
Ever repeated grade	0.25	0.22	***	20719
Ever suspended	0.33	0.27	***	20721
Ever expelled	0.06	0.04	***	20701
Ever truant	0.35	0.30	***	20576
Standardized scale of grades	0.12	-0.04	***	20516
Vocabulary score	96.75	100.60	***	20414
Disabled	0.02	0.02	***	20745
School integration scale	1.46	1.45		20587

Table 2-4 continued

Getting along with teachers scale	0.89	0.86	+	20589
Problem with attention scale	1.22	1.23		20588
Problems with homework scale	1.22	1.19	+	20588
Getting along with students scale	0.84	0.87	*	20589
College expectations scale	4.0	4.2	***	20640
Desire for college attendance scale	4.4	4.4	***	20645
Expectations to live to 35 scale	4.3	4.4	***	20668
Expectations killed by 21 scale	1.7	1.7		20650
Protective factors scale	0.0	0.0		20693
Depression scale	0.0	0.0	**	20722
Ever had sex	0.4	0.4	***	20628
Self-rated health	3.9	3.9		20731
How often missed school	0.42	0.42		20693
Smoking status				
Daily smoker	0.09	0.09		20610
Former smoker	0.03	0.03		20610
Infrequent smoker	0.08	0.08		20610
Nonsmoker				
Number of close friends that smoke	0.85	0.81	**	20565
BMI	22.35	22.62	***	20543
Alcohol consumption				
Nondrinker				
Usually has one drink	0.09	0.11	***	20576
Usually has two drinks	0.08	0.08		20576
Usually has 3+ drinks	0.29	0.28		20576
Days in past year drunk/high	1.46	1.31	***	17452
Number of close friends that drink	1.12	1.1		20578
Physical activities in last week	5.36	5.34		20731
Visited dentist within last year	0.63	0.67	***	20708
Vegetable consumption				
None	0.36	0.33	***	20732
Once	0.38	0.39		20732
Twice				
Sweet snack consumption				
None				
Once	0.32	0.33		20732
Twice	0.21	0.21		20732
How often wears seatbelt	3.05	3.1	**	20733
Usually gets enough sleep	0.74	0.71	***	20727
Hours of screentime	23.52	22.97		20697
Delinquent behaviors scale	0.04	-0.01	**	20672
Religious attendance scale	1.66	1.75	***	20577
Religious importance scale	1.24	1.28	***	20577
Neighborhood quality scale	0.07	-0.02	***	20692

*** p < .001; ** p < .01; * p <.05; + p>.10

Source: National Longitudinal Study of Adolescent to Adult Health

Conclusion

I use the best available data and methods to answer my research questions. The longitudinal data provides the necessary span of information so I can look at individuals before and after the college years. The wealth of information available in adolescence allows me to effectively model selection into college degrees and the data in young adulthood provides important information on mechanisms. And I focus on the health behaviors that are most crucial for the health of U.S. adults: smoking, weight status, diet, activity, and alcohol consumption.

Propensity scores, while imperfect, improve upon prior studies using associational methods. The incorporation of matching, heterogeneous treatment effect models, and inverse probability weighting evaluate hypotheses with significance tests for average treatment effects and heterogeneity in these effects.

ENDNOTES

[2-1]Cohabitation status was also examined, but did not differ significantly across college degree attainment so was not included in the mediation analysis. For simplicity, I use marital status in future chapters.

[2-2]I use the term psychological traits, but recognize that this is an imprecise term since I do not examine all psychological qualities. Others use different terminology to describe these characteristics. The labor market literature, for example, uses the term "noncognitive" traits (see Farkas 2003) and Heckman and Kautz (2012) use "soft skills," but these terms are also imprecise.

[2-3]A small number of individuals in the sample were incarcerated at the time of the Wave IV interview (N=65). The prison environment likely structures both educational opportunities and health behaviors, but without going into detail about the length of time spent in prison, it is difficult to know how to model this influence. Further, it is not clear that the prison environment should be removed from the analysis since it is an important context. Thus, I favor including (rather than excluding) these individuals.

Chapter 3: Effects of college degrees on health behaviors

Introduction

Individuals with more education have healthier behaviors in adulthood, but how much education causes this association is unknown. Individuals with college degrees differ from their less educated peers in many ways, and it could be that these other characteristics influece health behaviors. This chapter examines the causal effect of college degrees on health behaviors, controlling for selection and confounding influences. Without a randomized, controlled trial, causality can only be estimated. Since college degrees cannot be randomly allocated, this study uses observed data and improves on prior research through a thorough examination of individuals' selection into college degrees.

Results indicating that college degrees influence health behaviors beyond selection would support the argument that education changes individuals (transformative theory). On the other hand, results revealing that the college degree-health behavior association is mostly due to selection or confounding factors would provide evidence for the argument that education reproduces inequality (sorting theory). However, these perspectives do not allow college to influence individuals differently. This chapter also tests for heterogeneity to determine whether college degrees have stronger or weaker effects among those who are more or less likely to attain such a degree. Evidence of a conditional reproductionist approach would consist of greater benefits observed for those most likely to attain a degree or those from socioeconomically advantaged households. If greater benefits emerge among those least likely to get a Bachelor's degree or those who grew up in socioeconomically disadvantaged households, a conditional equalizing approach would be supported. An additional consideration is the extent to which college degrees eliminate the relationship between background socioeconomic advantage and

health behaviors, which would indicate the amount of (conditional) reproduction or equalization that college degrees offer.

This chapter provides evidence that college degrees influence a range of health behaviors beyond selection into degree attainment, though selection accounts for a substantial portion of the observed associations. There does not appear to be conditionality in the effects of college degrees on smoking across class or likelihood for degree attainment, suggesting that the transformative effects of college degrees are available to all. For most other outcomes, degrees mitigate but do not negate the effects of class background. However, in support of a conditional reproduction approach, college degrees have greater BMI reductions for those most likely to attain a college degree.

Methods

Analytic Approach

Frequencies, growth curve models, propensity score matching, heterogeneous treatment effect models, and inverse probability weighting models evaluate the college degree-health behavior relationship. First, frequencies describe behaviors in young adulthood across degree status, without any controls or adjustments. Second, growth curve models indicate if and when education-based differences emerge through comparing trajectories of health behaviors from adolescence to adulthood. These models predict health behavior outcomes at each of the four waves using a multilevel approach that nests time points within individuals. The only covariates are age, age squared (if appropriate), college degree attainment, and interaction terms between age/age squared and college degree attainment. The interactions reveal how health behaviors differ over time for those who do or do not attain a college degree. If differences between the

groups are relatively constant over time, then college degree attainment would appear to be a proxy for differences that existed during adolescence. If, in contrast, differences emerge later or continually diverge, it likely suggests some influence of education beyond selection. In either case, further analysis will need to do more to try to isolate the relative importance of selection and education.

Third, propensity score matching (PSM) produces averages treatment effects. PSM approximates a counterfactual through matching individuals who did not receive a college degree (control) that are similar to those who did receive a college degree (treatment).[3-1] PSM first estimates a propensity score with a logit model predicting college degree attainment, and the predicted probability for each respondent is the propensity score, or likelihood of degree attainment. Individuals with college degrees are then matched to individuals without degrees who have similar propensity scores. For further details on propensity score matching, see *Chapter 2 Data and Methods*. The Stata package *teffects* assumes fixed weights and homoscedasticity of the outcome variable within the treated and control groups (Statacorp 2013). As with all PSM, it also assumes independent observations. Abadie-Imbens standard errors adjust for the estimation of the propensity score. Results presented here reflect matching using 5 nearest neighbors, but findings from alternative specifications are also provided. For each matched sample, balance on the covariates indicates whether the matching results in similar treatment and control groups. As indicated in the introduction, higher propensities are more common among the treatment and lower scores among the control groups, but the treatment and control groups display a range of overlapping propensity scores and no observations are dropped from any analysis. The average treatment effect for the treated is then the difference between the mean of the control and treatment groups on the outcomes.

Fourth, models explore whether there is heterogeneity in the treatment effects. PSM assumes that the treatment effect is homogenous. To evaluate whether this assumption has been violated in addition to substantively evaluate whether college degree effects differ across one's likelihood of degree attainment, the analysis tests for differences in treatment effects across propensity scores using heterogeneous treatment effect (HTE) models. Two types of HTE models examine heterogeneity across propensity scores: stratification-multilevel method and matching-smoothing method (Xie et al. 2012). The stratification-multilevel method divides the matched sample into strata based on propensity scores and calculates a treatment effect for each stratum. Then, a variance-weighted least squares regression of the stratum-specific effects assesses whether there is a linear trend of treatment effects across propensity score strata. Similar to the stratification-multilevel method, the matching-smoothing method identifies trends of treatment effects across propensity scores, but instead of calculating stratum-specific effects, the matching-smoothing method calculates the effect for each matched pair. Then, a nonparametric smoothed curve plots the differences across pairs to determine whether there is a pattern of treatment effects across propensity scores.

Fifth, this chapter examines treatment effects across class background using IPW. IPW regression models account for selection through weighting based on the propensity scores. Individuals are weighted according to the inverse probability of the treatment condition he or she experienced. These regression models can then incorporate variables for college degree, class background, and the interaction between class background and degree attainment. These interaction terms will reveal if and how much the effects of college degrees vary across class background.

Data

This chapter uses data from the National Longitudinal Study of Adolescent to Adult Health (Add Health). The sample consists of 14,796 respondents with valid sample weights and college degree attainment information at Wave IV. The analyses use slightly different samples.

For propensity score matching and heterogeneous treatment effect models, individuals are omitted if they are missing on the health behavior outcomes. There are only small numbers of individuals missing on each of the health behavior outcomes, resulting in sample reductions of less than 1% for physical activity, sugar-sweetened beverage consumption, and fast food consumption, 1% for smoking and drinking, and 5% for obesity and body-mass index. The 5% reduction for weight status includes individuals dropped from analysis due to pregnancy or unknown pregnancy status. No respondents are missing on propensity score. Because the coefficients of the propensity score model are of little substantive importance, missing data on predictors for propensity score are filled in with the sample mean. Thus, each predicted probability is based on the valid indicators for that individual. This mean imputation may result in slightly underestimated standard errors, but is preferable to listwise deletion (which would produce a small sample) or multiple imputation (which would require problematic assumptions).

Each of the steps outlined in the methods are conducted separately for each of the samples defined by available data for a particular outcome. For example, the propensity score creation, matching, and heterogeneous treatment effect models are run on the smoking sample for the smoking outcomes (i.e., those with valid smoking data). Because of the slightly different samples due to differences in missing data across outcome measures, trends across outcomes are generally described, but direct comparisons across outcomes are not calculated.

However, the analyses looking at interactions between college degrees and class background that account for selection using IPW, multiple imputation accounts for item missingness on health behavior outcomes and all propensity score predictors. Because there is a consensus on incorporating multiple imputation in regression model, I use it in the IPW analyses. However, as described in the previous chapter, no such consensus exists for matching.

Measures include college degree attainment, likelihood of college completion, race, gender, and class background, all described in *Chapter 2.* College degree attainment is a constructed variable from Wave IV. Likelihood of college completion is created from a range of parent, school, and respondent information collected at Wave I. Class background is operationalized with a categorical variable representing the highest degree attained by the respondent's parent(s).

Results

Descriptive

Table 3-1 displays the outcome means for the sample and by college degree attainment. Overall, those with a college degree have healthier behaviors than those who do not have this degree. College degree holders have a lower average BMI and are far less likely to be obese or to be in the higher obesity categories, compared to those with less education. Twice as many individuals without a college degree currently smoke compared to those with a degree, and four times as many smoke daily. Degree holders also have significantly healthier physical activity, sugar-sweetened beverage, and fast food consumption. Odds ratios (dichotomous outcomes) and Cohen's d (continuous outcomes) illustrate the sizes of these effects. Smoking shows the largest effects (medium-large to large), followed by BMI, obesity, fast food, and sugar-sweetened

beverages (small-medium to medium). Physical activities display the smallest effects, with small to small-medium effect sizes. However, these unadjusted associations do not indicate whether these differences are due to advantages gained during college or preexisting differences that influenced both educational attainment and health behaviors.

Table 3-1. Unadjusted means of health behavior outcomes, across college degree attainment (U.S. young adults ages 24-32)

	Full sample	College Degree	No Coll. Degree	Diff	OR	d	N
Smoking status							
Current smoker	0.35	0.19	0.43	-0.24 ***	0.31		14674
Daily smoker	0.21	0.07	0.28	-0.21 ***	0.19		14674
Weight status							
BMI	29.12	27.45	29.89	-2.44 ***		-0.32	14070
Obese	0.37	0.27	0.41	-0.14 ***	0.53		14070
Obese II	0.18	0.12	0.22	-0.10 ***	0.48		14070
Obese III	0.09	0.05	0.11	-0.06 ***	0.43		14070
Physical activity							
No phys activities	0.15	0.11	0.18	-0.07 ***	0.56		14778
# physical activities	6.32	6.76	6.11	0.65 ***		0.11	14778
Nutrition							
Sugary beverages	11.01	7.38	12.73	-5.35 ***		-0.49	14763
Fast food	2.37	1.78	2.65	-0.87 ***		-0.32	14724
Drinking status							
Abstainer	0.28	0.19	0.32	-0.13 ***	0.50		14594
Light drinker, no HED	0.25	0.30	0.23	0.07 ***	1.43		14594
Light drinker, HED	0.37	0.43	0.35	0.08 ***	1.40		14594
Heavy drinker	0.10	0.09	0.10	-0.01 **	0.89		14594

*** p < .001; ** p < .01
Source: National Longitudinal Study of Adolescent to Adult Health, Wave IV

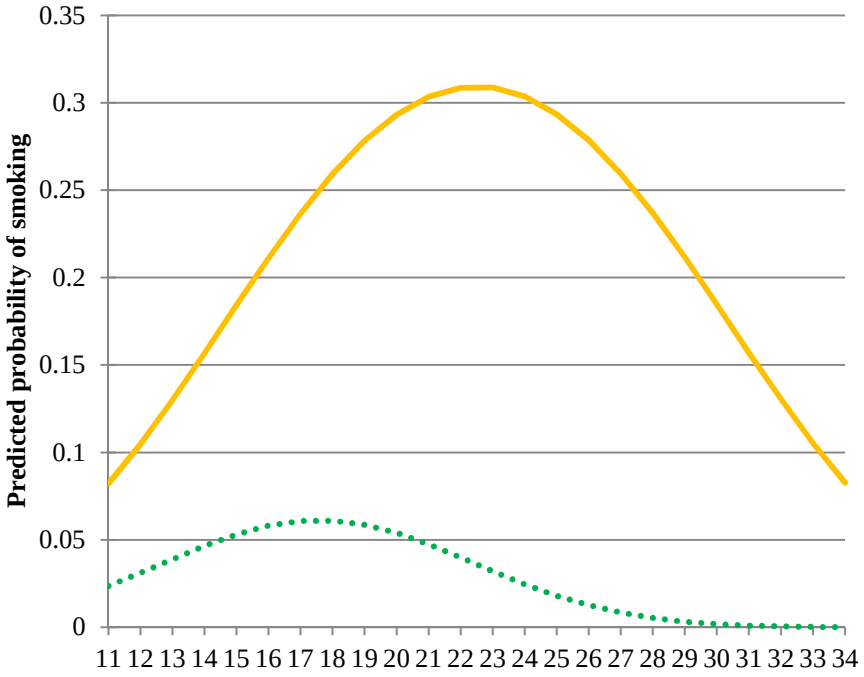
Drinking is more complex, because of the J-shaped relationship between alcohol consumption and health, and because of the patterns across degree attainment. As demonstrated in Table 3-1, abstaining from alcohol is more common among those who do not attain a college degree (32% vs. 19%). However, light drinking, both with and without heavy episodic drinking

(HED), is more common among degree holders. Heavy drinking rates are similar, with college graduates displaying only a small advantage. Better health outcomes have been observed among light drinkers, compared to abstainers, but the difference is small, especially as compared to the health difference between heavy and light drinkers. Additionally, abstainers may have heterogeneous health outcomes, based on the underlying causes of their abstention (Rogers et al. 2013). It is not clear that fewer abstainers is an advantage, especially considering that a greater number of college graduate drinkers engage in HED. The consumption level with the clearest (poor) health implications is heavy drinking, which has only a small advantage among degree attainers. Because of the diverse consumption patterns across degree attainment, it is not clear that college graduates have healthier behaviors, and I do not further examine this outcome.

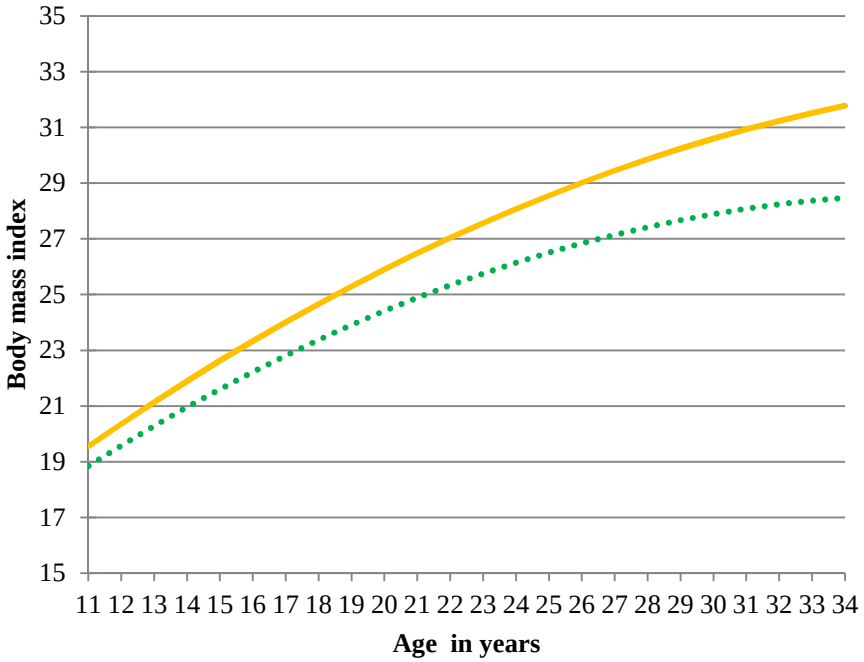
To determine whether differences in health behaviors emerge prior to young adulthood, growth curve models (Figure 3-1) plot the trajectories of smoking, body-mass index, obesity, and physical activities by single year of age from adolescence to young adulthood. Sugar-sweetened beverage and fast food consumption were not asked at all waves and are not included. Full tables of results used to create these figures are available in Appendix Table A3-1. Overall, the figures demonstrate that there are differences in health behaviors at younger ages among these groups, but trajectories diverge and disparities grow over time, supporting the need for further examination of college degree effects. However, for physical activities, the growth in the gap appears to be mostly during the teen years, with less change during young adulthood. Further analysis will investigate these disparities.

Figure 3-1. Growth trajectories demonstrating health behavior trajectories for individuals attaining and not attaining a college degree

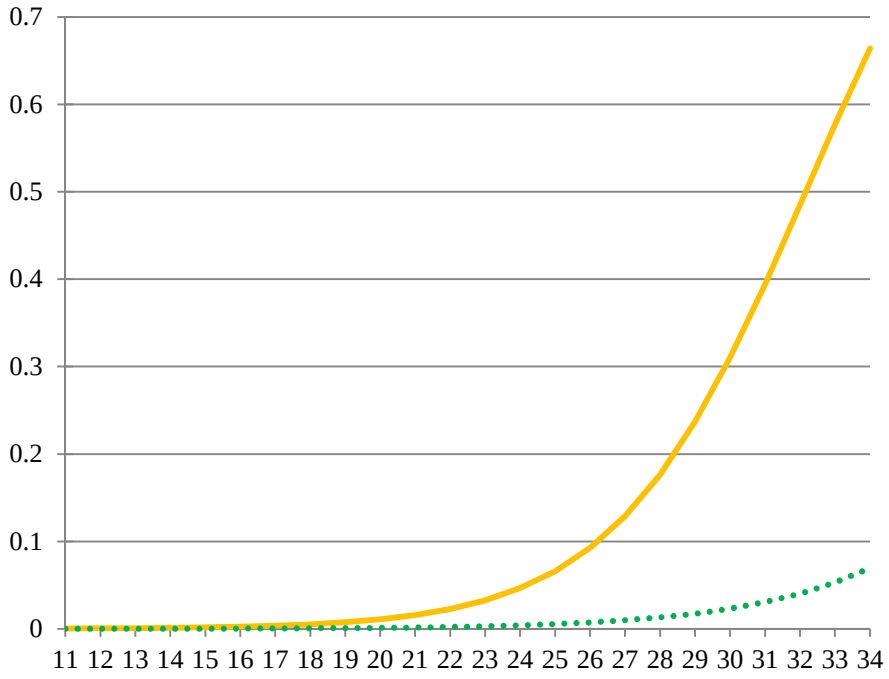
Panel A. Predicted probability of current smoking



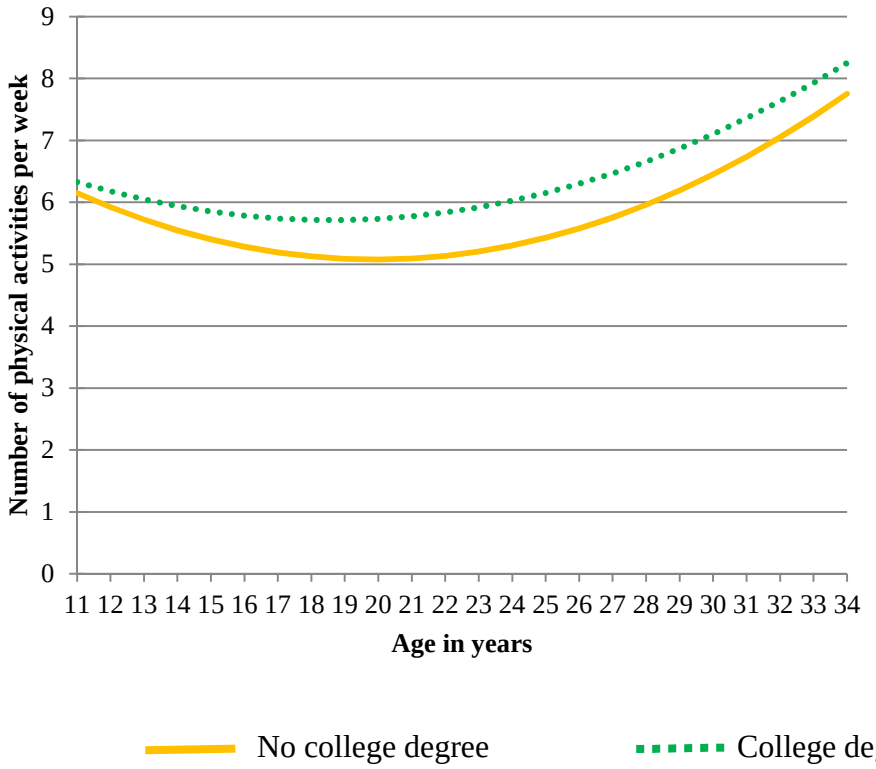
Panel B. Predicted body-mass index



Panel C. Predicted probability of obesity



Panel D. Predicted physical activities



Average Causal Estimates

I now turn to PSM to determine whether controlling for selection nets out the positive effect of college. First, a logit model estimates the propensity score, or predicted probability of college degree attainment for each individual. The results of the logit model (using the smoking sample) are given in Table 3-2. Each of the samples has its own model and set of propensity scores, but the results are nearly identical since there are only small differences in the samples. Many factors remain significant and moderately strong despite the large number of covariates. However, the model was not specified to interpret coefficients and significance levels. For example, the positive association between being Black and attaining college may not accurately describe this relationship since the coefficient represents the effect in specific and probably unlikely conditions (when the many other variables are at their means). I retain the nonsignificant variables because they still can contribute to the model and because overfitting these models can improve propensity score matching results (Lunceford & Davidian 2004). Additionally, running OLS and logit models predicting health behaviors with college degree attainment and propensity scores as the independent variables revealed that logit models including the full set of variables did the most to reduce the college degree-health behavior association.

