Conditional and Unconditional Benefits of College Degrees for Young Adult Health Behaviors

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Abstract

Among U.S. adults, college degree earners live much healthier lives than those with less education, but we know little about why. Determining how and why educational attainment influences smoking, exercising, and other behaviors can reveal the role of education in social stratification. This study accounts for selection into college degree attainment to estimate causal effects and determine whether effects are conditioned on the likelihood of achieving the degree or a person's social background. The National Longitudinal Study of Adolescent Health (Add Health) provides longitudinal data on education and health behaviors. Methods include growth curve models, propensity score matching, and heterogeneous treatment effect models. Results indicate that college degrees are influential on a range of health behaviors beyond selection into degree attainment. For most outcomes, degrees mitigate, but do not negate the effects of class background. However, for BMI and fast-food consumption, college degrees have greater benefits for advantaged individuals.

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Introduction

College degree earners live much healthier lives than those with less education. However, we know little about why. Although research has established strong and consistent gradients between education and smoking, drinking, exercising, and maintaining healthy weight, scholars have only begun to identify mechanisms and establish the extent to which the education-health behavior relationship is causal (for examples, see Conti and Heckman 2010; Cutler and Lleras-Muney 2010; Frech 2012; Pampel et al. 2010). For instance, researchers have asked whether the college degree-health behavior association (a) indicates changes in individuals' cognitive abilities, social networks, or other characteristics from experiences during college, or (b) reflects differences in individuals that existed before college, such as levels of self-control. Yet, studies have not considered that (a) may apply to some individuals and (b) may to others. Thus far, no study has examined whether education's benefits for health behaviors differ across groups.

Understanding for whom, if anyone, college degrees are most influential would indicate whether education serves to level social inequalities. Further, identifying the value of college degrees beyond future income is especially relevant at a time of rising tuition and high unemployment rates. And health behaviors matter: In the year 2000, the leading 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). This paper addresses the important issue of educational disparities in health behaviors through distinguishing the conditional effects of college degrees on multiple health behavior outcomes.

Health behaviors exhibit strong associations with educational attainment. Current smoking, heavy cigarette consumption, heavy drinking, and obesity all show strong inverse relationships to education, while physical activity, nutrition, and overall healthy lifestyles have strong, positive associations to educational attainment (Beydoun and Wang 2008; CDC 2013; Cohen et al. 2013; Cutler and Lleras-Muney 2010; Forshee and Storey 2006; HHS 2008; Margerison-Zilko and Cubbin 2012; Pampel et al. 2010). Although some may interpret these associations to mean that education causally reduces smoking, obesity, and other behaviors, they may instead reflect either the reverse direction of causality (health affects education) or the influence of prior characteristics on both education and health. An example of the latter interpretation would be the influence of growing up with highly educated parents on higher educational attainment and also eating more nutritional food. Better data and advances in research have led to increased attention to causal mechanisms, but there has not yet been a thorough analysis of the causal effect of education on health behaviors. Studies using methods designed to isolate the exogenous influence of education have been limited and do not indicate a conclusive pattern among a representative population of U.S. adults (Conti and Heckman 2010; de Walque 2007; Gilman et al. 2008; Webbink, Martin, and Visscher 2010).

An average causal effect may also obscure differences. Testing for conditionality across this likelihood is important methodologically. Producing a single estimation for a causal effect assumes homogeneity, and this study directly tests this assumption. Further, distinguishing for whom college degrees are most influential has theoretical implications. This study will explore heterogeneity across likelihood of achieving a degree, which depends on a host of factors, and one’s social background.

This study intends to contribute to the empirical, practical, and theoretical understanding of education's effects. Empirically, the education-health behavior relationship is complex and defies obvious explanations that focus on income and resources, since many unhealthy behaviors, like smoking, are more expensive than healthy behaviors. Practically, health behaviors are an important contributor to health and longevity. Theoretically, health behaviors are an important signal of social class. Weber (1978[1922]) identified health behaviors as part of his concept of life conduct, or how individuals actively reproduce status group distinctions through habits and behaviors. Similarly, health behaviors are part of Bourdieu's (1986; 1990) "habitus", a concept describing everyday practices that both reflect and produce social class.

Theoretical Framework

Two opposing perspectives lie at the core of educational stratification theory. One focuses on education as the key to upward mobility ("education as leveler") and the other highlights the role of education in reproducing inequality across generations ("education as source of inequality").

The "education as leveler" perspective 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. The abilities, knowledge, and resources acquired through education allow individuals to achieve more prestigious occupations and higher incomes. In asserting education as a solution to the negative consequences of inequality, this perspective does not perceive education to be a zero-sum game 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, the "education as source of inequality" perspective takes a more critical view. This approach emphasizes how education allows individuals with high status to maintain their position. Education uses the illusion of meritocracy to justify social inequality, but employers use educational attainment to exclude individuals because of their social class, not because the attainment reflects skills useful for employment (Berg 1971; Collins 1979). The social strata resulting from educational differences are not reflective of meaningful differences. Further, from this point of view, higher educational attainment is not a solution to 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 "education as source of inequality" perspective. Reproductionists argue that schooling rewards children of higher status, essentially serving to sort children based on their background. Teachers, staff, and

administrators identify students from families with higher socioeconomic status (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, while 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 reflect important skills learned in school, signify social class membership.

These broad theories can be tested through causal analysis. 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 equalizing perspective. Conversely, a weak or near zero average causal effect would demonstrate that observed associations merely signal prior differences and are not caused by education, supporting the reproductionist 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 roles 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 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 not able 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 theoretical positions on heterogeneity in education's effects. Determining whether college degrees primarily help those who are disadvantaged or advantaged 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) education as equalizer, and (2) education as reproducer.

Conditional Equalizing Effects

As described above, an "education as leveler" approach 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 get them through higher educational attainment. Thus, a "conditional equalizing effects" approach argues that education is more influential on those 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). However, the "conditional equalizing effects" approach argues that education can help individuals overcome prior disadvantage, while resource substitution theory looks at concurrent disadvantage. Additionally, "conditional equalizing effects" is not limited to a particular mechanism.

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 is beyond the scope of this paper). 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 yet unknown. Individuals with college degrees 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 get 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.

Conditional Reproduction Effects

The opposing 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 2005[1985]).

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. Furthermore, students from disadvantaged

backgrounds may have to make changes to conform to middle- or upper-class norms. It may be harder for disadvantaged students to change their health behaviors than it is for advantaged students to maintain their lifestyle habits.

Unconditional effects

A third option is that college degrees have a homogeneous effect on health behaviors. If there is no heterogeneity, then one of the broad stratification theories "education as leveler" or "education as source of inequality" 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.

Research Question

Using Add Health data and quantitative methods, this study will answer two research questions: (1) What are the average causal effects of college degrees on multiple indicators of health behaviors? (2) How are the effects of college degrees on the different health behavior outcomes conditioned on the likelihood of achieving the degree or a person's social background? Studies exploring the causal relationship between education and health behaviors are few and have not yet established the patterns among nationally representative U.S. population, and answering the first question will meet this need. The second question will then allow for heterogeneity in these relationships.

The results demonstrate that college degrees are influential on a range of health behaviors beyond selection into degree attainment. There does not appear to be conditionality in the effects of college degrees on smoking across class or likelihood for degree attainment, suggesting that educational attainment equalizes this behavior. 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 benefits for advantaged individuals on BMI and fast-food consumption.

Methods

Data

Analyses use Add Health, a longitudinal, nationally representative dataset widely used in social science research. It first collected data on 20,745 adolescents ages 11-17 in 1994-1995, and conducted follow-ups in 1996, 2001, and 2007-2008. The last wave of data includes 15,701 respondents. This study will take advantage of respondent interviews at each wave and Wave 1 parent and school administrator interviews for the full sample provided by the restricted-use dataset. All analysis will adjust for complex sampling design, which will also account for clustering of individuals in schools and households.