Table 3-2. Unstandardized coefficients and significance levels for logit models predicting college degree attainment at Wave 4

Age at Wave 4	0.14	***	Protective factors scale	0.04	
Female	0.29	***	Depression scale	0.01	
Race (White)			Ever had sex	-0.29	***
Black	0.33	***	Self-rated health	0.13	***
Hispanic	0.34	***	How often missed school	-0.21	***
A/PI	0.36	***	Smoking status (non-smoker)		
AI/AN	-0.71	*	Daily smoker	-0.51	***
Other race	-0.71		Former smoker	-0.61	***
Born in the U.S.	-0.23	*	Infrequent smoker	-0.40	***
Household smoker	-0.12	*	Number of close friends that smoke	-0.16	***
Parent smoker	-0.07		BMI	-0.01	*
Frequency of parent HED	-0.02		Alcohol consumption (nondrinker)		
Parent educational attainment	0.18	***	Usually has one drink	0.12	
Mom is professional	0.08		Usually has two drinks	0.33	***
Dad is professional	0.23	***	Usually has 3+ drinks	0.17	*
Income-to-needs ratio (400%+)			Days in past year drunk/high	0.10	***
Below 100%	-0.65	***	Number of close friends that drink	0.05	+
100-<200%	-0.62	***	Physical activities in last week	0.00	
200-<300%	-0.46	***	Visited dentist within last year	0.19	***
300-<400%	-0.35	***	Vegetable consumption (twice)		
Missing	-0.30	***	None	-0.12	*
Parent receiving public assistance	-0.12	+	Once	0.03	
Social control	0.01		Sweet snack consumption (none)		
Parent-child closeness scale	0.03		Once	0.13	**
Parent disappointment for child not graduating college (Very disappointed)			Twice	0.24	***
Somewhat disappointed	-0.22	***	How often wears seatbelt	-0.03	
Not disappointed	-0.52	***	Usually gets enough sleep	-0.20	***
Household size	-0.01		Hours of screentime	0.00	**
Ever repeated grade	-0.76	***	Delinquent behaviors scale	-0.06	+
Ever suspended	-0.33	***	Religious attendance scale	0.07	**
Ever expelled	-0.56	**	Religious importance scale	-0.15	***
Ever truant	-0.14	*	Neighborhood quality scale	0.04	
Standardized scale of grades	-0.67	***	Number of missing items	0.00	
Vocabulary score	0.02	***	Wave 4 weight	0.00	*
Disabled	-0.16		Constant	-11.65	***
School integration scale	-0.01		Pseudo R-squared	0.33	
Getting along with teachers scale	-0.10	**			
Problem with attention scale	0.13	***			
Problems with homework scale	-0.05				
Getting along with students scale	-0.03				
College expectations scale	0.37	***			
Desire for college attendance scale	0.18	***			
Expectations to live to 35 scale	0.03				
Expectations killed by 21 scale	0.01				

*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

Notes: All covariates are taken from Wave 1, except where noted. N=14674.

Table 3-3 demonstrates covariate balance, before and after matching, for the smoking sample. Before matching, the treatment (college degree) and control (no degree) groups are quite

different, as nearly all of the comparisons demonstrate statistical significance, and the differences are sizable. For example, 59% of the treatment compared to 50% of the control is female, and 6% of the treatment compared to 28% of the control ever repeated a grade. These results confirm that college degree holders are indeed a select group. After matching, the two groups are similar. Though a few factors are significantly different, these differences are small. More importantly, each of the indicators displays less than 10% bias[3-2], indicating good covariate balance (Austin 2011). Overall, the matching has resulted in covariate balance, reducing the median percentage bias from 25.4 to 1.9. Covariate balance is similar for the other samples. No individuals were dropped, so the full sample of available subjects was included in all analyses.

Table 3-3. Covariate balance: means of covariates, before and after matching

		Before matching		After matching	
	College Degree	No coll. deg	% bias	No coll. deg	% bias
Age at Wave 4	28.44	28.61 ***	-9.7	28.37 +	3.8
Female	0.59	0.50 ***	17.8	0.58	3.0
Race (White)					
Black	0.19	0.23 ***	-9.4	0.18	0.7
Hispanic	0.11	0.18 ***	-20.1	0.13 *	-4.2
A/PI	0.10	0.05 ***	20.0	0.12 ***	-8.9
AI/AN	0.00	0.01 ***	-8.1	0.00	0.1
Other race	0.00	0.02 +	-3.3	0.00	-1.0
Born in the U.S.	0.92	0.93 **	-4.6	0.89 ***	9.2
Household smoker	0.33	0.51 ***	-40.4	0.32	0.8
Parent smoker	0.57	0.67 ***	-21.7	0.57	-0.3
Frequency of parent HED	1.17	1.28 ***	-16.2	1.17	-0.7
Parent educational attainment	14.48	12.55 ***	82.8	14.49	-0.5
Mom is professional	0.41	0.21 ***	43.0	0.39 +	3.8
Dad is professional	0.80	0.67 ***	31.1	0.80	0.8
Income-to-needs ratio (400%+)					
Below 100%	0.06	0.17 ***	-35.6	0.06 *	-1.9
100-<200%	0.12	0.21 ***	-24.5	0.12	-0.2
200-<300%	0.16	0.16	-0.6	0.16	-0.9
300-<400%	0.16	0.10 ***	15.0	0.16	-1.9
Missing	0.23	0.25 **	-4.9	0.21 *	4.9
Parent receiving public assistance	0.17	0.32 ***	-39.3	0.16	1.4
Social control	3.91	3.95 *	-4.0	3.93	-2.2
Parent-child closeness scale	-0.09	0.05 ***	-14.2	-0.10	1.0
Parent disappointment for child not graduating college (Very disappointed)					
Somewhat disappointed	0.38	0.42 ***	-7.1	0.39	-0.8
Not disappointed	0.07	0.18 ***	-36.2	0.07	0.9
Household size	4.43	4.62 ***	-12.5	4.42	0.5
Ever repeated grade	0.06	0.28 ***	-59.4	0.06	0.3
Ever suspended	0.11	0.34 ***	-58.8	0.11	-1.5
Ever expelled	0.01	0.06 ***	-28.9	0.01	-0.5
Ever truant	0.19	0.35 ***	-35.7	0.21 +	-3.4
Standardized scale of grades	-0.62	0.23 ***	-96.4	-0.61	-1.5
Vocabulary score	107.13	97.97 ***	69.3	107.19	-0.5
Disabled	0.02	0.03	-2.3	0.02	0.5
School integration scale	1.33	1.51 ***	-27.4	1.33	0.3
Getting along with teachers scale	0.66	0.94 ***	-31.5	0.66	0.2
Problem with attention scale	1.15	1.27 ***	-12.9	1.14	0.6
Problems with homework scale	1.02	1.28 ***	-25.4	13.04	-1.9
Getting along with students scale	0.73	0.93 ***	-22.2	0.73	-0.4

Table 3-3 continued

College expectations scale	4.73	3.89 ***	86.9	4.72	1.7
Desire for college attendance scale	4.83	4.26 ***	64.3	4.81 +	2.4
Expectations to live to 35 scale	4.54	4.29 ***	30.7	4.52	2.0
Expectations killed by 21 scale	1.61	1.68 ***	-9.5	1.64 *	-4.5
Protective factors scale	0.10	-0.04 ***	24.1	0.08	2.2
Depression scale	-0.25	0.09 ***	-35.8	-0.23	-1.3
Ever had sex	0.26	0.45 ***	-41.1	0.26	0.5
Self-rated health	4.10	3.77 ***	37.1	4.12	-2.9
How often missed school	0.30	0.47 ***	-28.2	0.30	0.8
Smoking status (non-smoker)					
Daily smoker	0.03	0.12 ***	-32.1	0.03	0.7
Former smoker	0.02	0.04 ***	-10.5	0.02	0.6
Infrequent smoker	0.05	0.09 ***	-19.2	0.04	1.4
Number of close friends that smoke	0.48	0.96 ***	-49.0	0.46	1.6
BMI	21.88	22.99 ***	-25.9	21.73 +	3.3
Alcohol consumption (nondrinker)					
Usually has one drink	0.12	0.10 *	4.4	0.12	-0.4
Usually has two drinks	0.08	0.08	0.5	0.07 *	4.2
Usually has 3+ drinks	0.23	0.31 ***	-17.7	0.25	-2.9
Days in past year drunk/high	1.22	1.35 ***	-12.7	1.23	-1.1
Number of close friends that drink	0.95	1.18 ***	-20.5	0.98	-2.6
Physical activities in last week	5.63	5.18 ***	12.4	5.78 +	-4.1
Visited dentist within last year	0.78	0.62 ***	36.2	0.76 *	4.2
Vegetable consumption (twice)					
None	0.24	0.37 ***	-27.5	0.23	2.4
Once	0.42	0.38 ***	8.3	0.41	2.0
Sweet snack consumption (none)					
Once	0.37	0.32 ***	11.1	0.38	-2.7
Twice	0.22	0.21	1.8	0.21	1.5
How often wears seatbelt	3.38	2.98 ***	36.5	3.36	1.5
Usually gets enough sleep	0.69	0.72 ***	-6.4	0.69	-0.1
Hours of screentime	19.43	24.38 ***	-24.2	19.73	-1.5
Delinquent behaviors scale	-0.21	0.07 ***	-31.0	-0.17 *	-4.3
Religious attendance scale	1.94	1.66 ***	24.3	1.97	-2.1
Religious importance scale	1.33	1.26 ***	10.5	1.32	1.1
Neighborhood quality scale	-0.12	0.02 ***	-13.7	-0.09	-2.8
Number of missing items	2.09	2.25 **	-5.5	2.00 +	3.0
Wave 4 weight	1387.60	1525.90 ***	-9.9	1376.50	0.8

*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

Notes: Significance levels indicate results from t-tests based on regressions of the variables on a treatment indicator. Percentage of covariate bias is defined as the difference of the sample means in the treated and non-treated (full or matched) sub-samples as a percentage of the square root of the average of the sample variances in the treated and non-treated groups (Rosenbaum and Rubin, 1985). N=14674.

After creating the propensity scores and checking covariate balance, the matched sample produces treatment effects. Table 3-4 presents the treatment effects: the differences between those with and without college degrees after matching. College degrees exert sizable effects on each of the health behaviors even after accounting for selection. Effects are largest for smoking (urrent smoking OR=.42; daily smoking OR=.28) and sugar-sweetened beverage consumption (Cohen's d=-.35). Physical activity displays the smallest effects. Standard errors may be slightly underestimated because of mean imputation (as described in the methods section), but significance levels are less than .001 for all outcomes except physical activity.

Table 3-4. Treatment effects after matching using 5 nearest neighbors

	College Degree	No coll degree	Difference		OR	d	Reduction by Matching
Current smoker	0.19	0.36	-0.17	***	0.42		29%
Daily smoker	0.07	0.21	-0.14	***	0.28		33%
BMI	27.45	28.36	-0.91	***		-0.12	63%
Obese	0.27	0.32	-0.05	***	0.79		64%
Obese II	0.12	0.17	-0.05	***	0.67		50%
Obese III	0.05	0.08	-0.03	***	0.61		50%
No phys activities	0.11	0.14	-0.03	+	0.76		57%
# physical activities	6.76	6.23	0.53	*		0.09	18%
SSB	7.38	11.19	-3.81	***		-0.35	29%
Fast food	1.78	2.11	-0.33	***		-0.12	62%

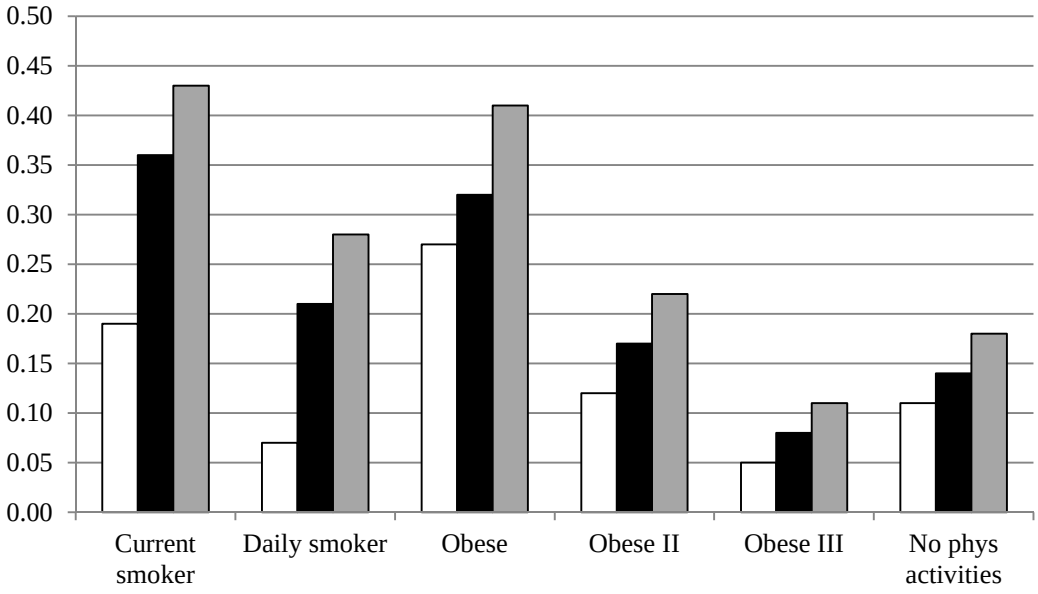
*** p < .001; ** p < .01; * p <.05; + p<.10
Source: National Longitudinal Study of Adolescent to Adult Health

Figure 3-2 illustrates the associations between college degrees and health behaviors, before and after accounting for selection. This figure charts the means of the treatment group, the unmatched control group, and the matched control group from Tables 3-1 and 3-4.[3-3] Accounting for selection through using the matched control group reduces the college degree-health behavior association, since for all outcomes, the matched control is closer to the treatment than the

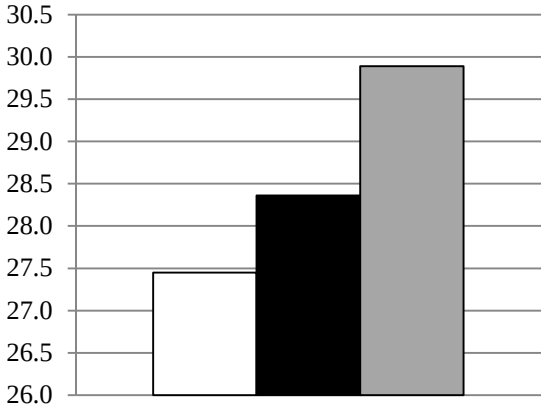
unmatched control. It should also be noted that the difference between college graduates and the matched control is only significant for physical inactivity at p<.10.

Figure 3-2. Comparison of health behavior outcome means for treatment, matched control, and unmatched control groups

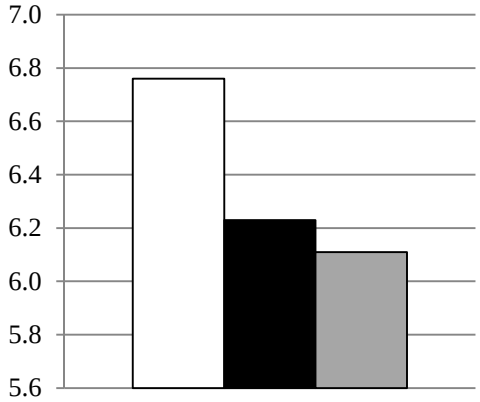
A. Dichotomous outcomes

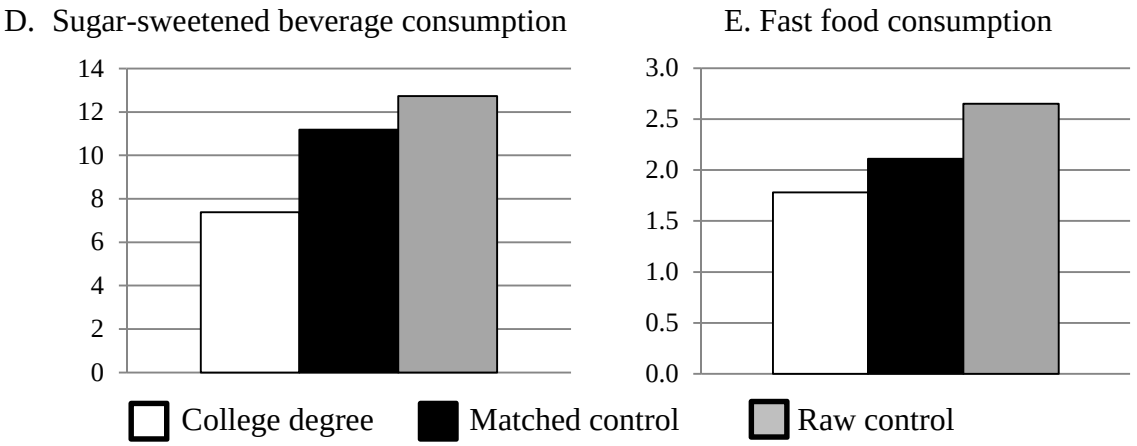


B. BMI



C. Number of physical activities





The last column in Table 3-4 shows that matching reduces the differences between the two groups for all outcomes. These percentages reflect the overestimation of college degrees' effects by 18-64%, for raw comparisons that do not account for selection. Matching reduces BMI, obesity, and fast food consumption the most, with reductions of nearly two-thirds, suggesting that selection effects are larger for these outcomes. However, accounting for selection through using the matched control group reduces the college degree-health behavior association for all outcomes.

Table 3-5 compares results from different propensity score approaches. The first column represents the effects from matching using five nearest neighbors and used in Table 3-4 and Figure 3-2. The second column shows treatment effects for matching using three nearest neighbors. These effects are very close to those for five neighbors, but appear to be slightly larger. Next, treatment effects using IPW regression models also show similar results, except physical activity and fast food consumption no longer show a significant effect for college degrees. Effects for smoking and sugar-sweetened beverage are similar but slightly smaller, whereas BMI and obesity outcomes have slightly larger effects. The models for five nearest neighbors, three nearest neighbors, and IPW all use the same samples, but the last column displaying IPW with multiple imputation uses the full sample. The results are nearly identical to

those of IPW without imputation. Overall, the results appear robust for smoking, weight status, and sugar-sweetened beverage consumption. Physical activity differs across approaches, has small average treatment effects, and also does not diverge much across age in the growth curve models. Effects of college degrees on fast food consumption appear particularly sensitive to whether the propensity scores are matched or weighted.

Table 3-5. Treatment effects for multiple propensity score approaches

	5 nearest neighbors	3 nearest neighbors	IPW	IPW with imputation
Current smoker	-0.17 ***	-0.18 ***	-0.15 ***	-0.15 ***
Daily smoker	-0.14 ***	-0.15 ***	-0.12 ***	-0.12 ***
BMI	-0.91 ***	-0.97 ***	-1.06 **	-1.18 ***
Obese	-0.05 **	-0.06 ***	-0.08 **	-0.09 **
Obese II	-0.04 ***	-0.05 ***	-0.05 **	-0.06 **
Obese III	-0.03 ***	-0.03 ***	-0.04 ***	-0.05 ***
No phys activities	-0.03 +	-0.03 *	-0.01	-0.01
# physical activities	0.53 *	0.53 *	0.49	0.52
SSB	-3.81 ***	-3.79 ***	-3.64 ***	-3.64 ***
Fast food	-0.33 ***	-0.33 ***	-0.21	-0.20

*** p < .001; ** p < .01; * p <.05; + p<.10
Source: National Longitudinal Study of Adolescent to Adult Health

Heterogeneity across propensity score

Heterogeneous treatment effect models tested differences in treatment effects across propensity score strata. However, balance could not be achieved within strata using the stratification-multilevel models. That is, dividing cases into smaller groups with similar propensity scores resulted in differences across treatment and control groups. For example, among those that had a propensity score of .9 or higher, the percentage of Asians with and without degrees differed and could not be reconciled. Thus, I compare the average treatment effects for those with propensity scores below to those at or above the sample mean. I also use the matching-smoothing method to

look at differences across the continuum of propensity scores. Overall, the results suggest that treatment effects are generally similar across propensity scores, except for BMI which has greater degree benefits for those with greater propensity scores.

Table 3-6 displays treatment effects (the difference between the treatment and control groups for the matched sample) for those below the propensity score mean and those at or above the propensity score mean. Overall, the effects are similar across the two groups, and are not statistically significant, except for BMI. The treatment effect for BMI is much greater for those with higher propensity scores (-1.52) compared to those with lower propensity scores (-.54). A smoothed local polynomial of treatment effects across propensity scores further examines heterogeneity across BMI, displayed in Figure 3-3, Panel A. This graph shows the difference at BMI over one's likelihood to attain a college degree. The linear trend downward indicates increased reductions in BMI for those more likely to attain a college degree. That is, although college degrees reduce BMI generally, they reduce BMI even more for those most likely to attain a degree.