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. Importantly, detailed information collected during adolescence will capture well background factors influencing college degree attainment.

Measures

Outcomes. Health behavior outcomes measured in Wave 4 include smoking, alcohol consumption, body-mass index (BMI), physical activity, and nutrition. Smoking is operationalized in two dichotomous measures: having smoked in the last 30 days (current smoker) and reporting smoking each of the last 30 days (daily smoker). Since light drinking is associated with the best health and mortality outcomes, respondents are categorized as light drinkers or not. Respondents reported how often and how much they usually drink, and these measures informed a weekly drinking volume. 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. BMI captures how respondents manage their weight. Add Health provides a constructed variable indicating categories for obese and non-obese, with obesity defined as having a BMI of 30 or higher (Flegal et al. 2010). Additional indicators use the continuous BMI indicator to divide obesity into classifications, Class I (BMI of 30 to less than 35), Class II (35 to less than 40), and Class III (40 or greater). Pregnant individuals are omitted from weight status analyses. How often respondents participated in physical activities in the last seven days measure physical activity, and indicators of nutrition include how often respondents report drinking sugar sweetened beverages and eating fast food per week. The physical activity measure sums together the number of times the respondent reported engaging in different types of activities in the last seven days: (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) strenuous team sports such as football, soccer, basketball, lacrosse, rugby, field hockey, or ice hockey; (4) individual sports such as running, wrestling, swimming, cross-country skiing, cycle racing, or martial arts; (5) gymnastics, weight lifting, or strength training; (6) play golf, go fishing or bowling, or play softball or baseball; (7) walk for exercise. This sum is used

as a continuous indicator and a dichotomous measure indicating whether the respondent reported any or no activities.

Independent variables. Respondent interview data from Wave 4 indicates whether individuals earned a college degree. As participants are ages 26-34 in this last wave of data, most have completed schooling. Sensitivity analyses evaluate whether results are sensitive to the ages of respondents or school enrollment.

Parent, school, and respondent information from Wave 1 inform likelihood of college completion (propensity score). A broad range of information from adolescence creates this likelihood: basic demographic information (age, sex, race, nativity), family background (e.g., family structure, household and parent SES, parent health behaviors, parents' educational expectations, parent-child relationship), educational experiences (e.g., repeating a grade, having been suspended or expelled, school grades, school integration), academic potential (cognitive test scores, college expectations, future expectations), health considerations (self-rated health, disability, depression, school absences due to illness), health behaviors, delinquent behaviors, religiosity, and neighborhood quality.

Class background is operationalized through highest education of a parent. The parent completing the Wave 1 interview reported his or her education and, in the case of two resident parent families, the educational attainment of the other parent. A categorical variable of degree attainment includes 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.

Analytic Approach

Frequencies, growth curve models, propensity score matching, and heterogeneous treatment effect models evaluate the college degree-health behavior relationship. First, frequencies describe behaviors in young adulthood across degree status, without any controls or adjustments. Then, 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 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, further analysis will need to determine the role of selection.

Next, propensity score matching (PSM) estimates causal effects. 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. Analysis must therefore go beyond a correlational approach and separate the effect of the treatment (college degrees) from selection effects (the influence of those preexisting differences).

The underlying idea of 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 that received the treatment (college degree) to a similar individual that 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 probit model predicting college degree attainment[1], 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 then the difference between the mean of the control and treatment groups on the outcomes.

The Stata package psmatch2 assumes fixed weights and homoscedasticity of the outcome variable within the treated and control groups. As with all PSM, it also assumes independent observations. Standard errors may be underestimated as they do not take into account that propensity scores are estimated. Results presented here reflect kernel matching using the Epanechnikov kernel, an approach that matches all control cases to each treatment case through weighting the distance between the control cases to the treatment case. Some researchers argue that kernel matching is the most efficient, but there is no clear consensus on the "best" matching procedures (Morgan and Harding 2006). Additional details on kernel matching can be found in Smith and Todd (2005). Matching using 3 or 5 nearest neighbors or matching within a specified radius of .005 produced nearly identical results (see Appendix Table A1), suggesting that findings are not sensitive to the matching procedures. For each matched sample, balance on the covariates indicates whether the matching has resulted in similar treatment and control groups.

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. However, 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.

Because the coefficients and standard errors of the probit 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. 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. Because of the different samples, trends across outcomes are generally described but not calculated precisely.

PSM assumes that the treatment effect is homogenous. To evaluate whether this assumption has been violated, 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 matching-smoothing 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.

Lastly, treatment effects are estimated within class background (highest parent education). Individuals are matched by propensity score as in the first step, but matching is conducted within each parent educational group. Results across groups will then reveal general patterns or trends.

Sample. The sample consists of 14,796 respondents with valid sample 4 weights and college degree attainment information at Wave 4. Small numbers of individuals are 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. As described above, no respondents are missing on propensity score. Calculations of means and effect sizes adjust for complex sampling design.

Results

Descriptive

Table 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 about half as likely to be obese, or to be in the higher obesity categories, compared to those with less education. Having a bachelor's is associated with one-third the likelihood of smoking in the last 30 days and just over one-fifth the likelihood of smoking daily. Light drinking, the consumption level associated with the healthiest outcomes, is nearly twice as common among degree attainers. Degree holders also have significantly healthier physical activity, sugar-sweetened beverage, and fast food consumption. 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.

To determine whether differences in health behaviors emerge prior to young adulthood, growth curve models (Figure 1) plot the trajectories of smoking, body-mass index, obesity, and physical activities from adolescence to young adulthood. Since drinking under the age of 21 is illegal in the United States, light drinking in adolescence does not have the same health connotations and is thus not examined over time. Sugar-sweetened beverage and fast food consumption were not asked at all waves and are not included. Full tables are available on request. 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. Further analysis will investigate these disparities.

Average Causal Estimates

I now turn to PSM to determine whether controlling for selection nets out the positive effect of college. First, a probit model estimates the propensity score, or predicted probability of college degree attainment for each individual. The results of these probit models are given in Table 2. Each of the samples has its own model and set of propensity scores, though, as indicated in the table, the results are similar since the samples are similar across outcomes. 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. Running OLS and logit models predicting health behaviors with college degree attainment and propensity scores as the independent variables revealed that probit models that included the full set of variables did the most to reduce the college degree-health behavior association.

Table 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 quite small, with less than 5% bias, except Asian/Pacific Islander and born in the U.S.[2] These two characteristics, however, are still similar, with 10 and 12% for Asian/Pacific Islander and 92 and

89% for born in the U.S. Overall, the matching has resulted in covariate balance, reducing the median percentage bias from 21.7 to 1.4. Covariate balance is similar for the other samples.

After creating the propensity scores and checking covariate balance, the matched sample produces treatment effects. Table 4 presents the means of the treatment and control groups within the matched sample. As the results show, college degrees exert sizable effects on each of the health behaviors even after accounting for selection. Effects are largest for smoking and sugar-sweetened beverage consumption, and smallest for light drinking and physical activity. Standard errors are likely underestimated (as described in the methods section), but significance levels are less than .001 for all outcomes.

Figure 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 1 and 4.[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. The far right column in Table 4 presents the percentage reduction in college degree's effects from matching, compared to no adjustment. These percentages reflect the overestimation of college degrees' effects by 31-50%.

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 and fast food consumption, which have greater degree benefits for those with greater propensity scores.

Table 5 displays means and 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. T-tests compare treatment effects for the two groups. Overall, the effects are similar across the two groups and are not statistically significant, except for BMI (marginally significant) and fast food consumption. The treatment effect for BMI is greater for those with higher propensity scores (-1.47) compared to those with lower propensity scores (-.70). A smoothed local polynomial of treatment effects across propensity scores further examines heterogeneity across BMI, displayed in Figure 3, Panel A. 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. Obesity, however, does not display the same clear pattern. Treatment effects are not significantly different across the two groups of propensity scores and the smoothed local polynomial regression is less definitive, with a slight U-shape and a broad confidence interval. Together, these findings suggest that college degrees may reduce BMI more for those with greater likelihood of attaining a degree, but these reductions do not seem to translate into differences in risk status for obesity.

The effect of education on fast food consumption also differs across the low and high propensity score groups, (Table 5), with greater reductions for individuals with higher propensity of achieving a college degree. The smoothed regression of treatment differences in Figure 3, Panel C confirms that there is greater reduction in fast food consumption among those with higher propensities for college degrees. Similar to weight status, means for fast food consumption demonstrate a gradient across both degree attainment and propensity score such that both factors are associated with reduced consumption.

Additionally, patterns in Table 5 suggest that higher propensity to degree attainment is associated with improved health behaviors, regardless of degree attainment. For example, 32% of the matched sample with a high propensity score and no college degree is obese, compared to 36% of those with a low propensity score and a college degree. These results support previous research establishing the childhood or adolescent origins of adult education-health behavior gradients (Maralani 2014).

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. Means for matched treatment and control groups within each of the education groups are shown in Table 6. Several patterns emerge. First, the group with less than high school as the highest parent education is distinct from the other groups. They display the lowest rates of smoking (for both treatment and control groups) and show the strongest effects for BMI, obesity, physical activity and sugar-sweetened beverage consumption. Approximately one-third of this group have foreign-born parents, compared to 9%

of those with higher parent educational attainment. This is a small group, but appears to have different underlying sources of health behaviors.

For groups other than those with the lowest parent education, effect sizes are fairly similar across class background for smoking. Figure 4, Panel A shows the means for the treatment and control groups by parent education. Similar effect sizes are also observed for light drinking, sugar-sweetened beverage, and fast food consumption. Some differences emerge for physical activity, but they are not consistent across the two outcomes and do not display a systematic pattern.

Patterns across parent education indicate the extent to which college degrees negate these background effects. Differences in smoking rates are surprisingly similar across these groups, suggesting that parent education does not exert an influence on smoking beyond one's likelihood for educational attainment. In contrast, BMI and obesity statuses show a generally linear pattern of stronger effects for individuals with more educated parents. Panel B in Figure 4 provides further support for this linear pattern. Not only are the differences between treatment and control greater for the higher education groups, but the BMI levels for both treatment and control individuals demonstrate a linear relationship with parent education. For instance, college degree holders whose parents' highest educational attainment is a high school diploma have higher average BMI than individuals who do not have college degrees but whose parents do.

Sensitivity Analyses

Further analysis determined whether findings are sensitive to the threshold of education (results now shown). Health behaviors generally have a linear relationship with educational attainment such that the more education one attains, the healthier one behaves. However, the largest

discrepancies in behaviors are viewed at the college degree threshold. Using some college experience rather than a four-year degree results in smaller effects. Further analysis also assessed whether findings are sensitive to respondents who had not achieved a college degree but were in school at Wave 4. Excluding these individuals (approximately 1600) produced nearly identical results.

Discussion

The puzzle of widening health and social disparities across educational levels illustrates the urgent need for research into the stratifying mechanisms of education. As the first to examine conditional effects of college degrees on health behaviors, this study contributes to our understanding of educational stratification in modern society. This project is also the first to apply and test theories of educational stratification to the outcome of health behaviors.

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 size, on health behaviors. Education thus does have an overall equalizing effect for health behaviors. Regardless of one's characteristics, attaining a college degree results in a healthier lifestyle, on average. Selection explains a portion of the associations in young adulthood, since for each health behavior, the "treatment effect" was smaller after controlling for one's likelihood to attain a college degree. The average percentage reduction was 44%, with the largest reductions observed for light drinking (53%), obesity (50%), and daily smoking (49%), as indicated in Table 4.

Testing for heterogeneity across treatment effect sizes produced some mixed results, with some outcomes showing similar effects across subgroups and other outcomes indicating

increased benefits for advantaged individuals. For some outcomes (physical activity and being a light drinker), effects were similar across propensity score and parent education. However, strong patterns emerged for smoking and weight status. I draw three conclusions from the patterns.

First, treatment effects and overall levels of smoking were similar across propensity score and parent education, excluding the group with the lowest parent education. Surprisingly, college degrees essentially negated background effects, providing strong support for the education as equalizer argument. Educational attainment thus appears to be the main pathway through which social background shapes adult smoking status.

Second, the effects of college degrees on weight status were stronger for those most likely to attain a college degree or with higher parent education. In support of a conditional reproduction approach, BMI was reduced by a college degree to a greater extent for advantaged individuals. Not only were treatment effects larger for these individuals, but absolute levels of BMI and obesity were lower.

Third, for most health behaviors, factors influencing selection are associated with outcomes in adulthood independently of college degrees. Generally, absolute levels of behaviors are healthier among those more likely to attain a degree or those with higher parent education across degree attainment. Educational attainment may serve to equalize, but prior individual, family, neighborhood, or school differences are influential through pathways other than college degrees.

Interestingly, smoking and obesity display contrasting results. Smoking rates in young adulthood are primarily driven by college degrees, while 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 decisive 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 on self-rated health and Schafer et al. (2013) reported greater benefits of education for those least likely for hypertension, heart problems, and mortality.

It is important to note that this study is limited in its ability to estimate causal effects. Without an experimental framework that randomizes college education, causality can only be approximated. However, this study improves on other studies, as it not only accounts for selection through its methodological approach, but uses a wide range of data to model selection.

Conclusion

In support of the education as equalizer approach, college degrees generally leveled health behaviors. However, it did not negate other influences on health behaviors. Some support for increased benefits among advantaged individuals suggest that different responses to college degrees results in different health behavior outcomes. Somewhat surprisingly, no support was found for a conditional equalizing approach theorizing greater benefits for those least advantaged. These results, along with qualitative studies identifying concerns for socioeconomically disadvantaged students, suggest that colleges do more to engage this population.

ENDNOTES

[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.

[2]Percent bias is calculated as the difference in means as a percentage of the standard deviations. See Rosenbaum and Rubin (1985) for details on calculations.

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

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Table 1. Unadjusted health behavior means and treatment effects

	College Degree	No Coll. Degree	Diff	OR	Cohen's d		N
Current smoker	0.22	0.46	-0.24	0.33		***	14674
Daily smoker	0.09	0.31	-0.22	0.22		***	14674
BMI	27.38	29.74	-2.36		-0.33	***	14070
Obese	0.26	0.41	-0.15	0.51		***	14070
Obese II	0.12	0.21	-0.09	0.51		***	14070
Obese III	0.05	0.10	-0.05	0.47		***	14070
Light drinker	0.73	0.58	0.15	1.96		***	14599
No phys activities	0.10	0.17	-0.07	0.54		***	14778
# physical activities	7.00	6.06	0.94		0.16	***	14778
SSB	7.37	13.24	-5.87		-0.58	***	14763
Fast food	1.67	2.65	-0.98		-0.38	***	14724

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

Source: National Longitudinal Study of Adolescent to Adult Health

Notes: Accounts for complex sampling design. Effect sizes are odds ratios for dichotomous outcomes and Cohen's D for continuous measures.