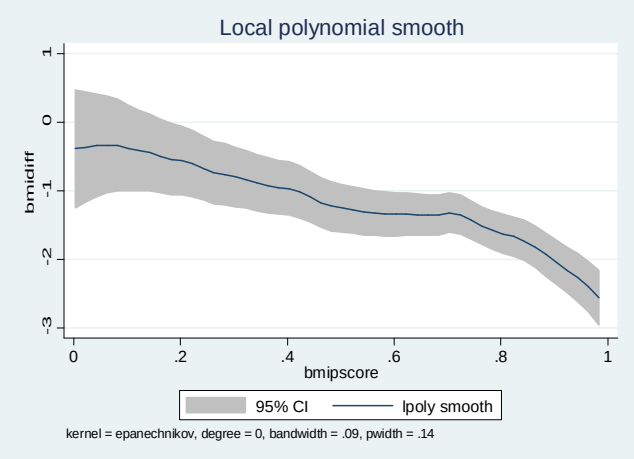
Table 3-6. Treatment effects for matches within high and low propensity score groups

	< mean PS	>= mean PS	Sig diff?
Current smoker	-0.17	-0.16	
Daily smoker	-0.13	-0.14	
BMI	-0.54	-1.52	**
Obese	-0.05	-0.09	+
Obese II	-0.05	-0.07	+
Obese III	-0.03	-0.03	
# physical activities	0.49	0.37	
No physical activities	-0.03	-0.03	
SSB	-3.48	-2.96	
Fast food	-0.29	-0.48	+

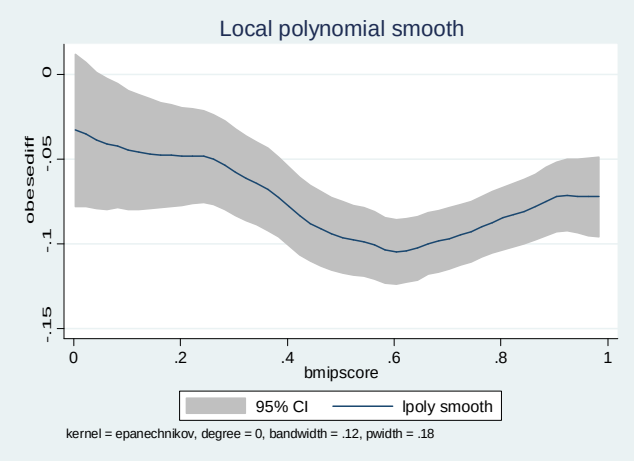
*** p < .001; ** p < .01; * p <.05; + p<.10
Source: National Longitudinal Study of Adolescent to Adult Health

Figure 3- 3. Smoothed local polynomial of differences in outcomes for matched sample across propensity score

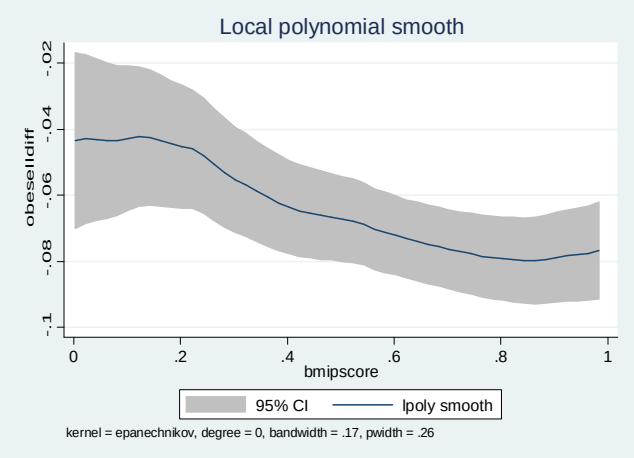
A. BMI



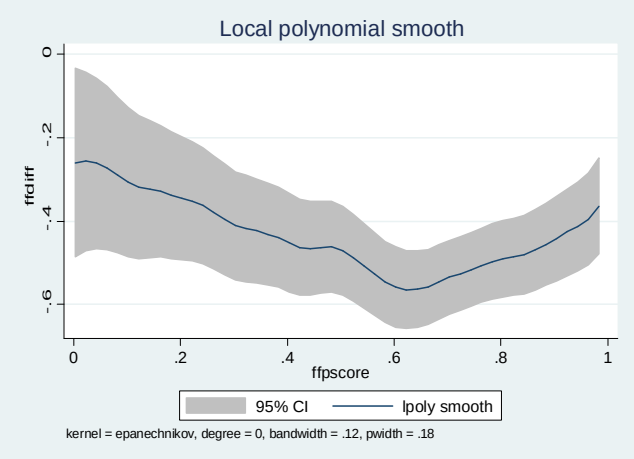
B. Obesity



C. Obesity, Class II



D. Fast food consumption



Obesity, however, does not display the same clear pattern. The treatment effects are only significantly different at less than .10 across the two groups of propensity scores (Table 3-6) and the smoothed local polynomial regression is less definitive (Figure 3-3, Panel B), with a slight U-shape and a broad confidence interval. Similarly, effects for class II obesity are significantly different at $p<.10$ and the smoothed polynomial trends downward (Figure 3-3, Panel C), but has a wide confidence interval. Together, these findings suggest that college degrees may reduce BMI more for those with a greater likelihood of attaining a degree, but these reductions do not seem to translate into strong differences in risk status for obesity.

The effect of education on fast food consumption is also significantly different ($p<.10$) across the low and high propensity score groups (Table 3-6), with greater reductions for individuals with higher propensity of achieving a college degree. The smoothed regression of treatment differences in Figure 3-3, Panel D is not definitive. It appears that reductions in fast food consumption are greatest for individuals who have a propensity score around 0.6, but the confidence interval is again wide. Additionally, the different results reported in Table 2-5 suggest that findings may be inconsistent.

Heterogeneity across class background

While propensity for degree attainment includes class background, this specific trait may condition the effects of college degrees. Examining effects within parent education will distinguish heterogeneity across class background. Results from regression models weighted by the IPW to account for selection are shown in Table 3-7. Panel A shows the direct effects of both parent education and degree attainment, controlling for selection. As in the imputed IPW treatment effects reported in Table 3-5, college degrees are significant predictors of smoking, weight status, and sugar-sweetened beverage consumption, but not physical activity or fast food consumption. Parent education is not significantly associated with current smoking, class III obesity, or physical activity. In contrast, BMI and fast food consumption have consistent associations with parent education such that respondents with less educated parents have greater BMI and greater fast food consumption. Daily smoking, obesity, and sugar sweetened beverage consumption have less consistent results; individuals with parents who have only a high school diploma or some college have increased levels of daily smoking and obesity, and those whose highest parent education is a high school diploma have higher levels of sugary beverage consumption. Overall, these results suggest that degree attainment negates most class background differences for smoking and sugar-sweetened beverage consumption, but not for BMI and fast food consumption.

Table 3-7. Coefficients and significance from OLS and logistic regression models predicting health behavior outcomes

	Current smoker	Daily smoker	BMI	Obesity	Obesity II	Obesity III	Inactive	# activities	Sugary beverages	Fast food
					Panel A: direct effects only					
College degree	-0.69 ***	-0.78 ***	-1.24 ***	-0.36 **	-0.38 **	-0.57 ***	-0.10	0.52	-3.57 ***	-0.24
Parent ed (Adv degree)										
Less than HS	0.01	0.16	2.12 **	0.36	0.50	0.12	0.53 +	-0.72	-0.43	1.07 ***
High school diploma	0.16	0.57 *	1.07 *	0.33 *	0.42 **	0.23	0.26	-0.03	2.27 *	0.53 *
Some college	-0.01	0.33 *	1.25 **	0.30 *	0.24	0.04	0.62 +	-0.74	0.77	0.53 ***
College degree	-0.01	0.15	0.64 +	0.14	0.20 +	0.14	0.12	-0.27	0.08	0.34 **
Constant	-0.41 ***	-1.32 ***	28.60 ***	-0.64 ***	-1.57 ***	-2.18 ***	-1.97 ***	6.62 ***	11.27 ***	2.05 ***
					Panel B: Interaction effects					
College degree	-0.67 ***	-1.07 ***	-0.84	-0.18	-0.43 *	-0.11	-0.17	0.09	-2.19 +	-0.49 **
Parent ed (Adv degree)										
Less than HS	-0.20 +	-0.04	2.58 ***	0.64 ***	0.55 ***	0.67 **	0.54 ***	-1.2 ***	1.77 **	0.54 ***
High school diploma	0.15	0.33 *	1.79 ***	0.48 ***	0.37 *	0.47 *	0.42 **	-0.77 *	2.62 ***	0.39 **
Some college	0.08	0.26 *	1.11 *	0.36 **	0.17	0.27	0.30 *	-0.54 +	1.52 **	0.39 **
College degree	0.04	0.12	0.75	0.19	0.24	0.29	0.29 +	-0.55	1.14 +	0.31 *
College degree*Parent ed										
Less than HS	0.34	0.44	-0.75	-0.48	-0.09	-1.19 *	0.00	0.81	-3.61 *	0.87 +
High school diploma	0.00	0.55	-1.30	-0.29	0.10	-0.51	-0.32	1.34 *	-0.56	0.25
Some college	-0.20	0.15	0.36	-0.10	0.16	-0.48	0.63	-0.47	-1.33	0.25
College degree	-0.13	0.02	-0.14	-0.07	-0.10	-0.25	-0.40	0.50	-1.98	0.03
Constant	-0.42 ***	-1.21 ***	28.37 ***	-0.75 ***	-1.55 ***	-2.41 ***	-1.94 ***	6.86 ***	10.49 ***	2.20 ***

*** p < .001; ** p < .01; * p <.05; + p>.10

Source: National Longitudinal Study of Adolescent to Adult Health

Notes: Models weighted by IPW.

Panel B then displays the interaction effects to determine whether the returns to college degrees differ across class background. Of the 40 interaction terms (4 terms x 10 outcomes), 3 are significant ($p<.01$) and one is significant at $p<.10$. Additionally, Wald tests evaluating whether the joint group of interaction terms are equal to zero were nonsignificant for all outcomes, indicating acceptance of the null hypothesis that the interaction terms are equal to zero. Surprisingly, college degrees have similar effects on health behaviors regardless of parent education.

Sensitivity Analyses

Further analysis determined whether findings are sensitive to the threshold of education, with results available in Appendix Tables A3-2 and A3-3. Health behaviors generally have a linear relationship with educational attainment such that the more education one attains, the healthier one behaves (see Table 2-1 in Chapter 2). However, the largest discrepancies in behaviors are viewed at the college degree threshold; using some college experience rather than a four-year degree generally results in smaller effects (Table A3-2). Further analysis also assessed whether findings are sensitive to respondents who had not achieved a college degree but were in school at Wave IV. Excluding these individuals (approximately 1600) produced similar results (Table A3-3). Models examining only older individuals (ages 26-32 or 28-32) also produced similar results.

Discussion

Overall, the results provide support for the broad benefits of college degrees. After accounting for selection as best as possible, college degrees have significant effects, ranging from small to medium-large, on health behaviors. Education thus does have an overall positive effect for health

behaviors. Regardless of one's characteristics and background, attaining a college degree results in a healthier lifestyle, on average. Selection explains a substantial portion of the associations in young adulthood, since for each health behavior, the treatment effect was smaller after controlling for likelihood to attain a college degree. The average percentage reduction was 46%, with the largest reductions observed for BMI (63%), obesity (64%), and fast food consumption (62%), as indicated in Table 3-4. For those with the smallest percentage reduction – smoking, physical activity, and sugar-sweetened beverages – the effects of college completion appear dominant.

The college degree-physical activity relationship is the weakest of the outcomes. The increased levels of physical activity among college graduates are small even before adjusting for selection. The treatment effects are inconsistent across propensity score approaches, with nearest neighbors showing significant (at $p<.05$ or $p<.10$) but small effects, whereas IPW shows nonsignificant effects. These results may mean that college degrees produce a smaller (or nonexistent) physical activity benefit. Or, it may be that the two operationalizations, which are based on the same reports of physical activity engagement, do not represent well activity levels. They emphasize leisure physical activity, but do not ask about other types of activities such as paid manual labor or strenuous housework. Further, the data does not provide information on the duration or intensity of physical activities.

Fast food consumption and to some extent physical activity showed weaker effects in the IPW compared to the matching with 5 or 3 nearest neighbors (Table 3-5). Because weighting gives each individual a weight equal to the inverse probability of the treatment experienced, individuals with very low propensity scores but who graduated college (and those with high propensity scores but who did not graduate) contribute disproportionately to the models. IPW

will be more sensitive to these extreme cases than matching. Substantively, it is unclear whether matching or IPW will produce more accurate results. On one hand, a small number of cases should not contribute excessively, but on the other, these special cases should contribute more since their unique circumstances can provide insight into the role of college degrees. I therefore cautiously interpret these effects to mean that there may be a small effect of college degrees on fast food consumption and physical activity.

Testing for heterogeneity across treatment effect sizes generally indicated that college's effects on health behaviors are similar across groups. That is, college degrees provide similar benefits regardless of one's likelihood to achieve that degree or one's class background. However, BMI did display heterogeneous treatment effects: the effects of college degrees on BMI were stronger for those most likely to attain a college degree. In support of a conditional reproduction approach, BMI was reduced by a college degree to a greater extent for individuals most likely to attain a degree.

Interestingly, smoking and obesity display contrasting results. Surprisingly, college degrees overwhelmed class background effects on smoking, providing strong support for the "transformative theory" perspective. Smoking rates in young adulthood are primarily driven by college degrees; educational attainment thus appears to be the main pathway through which social background shapes adult smoking status. In contrast, weight status is determined by a combination of educational attainment, likelihood of degree attainment, and class background. These results do not point to causes for these different results, and such tests are beyond the scope of this paper. However, future research should explore this important question.

This study does not provide a simple answer to the question of overall differences in returns to college degrees on health outcomes. The pattern has been thus far mixed for health

outcomes, as Bauldry (2014) found greater benefits of education for those with greater likelihood of degree attainment on self-rated health and Schafer et al. (2013) reported greater benefits of education for those least likely to attain college degrees for hypertension, heart problems, and mortality.

Turning back to the hypotheses outlined in Chapter 1:

Hypothesis 1a (Transformative theory): College degrees have positive effects on healthy behaviors.

Hypothesis 1b (Sorting theory): Selection into degree attainment accounts for the healthier behaviors of college graduates.

The evidence supports Hypothesis 1a for most outcomes: college degrees have positive effects on healthy behaviors. College graduates display healthier behaviors than their less educated counterparts, and accounting for selection did not eliminate these differences in smoking, weight status, and sugar-sweetened beverage consumption.

Hypothesis 2a (Conditional equalizing): College degrees benefit the health behaviors of individuals from disadvantaged (or historically disadvantaged) social statuses more than those of their advantaged counterparts.

Hypothesis 2b (Conditional reproduction): College degrees benefit the health behaviors of individuals from advantaged (or historically advantaged) social statuses more than those of their advantaged counterparts.

The evidence mostly does not support either hypothesis 2a or 2b. College degrees reduced BMI to a greater extent for those most likely to earn degrees, suggesting that there is some conditional reproduction. However, no other outcomes displayed heterogeneity in treatment effects across likelihood or class background. Furthermore, weight status displayed

"sorting" more generally since the majority (50-64%) of college degree effects was eliminated through accounting for selection. College degrees appear to be a pathway through which background characteristics result in healthier behaviors.

For smoking and sugar-sweetened beverage consumption, selection into degree attainment reduced the effects of college degrees a small amount (29%-33%) and direct effects of class background were minimal. These outcomes display support for transformative theory (Hypothesis 1a), since degree attainment appears to be the main source of the college graduate advantage.

Chapter 3 Endnotes

[3-1]Treatment is considered to be college degree attainment. I use the terms treatment and control to refer to those with and without college degrees, respectively.

[3-2]Percent bias is calculated as the difference in means as a percentage of the standard deviations (Rosenbaum and Rubin 1985).

[3-3]The treatment group is the same in the matched and unmatched samples.

Chapter 4. Differences across gender, race/ethnicity, and immigrant status

Life chances differ across race/ethnicity and gender in the United States. While our society promotes education as the key to overcoming obstacles, educational opportunities are unequal. Children of different race/ethnic groups have different household resources, attend schools of differing quality, live in different kinds of neighborhoods, and interact with different friends, resulting in unequal educational outcomes and, in turn, adult well-being. However, we have yet to fully understand the role of the educational institution in the production of social inequalities across race/ethnic groups. Some evidence suggests that college experiences differ across social groups, marginalizing historically disadvantaged groups. For example, women and race/ethnic minorities display lower social integration and academic engagement (Fischer 2007). In contrast, some research concludes that women and race/ethnic minorities have greater returns from education on socioeconomic achievement in adulthood (DiPrete and Buchmann 2006; Perna 2005).

We know very little about the role of education in racial/ethnic differences in health behaviors. In particular, we do not know whether higher education has different effects on the health behaviors of men and women from different race/ethnic backgrounds or immigrant status. This chapter tests whether college degrees have different effects on the health behaviors of young adults across race/ethnicity, gender, and immigrant status. Because there are important social and health differences in race effects by gender and in gender effects by race (Hankivsky 2012), I consider the intersecting categories of race/ethnicity and gender (e.g. Black females).

A conditional reproduction approach would argue that the historically advantaged group of White men should receive greater benefits compared to White women, or men and women of

Black, Hispanic, or Asian descent. Similarly, individuals who are U.S.-born and whose parents are U.S.-born would receive greater benefits compared to young adults who are foreign-born or whose parents are foreign-born. As described in the introduction, historically advantaged individuals may be more privileged on campus and better able to convert their college degree into benefits. In contrast, a conditional equalizing perspective would expect White men and U.S. born individuals to receive the smallest benefits compared to historically disadvantaged groups. From this perspective, historically disadvantaged groups may have more to gain from their degrees as advantaged individuals may be able to draw upon other resources. If the effects of college degrees are similar across subgroups, an unconditional approach will be supported.

Overall, the findings provide evidence that college degrees result in healthier behaviors similarly across race/ethnicity, gender, and immigrant status. The differences for college graduates and non-graduates vary across these groups, with White men showing the greatest reductions for sugar-sweetened beverages but the smallest reductions for BMI. However, once selection into degree attainment has been accounted for, the effects of college degrees are not significantly different across groups. Overall, the effects of college degrees and selection into degree attainment on health behaviors are independent of differences across race/ethnicity, gender, and immigrant status.

Methods

Analytic Approach

First, frequencies describe behaviors in young adulthood across degree status for each of the race/ethnic and gender categories and immigrant statuses. Second, ordinary least squares (OLS) and logistic regressions determine how the effects of college degrees differ for different groups

by interacting race/ethnic and gender category and immigrant status with degree attainment. Third, these regression models then incorporate an inverse probability weight (IPW) to account for selection. The terms interacting social groups with college graduation in IPW models indicate differences in college degree effects after accounting for selection into college degree attainment.

As described in the introduction, IPW is a propensity score method that uses weighting instead of matching. Propensity scores are created as in the previous chapter, with the logit model shown in Table 3-2 and the covariate balance shown in Table 3-3. Then, OLS (continuous outcomes) and logistic (dichotomous outcomes) regression models weight each individual based on the inverse probability of the treatment condition he/she experienced. These regression models therefore account for selection into college degree attainment through this weighting. I use IPW because it allows for a flexible regression approach that can easily incorporate additional variables and interaction terms. Propensity score matching does not have a test for evaluating additional factors. With IPW models, I interact gender, race/ethnicity, and immigrant status with college degrees, providing a test of significance for the difference in college degree effects across these groups. I also look at whether the interaction terms together differ significantly from zero using a Wald test. Since I use multiple imputation, model fit statistics based on log likelihoods are complex and not provided by current software. There is no current consensus for approaching model fit in multiply imputed data (Chaurasia and Harel 2012).[4-1] The Wald test therefore performs an overall test of the group of interaction terms.

The Stata package *teffects* conducts IPW in a single step (Statacorp 2013). However, separating out propensity score estimation and regression models predicting outcomes allows me to adjust the models for non-normal distributions of outcome variables, use multiple imputation to account for item missingness, and directly test differences in degree effects across the groups

through interaction terms. Table A4-1 displays a comparison of results from *teffects* single step models and models from separate steps. The coefficients are identical as expected, and the standard errors differ slightly with the two step approach displaying slightly higher values. The standard errors from the two steps therefore appear conservative, and I use this approach.

I also compare results from these IPW models that interact college degrees with race/ethnicity and gender categories and immigrant status to PSM conducted within race/ethnic and gender and immigrant status groups. PSM within subgroups does not provide a significance test to compare differences in treatment effects as the IPW models do. However, prior research has demonstrated that separate models provide the best balance (Green and Stuart 2014). That is, matching individuals within each social group produces more similar comparisons than matching conducted across the sample. I therefore conduct PSM within each of the subgroups and compare the general trends to the IPW results as a test of robustness of the IPW approach for this sample.

Data

As in the previous chapter, analyses use data from the National Longitudinal Study of Adolescent to Adult Health (Add Health). The sample consists of respondents with valid sample weights and college degree attainment information at Wave IV: 3,869 White males; 4,283 White females; 1,354 Black males; 1,801 Black females; 1,124 Hispanic males; 1,248 Hispanic females; 480 Asian males; and 442 Asian females. American Indian/Alaska Native (N=111) and individuals reporting other racial background (N=29) had sample sizes too small for examination.

Across these categories, there are 14,101 non-pregnant White, Black, Hispanic, and Asian men and women with a valid Wave IV weight. An additional four individuals are missing

on college degree attainment. I retain all of these respondents (N=14,097) using multiple imputation to account for missingness on covariates predicting college degree attainment (propensity score) and health behavior outcomes. Imputation ranged from less than 1% to 1% for health behavior outcomes and 0 to 16% for college degree attainment covariates (except days in past year the respondent was drunk or high, which is missing 55%), with an average imputation of 3% across these covariates. I use a Markov chain Monte Carlo (MCMC) approach with 10 imputed datasets. In addition to the health behavior outcomes and covariates being imputed, college degree attainment and a number of auxiliary variables[4-2] inform imputation. Assuming the data are missing at random, multiple imputation yields less biased results than listwise deletion or mean imputation (Allison 2002; Graham 2009).

Measures

Measures include college degree attainment, likelihood of college completion, race/ethnicity, and gender. As described in *Chapter 2 Data and Methods,* college degree attainment is a constructed variable from Wave IV. Likelihood of college completion is created from a range of parent, school, and respondent information collected at Wave I. Gender is represented with a dichotomous indicator of male/female taken from the Wave IV measure, since this includes any corrections or updates since Wave I. Race and ethnicity is captured with mutually exclusive categories for non-Hispanic White, non-Hispanic Black, and Hispanic, and Asian/Pacific Islander. Individuals reporting American Indian/Native American descent and other racial background (individuals who responded "other" to the question of race and ethnicity) are excluded due to the small sample sizes. Information from Wave III reports of race/ethnicity fills

in missing information from Wave IV. Persons reporting more than one race are assigned to the one category that they report best describes their racial background.

Results

Descriptive

Table 4-1 displays health behavior means for each of the race/ethnic and gender groups, across college degree attainment. Because there are so many results in this table, Figure 4-1 depicts the overall means for each group (from the information provided in Table 4-1). Overall, there is variability across the groups in levels of health behaviors. For Black, Hispanic and Asian respondents, men smoke far more than women: current smoking is 1.8 times more common among Black men than women, and 1.5 times as frequent among Hispanic and Asian men compared to Hispanic and Asian women. Whites smoke the most, with White women smoking nearly as much as White men. Obesity rates and physical inactivity are most common among Black (49% obese; 22% physically inactive) and Hispanic women (40% obese; 20% physically inactive). Obesity is least common among Asian men and women, followed by White men and women. For all groups, men participate in a greater average number of physical activities, but also drink more sugar-sweetened beverages. Fast food consumption differs by race/ethnicity but not gender, as Blacks eat the most fast food (3.44 times per week on average for males and 2.86 times for women), followed by Hispanics, Asians, and Whites, with similar rates across men and women within each group. Asians display the healthiest behaviors, but other groups have mixed results. For example, among men, Whites smoke the most and drink the most sugar-sweetened beverages, but have lower rates of obesity than Blacks and Hispanics and eat fast food less often than the other men.