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

Sample:	BMI	Smoking	Drinking	Phys Act	SSB	Fast food
Age at Wave 4	0.08 ***	0.08 ***	0.08 ***	0.08 ***	0.08 ***	0.08 ***
Female	0.17 ***	0.17 ***	0.16 ***	0.17 ***	0.16 ***	0.16 ***
Race (White)						
Black	0.20 ***	0.19 ***	0.19 ***	0.19 ***	0.19 ***	0.19 ***
Hispanic	0.21 ***	0.20 ***	0.21 ***	0.20 ***	0.20 ***	0.20 ***
A/PI	0.21 ***	0.21 ***	0.22 ***	0.22 ***	0.21 ***	0.21 ***
AI/AN	-0.34 +	-0.41 *	-0.41 *	-0.41 *	-0.41 *	-0.41 *
Other race	-0.16	-0.31	-0.31	-0.31	-0.31	-0.30
Born in the U.S.	-0.14 *	-0.13 *	-0.12 *	-0.13 *	-0.13 *	-0.13 *
Household smoker	-0.07 *	-0.06 +	-0.06 +	-0.06 +	-0.06 +	-0.06 +
Parent smoker	-0.04	-0.05	-0.05 +	-0.05	-0.05 +	-0.05
Frequency of parent HED	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02
Parent educational attainment	0.11 ***	0.10 ***	0.11 ***	0.10 ***	0.10 ***	0.10 ***
Mom is professional	0.04 +	0.05 +	0.06 +	0.06 +	0.06 +	0.05 +
Dad is professional	0.12 **	0.13 ***	0.13 ***	0.13 ***	0.13 ***	0.13 ***
Income-to-needs ratio (400%+)						
Below 100%	-0.40 ***	-0.37 ***	-0.36 ***	-0.37 ***	-0.38 ***	-0.38 ***
100-<200%	-0.39 ***	-0.37 ***	-0.37 ***	-0.37 ***	-0.37 ***	-0.38 ***
200-<300%	-0.30 ***	-0.28 ***	-0.27 ***	-0.28 ***	-0.28 ***	-0.28 ***
300-<400%	-0.22 ***	-0.21 ***	-0.20 ***	-0.21 ***	-0.21 ***	-0.21 ***
Missing	-0.19 ***	-0.18 ***	-0.16 **	-0.17 ***	-0.17 ***	-0.18 ***
Parent receiving public assistance	-0.06	-0.06	-0.06	-0.06 +	-0.06	-0.06
Social control	0.01	0.01	0.01	0.01	0.01	0.01
Parent-child closeness scale	0.01	0.02	0.01	0.01	0.01	0.01
Parent disappointment for child not graduating college (Very disappointed)						
Somewhat disappointed	-0.12 ***	-0.13 ***	-0.13 ***	-0.13 ***	-0.13 ***	-0.13 ***
Not disappointed	-0.28 ***	-0.28 ***	-0.28 ***	-0.28 ***	-0.28 ***	-0.28 ***
Household size	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
Ever repeated grade	-0.42 ***	-0.43 ***	-0.43 ***	-0.43 ***	-0.43 ***	-0.43 ***
Ever suspended	-0.17 ***	-0.17 ***	-0.17 ***	-0.18 ***	-0.17 ***	-0.18 ***
Ever expelled	-0.28 *	-0.26 *	-0.28 **	-0.26 *	-0.26 **	-0.26 *
Ever truant	-0.09 **	-0.08 *	-0.08 *	-0.08 *	-0.08 *	-0.08 *
Standardized scale of grades	-0.39 ***	-0.39 ***	-0.39 ***	-0.39 ***	-0.39 ***	-0.39 ***
Vocabulary score	0.01 ***	0.01 ***	0.01 ***	0.01 ***	0.01 ***	0.01 ***
Disabled	-0.06	-0.07	-0.08	-0.07	-0.07	-0.07
School integration scale	-0.01	0.00	0.00	0.00	0.00	0.00
Getting along with teachers scale	-0.05 **	-0.05 **	-0.05 **	-0.05 **	-0.05 **	-0.05 **
Problem with attention scale	0.08 ***	0.08 ***	0.08 ***	0.08 ***	0.08 ***	0.08 ***
Problems with homework scale	-0.03 +	-0.03	-0.02	-0.03	-0.03	-0.03 +
Getting along with students scale	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03
College expectations scale	0.20 ***	0.20 ***	0.20 ***	0.20 ***	0.20 ***	0.20 ***
Desire for college attendance scale	0.08 ***	0.09 ***	0.09 ***	0.09 ***	0.09 ***	0.09 ***
Expectations to live to 35 scale	0.01	0.02	0.01	0.01	0.01	0.02
Expectations killed by 21 scale	0.00	0.00	0.01	0.01	0.01	0.01
Protective factors scale	0.00	0.02	0.02	0.02	0.02	0.02
Depression scale	0.01	0.01	0.01	0.01	0.01	0.01
Ever had sex	-0.17 ***	-0.17 ***	-0.17 ***	-0.17 ***	-0.17 ***	-0.17 ***
Self-rated health	0.07 ***	0.08 ***	0.07 ***	0.08 ***	0.08 ***	0.07 ***
How often missed school	-0.11 ***	-0.11 ***	-0.11 ***	-0.11 ***	-0.11 ***	-0.11 ***

Table 4-2 continued

Smoking status (non-smoker)						
Daily smoker	-0.3117 ***	-0.29 ***	-0.29 ***	-0.29 ***	-0.29 ***	-0.29 ***
Former smoker	-0.32 ***	-0.36 ***	-0.36 ***	-0.36 ***	-0.36 ***	-0.36 ***
Infrequent smoker	-0.22 ***	-0.22 ***	-0.22 ***	-0.23 ***	-0.23 ***	-0.22 ***
Number of close friends that smoke	-0.09 ***	-0.09 ***	-0.09 ***	-0.09 ***	-0.09 ***	-0.09 ***
BMI	-0.01 +	-0.01 *	-0.01 *	-0.01 *	-0.01 *	-0.01 *
Alcohol consumption (nondrinker)						
Usually has one drink	0.05	0.06	0.06	0.06	0.05	0.05
Usually has two drinks	0.1724 **	0.18 **	0.17 **	0.17 **	0.18 **	0.17 **
Usually has 3+ drinks	0.08 *	0.09 *	0.09 *	0.10 *	0.10 *	0.09 *
Days in past year drunk/high	0.05 **	0.05 **	0.05 **	0.05 **	0.05 **	0.05 **
Number of close friends that drink	0.03 *	0.03 +	0.03 +	0.03 +	0.03 +	0.03 +
Physical activities in last week	0.00	0.00	0.00	0.00	0.00	0.00
Visited dentist within last year	0.11 **	0.11 ***	0.11 ***	0.11 ***	0.11 ***	0.11 ***
Vegetable consumption (twice)						
None	-0.07 *	-0.0689 *	-0.07 +	-0.07 +	-0.07 +	-0.07 +
Once	0.01	0.01	0.01	0.01	0.01	0.01
Sweet snack consumption (none)						
Once	0.0872 **	0.08 **	0.07 *	0.08 *	0.08 **	0.08 **
Twice	0.15 ***	0.1326 ***	0.13 ***	0.13 ***	0.13 ***	0.13 ***
How often wears seatbelt	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Usually gets enough sleep	-0.1185 ***	-0.11 ***	-0.11 ***	-0.11 ***	-0.11 ***	-0.11 ***
Hours of screentime	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **	0.00 **
Delinquent behaviors scale	-0.03 +	-0.03 +	-0.04 +	-0.04 +	-0.04 +	-0.03 +
Religious attendance scale	0.04 *	0.04 *	0.04 **	0.04 *	0.04 *	0.04 **
Religious importance scale	-0.08 **	-0.08 **	-0.08 **	-0.08 **	-0.08 **	-0.08 **
Neighborhood quality scale	0.02	0.02 +	0.02	0.02 +	0.03 +	0.02 +
Number of missing items	0.00	0.00	0.00	0.00	0.00	0.00
Wave 4 weight	0.00 *	0.00 *	0.00 *	0.00 *	0.00 *	0.00 *
Constant	-6.48 ***	-6.62 ***	-6.64 ***	-6.60 ***	-6.60 ***	-6.64 ***
Pseudo R-squared	0.33	0.33	0.33	0.33	0.33	0.33

*** 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.

Table 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	28.40	1.9
Female	0.59	0.50 ***	17.8	0.57 +	3.6
Race (White)					
Black	0.19	0.23 ***	-9.4	0.19	0.1
Hispanic	0.11	0.18 ***	-20.1	0.13 *	-4.9
A/PI	0.10	0.05 ***	20.0	0.12 **	-8.5
AI/AN	0.00	0.01 ***	-8.1	0.00	0.5
Other race	0.00	0.02 +	-3.3	0.00	-0.6
Born in the U.S.	0.92	0.93 **	-4.6	0.89 ***	8.7
Household smoker	0.33	0.51 ***	-40.4	0.33	-0.4
Parent smoker	0.57	0.67 ***	-21.7	0.57	0.0
Frequency of parent HED	1.17	1.28 ***	-16.2	1.18	-2.3
Parent educational attainment	14.48	12.55 ***	82.8	14.46	1.0
Mom is professional	0.41	0.21 ***	43.0	0.39 +	3.7
Dad is professional	0.80	0.67 ***	31.1	0.80	1.6
Income-to-needs ratio (400%+)					
Below 100%	0.06	0.17 ***	-35.6	0.07 *	-3.1
100-<200%	0.12	0.21 ***	-24.5	0.12	-0.3
200-<300%	0.16	0.16	-0.6	0.16	0.8
300-<400%	0.16	0.10 ***	15.0	0.16	-1.9
Missing	0.23	0.25 **	-4.9	0.21 *	4.2
Parent receiving public assistance	0.17	0.32 ***	-39.3	0.17	-0.4
Social control	3.91	3.95 *	-4.0	3.93	-2.3
Parent-child closeness scale	-0.09	0.05 ***	-14.2	-0.09	-0.6
Parent disappointment for child not graduating college (Very disappointed)					
Somewhat disappointed	0.38	0.42 ***	-7.1	0.38	0.0
Not disappointed	0.07	0.18 ***	-36.2	0.08	-0.5
Household size	4.43	4.62 ***	-12.5	4.43	-0.2
Ever repeated grade	0.06	0.28 ***	-59.4	0.07	-0.5
Ever suspended	0.11	0.34 ***	-58.8	0.12 +	-3.1
Ever expelled	0.01	0.06 ***	-28.9	0.01	-1.6
Ever truant	0.19	0.35 ***	-35.7	0.21	-2.9
Standardized scale of grades	-0.62	0.23 ***	-96.4	-0.59 +	-3.6
Vocabulary score	107.13	97.97 ***	69.3	107.13	0.0
Disabled	0.02	0.03	-2.3	0.02	-0.8
School integration scale	1.33	1.51 ***	-27.4	1.33	-1.2
Getting along with teachers scale	0.66	0.94 ***	-31.5	0.67	-0.7
Problem with attention scale	1.15	1.27 ***	-12.9	1.16	-1.1
Problems with homework scale	1.02	1.28 ***	-25.4	1.04	-2.8
Getting along with students scale	0.73	0.93 ***	-22.2	0.72	0.7

Table 4-3 continued

College expectations scale	4.73	3.89 ***	86.9	4.70 **	3.6
Desire for college attendance scale	4.83	4.26 ***	64.3	4.80 **	3.7
Expectations to live to 35 scale	4.54	4.29 ***	30.7	4.53	1.3
Expectations killed by 21 scale	1.61	1.68 ***	-9.5	1.64 *	-3.9
Protective factors scale	0.10	-0.04 ***	24.1	0.07 *	4.2
Depression scale	-0.25	0.09 ***	-35.8	-0.22	-2.5
Ever had sex	0.26	0.45 ***	-41.1	0.26	-0.6
Self-rated health	4.10	3.77 ***	37.1	4.11	-1.9
How often missed school	0.30	0.47 ***	-28.2	0.30	0.0
Smoking status (non-smoker)					
Daily smoker	0.03	0.12 ***	-32.1	0.03	0.4
Former smoker	0.02	0.04 ***	-10.5	0.02	0.2
Infrequent smoker	0.05	0.09 ***	-19.2	0.04	0.7
Number of close friends that smoke	0.48	0.96 ***	-49.0	0.46	1.5
BMI	21.88	22.99 ***	-25.9	21.82	1.4
Alcohol consumption (nondrinker)					
Usually has one drink	0.12	0.10 *	4.4	0.11	0.5
Usually has two drinks	0.08	0.08	0.5	0.07 +	3.5
Usually has 3+ drinks	0.23	0.31 ***	-17.7	0.25	-2.8
Days in past year drunk/high	1.22	1.35 ***	-12.7	1.23	-1.2
Number of close friends that drink	0.95	1.18 ***	-20.5	0.97	-2.3
Physical activities in last week	5.63	5.18 ***	12.4	5.74	-3.1
Visited dentist within last year	0.78	0.62 ***	36.2	0.76 *	3.8
Vegetable consumption (twice)					
None	0.24	0.37 ***	-27.5	0.24	1.2
Once	0.42	0.38 ***	8.3	0.41	1.1
Sweet snack consumption (none)					
Once	0.37	0.32 ***	11.1	0.38	-1.5
Twice	0.22	0.21	1.8	0.21	0.8
How often wears seatbelt	3.38	2.98 ***	36.5	3.37	1.0
Usually gets enough sleep	0.69	0.72 ***	-6.4	0.69	-0.2
Hours of screentime	19.43	24.38 ***	-24.2	19.99	-2.7
Delinquent behaviors scale	-0.21	0.07 ***	-31.0	-0.17 **	-4.5
Religious attendance scale	1.94	1.66 ***	24.3	1.95	-0.8
Religious importance scale	1.33	1.26 ***	10.5	1.33	0.0
Neighborhood quality scale	-0.12	0.02 ***	-13.7	-0.09	-2.7
Number of missing items	2.09	2.25 **	-5.5	1.98 *	3.5
Wave 4 weight	1387.60	1525.90 ***	-9.9	1366.20	1.5

*** 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).

Table 4. Means for matched groups

	College Degree	No coll degree	Diff		by Matching
Current smoker	0.22	0.35	-0.13	***	46%
Daily smoker	0.09	0.20	-0.11	***	49%
BMI	27.38	28.70	-1.32	***	44%
Obese	0.26	0.34	-0.08	***	50%
Obese II	0.12	0.18	-0.06	***	31%
Obese III	0.05	0.08	-0.03	**	46%
Light drinking	0.73	0.66	0.07	***	53%
No phys activities	0.10	0.14	-0.04	**	43%
# physical activities	7.00	6.35	0.65	*	31%
SSB	7.37	10.51	-3.14	***	47%
Fast food	1.67	2.26	-0.59	***	40%

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

Source: National Longitudinal Study of Adolescent to Adult Health

Notes: Accounts for complex sampling design.

Table 5. Means and differences for matched groups, across propensity score

	< mean propensity score			>= mean propensity score			
	Coll deg	No deg	diff	Coll deg	No deg	diff	
Current smoker	0.26	0.41	-0.15	0.21	0.33	-0.12	
Daily smoker	0.14	0.26	-0.12	0.07	0.19	-0.11	
BMI	29.23	29.94	-0.70	26.95	28.42	-1.47	+
Obese	0.36	0.42	-0.06	0.24	0.32	-0.08	
Obese II	0.18	0.22	-0.04	0.10	0.17	-0.07	
Obese III	0.08	0.11	-0.03	0.04	0.08	-0.04	
Light drinking	0.67	0.59	0.08	0.74	0.68	0.06	
# physical activities	6.98	6.19	0.79	7.00	6.38	0.62	
No physical activities	0.12	0.17	-0.05	0.09	0.13	-0.04	
SSB	9.11	12.34	-3.23	6.97	10.09	-3.11	
Fast food	2.26	2.60	-0.34	1.53	2.19	-0.65	*

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

Source: National Longitudinal Study of Adolescent to Adult Health

Notes: Accounts for complex sampling design.