Table 4-1. Unadjusted health behavior means by college degree attainment

	Overall	No degree	College Degree	Sig diff?	Diff	Diff, compared to White Male
Panel A: White Male (N=3820-3869)						
Population share		0.70	0.30			
Current smoker	0.44	0.52	0.25	***	-0.27	
Daily smoker	0.29	0.38	0.09	***	-0.29	
BMI	28.62	29.04	27.67	***	-1.37	
Obese	0.34	0.37	0.27	***	-0.10	
Obese II	0.14	0.16	0.09	***	-0.07	
Obese III	0.05	0.07	0.03	***	-0.04	
No phys activities	0.12	0.15	0.07	***	-0.08	
# physical activities	7.00	6.69	7.72	***	1.03	
SSB	13.29	15.50	8.27	***	-7.23	
Fast food	2.43	2.74	1.75	***	-0.99	
Panel B: White Female (N=3940-4283)						
Population share		0.62	0.38			
Current smoker	0.37	0.49	0.19	***	-0.30	**-0.03**
Daily smoker	0.25	0.37	0.08	***	-0.29	0.00
BMI	28.32	29.56	26.29	***	-3.27	**-1.90**
Obese	0.33	0.40	0.22	***	-0.18	**-0.08**
Obese II	0.19	0.23	0.11	***	-0.12	**-0.05**
Obese III	0.09	0.12	0.04	***	-0.08	**-0.04**
No phys activities	0.15	0.18	0.10	***	-0.08	0.00
# physical activities	5.91	5.49	6.59	***	1.10	**0.07**
SSB	9.64	11.88	6.06	***	-5.82	1.41
Fast food	1.72	1.98	1.29	***	-0.69	0.30
Panel C: Black Male (N=1341-1354)						
Population share		0.79	0.21			
Current smoker	0.39	0.45	0.17	***	-0.28	**-0.01**
Daily smoker	0.21	0.24	0.07	***	-0.17	0.12
BMI	29.03	28.78	29.89	*	1.11	2.48
Obese	0.36	0.35	0.40	+	0.05	0.15
Obese II	0.16	0.17	0.15		-0.02	0.05
Obese III	0.08	0.08	0.08		0.00	0.04
No phys activities	0.15	0.16	0.10	**	-0.06	0.02
# physical activities	7.29	7.18	7.71		0.53	-0.50
SSB	12.88	13.34	11.25	**	-2.09	5.14
Fast food	3.44	3.6	2.90	***	-0.70	0.29
Panel D: Black Female (N=1681-1801)						
Population share		0.68	0.32			
Current smoker	0.22	0.27	0.10	***	-0.17	0.10
Daily smoker	0.12	0.15	0.05	***	-0.10	0.19
BMI	31.63	32.35	30.13	***	-2.22	**-0.85**
Obese	0.49	0.53	0.41	***	-0.12	**-0.02**
Obese II	0.30	0.33	0.24	***	-0.09	**-0.02**
Obese III	0.17	0.19	0.14	**	-0.05	**-0.01**
No phys activities	0.22	0.23	0.20	+	-0.03	0.05
# physical activities	4.90	4.87	4.97		0.10	-0.93
SSB	10.80	11.94	8.44	***	-3.50	3.73
Fast food	2.86	3.04	2.49	***	-0.55	0.44

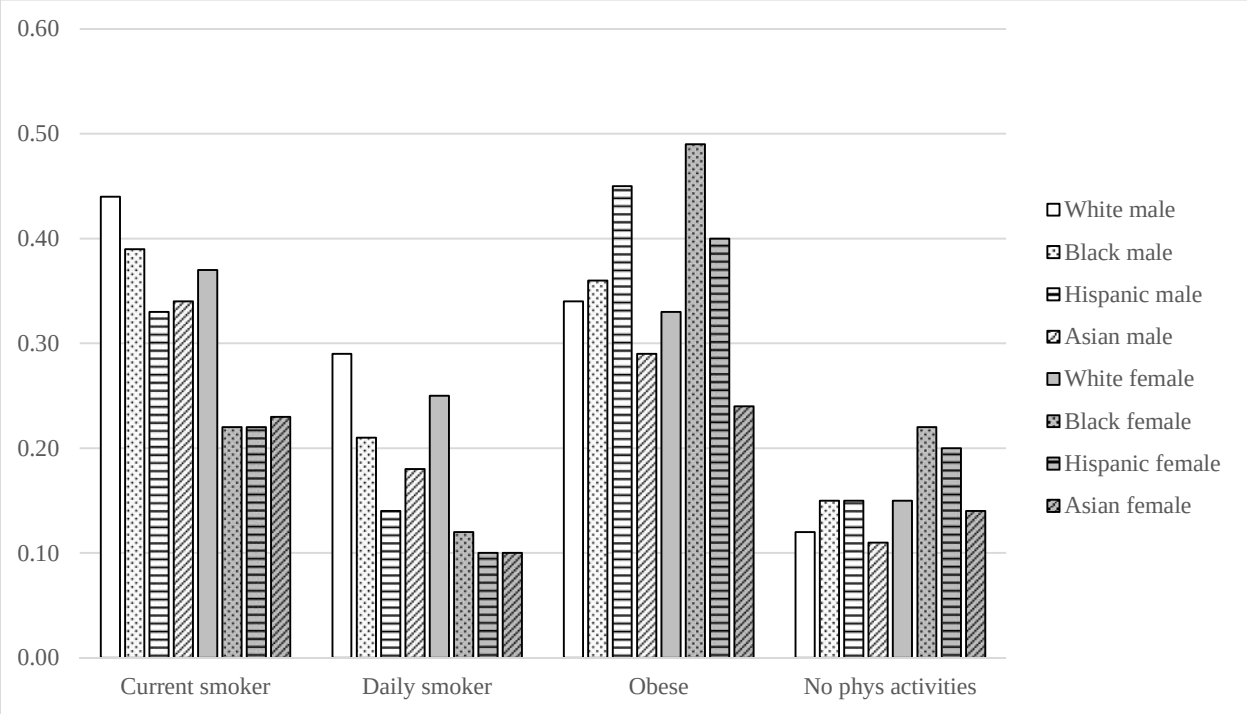
Table 4-1 continued

Panel E: Hispanic Male (N=1101-1124)						
Population share		0.83	0.17			
Current smoker	0.33	0.36	0.17	***	-0.19	0.08
Daily smoker	0.14	0.16	0.06	***	-0.10	0.19
BMI	30.55	30.91	28.85	***	-2.06	**-0.69**
Obese	0.45	0.48	0.34	***	-0.14	**-0.04**
Obese II	0.21	0.23	0.10	***	-0.13	**-0.06**
Obese III	0.10	0.10	0.05	**	-0.05	**-0.01**
No phys activities	0.15	0.16	0.09	**	-0.07	0.01
# physical activities	7.46	7.36	7.97		0.61	-0.42
SSB	11.07	11.69	8.05	***	-3.64	3.59
Fast food	2.93	3.06	2.29	**	-0.77	0.22
Panel F: Hispanic Female (N= 1149-1248)						
Population share		0.74	0.26			
Current smoker	0.22	0.25	0.14	***	-0.11	0.16
Daily smoker	0.1	0.12	0.04	***	-0.08	0.21
BMI	29.62	30.60	26.98	***	-3.62	**-2.25**
Obese	0.40	0.46	0.24	***	-0.22	**-0.12**
Obese II	0.22	0.26	0.12	***	-0.14	**-0.07**
Obese III	0.11	0.13	0.06	***	-0.07	**-0.03**
No phys activities	0.20	0.22	0.14	***	-0.08	0.00
# physical activities	5.16	4.95	5.72	*	0.77	-0.26
SSB	8.91	9.76	6.63	***	-3.13	4.10
Fast food	2.15	2.30	1.76	***	-0.54	0.45
Panel G: Asian Male (N=471-480)						
Population share		0.5	0.5			
Current smoker	0.34	0.49	0.19	***	-0.30	**-0.03**
Daily smoker	0.18	0.26	0.10	***	-0.16	0.13
BMI	28.61	30.25	26.94	***	-3.31	**-1.94**
Obese	0.29	0.38	0.20	***	-0.18	**-0.08**
Obese II	0.14	0.20	0.07	***	-0.13	**-0.06**
Obese III	0.07	0.11	0.03	***	-0.08	**-0.04**
No phys activities	0.11	0.12	0.09		-0.03	0.05
# physical activities	8.03	8.35	7.71		-0.64	-1.67
SSB	8.84	10.72	6.98	***	-3.74	3.49
Fast food	2.58	2.96	2.21	**	-0.75	0.24
Panel H: Asian Female (N=412-442)						
Population share		0.51	0.49			
Current smoker	0.23	0.32	0.14	***	-0.18	0.09
Daily smoker	0.1	0.18	0.03	***	-0.15	0.14
BMI	26.16	28.35	23.91	***	-4.44	**-3.07**
Obese	0.24	0.35	0.12	***	-0.23	**-0.13**
Obese II	0.11	0.20	0.03	***	-0.17	**-0.10**
Obese III	0.05	0.08	0.02	**	-0.06	**-0.02**
No phys activities	0.14	0.16	0.12		-0.04	0.04
# physical activities	5.33	5.00	5.68		0.68	-0.35
SSB	7.02	8.59	5.43	***	-3.16	4.07
Fast food	1.86	2.48	1.24	***	-1.24	**-0.25**

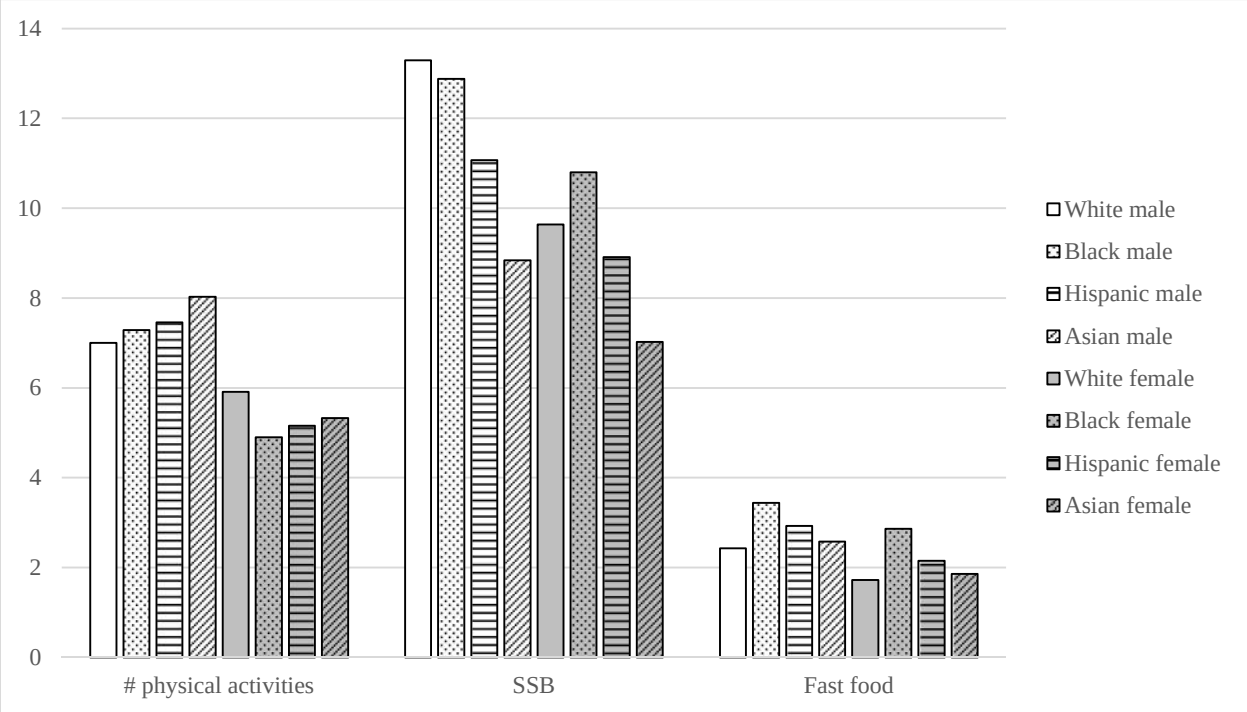
*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

Figure 4-1. Health behavior outcome means, by race/ethnicity and gender
Panel A. Dichotomous outcomes



Panel B. Continuous outcomes



There is also race/ethnic and gender variability in the health behavior *differences* by college degree attainment. The "Diff" column indicates the difference between college graduates and nongraduates for each health outcome and subgroup. Almost all comparisons display a statistically significant advantage among college graduates. Exceptions include physical activities among Asian males and females and Black females, and Black men with college degrees display a nonsignificant disadvantage for obesity and obesity class III. The rightmost column displays the difference between each subgroup compared to White males. A negative result therefore indicates a larger, more negative difference for that subgroup than White males (for all outcomes except number of physical activities which is positive). Stronger differences are in bold. White males generally have stronger effects than other subgroups, except BMI and obesity, which have stronger degree associations for all other groups except Black men. Generally, White men and women have large differences across college degree attainment for smoking, obesity, no physical activity, and sugar-sweetened beverages.

Table 4-2 displays the prevalence of drinking statuses across college degree attainment for each group. Light drinking is associated with the best health outcomes, while research has shown that abstention is associated with slightly increased mortality risk. Heavy episodic drinking (HED) also carries health risk, but heavy drinking has the worst health implications. For nearly all groups, those without college degrees are significantly more likely to abstain from alcohol while those with college degrees are more likely to be light drinkers; only white men do not differ significantly across degree attainment for light drinking without HED. For most groups, light drinking with HED is also more prevalent among college degree holders. Heavy drinking shows an advantage for college degree earners among White and Hispanic men (and significant for Asian men at $p<.10$), but a disadvantage among White women. Because the

overall patterns do not demonstrate clear advantages for college degrees, I do not further examine this outcome.

Table 4-2. Drinking status, by educational attainment

	No degree	College Degree	Sig diff?		No degree	College Degree	Sig diff?
Panel A: White Male (N=3835)				Panel E: Hispanic Male (N=1101)			
Abstainer	0.21	0.13	***	Abstainer	0.30	0.14	***
Light drinker, no HED	0.18	0.20		Light drinker, no HED	0.18	0.28	**
Light drinker, HED	0.45	0.56	***	Light drinker, HED	0.40	0.52	**
Heavy drinker	0.16	0.12	**	Heavy drinker	0.11	0.07	*
Panel B: White Female (N=4257)				Panel F: Hispanic Female (N= 1239)			
Abstainer	0.30	0.16	***	Abstainer	0.41	0.25	***
Light drinker, no HED	0.26	0.29	**	Light drinker, no HED	0.24	0.38	***
Light drinker, HED	0.36	0.44	***	Light drinker, HED	0.30	0.33	
Heavy drinker	0.08	0.10	*	Heavy drinker	0.06	0.04	
Panel C: Black Male (N=1317)				Panel G: Asian Male (N=477)			
Abstainer	0.38	0.25	***	Abstainer	0.32	0.18	***
Light drinker, no HED	0.26	0.35	***	Light drinker, no HED	0.17	0.32	***
Light drinker, HED	0.27	0.32	+	Light drinker, HED	0.40	0.44	
Heavy drinker	0.10	0.08		Heavy drinker	0.11	0.06	+
Panel D: Black Female (N=1783)				Panel H: Asian Female (N=437)			
Abstainer	0.47	0.31	***	Abstainer	0.46	0.28	***
Light drinker, no HED	0.28	0.41	***	Light drinker, no HED	0.22	0.35	**
Light drinker, HED	0.20	0.23	+	Light drinker, HED	0.26	0.32	
Heavy drinker	0.05	0.05		Heavy drinker	0.06	0.05	

*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

To further examine race/ethnic, gender, and immigrant status differences across degree attainment, I perform regression analyses to determine the joint associations between college degrees and race/ethnicity, gender, and immigrant status. Table 4-3 shows the results of these analyses; these models do not control for selection into degree attainment or any confounders. The interaction terms indicate the extent to which the associations between college degrees and health behavior outcomes differ for these race/ethnic and gender categories and for immigrant

status. The significant interaction terms for BMI, obesity, and sugar-sweetened beverages illustrate that unadjusted associations differ across these groups. Additionally, Wald tests determine whether the interaction terms as a whole are significantly different from zero. The interaction terms differ significantly from zero (with class III obesity and physical inactivity significant at $p<.10$) indicating that their inclusion improves the model.

Table 4-3. Coefficients and significance levels from OLS and logistic regressions predicting health behavior outcomes (N=14097)

	Current smoker	Daily smoker	BMI	Obese	Obese II	Obese III	No activity	# physical activities	SSB	Fast food
College degree	-1.18 ***	-1.84 ***	-1.39 ***	-0.46 ***	-0.53 ***	-0.46 **	-0.81 ***	1.04 ***	-7.29 ***	-0.97 ***
Race/ethnicity and gender (ref: white male)										
White female	-0.06	0.00	0.45 *	0.12 *	0.47 ***	0.62 ***	0.18 *	-1.08 ***	-3.50 ***	-0.74 ***
Black male	-0.22 **	-0.52 ***	0.01	-0.07	0.12	0.29 *	0.15	0.50 *	-2.10 ***	0.88 ***
Black female	-0.98 ***	-1.12 ***	3.47 ***	0.67 ***	0.98 ***	1.15 ***	0.58 ***	-1.69 ***	-3.47 ***	0.30 **
Hispanic male	-0.33 ***	-0.80 ***	2.51 ***	0.58 ***	0.60 ***	0.60 ***	-0.02	0.90 ***	-2.83 ***	0.44 ***
Hispanic female	-0.80 ***	-1.12 ***	1.94 ***	0.50 ***	0.74 ***	0.84 ***	0.46 ***	-1.50 ***	-4.71 ***	-0.27 *
Asian male	0.35 *	-0.08	2.02 ***	0.26 +	0.52 **	0.66 **	-0.35	2.00 ***	-3.35 ***	0.45 *
Asian female	-0.35 *	-0.54 **	0.11 ***	0.16	0.54 **	0.49 +	-0.03	-1.30 **	-5.50 ***	0.02
Referent=U.S. born										
Foreign-born	-0.92 ***	-0.88 ***	-2.10 ***	-0.53 ***	-0.65 ***	-0.66 ***	0.25 *	-0.61	-2.16 ***	-0.53 ***
Parents foreign-born	-0.30 ***	-0.42 ***	0.06	-0.06	0.01	0.11	0.07	-0.17	-1.37 **	-0.03
College degree interactions										
Deg*White female	-0.20 +	-0.13	-1.92 ***	-0.35 **	-0.29 *	-0.44 *	0.17	0.10	1.31 **	0.29 *
Deg*Black male	-0.24	0.34	2.18 ***	0.66 ***	0.38 +	0.32	0.22	-0.47 **	5.05 ***	0.29
Deg*Black female	-0.10	0.53 *	-1.22 *	-0.05	0.08	0.10	0.59 **	-1.00	3.62 ***	0.45 **
Deg*Hispanic male	-0.15	0.38	-1.06	-0.17	-0.38	-0.15	0.22	-0.54	2.30 *	0.22
Deg*Hispanic female	0.17	0.30	-2.36 ***	-0.55 **	-0.31	-0.24	0.17	-0.23 **	2.77 **	0.27
Deg*Asian male	-0.62 *	0.25	-2.39 **	-0.42 +	-0.33	-0.31	0.55	-1.79	1.52	0.17
Deg*Asian female	-0.25	-0.39	-3.46 ***	-0.91 **	-1.15 **	-0.54	0.58 +	-0.45	2.06 +	-0.44
Referent=U.S. born										
Deg*foreign-born	0.70 **	0.76 *	1.30 *	0.28	0.18	0.27	-0.27	0.25	3.01 ***	0.40 +
Deg*parents foreign-born	0.33 +	0.24	-0.37	-0.04	-0.09	-0.20	0.10	0.00	1.88 **	-0.25
Wald test of interactions	**	**	***	***	**	+	+	*	***	**

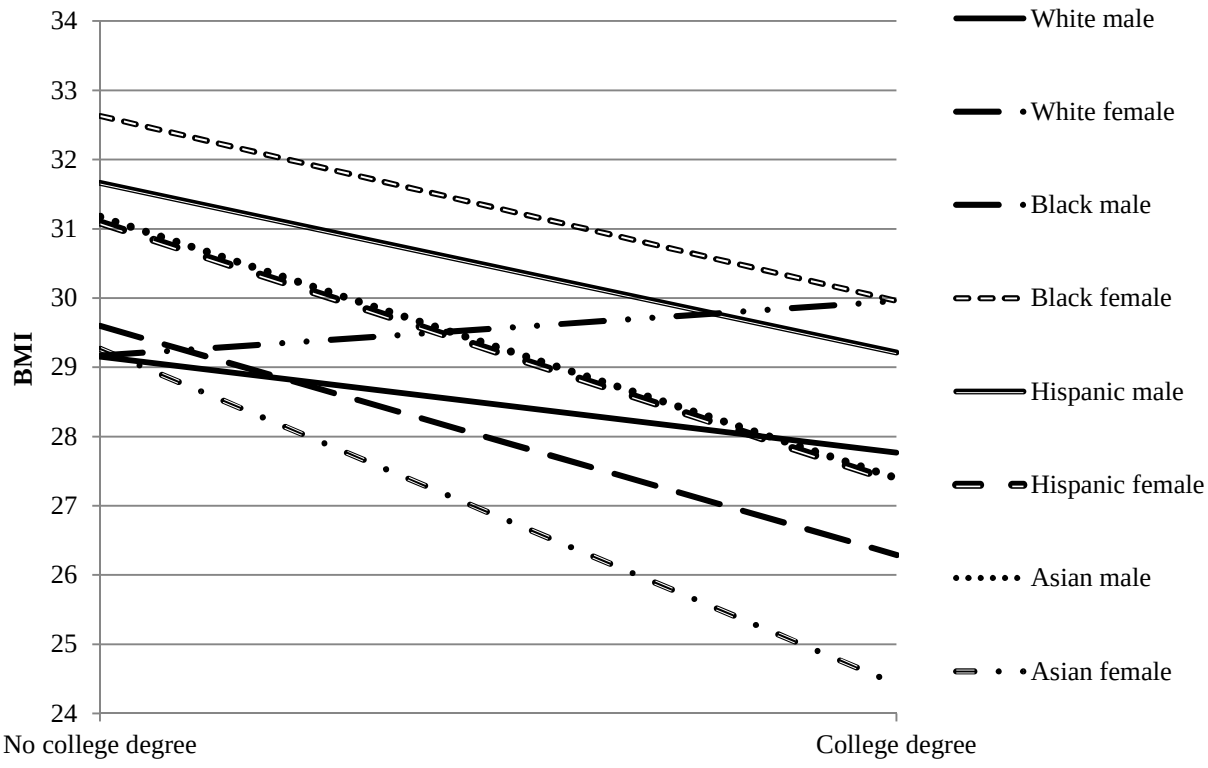
*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

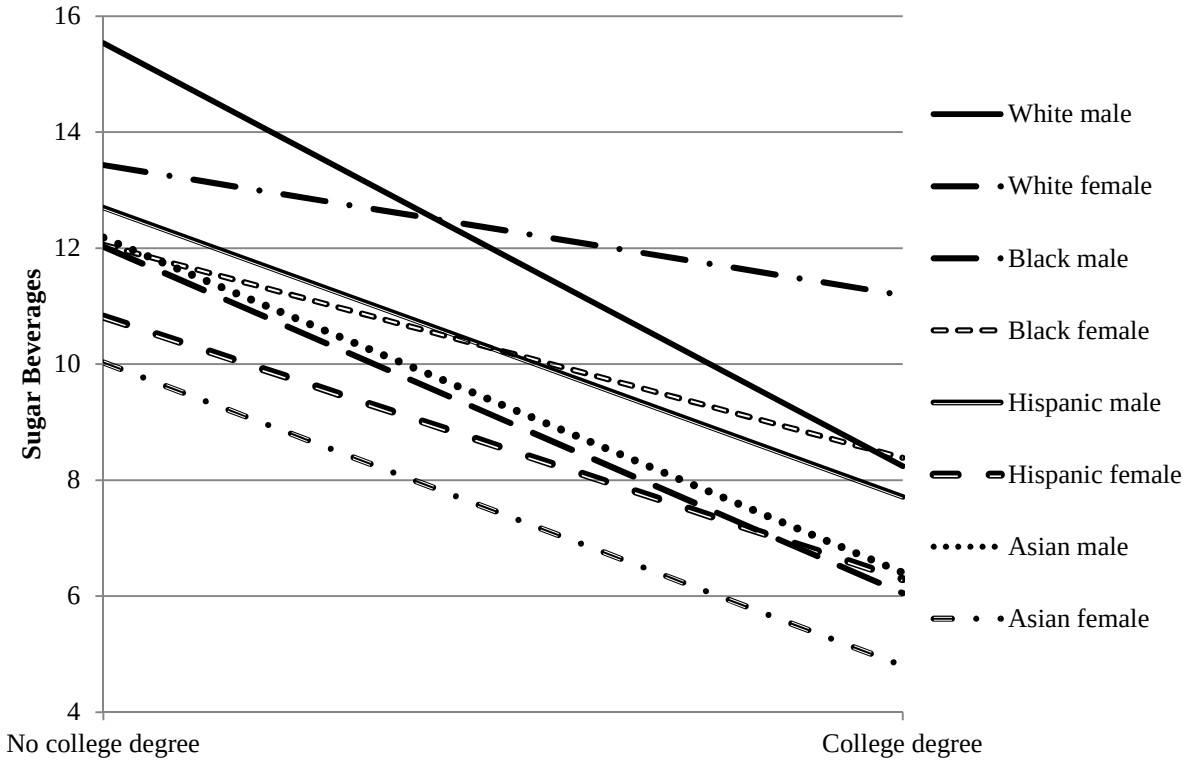
Figure 4-2 depicts the interaction effects for BMI (Panel A; patterns for obesity are similar to those of BMI) and sugar-sweetened beverages (Panels B and C). The solid black line demonstrates the lower BMI for White male college graduates compared to White male nongraduates (difference=1.39). Most other groups have lines with steeper slopes (differences given in parentheses): the BMI advantages for college graduates are stronger for White women (3.31), Black women (2.67), Hispanic men (2.45) and women (3.75), and Asian men (3.77) and women (4.85) compared to White men. Black males, however, display no BMI advantages for college graduates.

Figure 4-2. Interaction effects, unadjusted for confounding

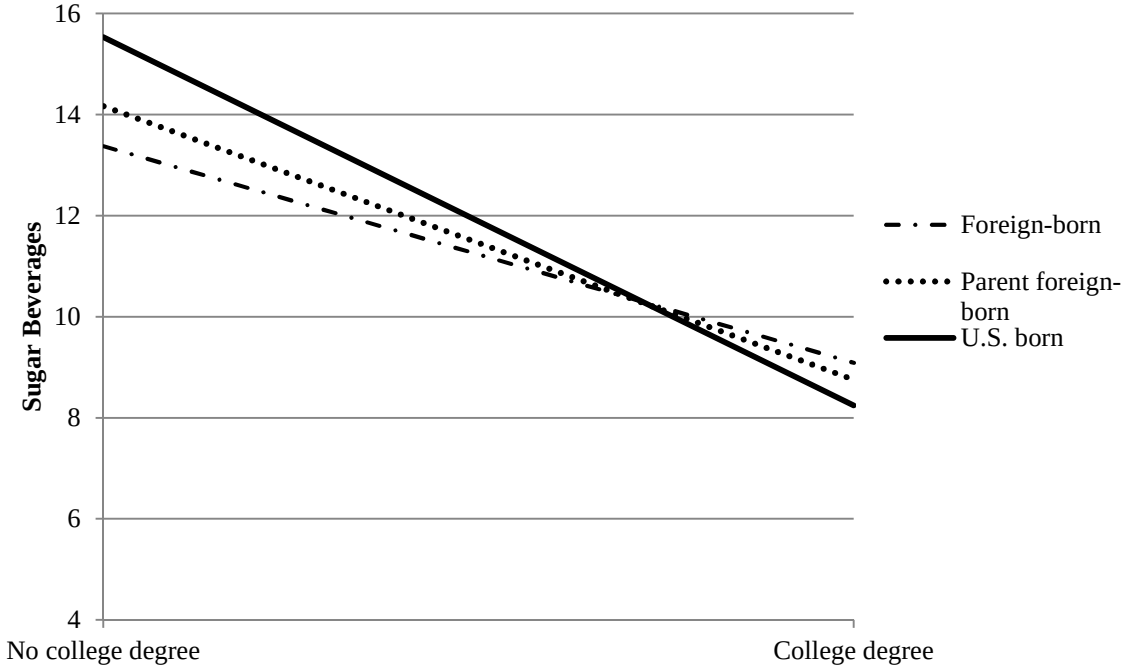
Panel A. BMI



Panel B. Sugar-sweetened beverage consumption, across race/ethnicity and gender categories



Panel C. Sugar-sweetened beverage consumption, across immigrant status (holding race/gender constant at predicted values for White males)



Sugar-sweetened beverage consumption displays the reverse pattern, with White males generally displaying the greatest difference across degree attainment. That is, the slope (Figure 4-2, Panel B; difference=7.29) is steepest for White males compared to the other groups. Black males have the flattest slope (difference=2.25), demonstrating the smallest college degree advantage for this outcome. Comparisons across immigrant status (Panel C) show that those who are U.S.-born and whose parents are U.S.-born have stronger degree advantages for sugar-sweetened beverage consumption (difference=7.29), compared to those who are foreign-born (difference=4.28) or whose parents are foreign-born (difference=5.41). These patterns will be further examined after accounting for selection into college degree attainment.

Additionally, smoking does not show differences across race/ethnicity and gender, with only two significant terms (that are different across the two outcomes). However, the advantage of earning college degrees for smoking is reduced among foreign-born individuals.

Propensity Score Analyses

I then conduct the same analyses but control for selection into degree attainment through the inclusion of IPW. Note that main effects of college degrees in these analyses represent effects for White males. Additionally, the restricted sample (only White, Black, Hispanic, and Asian individuals) differs from the sample in the previous chapter.

As in the previous table, the interaction terms in Table 4-4 demonstrate the differences in college degree effects on the outcomes for race/ethnic and gender categories and immigrant status, but in contrast to the previous table, these effects have accounted for selection into college degrees. The differences observed have been effectively eliminated. Of the 90 possible interaction effects (nine interaction terms x ten outcomes), 6 (or 7%) are significant at the .05

level and 11 (or 12%) at the .10 level. Because six significant terms is similar to the number one would expect due to chance, I do not interpret their effects. Rather, the lack of significance for the models that displayed differences in the previous table indicates that the observed differences across degree attainment are due to selection rather than differential responses to college degrees. Furthermore, the joint Wald tests show that the interaction terms as a group do not differ significantly from zero, except sugar-sweetened beverage consumption (current smoker and number of physical activities are significant at $p<.10$). There is also not a consistent pattern in the observed effects, further suggesting they should not be interpreted.

Table 4-4. Coefficients and significance levels from OLS and logistic regressions predicting health behavior outcomes, controlling for selection through Inverse Probability Weighting (IPW) (N=14097)

	Current smoker	Daily smoker	BMI	Obese	Obese II	Obese III	No activity	# physical activities	SSB	Fast food
College degree	-0.83 ***	-1.09 ***	-0.97 **	-0.49 *	-0.38 +	-0.56 +	-0.38	0.93 *	-5.84 ***	-0.21
Race/ethnicity and gender (ref: white male)										
White female	-0.10	0.00	0.25	0.11	0.48 ***	0.62 ***	0.17 *	-1.19 ***	-3.41 ***	-0.67 ***
Black male	-0.21 *	-0.48 ***	0.33	0.02	0.25 *	0.40 *	0.21 +	0.31	-1.44 **	0.97 ***
Black female	-1.01 ***	-1.03 ***	3.40 ***	0.70 ***	1.05 ***	1.18 ***	0.72 ***	-1.86 ***	-2.64 ***	0.47 ***
Hispanic male	-0.25 *	-0.74 ***	2.34 ***	0.59 ***	0.58 ***	0.53 ***	0.07	0.87 *	-2.47 ***	0.47 **
Hispanic female	-0.77 ***	-1.12 ***	1.94 ***	0.54 ***	0.76 ***	0.87 ***	0.54 ***	-1.50 ***	-4.10 ***	-0.25 +
Asian male	0.56 **	0.13	1.01	0.03	0.30	0.41	-0.40	1.80 **	-2.02 *	0.56 *
Asian female	-0.27	-0.56 +	-1.58 *	-0.24	0.05	0.01	-0.10	-1.35 **	-4.85 ***	-0.18
Referent=U.S. born										
Foreign-born	-1.00 ***	-0.97 ***	-1.41 **	-0.45 ***	-0.51 **	-0.51 *	0.27 *	-0.75 *	-2.04 **	-0.43 **
Parents foreign-born	-0.34 **	-0.39 **	0.07	-0.11	0.02	0.12	0.07	-0.40	-0.73	-0.06
College degree interactions										
Deg*White female	0.05	-0.08	-0.71	0.14	-0.15	-0.15	0.13	0.59	1.19	-0.12
Deg*Black male	0.97 +	1.86 **	1.36	0.59	0.71	-0.06	-0.42	-0.38	5.18 +	0.23
Deg*Black female	-0.89 *	-0.48	-0.73	-0.22	-0.19	0.16	0.96	-1.96 +	2.62 *	-0.39
Deg*Hispanic male	0.19	0.15	1.30	0.48	0.82	0.42	0.47	-2.07 *	1.90	0.18
Deg*Hispanic female	-0.14	0.50	-1.04	-0.18	-0.02	-0.07	-0.13	-0.36	1.36	0.75
Deg*Asian male	-0.71	0.57	0.97	0.69	1.02 +	0.06	-0.42	-1.37	0.90	0.10
Deg*Asian female	-0.62	0.22	0.80	0.47	0.37	0.45	0.03	-0.28	0.64	-0.45
Referent=U.S. born										
Deg*foreign-born	0.95 +	-0.42	-2.08	-0.26	-1.55 **	-0.70	-0.01	0.45	3.49 *	-0.56
Deg*parents foreign-born	-0.03	-0.55	-1.08	-0.05	-0.61	-0.29	0.23	-0.23	1.96	-0.25
Wald test of interactions	+							+	*	

*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

Table 4-5 provides results from models comparing the main effects of race/ethnicity, gender, and immigrant status with and without a control for college degree attainment (while controlling for selection with the IPW and not including interaction terms). While one cannot directly compare the coefficients across logistic regression models (Mood 2010), the general trend is apparent. The effects of group membership are very similar across the two panels. These results suggest that college degrees have little effect on differences in health behaviors across race/ethnicity, gender, and immigrant status. I do not compare models in Panel A to models not including IPW since the propensity scores include race/ethnicity, gender, and immigrant status.

Table 4-5. Coefficients of race/ethnicity, gender, and immigrant status in models controlling for selection through IPW (N=14097)

	Current smoker	Daily smoker	BMI	Obese	Obese II	Obese III	No activity	# physical activities	SSB	Fast food
Panel A: Direct effects of race/ethnicity, gender, and immigrant status without degree attainment										
Race/ethnicity and gender (ref: white male)										
White female	-0.04	0.01	-0.10	0.19	0.44 **	0.61 ***	0.25	-0.94 *	-2.62 ***	-0.72 ***
Black male	0.46	0.69	1.69	0.51	0.94 +	0.29	-0.07	-0.17	0.68	1.08 *
Black female	-1.35 ***	-1.20 ***	2.79 ***	0.53 +	0.91 ***	1.24 ***	1.27 **	-2.97 ***	-1.39	0.19
Hispanic male	-0.08	-0.57 *	3.21 ***	0.89 ***	1.02 **	0.80 **	0.39	-0.39	-1.34	0.51
Hispanic female	-0.73 ***	-0.83 ***	1.60 **	0.50 **	0.81 ***	0.92 ***	0.50 *	-1.71 ***	-3.26 ***	0.16
Asian male	0.24	0.40	1.81 *	0.47 +	0.86 **	0.51 +	-0.60 *	1.03 +	-1.64	0.62 *
Asian female	-0.33	-0.22	-0.68	0.08	0.38	0.35	-0.03	-1.62 **	-4.02 ***	-0.25
Referent=U.S. born										
Foreign-born	-0.61 +	-1.23 ***	-2.96 **	-0.66 **	-1.24 ***	-0.89 **	0.21	-0.46	-0.21	-0.79 **
Parents foreign-born	-0.47 **	-0.72 ***	-0.96 +	-0.24	-0.36 +	-0.12	0.21	-0.51	0.16	-0.23
Constant	-0.43 ***	-1.12 ***	28.43 ***	-0.80 ***	-1.87 ***	-2.86 ***	-2.07 ***	7.40 ***	11.45 ***	2.49 ***
Panel B: Direct effects of race/ethnicity, gender, and immigrant status controlling for degree attainment										
College degree	-0.68 ***	-0.75 ***	-1.15 **	-0.33 *	-0.29	-0.61 ***	-0.14	0.46	-3.86 ***	-0.29 +
Race/ethnicity and gender (ref: white male)										
White female	-0.07	-0.01	-0.14	0.18	0.43 **	0.60 ***	0.24	-0.93 *	-2.75 ***	-0.73 ***
Black male	0.52	0.77	1.78	0.54	0.97 +	0.34	-0.06	-0.20	0.98	1.10 *
Black female	-1.33 ***	-1.18 ***	2.87 ***	0.55 *	0.93 ***	1.28 ***	1.28 **	-3.00 ***	-1.14	0.21
Hispanic male	-0.10	-0.61 *	3.18 ***	0.89 ***	1.01 **	0.77 **	0.38	-0.38	-1.44	0.50
Hispanic female	-0.80 ***	-0.89 ***	1.52 **	0.47 **	0.80 ***	0.88 ***	0.49 *	-1.68 ***	-3.54 ***	0.14
Asian male	0.23	0.40	1.79 *	0.47 +	0.86 **	0.50 +	-0.61 *	1.04 +	-1.71	0.62 *
Asian female	-0.47 +	-0.37	-0.91	0.01	0.32	0.23	-0.06	-1.53 **	-4.79 ***	-0.31
Referent=U.S. born										
Foreign-born	-0.57 +	-1.20 ***	-2.86 **	-0.63 *	-1.21 ***	-0.83 **	0.22	-0.50	0.13	-0.77 **
Parents foreign-born	-0.40 *	-0.65 **	-0.82	-0.20	-0.33	-0.05	0.22	-0.56	0.62	-0.20
Constant	-0.08	-0.76 ***	29.04 ***	-0.63 ***	-1.73 ***	-2.58 ***	-1.99 ***	7.16 ***	13.48 ***	2.64 ***

*** p < .001; ** p < .01; * p <.05; + p>.10

Source: National Longitudinal Study of Adolescent to Adult Health

Sensitivity Analyses

Further analysis determined the robustness of the results. First, I examined means across individuals who attended any college to those who did not to examine whether it is matriculation rather than graduation that is most influential for health behaviors. Table A4-2 displays unadjusted means for those with and without any college experience. The differences reported in this table are smaller, and fewer are significant, compared to differences across degree attainment (Table 4-1). A notable exception is Black females, for whom differences across college degree attainment and college experience appear similar, suggesting that college exposure may be sufficient for health improvement among this group.

Second, I compare the results with those of propensity score matching conducted within subgroups. The results indicate that while there are some differences in the average treatment effect, the confidence intervals generally overlap with one another, across subgroups and across outcomes. For each subgroup, I calculated propensity scores for college degree attainment and matched individuals. For example, I ran a logit model predicting college graduation for White males, calculated propensity scores, and then matched White male college graduates to White male non-graduates with similar propensity scores. However, covariate balance (discussed in previous chapters) could not be achieved for Asian males and females. I therefore compare the other groups. Additionally, physical activity did not show a significant advantage for college graduates within subgroups (except White females) and is thus not examined. Figure A4-3 displays the treatment effects and 95% confidence intervals for these results.

For immigrant status, balance could not be obtained for the small group of individuals who were U.S. born and whose parents were foreign-born. However, confidence intervals overlapped across all outcomes for U.S. born individuals and foreign-born individuals. Thus, the

results suggesting that there are no statistically significant differences in treatment effects across subgroups is confirmed by these within-group models.

Discussion

This chapter sought to distinguish the effects of attaining a college degree on the health behaviors of individuals across race/ethnicity and gender groups. Overall, the results indicated that college is beneficial for the health behaviors of individuals regardless of race/ethnicity, gender, or immigrant status.

Before accounting for selection, the college degree-health behavior relationship displayed differences in effects across subgroups. White males without college degrees have the lowest BMI and the highest sugar-sweetened beverage consumption, but among college graduates, are middle of the pack for both of these outcomes. Black males stand out, with no BMI advantage and the smallest sugar-sweetened beverage advantage for college degree earners. Asian and White females, in contrast, display strong effects and low levels of BMI and sugar-sweetened beverage consumption. Foreign-born individuals have a lessened advantage among college graduates for smoking, BMI, and sugar-sweetened beverage consumption.

However, these differences were eliminated when the propensity scores were included in the models through IPW, indicating that responses to college degrees are similar across these subgroups. The differences therefore were due to selection into college degrees, suggesting that selection processes differ by race/ethnicity, gender, and immigrant status. For example, the larger difference in BMI across degree attainment before accounting for selection among Asian women suggests that this group is more select than White men. College graduates are the kind of people who have lower BMI, but this relationship is stronger for Asian women than White males.

With unconditional effects of college degrees, the evidence supports neither conditional reproduction nor conditional equalization. The results point to a transformative theory of education that argues that benefits of college degrees are equally available to all. Since selection has been accounted for, it thus appears that the equal benefits are the result of college degrees providing skills and resources (that improve health behaviors) equally. However, in a different sense, the ease or difficulty of graduating college differs across social groups, suggesting that benefits are not really "equal" because the accomplishment required different effort and circumstances.

Additionally, the observed differences in levels of behaviors across subgroups does not appear to be due to college degree attainment, since effects of race/ethnicity, gender, and immigrant status were similar with and without inclusion of degree attainment. Surprisingly, college degrees are not the reason why there are race/ethnic disparities in health behaviors. College degree prevalence varies across race/ethnicity, ranging from 17% of Hispanic males graduating to 50% of Asian males (Table 4-1). Yet, these differences are not the source of race/ethnic and gender disparities in health behaviors. Explanations for race/ethnic disparities other than SES, such as normative environments or discrimination, appear to operate independently of education (Lawrence et al. 2014).

Conclusion

Turning back to the original hypotheses, neither conditional equalizing nor conditional reproduction theories were supported in this chapter. In support of transformative theory, the effects of college graduation on health behaviors do not differ across race/ethnicity, gender, and immigrant status and are positive for all individuals. Selection into college degree attainment is

an important component of educational disparities in health behaviors across race/ethnicity, gender, and immigrant status. Apparent differences can be attributed to differential selection into college degree attainment and college graduation appears to have little influence on health behavior disparities across racial/ethnic, gender, and immigrant status.

Chapter 5. Mechanisms for the effects of college degrees on health behaviors

As demonstrated in Chapter 3, graduating college improves health behaviors, even after accounting for selection into college degree attainment. Why? As described in the introduction, there has been little research on the mechanisms for the education–health behavior relationship, with the notable exceptions of Cutler and Lleras-Muney (2010) and Pampel and colleagues (2010). Cutler and Lleras-Muney (2010) reported that income, health insurance, and family background account for 30% of the relationship between educational attainment and health behaviors, knowledge and cognitive abilities account for 30%, and social networks 10%. Although this study takes the first steps towards understanding the education-health behavior relationship, it is limited in a number of ways. The authors used multiple datasets with different ages and cohorts, restricted their sample to White adults, and had limited information on mechanisms (resulting in some dispute over their findings, see Conti and Hansman [2013]). Pampel and colleagues lay out the different mechanisms for the broader SES-health behavior relationship and offer theoretical guidance. This chapter builds on these two studies to test and make sense of a diverse set of mechanisms for the education-health behavior relationship.

As described in the introduction, the resources education can provide that are examined can be categorized as: financial, occupational, status, social, and cognitive/psychological. First, college degrees improve one's financial resources. College graduates earn more and are more likely to marry individuals who earn more (Hout 2012). The jobs of college graduates more often provide additional financial resources, such as health insurance. The financial advantage also includes wealth, as degree earners are more likely to own homes and have other assets. These financial advantages can be converted into healthier behaviors through the purchase of

technology, aids, and programs that can facilitate healthier behaviors, such as tobacco cessation products or gym memberships. Second, college graduates have better employment and occupations than those less educated. Being employed in more prestigious jobs may support healthy behaviors through norms and workplace policies. Third, research has shown that increased relative social status is associated with better health. College graduates have higher overall social standing, which in turn can lead to healthier behaviors through distinction of this standing and through different stress from one's position in the social hierarchy. Fourth, social resources can improve health behaviors. College graduates are more likely to be married, have friends, and be civically engaged, all which can reduce stress and increase personal control, leading to healthier behaviors.

Fifth, education increases cognitive abilities and psychological resources, which in turn improve health behaviors. Through schooling, individuals learn analytic skills such as problem solving and critical thinking. These skills can then be implemented toward improving health. Schooling improves other traits besides cognitive skills, including conscientiousness or perseverance. While schooling gives individuals the skills to solve problems, it also gives individuals the effort and motivation to address a problem (Mirowsky and Ross 2003). College graduates can harness these traits to engage in healthier habits.

In addition to these mechanisms, diet and physical activity are explored as mechanisms for weight status maintenance outcomes (BMI and obesity). First, media and individuals focus on diet and physical activity as proximal determinants of weight, since these factors comprise caloric intake and expenditures. The CDC website introduces the topic of "Healthy Weight," reporting that "It's about a lifestyle that includes healthy eating, regular physical activity, and balancing the number of calories you consume with the number of calories your body uses."

(CDC nd). As seen in the previous chapters, college graduates engage in more physical activities and consume fewer sugar sweetened beverages or fast food. However, we do not know whether these behaviors are mechanisms for the college degree-weight status relationship. The biological process of taking in and burning calories is established, but we know little about the extent to which consumption of certain foods and drinks leads to obesity across the population. There appear to be important factors that shape the relationship between caloric intake, number of calories used by the body, and weight status. Genetics, gut bacteria, sleep patterns, and other considerations may prevent a straightforward caloric understanding of obesity (Cappuccio et al. 2008; Frayling et al. 2007; Turnbaugh et al. 2009). Thus, we do not know whether activity and diet are mediating mechanisms for the effect of college degrees on weight status.

Overall, the results show that we cannot fully account for the college degree-health behavior relationship with these different resources. Occupation and status appear to explain the largest proportions of these relationships, followed by financial resources. Social, cognitive, and psychological resources explain the smallest proportions. The full set of mechanisms (including diet and activity) explains very little of the effects of college degrees on BMI and obesity, suggesting that there are other processes at work.