Table 6. Within parent educational attainment groups, means and differences for matched groups

	Highest parent educational attainment														
	<12			12			13-15			16			17+		
	Deg	No deg	Diff	Deg	No deg	Diff	Deg	No deg	Diff	Deg	No deg	Diff	Deg	No deg	Diff
Current smoker	0.13	0.26	-0.13 ***	0.21	0.34	-0.13 ***	0.21	0.34	-0.13 ***	0.23	0.34	-0.11 ***	0.23	0.39	-0.16 ***
Daily smoker	0.01	0.13	-0.12 ***	0.11	0.21	-0.10 ***	0.09	0.21	-0.12 ***	0.09	0.20	-0.11 ***	0.08	0.22	-0.14 ***
BMI	28.52	30.71	-2.19 **	28.81	29.49	-0.68	28.07	28.88	-0.81 **	26.91	28.19	-1.28 ***	26.41	27.99	-1.58 ***
Obese	0.31	0.45	-0.14 **	0.36	0.41	-0.05 *	0.30	0.38	-0.08 ***	0.24	0.30	-0.06 **	0.20	0.29	-0.09 ***
Obese II	0.14	0.25	-0.11 ***	0.18	0.22	-0.04	0.13	0.17	-0.04 **	0.11	0.17	-0.06 ***	0.07	0.15	-0.08 ***
Obese III	0.07	0.14	-0.07 **	0.09	0.09	0.00	0.05	0.08	-0.03 *	0.04	0.08	-0.04 ***	0.03	0.06	-0.03 ***
Light drinking	0.67	0.58	0.09 *	0.71	0.63	0.08 ***	0.71	0.67	0.04 +	0.74	0.64	0.10 ***	0.75	0.70	0.05 ***
No phys activities	0.11	0.18	-0.07 *	0.14	0.17	-0.03 +	0.12	0.15	-0.03 **	0.07	0.15	-0.08 ***	0.08	0.10	-0.02 *
# physical activities	7.11	5.37	1.74 *	6.43	6.16	0.27	6.96	6.04	0.92 ***	7.01	6.07	0.94 ***	7.30	7.27	0.03
SSB	6.84	11.10	-4.26 ***	8.42	11.76	-3.34 ***	8.37	10.13	-1.76 ***	6.58	10.35	-3.77 ***	6.76	10.10	-3.34 ***
Fast food	2.46	2.59	-0.13	1.81	2.52	-0.71 ***	1.97	2.32	-0.35 ***	1.54	2.34	-0.80 ***	1.38	1.95	-0.57 ***

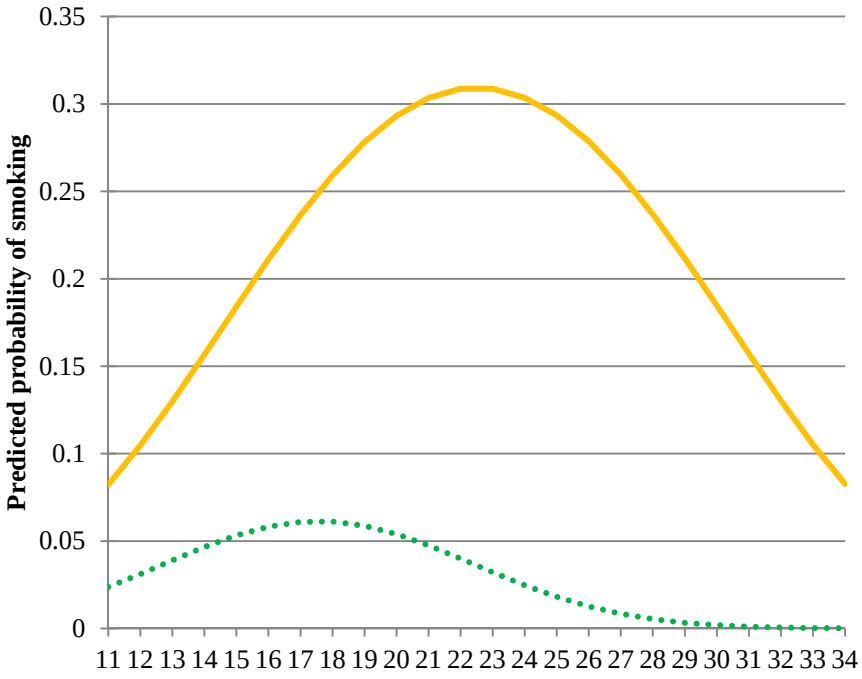
*** p < .001; ** p < .01; * p <.05; + p>.10

Source: National Longitudinal Study of

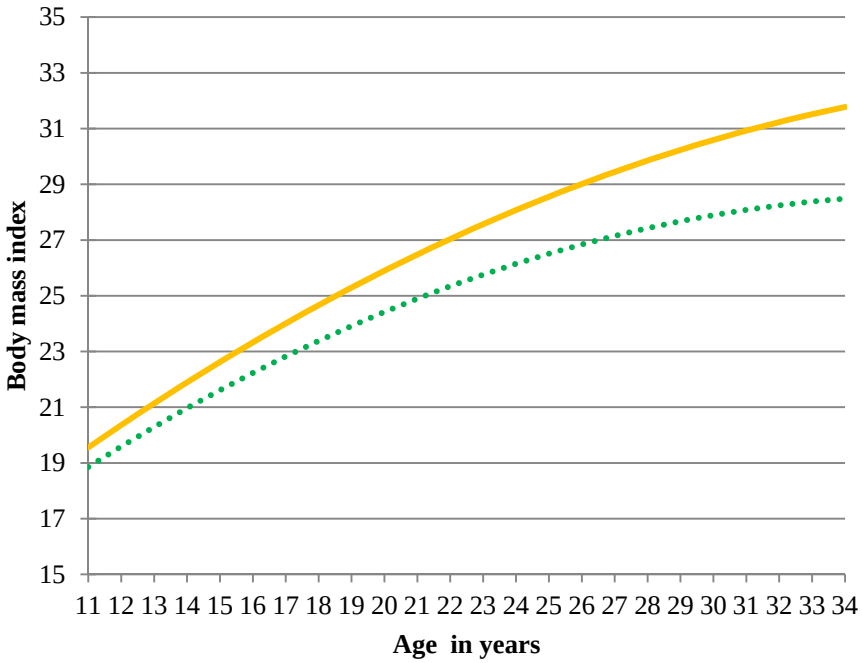
Notes: Accounts for complex sampling design.