Methods

Analytic Approach

The approach for this chapter uses the mediation model in regression, as outlined in Baron and Kenny (1986). To determine mediation, four criteria need to be met. The independent variable of interest (college degree attainment) needs to be a significant predictor of the outcome (criterion #1) and the mediator examined (criterion #2). Second, models should compare the effect of the

independent variable of interest (college degree attainment) in two models, one excluding and one including the mechanism variable. If the effect of college degrees is reduced in magnitude in the model including the mechanism (criteria #3) and the mechanism variable is significant (criteria #4), then mediation can be identified.

Regression models evaluate these criteria and also incorporate inverse probability weights (IPW) to account for selection, similar to the previous chapter. First, OLS and logistic regression models determine whether college degree attainment is a significant predictor of each of the mechanisms. Second, base models regressing each health behavior outcome on college degree attainment (weighted by the IPW) determines whether there is a significant relationship between college degree and outcome and provides a base level of college degree effects that can be compared to the later models. Regression models then add in mechanisms sequentially. Changes in the effect of college degree when mechanisms are included indicate the extent to which these resources mediate the effect of college degrees on the different health behavior outcomes.

I use IPW rather than matching in this chapter because the former allows for a flexible regression approach. The IPW regression models can easily add in new variables (i.e. mechanisms), while matching does not easily provide a framework for mediation. However, it should be noted that the selection model considers selection into college degrees, not into the different mechanisms. Because subjects have not been matched on background factors influencing the mediators the way college graduates and nongraduates have been matched, one cannot consider the mediators to be "causal" in this framework since there are likely confounders shaping both mediators and outcomes (and that are different than those for college degree

attainment). However, since I am only concerned with the mediation rather than the effects of these mechanisms on the outcome, this is a very minor limitation.

Further, the more flexible IPW approach allows for multiple imputation, a method preferable to listwise deletion or mean imputation. Because of the many variables included in the two steps of the analysis, I conduct two imputations: the logit model used to create the propensity score is imputed separately from the IPW regression models. Both use an MCMC method with 10 created datasets. All dependent and independent variables are used to inform the imputation models, and auxiliary variables are also incorporated. For the logit model producing the likelihood of degree attainment, the percentage of imputed values ranged from 0-15% across the variables, and an average of 2.2% missing. Wave I items exceeding 2% missingness include household smoker (13.9% missing), parent heavy episodic drinking (14.1%), family received public assistance (15.4%), scale of social control (14.6%), parent disappointment for child not graduating college (13.3%), vocabulary test score (4.8%), and BMI (2.5%). For the mediation models, imputed values ranged from 0-20% with an average missingness of 1.6%. Most variables were missing less than 1%; exceptions included the vocabulary score (20% missing), household income-to-needs (7.5%), personal earnings (2.3%), asset-debt ratio (3.8%), job satisfaction (1.6%), job efficacy (1.5%), number of friends (1.3%), BMI (1.5%), and obesity (1.6%).

Because the models incorporate multiple imputation, log likelihoods across imputed datasets are not easily calculated and model fit cannot be determined with fit statistics such as the Bayesian Information Criterion (BIC). I use an alternative approach that employs joint Wald tests to determine whether the additional variables (i.e. mechanisms) are statistically equivalent to zero.

Data

Add Health provides the data for this chapter's analyses. A sample of 14,254 respondents have valid information for the Wave IV weight, college degree attainment, and are not pregnant. All of these respondents are retained using multiple imputation to account for missingness.

Measures

College degree attainment is operationalized the same as in previous chapters. Likelihood of degree attainment is calculated using a logit model predicting college degree attainment the same as in Chapter 3, except that multiple imputation is used in this model.

The mechanisms are all taken from Wave IV, concurrent with the health behavior outcomes and operationalized within broad categories of financial resources, occupation, status, social resources, and cognitive and psychological resources. Financial resources include household income-to-needs ratio, personal earnings, home ownership, debt-to-assets ratio, number of financial hardships, and health insurance. Employment status, job satisfaction, and personal efficacy at work are included as occupational resources. A measure of status on a ten-step ladder reflects subjective status. Marital status, the number of reported close friends, a scale of religiosity, and a measure of volunteerism comprise social resources. Lastly, a vocabulary test score and scales for mastery, perceived stress, and depression capture cognitive and psychological traits. Details on the coding of variables are available in Chapter 2.

The concurrent measurement of mechanisms and health behavior outcomes leaves open the possibility of reverse causality. That is, health behaviors could be shaping mechanisms. For example, higher weight status could influence income (through discriminatory practices) or

smoking could restrict the type of occupation one seeks (and gets). Given the dearth in the literature on this topic, getting a sense of the mechanisms among a diverse group of young adults will be an important contribution. Nonetheless, associations may overstate the extent to which mechanisms lead to health behaviors and conclusions should not overemphasize the causal relationships.

Results

Table 5-1 presents descriptive statistics for each of the mechanisms examined. For this cohort, the average income-to-needs ratio is 3.82, though it ranges from nearly 0 to over 18. Most individuals have more assets than debt (60%) and most have health insurance (21% have no health insurance). The largest proportion of individuals is employed in nonprofessional occupations. About two-fifths of individuals are married and over one-third volunteer. Looking at the means of these mechanisms across degree attainment, those with college degrees have greater financial, occupational, social, and cognitive/psychological resources. For example, 9% of college graduates had no health insurance, while 27% of those less educated were without coverage. A notable exception is marital status, as similar proportions of graduates and non-graduates are married.

Table 5-1. Descriptive statistics of mechanisms, U.S. young adults ages 24-32

	Mean	Min	Max	No degree	College degree
Financial					
Household income-to-needs	3.82	0.06	18.54	3.09	5.39
Personal earnings	35207	0.00	999995	29445	47570
Home ownership	0.40	0	1	0.37	0.47
Debt-assets					
Some left over	0.60	0	1	0.58	0.65
Even	0.18	0	1	0.21	0.13
Left with debt	0.22	0	1	0.21	0.22
# financial hardships	0.51	0	6	0.66	0.17
No health insurance	0.21	0	1	0.27	0.09
Occupation					
Employment					
Professional	0.33	0	1	0.19	0.64
Non professional	0.49	0	1	0.60	0.25
Unemployed	0.18	0	1	0.21	0.11
Job satisfaction	2.15	1.00	5.00	2.19	2.07
Personal efficacy at work	0.00	-2.08	1.28	0.09	-0.20
Status					
Subjective status	5.04	1.00	10.00	4.64	5.89
Social					
Married	0.42	0	1	0.41	0.42
# close friends	4.44	0.00	10.00	4.07	5.24
Religiosity	-0.01	-1.56	1.61	-0.04	0.05
Volunteers	0.36	0	1	0.28	0.53
Cognitive/Non-cognitive					
Vocabulary score	50.30	0.00	100.00	43.36	65.21
Mastery scale	19.47	5.00	25.00	19.08	20.30
Perceived stress	4.84	0.00	16.00	5.16	4.17
CES-D	2.61	0.00	15.00	2.85	2.09
Diet/exercise					
Number of physical activities	6.40	0.00	49.00	6.19	6.85
Sugar-sweetened beverages	11.11	0.00	40.00	12.81	7.44
Fast food consumption	2.39	0.00	21.00	2.67	1.77

Source: National Longitudinal Study of Adolescent to Adult Health, Wave IV

Table 5-2 presents results from models testing the mediation criterion of whether degree attainment is significantly related to each of the examined mediators (after accounting for selection through IPW). The coefficients and significance display the effect of college degrees in

OLS or logistic regression models predicting each of the mechanisms. Most of the mediators are significantly (or significant at p<.10) predicted by college degree, but home ownership, asset-debt ratio, married, and number of physical activities are not. I therefore no longer examine these variables as mediators.

Table 5-2. Coefficient and significance of college degrees' effects on mechanisms, accounting for selection through IPW (N=14,254)

Financial			**Social**		
Income-to-needs	1.04	***	Married	-0.05	
Personal earnings	9651	***	# friends	0.55	*
Home ownership	0.12		Religiosity	0.16	***
Asset-debt (some left over)			Volunteers	0.61	***
Even	-0.08		**Cognitive/ Non-cognitive**		
Left with debt	0.24				
# financial hardships	-0.27	***	Vocab test (W3)	4.37	*
Health insurance	-0.44	*	Mastery scale	0.78	***
Occupational			Perceived stress	-0.65	***
Occupational type (prof)			Depression (CES-D	-0.29	+
Not professional occ	-1.32	***	**Diet/nutrition**		
No occupation	-1.47	**	# activities	0.5	
Job satisfaction	-0.14	*	Sugary beverges	-3.64	***
Job efficacy	-0.20	***	Fast food	-0.25	+
Status					
Status ladder	0.72	***			

Source: National Longitudinal Study of Adolescent to Adult Health
*** p < .001; ** p < .01; * p <.05; + p<.10
Notes: OLS regression used for income-to-needs, personal earnings, number of financial hardships, job efficacy, job satisfaction, status ladder, religiosity, vocabulary score, mastery scale, perceived stress, and CES-D depression scale. Logistic regression used for home ownership, health insurance, married, and volunteers. Multinomial logistic regression used for asset-debt ratio, and occupational type (base category given in parentheses.

Tables 5-3, 5-4, and 5-5 show results from the logistic and OLS regression models that account for selection through the IPW. Results for physical inactivity and number of physical activities are not presented as they did not show a significant college degree advantage after

accounting for selection. Since the IPW is included in all models, the coefficient for college degree in the base models indicates the health behavior advantage for graduates after accounting for selection into degree attainment. I then compare this coefficient to the college degree coefficients in the subsequent models that include different groups of mechanisms. Wald tests evaluate model fit for these subsequent models. The significance and magnitude of the mechanism variables are not interpreted in detail since each of the groups include correlated terms that overlap conceptually and the objective is to determine mediation of college degree-health behavior relationships rather than independent influences on health behaviors. However, significance of the mediators on the outcome is an important part of the test for mediation.

Models for current and daily smoking are presented in Table 5-3. Coefficients for college degrees are lowest in the full models that include all mechanisms. For current smoking, college degrees still have a significant influence after accounting for all the mechanisms, though the magnitude is reduced by a little less than half. However, college degrees are only related to daily smoking at a significance level less than .10 once mechanisms have been considered. Turning to the different groups of mechanisms, all display improved model fit compared to the base model with no mechanisms included. The coefficients for college degree attainment are lowest in the model considering occupational mechanisms. Behind occupation, status and financial mechanisms display the next greatest reductions. Social and cognitive/psychological mechanisms reduce smaller proportions of college degree effects.

Table 5-3. Coefficients and significance levels from logistic regression models predicting smoking outcomes and accounting for selection through IPW (N=14,254)

		Base	Financial	Occupation	Status	Social	Cog/Noncog	All
Current smoking	College degree	-0.70 ***	-0.62 **	-0.55 **	-0.59 ***	-0.62 ***	-0.68 ***	-0.40 *
	Income-to-needs		-0.01					-0.01
	Personal earnings		0.00					0.01
	# financial hardships		0.21 **					0.19 **
	Health insurance		0.36 +					0.27 +
	Occupation (none)							
	Professional occ			-0.85 ***				-0.74 **
	Not professional occ			-0.28				-0.24
	Job satisfaction			0.14 +				0.06
	Job efficacy			-0.20 +				-0.23
	Status ladder				-0.16 ***			-0.10 *
	# friends					0.02		0.04
	Religiosity					-0.40 ***		-0.46 ***
	Volunteers					-0.37 *		-0.33 +
	Vocab test (W3)						0.00	0.00
	Mastery scale						0.03	0.06 +
	Perceived stress						0.05 +	0.02
	CES-D						0.05	0.05
	Constant	-0.33 ***	-0.52 ***	-0.28	0.43 *	-0.32 *	-1.38 *	-1.28 *
	Wald test		*	***	***	***	**	***
		Base	Financial	Occupation	Status	Social	Cog/Noncog	All
Daily somking	College degree	-0.78 **	-0.66 *	-0.58 *	-0.61 *	-0.70 **	-0.74 **	-0.40 +
	Income-to-needs		-0.04					-0.02
	Personal earnings		-0.01					0.00
	# financial hardships		0.28 **					0.24 **
	Health insurance		0.11					-0.02
	Occupation (none)							
	Professional occ			-1.06 **				-0.87 **
	Not professional occ			-0.30				-0.25
	Job satisfaction			0.15 +				0.08
	Job efficacy			-0.20				-0.25 *
	Status ladder				-0.26 ***			-0.19 ***
	# friends					0.00		0.02
	Religiosity					-0.22 **		-0.31 ***
	Volunteers					-0.40		-0.32
	Vocab test (W3)						-0.01	-0.01
	Mastery scale						0.04	0.06
	Perceived stress						0.04	-0.01
	CES-D						0.07	0.06
	Constant	-0.99 ***	-1.05 ***	-0.94 **	0.20	-0.88 ***	-1.84 *	-1.18 +
	Wald test		**	***	***	*	**	***

Source: National Longitudinal Study of Adolescent to Adult

*** p < .001; ** p < .01; * p <.05; + p<.10

Table 5-4 displays results for weight status. In contrast to smoking, the lowest college degree coefficient is not found in the full model, but rather the model with social status. For both

BMI and obesity, reductions are almost as large for the models including occupation compared to social status, though the Wald test results do not show that the overall group of terms is significantly different from zero. Financial resources also reduce the magnitude of college degree's effects a small amount, followed by cognitive/psychological resources. Interestingly, social resources are suppressing college degree's effects, as considering these variables increases the college degree advantage. However, there is only the suggestion of suppression for obesity, since the variables are not significant and the Wald test is not significant. College graduates have greater social resources, but these resources do not explain the weight status advantage. Further, for BMI there appears to be a suppression such that social resources limit the advantage of college graduates.

Table 5-4. Coefficients and significance from logistic (obesity) and OLS (BMI) regression models predicting weight status outcomes and accounting for selection through IPW (N=14,254)

		Base	Financial	Occupation	Status	Social	Cog/Noncog	Diet/Exer	All
Obesity	College degree	-0.34 **	-0.31 *	-0.30 *	-0.29 *	-0.38 **	-0.33 **	-0.36 **	-0.31 *
	Income-to-needs		-0.05 *						-0.05 *
	Personal earnings		-0.01						0.00
	# financial hardships		-0.03						-0.03
	Health insurance		-0.39 *						-0.39 *
	Occupation (none)								
	Professional occ			-0.06					-0.06
	Not professional occ			0.10					0.07
	Job satisfaction			0.15 *					0.15 *
	Job efficacy			-0.11					-0.13
	Status ladder				-0.07 +				-0.07 *
	# friends					0.01			0.01
	Religiosity					0.03			-0.01
	Volunteers					0.19			0.23 +
	Vocab test (W3)						0.00		0.00
	Mastery scale						0.01		0.00
	Perceived stress						-0.01		-0.02
	CES-D						0.01		0.00
	SSB							-0.01	-0.01
	Fast food							0.02	0.01
	Constant	-0.39 ***	-0.08	-0.76 ***	-0.06	-0.47 ***	-0.33	-0.35 ***	0.00
	Wald test		*		+				
		Base	Financial	Occupation	Status	Social	Cog/Noncog	Diet/Exer	All
BMI	College degree	-1.19 **	-1.00 **	-1.05 *	-0.98 *	-1.38 ***	-1.11 **	-1.29 ***	-1.08 **
	Income-to-needs		-0.23 ***						-0.17 **
	Personal earnings		-0.02						-0.01
	# financial hardships		0.07						0.06
	Health insurance		-1.05 **						-1.02 **
	Occupation (none)								
	Professional occ			0.17					0.33
	Not professional occ			0.64					0.64
	Job satisfaction			0.29					0.34 +
	Job efficacy			0.04					-0.09
	Status ladder				-0.29 *				-0.24 *
	# friends					-0.05			-0.02
	Religiosity					0.46 **			0.27 +
	Volunteers					0.96 *			1.14 **
	Vocab test (W3)						-0.02 *		-0.02 *
	Mastery scale						0.00		-0.02
	Perceived stress						-0.05		-0.09
	CES-D						0.07		0.04
	SSB							-0.03 *	-0.03 *
	Fast food							0.10 +	0.06
	Constant	29.67 ***	30.70 ***	28.62 ***	31.05 ***	29.61 ***	30.69 ***	29.81 ***	31.93 ***
	Wald test		***		*	**	*	*	***

Source: National Longitudinal Study of Adolescent to Adult

*** p < .001; ** p < .01; * p <.05; + p<.10

As operationalized in this study, diet does not explain any of the college degree advantage. For both weight status outcomes, the magnitude of the college degree coefficient has increased from the base model. For obesity, there is no significance for the variables individually

or jointly, but for BMI, the factors do contribute to the overall model. Thus, there appears to be a suppression effect of college degrees on BMI: college graduates would be even more advantaged on BMI if it were not for sugary beverages and fast food. Since physical activity was already eliminated as a potential mediator, neither diet nor activity appears to be a reason for the improved weight status of college graduates.

The full model, which incorporates all the mechanisms including diet, results in a very modest reduction of college degree's effects. For obesity, the full set of mechanisms are not jointly significant, though several individual variables are significantly associated with the outcome. These results appear sensitive to the threshold of obesity, since the joint set of mechanisms are significant for BMI, as indicated by the Wald test. However, the reduction in the college degree effect is still modest in this model predicting BMI.

Table 5-5 displays results for sugar-sweetened beverages and fast food consumption. Like smoking, sugar-sweetened beverages shows the greatest reduction in college degree's effects for the full model. Considering all the mechanisms reduces the college degree effect considerably, but remains significant. Of the different groups, occupation and financial resources show the greatest reductions, followed by social resources, social status, and cognitive/psychological resources. Fast food consumption displays a significant advantage for college graduates in the base model only at $p<.10$, but notably, this advantage is negated by any one of the groups of mechanisms.

Table 5-5. Coefficients and significance from OLS regression models predicting nutrition outcomes and accounting for selection through IPW (N=14,254)

		Base	Financial	Occupation	Status	Social	Cog/Noncog	All
Sugar-sweetened beverages	College degree	-3.64 ***	-3.13 ***	-3.10 ***	-3.28 ***	-3.18 ***	-3.36 ***	-2.28 ***
	Income-to-needs		-0.18 *					-0.14
	Personal earnings		0.03					0.03
	# financial hardships		1.18 ***					1.14 ***
	Health insurance		0.39					0.20
	Occupation (none)							
	Professional occ			-1.77 **				-0.92
	Not professional occ			-0.10				0.36
	Job satisfaction			0.51 *				0.37
	Job efficacy			-0.36				-0.60 +
	Status ladder				-0.49 **			-0.20
	# friends					-0.14 +		-0.08
	Religiosity					-0.57 +		-0.66 *
	Volunteers					-2.01 ***		-1.74 ***
	Vocab test (W3)						-0.01	0.00
	Mastery scale						-0.23 *	-0.14
	Perceived stress						0.08	-0.10
	CES-D						-0.03	-0.05
	Constant	12.16 ***	11.88 ***	11.51 ***	14.49 ***	13.35 ***	16.73 ***	16.35 ***
	Wald test		***	***	**	***	*	***
		Base	Financial	Occupation	Status	Social	Cog/Noncog	All
Fast food	College degree	-0.25 +	-0.19	-0.07	-0.13	-0.21	-0.15	0.02
	Income-to-needs		-0.03					0.02
	Personal earnings		0.00					0.01
	# financial hardships		0.10 +					0.02
	Health insurance		0.13					0.05
	Occupation (none)							
	Professional occ			0.28 +				0.47 **
	Not professional occ			0.87 ***				0.87 ***
	Job satisfaction			0.06				0.03
	Job efficacy			0.22 +				0.10
	Status ladder				-0.17 ***			-0.11 **
	# friends					0.00		0.01
	Religiosity					0.23 **		0.16 *
	Volunteers					-0.55 **		-0.38 **
	Vocab test (W3)						-0.01 ***	-0.01 ***
	Mastery scale						-0.02	-0.02
	Perceived stress						-0.01	-0.01
	CES-D						0.12 **	0.11 **
	Constant	2.56 ***	2.55 ***	1.85 ***	3.36 ***	2.74 ***	3.26 ***	2.94 ***
	Wald test			***	***	***	***	***

Source: National Longitudinal Study of Adolescent to Adult

*** p < .001; ** p < .01; * p <.05; + p<.10

Table 5-6 summarizes the mediation analyses through displaying the percentage reduction in college degree effects for each group of mechanisms and each outcome, except fast

food consumption since this variable only showed significance in the base model at p<.10. The negative percentages indicate *increases* in degree effects rather than reductions. For all outcomes, occupation has the largest reductions of all groups. Smoking displays the greatest overall reductions (43% and 49%), followed by sugar-sweetened beverages (37%). BMI and obesity are reduced *up to* 15% and 18% by the social status variables respectively, leaving much unexplained for these outcomes.

Table 5-6. Percent reduction in effects of college degrees by mechanism group and outcome

	Financial	Occupation	Status	Social	Cog/Noncog	Diet/Exerc	All
Current smoker	12%	22%	15%	11%	3%	n/a	43%
Daily smoker	16%	25%	22%	10%	5%	n/a	49%
BMI	7%	12%	15%	-11%	3%	-6%	10%
Obese	16%	12%	18%	-15%	7%	-8%	10%
Sugary beverages	14%	15%	10%	13%	7%	n/a	37%
Average	**13%**	**17%**	**16%**	**1%**	**5%**	**-7%**	**30%**

Source: National Longitudinal Study of Adolescent to Adult Health

Discussion

This chapter tested a number of mechanisms for the college degree-health behavior relationships. Overall, the results show that the various resources that education can provide account for some but not all of the effects of college degrees. The mechanisms explained a much larger proportion of effects on smoking (43-49%) and sugar-sweetened beverage consumption (37%) compared to BMI (10%) and obesity (10%). Occupation and status explained the largest proportion of college degree effects, averaging 17% and 16% reduction across outcomes, respectively. Social and cognitive/psychological resources explained the smallest proportions, at 1% and 5% respectively. Financial resources fell in the middle of the mechanism groups, reducing the effect of college degrees an average of 13% across outcomes. Diet and exercise did not mediate any of the effects on BMI or obesity.

These results diverge from prior research, and from Cutler and Lleras-Muney (2010) in particular. In contrast to the results reported here, Cutler and Lleras-Muney (2010) find that similar mechanisms explain a higher proportion of the education-health behavior relationship (60-80%), knowledge and cognitive ability explain approximately 30% of the relationship, and social networks account for 10%. However, compared to their analysis, this chapter only examines college degrees (rather than the full educational gradient), focuses on a more recent cohort in young adulthood, includes a more limited list of health behaviors, and explicitly accounts for selection through propensity scores. Yet, the results here point to occupational and status measures as important mechanisms and which Cutler and Lleras-Muney did not include.

Further, the results here can be used to help understand the complex education-health behavior relationship. Education is a metamechanism in that it produces multiple mechanisms that, in turn, shape health (and health behaviors) (Freese and Lutfey 2010). Understanding educational disparities in health behaviors requires making sense of the diverse mechanisms (Freese & Lutfey 2010; Pampel et al. 2010). Pampel et al. (2010) suggest separating mechanisms into means and motivations. Means can be knowledge, money, or access that increases healthy behaviors. Freese and Lutey (2010: 71) use the term "resource" to describe something that "purposive actors can use to benefit their health." They outline material, social and cognitive resources as types of resources that secure health. I therefore categorize the financial, social, and cognitive/psychological mechanisms in this chapter as "means." Diet and exercise are also "means" because individuals can use these behaviors to improve their weight status.

On the other hand, less educated individuals may be less motivated to be healthy, since they may perceive different rewards or have more stress to cope with. Additionally, more educated individuals may have the additional motivation of distinguishing themselves from those

less educated through achieving a healthy lifestyle (Cockerham 2005). In the mechanisms tested in this chapter, occupation and social status would be more related to motivations and means. There is also overlap between means and motivations, since having more means may spur motivations, or vice versa. However, as Pampel et al. (2010), the analytic distinction is still useful in understanding disparities in health behaviors more broadly. For example, distinguishing these categories may have important implications for policies and interventions that are focused on means or motivations.

This chapter provides evidence that means are less important than motivations for the college degree-health behavior relationship. Financial, cognitive/psychological, and social resources were far less explanatory than occupational and status mechanisms. Diet and exercise only suppressed the college graduate advantage in weight status. Highly educated individuals appear to have more incentive to be healthy.

Future research should focus more explicitly on these motivational mechanisms, which appear to be more important than means. Freese & Lutfey (2010) describe two metamechanisms related to motivations: spillovers and habitus. Spillovers refer to the contextual or social network dispersion of health, and in particular the influence of (nearby) purposive action of high-SES individuals with the means to be healthy. Habitus, on the other hand, refers to everyday practices that both reflect and produce social class, and in this case, can be healthful or harmful. The data and analysis here cannot distinguish between spillovers and habitus. Information on social networks would have been particularly useful in identifying spillover effects, but Add Health does not have information on friends, co-workers, or neighbors in Wave IV.

Returning to the hypotheses laid out in Chapter 1:

Hypothesis 3a: College degrees produce financial, occupational, status, social, cognitive, and psychological resources that improve health behaviors.

Hypothesis 3b: College degrees shape health behaviors independently of financial, occupational, status, social, cognitive, and psychological resources.

Both of these hypotheses are supported. College degrees produce these resources, which in turn, improve health behaviors. However, there is much left to be explained as college degrees still had independent effects on the outcomes after controlling for the mechanisms.

Conclusion

The findings show that we have a long way to go in understanding why college graduates are healthier than their less educated counterparts. Analyses considered financial, occupational, status, social, and cognitive/psychological resources, which together explained nearly half of college degree effects on smoking, but a smaller proportion (10%) of effects on BMI and obesity. Further, the occupational and status mechanisms explained the largest proportions, providing evidence that motivational explanations are more salient than those focused on means.

Chapter 6: Conclusion

This dissertation examines the relationship between college degrees and health behaviors. The findings support a transformative theory of education's effects. College degrees influence health behaviors and it is not just because college graduates are the kind of people who are healthier. However, accounting for selection into college degrees substantially reduced the observed associations, suggesting that these degrees also reflect prior differences. College degrees sort individuals and signal background advantages and they also confer broad benefits, with important implications for health. There is little evidence of heterogeneity in the effects of college degrees; they have strong benefits for the health behaviors of all individuals. College graduates have greater financial, occupational, status, social, cognitive, and psychological traits, which explain some of the improvements in health behaviors for this group. Overall, this dissertation contributes to the understanding of education as a meta-mechanism. Across outcomes and groups, education improves health behaviors through diverse ways. I describe below the implications of this study. From these implications and in light of the study's limitations, I then draw conclusions for public policy and future research.

Are college degrees' benefits conditional?

The findings of this study suggest that college degrees do not equalize or exacerbate inequalities so much as offer benefits equally. For the most part, degrees had similar effects across class background and race/ethnicity, gender, and immigrant status. The benefits of college degrees (and education) appear to be available to everyone, even if it is harder for some to achieve those degrees. College degrees transform individuals' lives.

The lack of heterogeneity[6-1] is surprising given the importance of race/ethnicity, gender, immigrant status, and class background generally in society and for health disparities in particular. Because race and SES are entangled, studies often cannot distinguish the source of disparities. For this study, race/ethnicity, gender, immigrant status, and class background shape health behaviors independently of educational attainment, suggesting that the social processes relating these characteristics to behaviors differ. The lack of heterogeneity is also surprising given recent research showing that college experiences appear to differ across groups (for example, see Stuber 2011). One might expect these experiences to translate into differential benefits, and some qualitative research also describes the advantages of the experiences of socioeconomically privileged individuals in the immediate post-college work force (Armstrong and Hamilton 2014). However, this study provides almost no evidence for differential returns to college degrees for health behaviors. It may be that there is heterogeneity for the labor market and income, but not for health behaviors. The mechanisms connecting these different outcomes to college degrees could be quite different.

The one exception is that college degrees reduce BMI more for individuals who are more likely to graduate college, consistent with a conditional reproduction approach. This pattern is not due to class background, race/ethnicity, gender, or immigrant status, as there was no heterogeneity for these groups. Adolescents who are most likely to graduate college have a bigger differential in young adult BMI across college degree attainment. The results do not identify the sources of this differential. It could be either because the "achievers" get more out of college or are better able to translate resources into healthy behaviors, or because not graduating college for likely graduates is detrimental for their BMI. Not achieving one's educational goals is not harmful for mental health (Reynolds and Baird 2010), but individuals who are likely to

graduate may experience negative consequences since they were invested in education and may have anticipated their degree.

Selection and background factors

Accounting for selection into college degrees greatly reduced the associations between college degrees and the health behavior outcomes. Selection accounted for nearly two-thirds of the association for BMI, obesity, and fast food consumption, and around one-third for smoking and sugar-sweetened beverage consumption. Selection in this study includes more than structural advantages; through academic, cognitive, and psychological variables, the selection model incorporates the development of skills critical for enrolling and completing college. The importance of being an adolescent who is likely to get a college degree is therefore advantageous for health behaviors both because it leads to degree attainment and because these characteristics are associated with healthier habits. However, selection into college degrees is a process that differs across social groups. For example, BMI differences across degree attainment are greater for White females, Black females, Hispanic males and females, and Asian males and females compared to White males when selection has not been accounted for, but BMI disparities are similar when selection has been considered. Thus, these subgroups appear to be more "select:" being the type of person who will likely complete college is more influential on the BMI of these individuals compared to White males.

Social class background, race/ethnicity, gender, and immigrant status generally shape health behaviors independently of college degrees (and selection into degrees). Class background directly shapes weight status, but not smoking, once college graduation and selection into

graduation has been accounted for. Race/ethnicity, gender, and immigrant status influence health behaviors, but these effects are quite similar regardless of college degree attainment. The benefits of college degrees are therefore available to everyone. However, this study does not shed light on why these ascribed characteristics are important for health behaviors, except to say that educational attainment is not the predominant pathway.

Smoking and weight status

Interestingly, some of the findings for smoking and weight status contrasted. While both outcomes displayed strong, significant effects of college degrees, the roles of selection, class background, and mechanisms differed. First, selection accounted for a greater proportion of the observed association between college degrees and health behaviors in young adulthood for weight status (63-64%) than smoking (29-33%). Second, controlling for college graduation and selection into graduation eliminated effects of class background for smoking, but not for weight status. Third, the mechanisms explained a greater proportion of college degree effects on smoking (43-49%) compared to weight status (10%). Smoking and weight status reflect the leading preventable causes of death (Mokdad et al. 2004) and are important points of intervention for policymakers, and understanding the differences may shed light on social processes.

Why might smoking and weight status differ? First, the histories of these behaviors are different. Smoking rose in the mid-20th century to its peak in the early 1960s, and then began a steady decline after the Surgeon General's report in 1964 (Link 2008). In contrast, the rise in obesity began in the 1980s and appears to be continuing to rise (Fryar et al. 2012). Thus, smoking was identified as a social problem decades before obesity, and policies and

interventions intending to reduce smoking have been around for much longer than those intending to reduce obesity. We are currently in the middle of the rise in obesity, whereas we have been largely successful in addressing smoking (though we have farther to go).

Second, the structural environments around smoking and obesity are different. The structural environment has been altered to prevent rather than promote smoking. Cigarette taxes have been raised, buildings and offices have prohibited smoking, and smoking has declined (Chaloupka et al. 2012; Evans et al. 1999). There are many similarities between the tobacco and food industries, but food is a more central component of capitalism and consumption and the food industry is much larger and more connected than the tobacco industry (Brownell and Warner 2009). For example, the government has competing interests beyond the public's healthy diet. Government subsidies keep agriculture producing processed, unhealthy foods. For example, the corn industry receives subsidies to keep the supply of corn larger than the demand, leading farmers to process the corn into high fructose corn syrup (Biglan 2011; Franck et al. 2012). The result is that the structural environment for obesity continues to promote unhealthy practices despite the consequences for public health.

Third, it may be that the role of stigma operates differently for smoking and obesity. Many researchers attribute (at least) some of the decline in smoking to the stigma around smoking; it is an undesirable habit (Graham 2012). Because individuals do not want to be associated with this negative characteristic, they give up the habit. In support of this perspective, smoking has become increasingly concentrated among low SES individuals; educational disparities in smoking have increased (Meara et al. 2008). Obesity is also a stigmatized status (Sikorski et al. 2012), but the stigma surrounding obesity appears counterproductive. Brewis (2014) identifies multiple ways in which weight-related stigma can contribute to weight retention

or weight gain, including decreased motivation to engage in weight loss activities and increased stress. Interestingly, while obesity rates continue to rise with more than one-third of adults classified as obese (and another third as overweight), stigma against this status is also continuing to rise (Brewis et al. 2011). It is unclear why stigma may have been effective for smoking since decreased motivation and increased stress from stigma could also overwhelm efforts to stop smoking. It may be that stigma is effective in preventing smoking initiation, an action with no equivalent for obesity. Researchers now suggest that stigma may counteract efforts to increase smoking cessation among disadvantaged smokers (Bell et al. 2010). Regardless, whereas stigma appears to have been historically effective in reducing smoking, it does not appear to be an effective weapon against obesity in today's society.

Physical activity

Physical (in)activity did not display the strong, robust results of the other outcomes. It may be that the measures were unable to accurately capture activity level. In asking individuals how many times they participated in a number of different types of activities, the survey did not ask about intensity or duration. As more affordable "fitness" apps have become available, future research may consider using these technologies to get at more direct measures of activity, such as heart rates, number of steps taken, or the amount of sedentary time. Alternatively, it may be that physical (in)activity differs less across educational attainment and the differences are primarily due to selection. The reasons to engage in physical activity are numerous and people of different education may engage in activities for different reasons, but with the same result.

Why are college graduates healthier?

This study's findings related to the mechanisms underlying the college degree-health behavior relationships were surprising. Based on the literature, financial, cognitive, and psychological resources played a smaller role than expected, and occupation and social status played a larger role than expected. These surprises suggest that we should expand our research and policy focus to include both means and motivations (Pampel et al. 2010). Freese and Lutfey (2014) describe the use of resources or means in explaining the SES-health relationship as a "durable narrative," and such explanation is easy to understand, logical, and avoids victim-blaming. However, these explanations are insufficient. Researchers should incorporate more complex understandings of when and how resources are harnessed, as well as consider other mechanisms that are more related to motivations. Education is a meta-mechanism. Education's effects on health are diverse and dynamic, but consistent and enduring. Further theorizing and understanding of the types of mechanisms beyond resources is needed.

Additionally, little research has looked at occupational types and characteristics and health behaviors. More work in this area could shed light on how and when status and distinction shape these behaviors. Recent research highlights the ability of occupation to capture inequality and "life conditions" better than financial variables (Weeden and Grusky 2012). Details on occupation may indicate political attitudes, personal values, and other tenets that shape daily routines and decision-making.

Also surprising was the minimal explanatory power of the various mechanisms. Given the rich set of possibilities, one would expect that the majority of the relationship between college graduation and health behaviors could be explained, yet there was much unexplained, especially for BMI and obesity. One reason for this is because the individual measures are unable

to capture the broader categories they represent. This may be particularly true for cognitive and psychological resources.

The vocabulary test score may not capture well the broader concept of "cognition." A discussion of standardized tests and their validity is beyond the scope of this project, but it may be that these tests do not capture broader, more flexible cognitive abilities. In comparing college students' scores on cognitive tests before and after college, Arum and Roksa (2011) argue that individuals learn little in college. This conclusion contrasts with the vast literature on the many advantages of college graduates in multiple areas, including health, income, employment and occupation, family stability, and civic engagement (Hout 2012) and respondents' own reports of their critical thinking gains in college (Chambliss and Takacs 2014). The inability of standardized tests to capture broader cognition may explain these divergent conclusions. Research looking at the predictive capacity of a single cognition measure for outcomes such as educational attainment or labor market success suggests that such measures do not perform well, explaining less than one would expect (Heckman and Kautz 2012). Additionally, there may be psychological resources that we are not currently measuring or capturing in survey research. Recently education researchers have begun to consider "grit," or "perseverance and passion for long-term goals" (Duckworth et al. 2007). Research on grit shows that it is conceptually distinct from IQ, but is important for understanding success.

As mentioned in Chapter 5, the dataset did not offer information on habitus or spillovers. Spillovers refer to the dispersion of health across contexts and interpersonal relationships (beyond just direct social control). Data on both the norms (in multiple contexts) and social networks of the respondents in young adulthood would provide the opportunity to do some preliminary studies on spillovers that could spur further research. Additionally, social science

research could innovate on new ways to get at "habitus," or the ways that everyday actions and habits produce an overall lifestyle, which also reflects and produces social class. College graduates report that social skills are one of the most important things they learn in college (Chambliss and Takacs 2014). How to comport oneself and navigate social situations (particularly among other college-educated persons) is a way in which individuals express their social class, and such skills are connected to health behaviors. For example, playing golf with friends or co-workers requires some physical endurance, or participating in a job interview makes stepping outside to smoke awkward. Yet, it is difficult to measure these social skills. Even the operationalization of a more defined, concrete concept such as cultural capital is debated widely in the literature (for examples, see Kingston [2001] and Lamont and Lareau [1988]), and sociologists have had a hard time proving the influence of such a concept (e.g. DiMaggio 1982, Jaeger 2011). Thus, researchers should consider new ways to operationalize these complex but important concepts.

Limitations

The conclusions of this study should be interpreted in light of its limitations. First, the study is limited by its narrow focus. As mentioned in the introduction, the study focused on internal validity, or careful estimation of effects for the population examined. The extent to which these patterns hold for other cohorts or contexts is unknown. Further, the focus on college degrees also leaves unknown the patterns for other levels of educational attainment. The sensitivity analyses suggest that the patterns are similar but weaker for some college experience with no degree. However, how educational attainment is operationalized will only increase in importance as educational attainment rises across the American population. The role of horizontal stratification

will also be of increasing importance, as individuals seek to distinguish themselves through enrollment in high quality or high prestige universities.

Second, this dissertation uses secondary data that provides a finite, defined set of variables. Although Add Health provides the best data available to answer the research questions of this study, there were additional variables that would have been useful. For example, it would have been informative to have social network data from young adulthood (which is difficult and costly to collect).

Third, the study is limited in its ability to estimate causality. Randomized controlled trials for this topic are impossible, and we must therefore rely on methods designed to estimate causal relationships from observational data. This study improves on prior associational methods through its use of propensity scores. However, propensity scores are not without weakness. Of greatest concern is the strong assumption that selection is conditional on unobservable variables. Reducing concern is that my selection model includes a rich set of information, including the outcome variables at an earlier time period. However, there is no way to test for that which we do not know.

A related limitation is that this study cannot shed light on what would happen to health behaviors if more individuals achieve college degrees. The findings suggest that education is beneficial for everyone, but the results cannot be extrapolated to changes in educational attainment patterns. For example, if a federal law were to make college free for everyone and suddenly 80% of young adults were achieving college degrees, the meaning of these degrees would very likely change. It could be that college degrees would no longer be a dominant marker of status, and individuals would then achieve further degrees or otherwise distinguish themselves. The consequences of these changes on health behaviors are completely unknown.

That is, we do not know the extent to which education's effects are zero-sum (or how much they would be zero-sum in future scenarios). One could assume that "means" are infinite since, at least theoretically, everyone could access the gym or smoking cessation programs. In contrast, one could assume that "motivations" are zero-sum, or at least somewhat zero-sum, if one argues that some of the motivation behind health behaviors is a matter of distinction. Some individuals will always behave more healthfully than others for no other reason than to distinguish oneself. In this characterization, education will continue to stratify individuals on health behaviors (through motivations) regardless of average attainment levels because some people will always seek to be more healthful than others.

Future scenarios of health behaviors will also depend on broader social inequality. Today's context of widening SES inequalities, where those with more financial assets get even greater shares of the nation's (or world's) assets as time goes on, suggests that health inequalities will continue to widen. And currently, SES disparities in smoking and mortality are widening. However, we have little evidence of what will happen if the trend is reversed such that SES inequalities narrow. It could be that in such a context, individuals increasingly turn to non-monetary elements to distinguish themselves, such as health habits. Or, it could be that access to resources will become more equal across individuals, narrowing the gap. This study cannot shed light on these trends, but future macro-level studies may provide insight.

Policy Implications

This study has implications for policymakers intending to improve population health behaviors and reduce educational disparities in health behaviors. Since the benefits of education are broad, long-lasting, and available to everyone, policies promoting higher education (and completion of

college degrees) will likely improve population health behaviors. Policies that reduce the cost of college could encourage greater attendance. Most other developed countries pay for their citizens to attend college, but the United States has no comprehensive higher education support other than student loans. And at the time of writing, a budget memo released by the House GOP proposes to freeze the support from Pell Grants at $5,775 per school year (Douglas-Gabriel 2015). These grants award money to students from low-income families, many of whom are Black or Latino. The modest amount that Pell Grants offer encourage students to attend college; rather than cutting, we should be adding funding. Other programs intending to increase college enrollment or graduation rates will likely also have broad benefits for health.

As the determinants of college graduation start early in the life course, resources directed toward children and their families can have short and long-term benefits. The best way to improve academic achievement is a hotly debated topic, but much less attention is paid to parents. Family socioeconomic status is an important predictor of college completion. For example, individuals growing up in the highest income quintile are *eight* times as likely to graduate college as those in the lowest quintile (Cahalan and Perna 2015). Improving the level and stability of parents' education, income, wealth, and occupation can improve the future educational attainment, health behaviors, and well-being of their children.

This study can also inform policies aimed at improving health behaviors more directly. These policies should consider motivations that shape behaviors in addition to the means. For example, programs could provide opportunities for healthy ways to deal with stress or have fun. Additionally, in addressing motivations, policies or programs should not stigmatize or shame those engaging in unhealthy behaviors. As described earlier, such shaming can be counterproductive, as the psychological effects can reduce motivations for healthy behaviors.

Additionally, shaming places blame and responsibility solely on the individual rather than acknowledge the broader social forces.

Policies aimed at social structure will likely be more effective than those focused on individual behaviors. At the state and local levels, we have instituted policies that have made smoking more expensive and more challenging for individuals to engage in. Recently, local policies intending to do something similar for the causes of obesity, such as Bloomberg's short-lived ban on sugar-sweetened beverages over 16 ounces (Grynbaum 2014), have received great amounts of attention. Most policies, such as taxes on sugar-sweetened beverages and requiring restaurants to post the calories of their items, are focused on individual behavior and decision-making rather than broader social structure. One can tax sugar-sweetened beverages hoping that individuals will then purchase these items less, or one can change the agricultural-industrial complex that produces cheap and abundant sugar-sweetened beverages. The continuing increase in obesity suggests that we have not yet effectively addressed this health issue.

In addition to improving behaviors across the population, policymakers should also consider the SES disparities in behaviors. We do not want to maintain or exacerbate the increasing disparities while reducing overall levels. Thus far, obesity's rise has not been concentrated among low SES individuals (Ljungvall and Zimmerman 2012; Zhang and Wang 2004), but it could be that in the future, high SES individuals are the quickest to adapt to healthier weight statuses (as they were to quit smoking [Link 2008]). And the educational gap in obesity from decades ago persists today. Thus, programs may choose to target those with less education or who are less likely to achieve higher education.

Lastly, the findings of this study support research arguing that SES is a fundamental cause of disparities in health and that education is a meta-mechanism for health. Since the

pathways from education to better health (and health behaviors) are many, to truly reduce disparities, policies should address the underlying distal source: social inequality.

Resources directed toward increasing educational attainment and improving health behaviors can have extensive benefits beyond their intended purposes, making such investments worthwhile. Further, the mechanisms with which unhealthy behaviors spread can be harnessed for positive change. As groups take on healthier habits, social connections (e.g. norms, habitus, and spillovers) can help to further spread these actions.

Future Directions

The findings of this study should be further examined and replicated across ages, periods, and cohorts to determine the generality of the relationships described here. However, future research should go beyond this analysis. This study contributes to our knowledge of the role of education in health behaviors, but we still know little about the sources of disparities in health behaviors. The differences across smoking and obesity, the divergent reductions in associations through accounting for selection, and the modest mediation of a number of theorized mechanisms suggest that we need new ways of thinking about health behaviors and disparities in health behaviors.

First, we need to consider the historical, social, and institutional contexts of behaviors. These contexts shape the ability and facility of engaging in behaviors, as well as the individual means and motivations for certain habits. Simply put, in a society without cigarettes, smoking is not a health concern. Some research has explored the influence of "opportunities" on behaviors, such as whether vending machines in schools shape weight status (Van Hook and Altman 2012) or if families in neighborhoods without grocery stores eat less produce (Pearson et al. 2005). However, these isolated factors obscure the complexity of health-related decisions. For example,

a family's decision to go through the drive-through on the way home from work is more likely if: both parents are working and do not want to prepare and clean up the meal; the food is relatively cheap due to agricultural subsidies, low (perhaps illegally low) wages of agricultural workers, and low wages of fast food workers; the family has a car that is relatively inexpensive to drive to and from the fast food restaurant; the family has watched commercials about the food; the children anticipate receiving toys in their meals; there are many different types and brands of fast food restaurants to choose from; the restaurant is nearby and easy to access from the street; and the food tastes good (if for no other reason, from the fat, salt, and sugar content). We like to think of our decisions as agentic, but focusing on the individual-level rather than the structural determinants prevents large-scale change. Most policies proposed for the obesity crisis, such as banning large soft drinks or taxing sugary beverages, are aimed at the individual level. However, if processed foods were not so plentiful and easy to obtain, such measures may not be necessary. We seldom consider the historical, political, and social conditions that produce the food system that is characterized by excess, choices, and availability of calories (and many unhealthy calories).