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

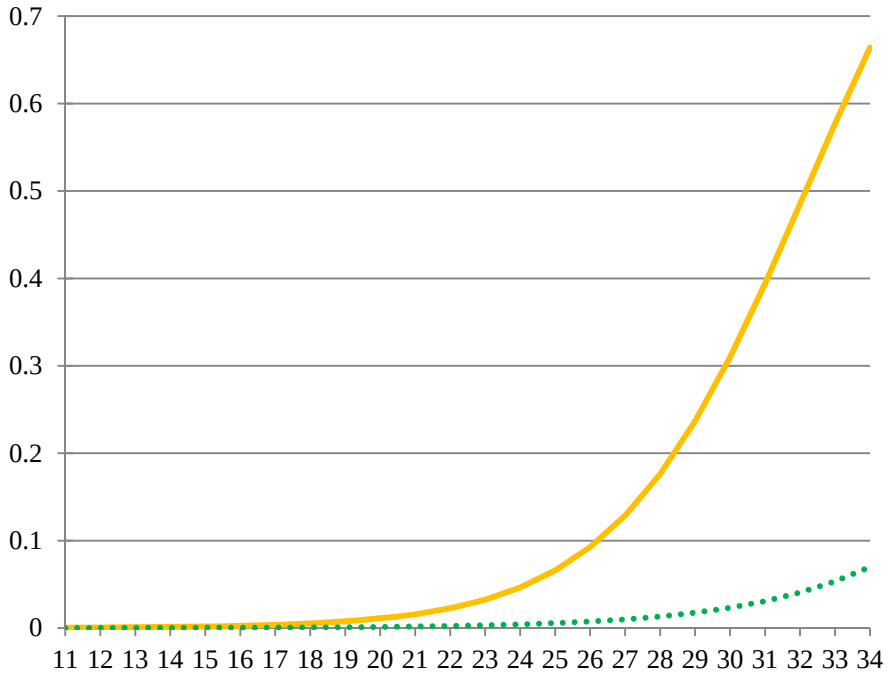
Panel A. Predicted probability of current smoking



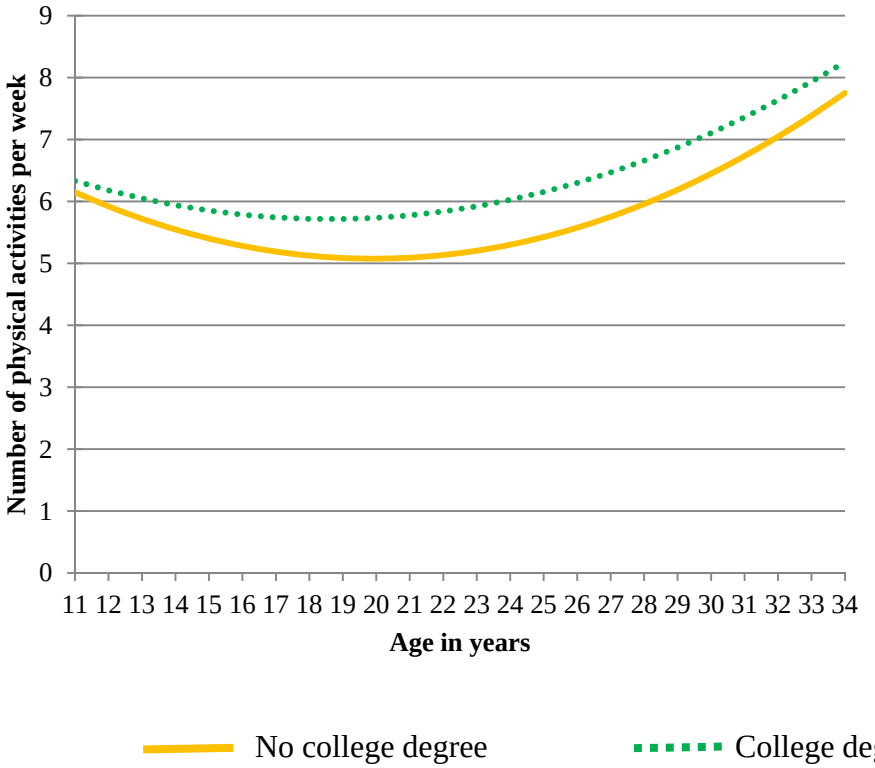
Panel B. Predicted body-mass index



Panel C. Predicted probability of obesity



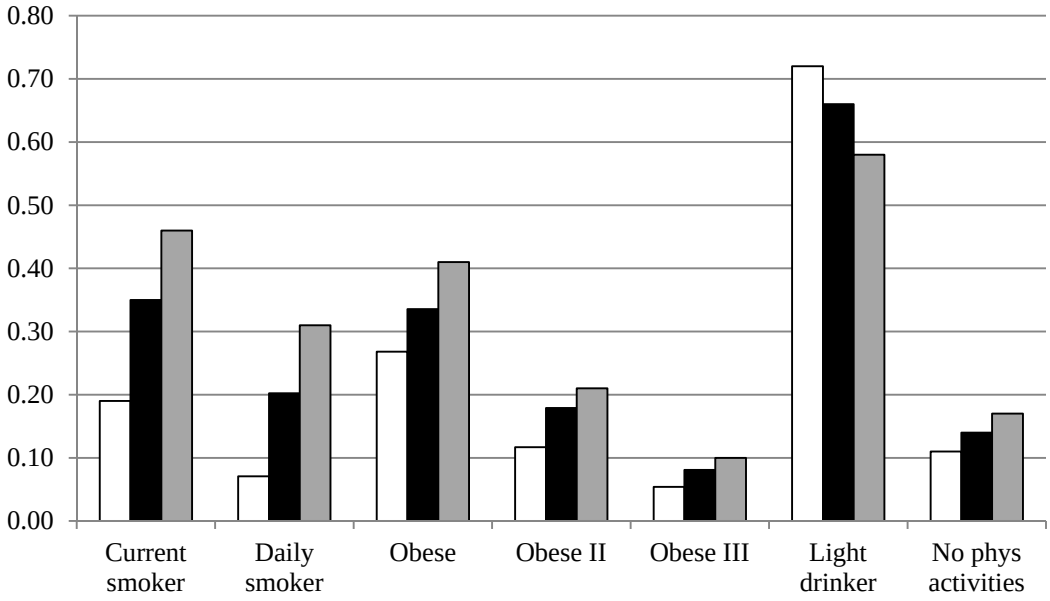
Panel D. Predicted physical activities



No college degree College degree

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

A. Dichotomous outcomes



B. Continuous outcomes

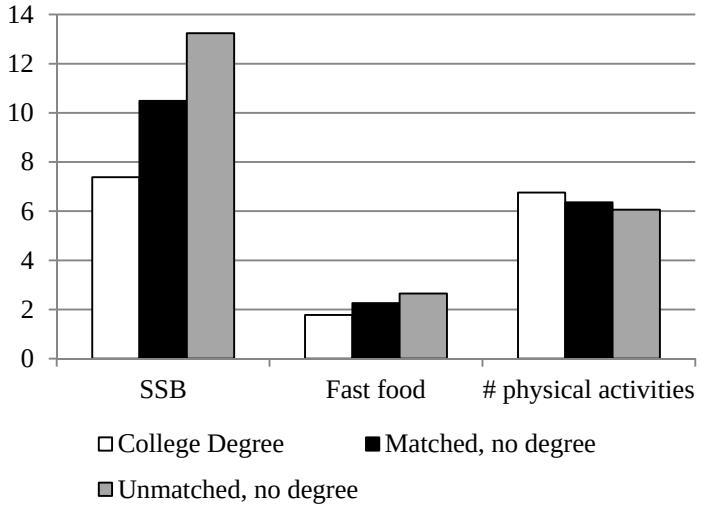
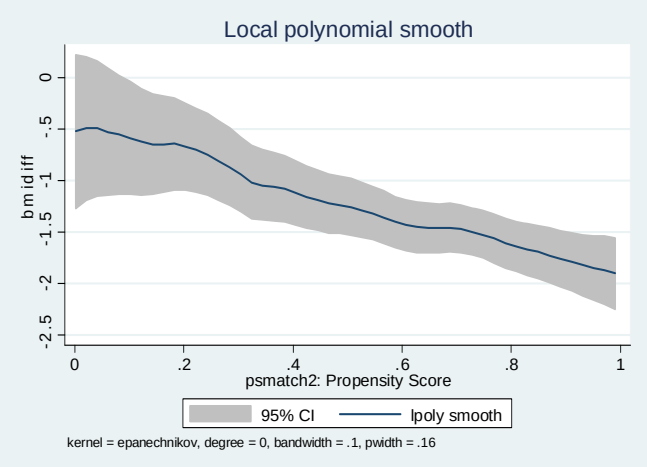
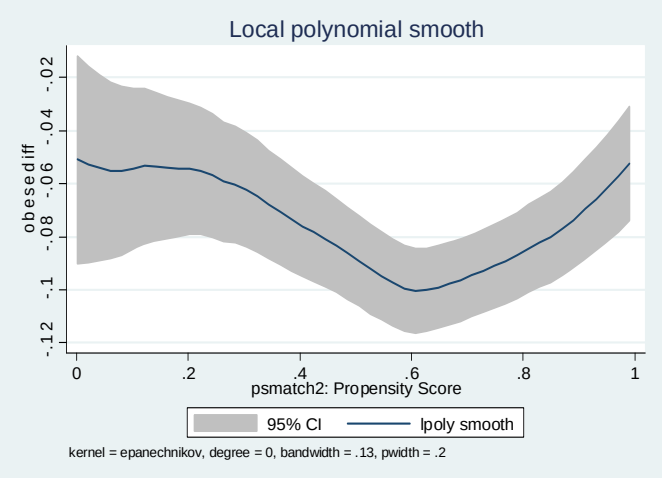