Similarly, current smoking practices reflect broad structural influences. The cigarette has been the dominant method of tobacco consumption for the last hundred years, and its existence is the result of technological and social conditions in the 19th and 20th centuries. The ability to mass produce cigarettes in the late 19th century propelled companies to market the product, with campaigns including collectibles and coupons to encourage consumption (Brandt 2007 ; Kluger 1997). The sharp rise in smoking in the 20th century started around World War I when cigarette companies framed smoking as a rare pleasure for soldiers overseas and social opposition to smoking declined. Advertising and media continued to encourage initiation and continuation of

smoking across the 20th century, while cigarette companies suppressed the scientific evidence of the health harms of smoking. Smoking became common for women as well, as advertising campaigns supported smoking as an empowering action for women (Brandt 2007). As noted in the Introduction, smoking has been on the decline for several decades since the Surgeon General's report in 1964, but social conditions continue to support smoking. The most highly visible regulations, such as high taxes on cigarettes or bans on smoking in public places, make smoking more difficult for individuals to engage in. But more extreme political measures are difficult, as Americans often view smoking as a personal choice that should not be infringed on. The tobacco industry, often termed "Big Tobacco" remains strong and profitable, employing farmers and machinists and donating to a panoply of worthy causes (Kluger 1997). In our capitalist and industrialist society, policies focus on reducing harm and cessation of smoking, rather than eliminating harm and cessation of production of tobacco products (Proctor 2011). Smoking must therefore be understood within these historical and social conditions.

Social science researchers can contribute to our understanding of behaviors through theorizing and testing ways in which overlapping contexts produce patterns. Little sociological theory has been applied to understanding SES disparities in health behaviors. Yet, there is much theoretically to draw upon. Weber (1922[1978]), Bourdieu (1986; 1990), and more recently, Cockerham (2005) and Abel (2008; Abel and Frochlich 2012) offer ways in which sociologists might consider how social class shapes health. Future research should bridge these theoretical perspectives with empirical research on how SES disparities in health behaviors develop.

However, researchers should hesitate about extrapolating across health behaviors given that smoking and weight status appear to operate so differently. The mechanisms explained greater proportions of education's effects on smoking and the associations between education

and smoking were reduced less by selection. Our understanding of education's effects on health behaviors appears may be more applicable to smoking than weight status. Theories should thus consider both the general and particular aspects of the SES-health behavior relationships.

Summary

This dissertation makes several theoretical, methodological, and empirical contributions to sociological literature in the areas of health and education. Theoretically, I bring educational stratification perspectives to bear on health behaviors and develop new approaches that consider how different responses among groups can obscure the process of inequality. Future research can incorporate these more nuanced perspectives. Additionally, most health researchers focus on the positive effects of education, but this study demonstrates that studies should consider both the transformative and stratifying effects of education on health and health behaviors.

Methodologically, the dissertation demonstrates the importance of controlling for and understanding the role of selection and allowing for heterogeneity. Most research examining health behaviors uses associational methods, which as the results of this dissertation show, obscure the importance of background factors that shape both education and health behaviors. Although the results did not produce conclusions as to heterogeneity in college degree effects, testing for these differences is important statistically and substantively.

Empirically, the dissertation contributes to our understanding of the causes of differences in health behaviors and of the effects of education. Very few studies have examined *why* and *how* more educated individuals behave more healthfully. Cutler and Lleras-Muney (2010) is a notable exception, but this single study, as described elsewhere in this dissertation, is limited in its methods and conclusions. The results presented here show that college degrees appear to

transform individuals' behaviors in young adulthood, but prior characteristics also explain a substantial proportion of the college degree-health behaviors associations. These results confirm prior research demonstrating the importance of education as well as prior characteristics that shape both education and health behaviors (for examples, Maralani 2014; Pudrovska et al. 2014)

The mostly homogenous effects substantiate the assertion that education's effects are available to everyone. Prior research has produced mixed findings as to whether college degrees have homogenous effects for other health and socioeconomic outcomes, with some showing greater effects for those most disadvantaged (Brand and Xie 2010; Schafer et al. 2013) and others indicating greater effects for those most advantaged (Bauldry 2014). The effects of college degrees may vary across outcomes, ages, or cohorts. However, in all of these studies, college degrees appear beneficial for all groups.

Lastly, this study provides new information on the mechanisms explaining why college degrees improve health behaviors. In line with previous research, multiple mechanisms explain some but not all of the effects of college degrees (Cutler and Lleras-Muney 2010; Pampel et al. 2010). In addition, I conclude that: means or resources explain little of the college degree-health behavior associations; occupation and status appear to be important mechanisms; and overall, the variables commonly used as mechanisms explain smaller proportions of the associations than one would expect, particularly for weight status.

This study affirms multiple functions of education: it sorts individuals, improves well-being, and stratifies the population into classes. College degrees improve health behaviors for all college graduates, leaving those without degrees lagging behind. A sociological understanding of why social groups engage in different behaviors can contribute to efforts in reducing social inequality and improving population health.

Chapter 6 Endnotes

[6-1]Heterogeneity is defined as an effect determined with 95% confidence (or 90% confidence as significance levels less than .10 were also reported). That is, the null hypothesis is that there is not heterogeneity, which may make the conclusion of homogeneity easier to reach. However, the inconsistent patterns across the findings, as well as the shift from significance to non-significance of gender, race/ethnic, and immigrant status differences in Chapter 4 suggest that describing the relationships between college degrees and health behaviors as homogeneous is most accurate.

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APPENDICES

Table A3-1. Unstandardized Coefficients for Multilevel Growth Curve Models Predicting Health Behaviors over Time

	Current smoking		BMI		Obesity		Physical Activity	
	b		b		b		b	
Fixed Effects								
Age/10	16.39	***	8.17	***	40.62	***	-2.41	***
Age/10 Squared	0.30	***	-1.24	***			1.35	***
College Degree	0.27	***	-0.70	***	0.26	***	0.18	
College Degree*age	1.24		-0.71	*	0.43	***	0.78	*
College Degree*age2	0.34	***	-0.18				-0.28	
Constant	0.09	***	19.55	***	0.00	***	6.15	***
Random Effects	Estimate		Estimate				Estimate	
Variance of age	4.00	0.38	107.60	3.42	8.27	0.71	136.11	60.43
Variance of age^2	1.82	0.17	21.50	0.69			29.08	1.37
Variance of constant	5.15	0.27	22.12	0.69	16.91	0.82	13.03	1.02
Covariance age, age2			-44.57	1.50			-60.80	2.93
Covariance age, constant			27.54	1.42			-37.94	2.46
Covariance age^2, constant			12.88	0.62			16.82	1.10
N	55646		54603		50356		56207	
N persons	15648		15611		14745		15689	

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

Source: National Longitudinal Study of Adolescent Health

Notes: Model estimates adjust for weights and clustering.

Table A3-2. Outcome means, using some college experience as treatment

	Some college	No college (unmatched)	No college (matched)	Diff	N
Current smoker	0.29	0.48	0.39	-0.10 ***	14674
Daily smoker	0.16	0.33	0.26	-0.10 ***	14674
BMI	28.66	30.00	28.87	-0.21	14070
Obese	0.42	0.34	0.44	-0.02	14070
Obese II	0.22	0.17	0.24	-0.02	14070
Obese III	0.11	0.08	0.11	0.00	14070
No phys activities	0.13	0.19	0.17	-0.04 **	14778
# physical activities	6.56	5.84	5.88	0.68 ***	14778
SSB	9.50	13.98	11.80	-2.30 ***	14763
Fast food	2.13	2.84	2.51	-0.38 ***	14724

*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

Table A3-3 Means for matched and unmatched groups, excluding individuals without college degrees enrolled in school

	College degree	No coll deg (unmatched)	No coll deg (matched)		N
Current smoker	0.19	0.44	0.37	-0.18 ***	13061
Daily smoker	0.07	0.29	0.23	-0.16 ***	13061
BMI	27.45	29.97	28.37	-0.92 ***	12516
Obese	0.27	0.42	0.33	-0.06 ***	12516
Obese II	0.12	0.22	0.16	-0.04 **	12516
Obese III	0.05	0.11	0.08	-0.03 ***	12516
No phys activities	0.11	0.18	0.14	-0.03 *	13156
# physical activities	6.76	5.94	6.11	0.65 **	13156
SSB	7.38	13.23	11.52	-4.14 ***	13144
Fast food	1.78	2.72	2.17	-0.39 ***	13123

*** p < .001; ** p < .01; * p <.05; + p<.10

Source: National Longitudinal Study of Adolescent to Adult Health

Table A4-1. Comparison of results from single step and two step models

	Single step from *teffects*		Two steps	
	ATE	SE	ATE	SE
Current smoker	-0.16412	0.02542	-0.16412	0.02613
Daily smoker	-0.13103	0.02345	-0.13103	0.02420
BMI	-1.05391	0.27435	-1.05391	0.30693
Obese	-0.07661	0.02325	-0.07661	0.02505
Obese II	-0.04770	0.01787	-0.04770	0.01929
Obese III	-0.03708	0.00831	-0.03708	0.00900
No phys activities	0.00076	0.03432	0.00076	0.03543
# physical activities	0.29481	0.33207	0.29481	0.34092
SSB	-3.73952	0.40083	-3.73952	0.41255
Fast food	-0.25430	0.12736	-0.25430	0.13387

Source: National Longitudinal Study of Adolescent to Adult Health

Table A4-2. Unadjusted health behavior means by some college participation

	No college	Some college	Sig diff?	Diff
Panel A: White Male (N=3820-3869)				
Population share				
Current smoker	0.55	0.37	***	-0.18
Daily smoker	0.43	0.21	***	-0.22
BMI	28.81	28.52		-0.29
Obese	0.36	0.33	*	-0.03
Obese II	0.15	0.13	+	-0.02
Obese III	0.06	0.05	*	-0.01
No phys activities	0.16	0.10	***	-0.06
# physical activities	6.23	7.45	***	1.22
SSB	17.05	11.11	***	-5.94
Fast food	2.12	2.97	***	0.85
Panel B: White Female (N=3940-4283)				
Population share				
Current smoker	0.56	0.30	***	-0.26
Daily smoker	0.44	0.18	***	-0.26
BMI	27.70	29.92	***	2.22
Obese	0.43	0.30	***	-0.13
Obese II	0.25	0.16	***	-0.09
Obese III	0.12	0.08	***	-0.04
No phys activities	0.20	0.13	***	-0.07
# physical activities	5.14	6.21	***	1.07
SSB	13.40	8.20	***	-5.20
Fast food	2.12	1.56	***	-0.56
Panel C: Black Male (N=1341-1354)				
Population share				
Current smoker	0.52	0.29	***	-0.23
Daily smoker	0.29	0.14	***	-0.15
BMI	28.52	29.42	*	0.90
Obese	0.34	0.38		0.04
Obese II	0.16	0.16		0.00
Obese III	0.07	0.09		0.02
No phys activities	0.18	0.12	**	-0.06
# physical activities	7.16	7.39		0.23
SSB	13.27	12.59		-0.68
Fast food	3.61	3.32		-0.29

Table A4-2 continued

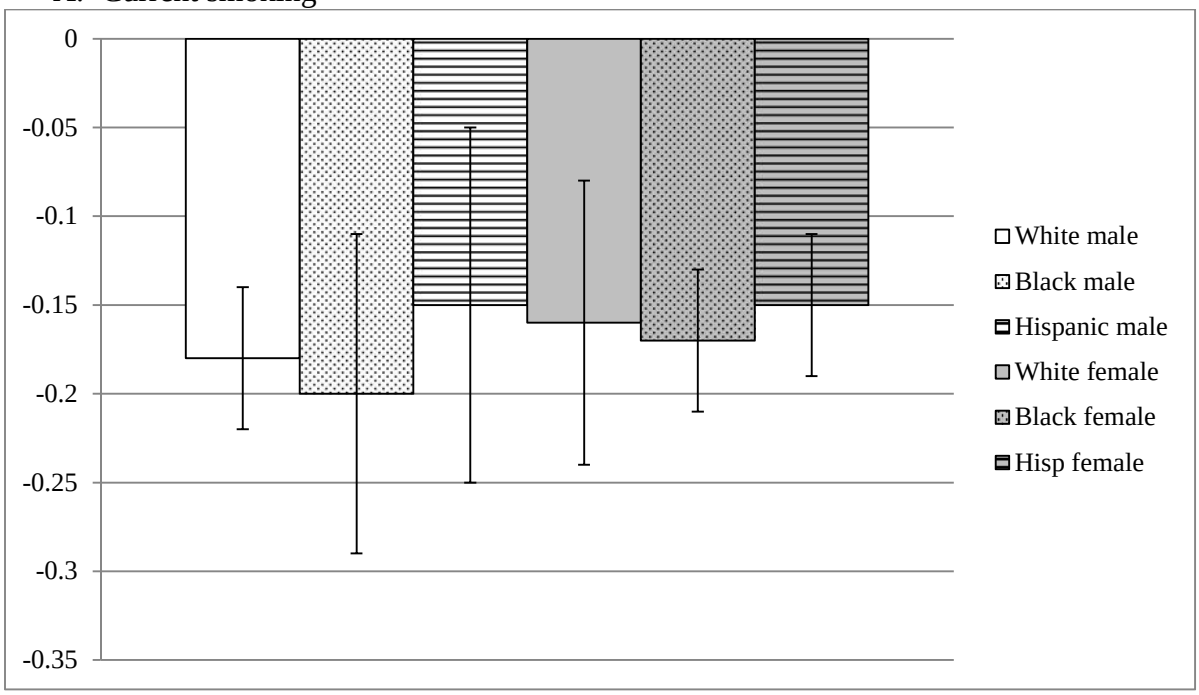
Panel D: Black Female (N=1681-1801)				
Population share				
Current smoker	0.34	0.16	***	-0.18
Daily smoker	0.18	0.09	***	-0.09
BMI	32.94	31.03	***	-1.91
Obese	0.57	0.46	***	-0.11
Obese II	0.35	0.28	**	-0.07
Obese III	0.21	0.16	**	-0.05
No phys activities	0.26	0.21	*	-0.05
# physical activities	4.44	5.11	**	0.67
SSB	13.19	9.71	***	-3.48
Fast food	3.23	2.69	***	-0.54
Panel E: Hispanic Male (N=1101-1124)				
Population share				
Current smoker	0.41	0.26	***	-0.15
Daily smoker	0.19	0.11	***	-0.08
BMI	31.18	30.04	**	-1.14
Obese	0.48	0.43	+	-0.05
Obese II	0.25	0.17	**	-0.08
Obese III	0.12	0.08	*	-0.04
No phys activities	0.18	0.12	**	-0.06
# physical activities	6.77	8.04	**	1.27
SSB	12.45	9.91	***	-2.54
Fast food	3.30	2.62	***	-0.68
Panel F: Hispanic Female (N= 1149-1248)				
Population share				
Current smoker	0.29	0.19	***	-0.10
Daily smoker	0.13	0.08	**	-0.05
BMI	30.74	29.01	***	-1.73
Obese	0.46	0.37	**	-0.09
Obese II	0.27	0.19	**	-0.08
Obese III	0.14	0.10		-0.04
No phys activities	0.24	0.18	*	-0.06
# physical activities	4.83	5.34	+	0.51
SSB	10.74	7.90	***	-2.84
Fast food	2.29	2.07		-0.22

*** p < .001; ** p < .01; * p <.05; + p<.10

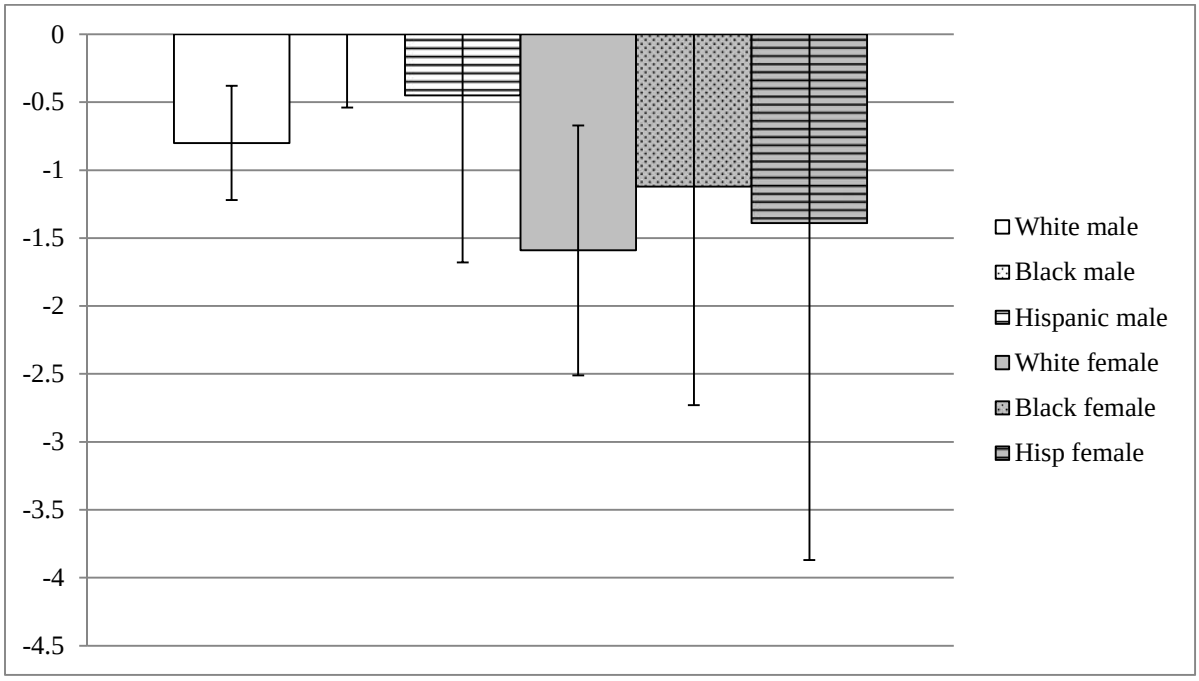
Source: National Longitudinal Study of Adolescent to Adult Health

Figure A4-1. Average treatment effects and 95% confidence intervals for propensity score matching conducted within subgroups

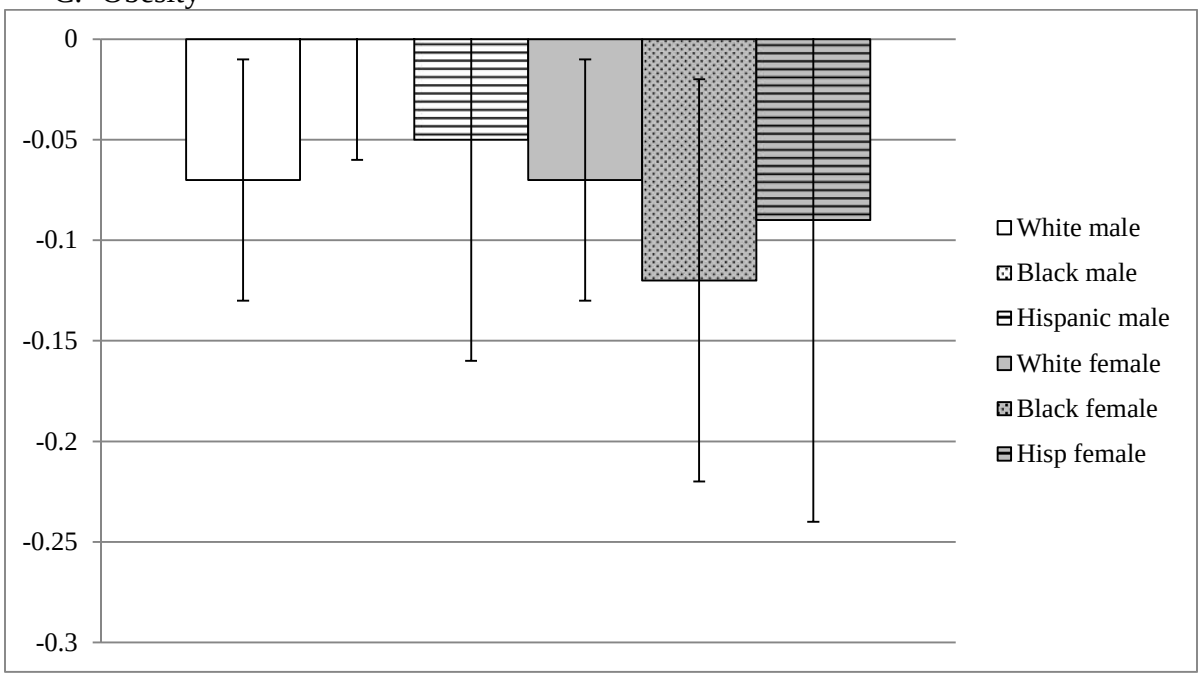
A. Current smoking



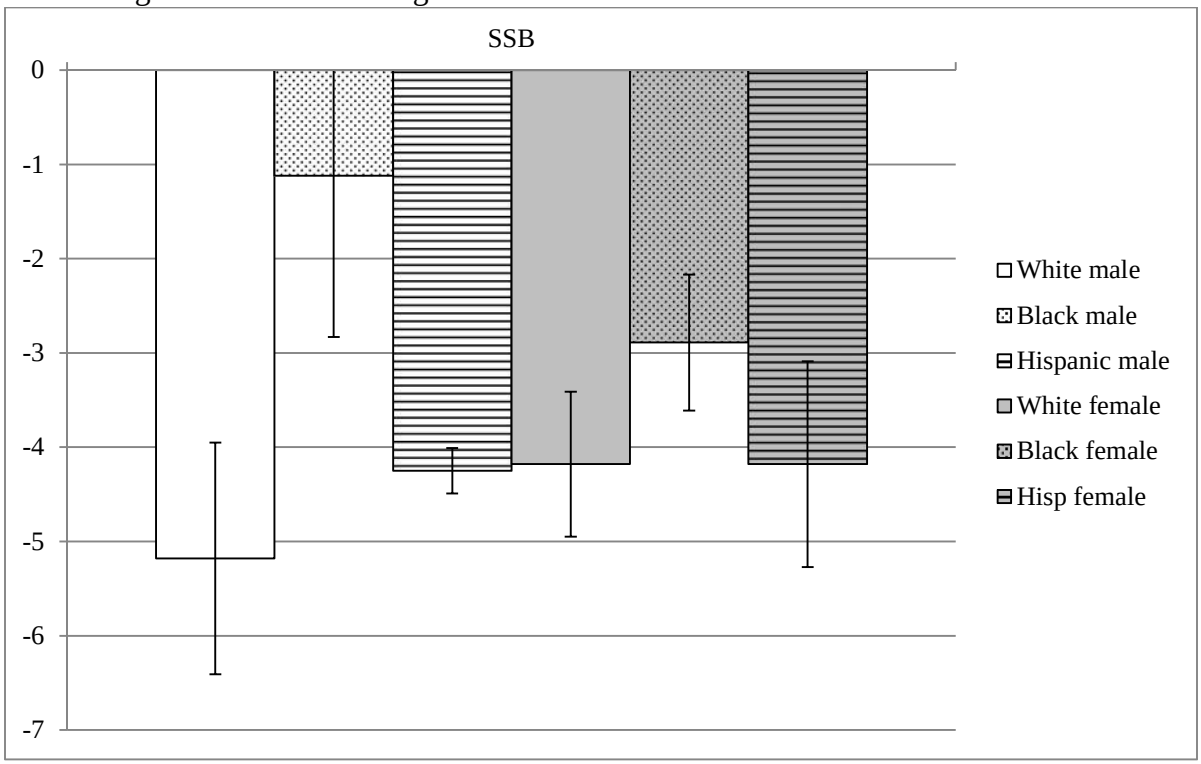
B. BMI



C. Obesity



D. Sugar-sweetened beverages



E. Fast food consumption