Figure 3. Smoothed local polynomial of differences in outcomes for matched sample across propensity score

A. BMI



B. Obesity



C. Fast food consumption

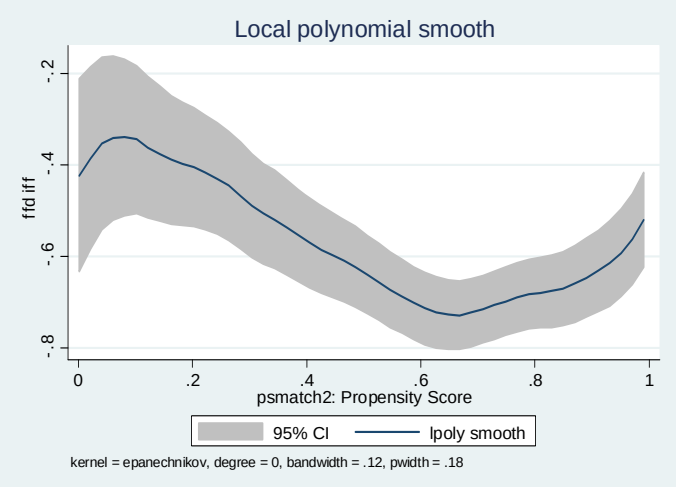
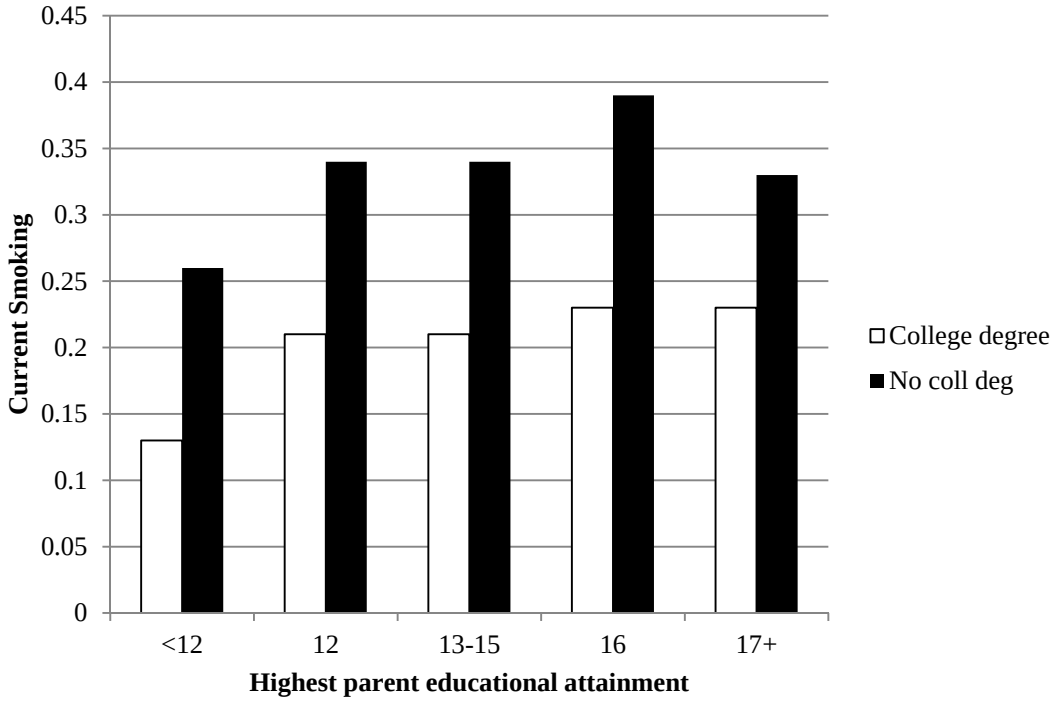


Figure 4. Comparison of matched treated and control groups, within parent educational levels

A. Current smoker



B. BMI

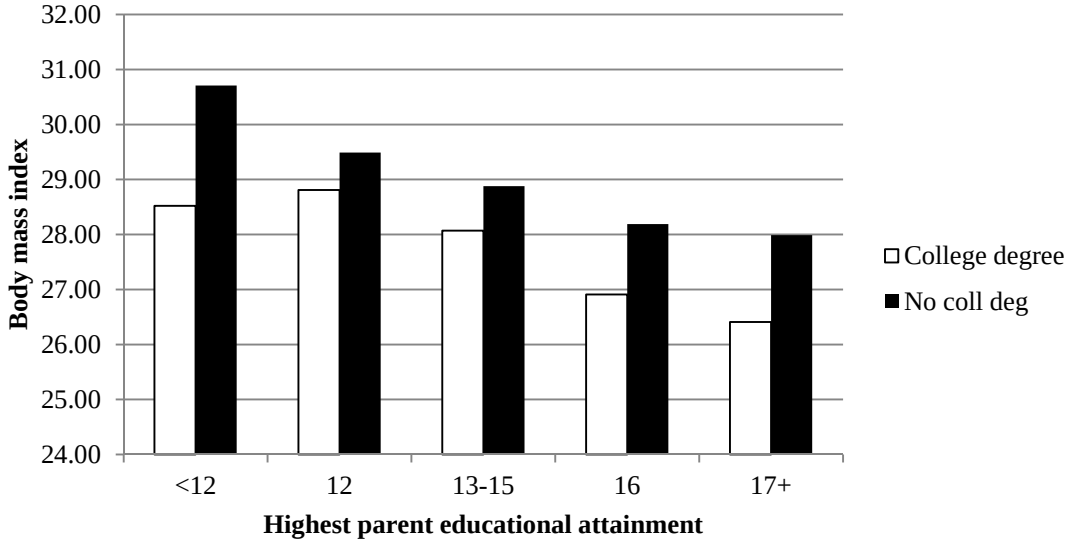


Table A1. Means for matched control groups using different matching specifications

	Kernel	3 nearest neighbors	Radius (.05)
Current smoker	0.35	0.36	0.35
Daily smoker	0.20	0.22	0.20
BMI	28.70	28.72	28.71
Obese	0.34	0.34	0.34
Obese II	0.18	0.18	0.18
Obese III	0.08	0.08	0.08
Light drinking	0.66	0.67	0.66
No phys activities	0.14	0.14	0.14
# physical activities	6.35	6.31	6.34
SSB	10.51	10.89	10.51
Fast food	2.26	2.27	2.26

Source: National Longitudinal Study of Adolescent to Adult Health
Notes: Accounts for complex sampling design.