Back to School:

Delayed College Education and Trajectories of Body Mass

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Abstract

This study examines whether the attainment of a college degree after first labor force entry significantly improves health, as measured by the body mass index (BMI). The analysis uses the longitudinal, nationally-representative Add Health study and focuses on 12,540 respondents who were first interviewed in 1994-5 when they were in 7^{th}-12^{th} grade and last interviewed in 2007-2008. Acquisition of a college degree after first labor force entry significantly improved BMI trajectories, but only for women. Analysis of potential mechanisms linking college degree status and BMI did not support an expected role for personal control, and instead suggested the importance of other health behaviors. For women, these results suggest that a college education is one of few weight management plans that actually works, and suggests that the historical trend leading increasing numbers of workers to pursue a college in later life should have a positive impact on population BMI.

Back to School:

Delayed College Education and Trajectories of Body Mass

A return to college after first labor force entry has become increasingly common in recent decades. The "traditional" life course marked by completion of all educational attainment before labor force entry is nearing minority status, as about 46% of the student population now enters the labor force before pursuing postsecondary education (National Center for Education Statistics 2002). Further evidence that workers are returning to college comes from the U.S. Census, which reports that in 2008 37% of all college students are age 25 or older, up from 28% in 1972 (U.S. Census Bureau 2010). The transition from school to work is becoming increasingly reversible, a trend that has been long in the making and is expected to continue in the future as a result of economic restructuring and the decline of long term employment contracts. Most likely the current, Great Recession has served to accelerate this trend as newly unemployed workers return to school to learn new skills required by an ever-changing economy.

Whether a return to school improves workers' health is an open question, and the topic of this study. On the one hand, the macrosocial trend toward increased educational attainment throughout the life course may lead to substantial improvements in population health. People with higher education have better health (Pampel, Krueger, and Denney 2010), and theories that posit a causal link for this association (Link and Phelan 1995; Mirowsky and Ross 2003) predict that a return to school should significantly and quickly improve workers' health. On the other hand, delayed college degree attainment may have fewer or no health benefits. Inertia in health habits and behaviors may blunt the beneficial impact of education on health at later ages. In addition, the delayed acquisition of a college degree may serve as an indicator for personal traits that are stronger predictors of BMI than college education. To examine the impact of delayed educational attainment on health we draw on the Add Health study, which is a longitudinal, nationally-representative study of 7th-12th graders initially interviewed in 1994-5 and followed up four times, most recently in 2007-2008.

This study's focus on changes in BMI during adolescence and young adulthood is strategic for four reasons. First, by focusing on the body mass index (BMI) we are responsive to the call to extend the outcomes repertoire in the sociological health disparities literature (Aneshensel 1992; Pearlin 1989), a call important to expand the scope and relevance of sociological disparities research. Second, the outcome of body mass has substantial policy importance given the well-documented and alarming increase in obesity levels during recent decades (Flegal et al. 2010). Third, adolescence is a key period in the life span to investigate changes in BMI because changes in this life stage have serious and life-long consequences at later stages (The et al. 2010); indeed, adolescent obesity is the single best predictor of obesity in adulthood (Whitaker et al. 1997). Finally, the analysis of health disparities during adolescence helps address a relatively understudied period of the life course in the health disparities field, which to date has focused primarily on young children and older adults (Harris 2010).

Theoretical Background

A prominent theory to posit a casual association of education on health is the "personal control" hypothesis of Mirowsky and Ross (2003). The theory emphasizes that college education provides people with personal resources to be effective agents in their own lives and to take charge of their health lifestyle, which includes walking, exercising, drinking moderately, not smoking, and avoiding overweight. Workers who go back to school would be expected to develop more personal control and change their health habits for the better, ultimately leading to better health and BMI levels. Importantly, through empirical research Mirowsky and Ross highlight the psychological characteristic of personal control as a key link between education and health that is more influential than other top contenders such as economic resources or employment.

A second, broader theory to posit a causal association of education on health is the "fundamental cause" hypothesis of Link and Phelan (1995; Link et al. 2008). They posit that a variety of mechanisms link education to health, and caution against attempting to highlight any specific one as the main link that connects education to all health outcomes during all historical periods. A mechanism such as personal control is clearly important, according to this perspective, but its mediating effect may vary across health outcomes, and its influence may be supplanted over time by new, emerging mechanisms. The 'fundamental cause' perspective places primary emphasis on broad categories of resources such as beneficial social connections, power, and money, which are concentrated in the upper social strata and strongly predict health even as the profile of major diseases and conditions affecting a society change over historical time. The 'fundamental cause' perspective predicts that workers who go back to school ultimately attain more personal, social, and material resources and their health improves as a result. According to this perspective the many, varied, and ever-changing mechanisms that link education to different health outcomes is a testament to the power of the association of education and health and also a challenge to theoretical development in the field.

One unique component of the 'fundamental cause' perspective is its focus on emerging associations of education with new health outcomes over historical time. The association of education and health has been remarkably persistent over the past century, according to this perspective, because as the association of education with health diminishes for some health outcomes it emerges in new ones. Consequently, the 'fundamental cause' perspective is receptive to, and indeed predicts that workers who go back to school would be protected from health threats and conditions that have newly entered a society, such as the obesity epidemic.

Alternative Hypotheses

Considerable reasons also exist to predict the alternative hypothesis that workers who return to school will ***not*** reap health benefits and have lower BMI levels. One reason later education may not impact health is what we term health behavior "inertia." Health habits formed in early adulthood may be difficult to modify later in the life course as they become increasingly ingrained. For example, a longitudinal analysis of children followed over 6 years indicated that eating behaviors emerged early in the developmental pathway and showed levels of stability comparable to personality traits (Ashcroft et al. 2008). More generally, to the extent that people's self-identity – which includes health beliefs and practices – begins to crystallize in adolescence and becomes more stable with increasing age (Klimstra et al. 2010), it is plausible that education will be less successful in modifying health habits at later stages of the life course.

Another reason that returning to school may not improve health is that the association of college and BMI may be confounded by individual level characteristics such as scholastic aptitude or ambition. This line of reasoning rests on three assumptions.

The first is that much of the association between college education and BMI is not a result of college per se but is instead the result of individual, personal traits of workers such as ambition and scholastic aptitude that were present before students attended college. A second assumption is that these traits are long-lasting and stable, and their presence early in the life course explains subsequent educational attainment and BMI levels. A third assumption is that people who return to school later in life exhibit considerably lower levels of these personal traits. Evidence for this third assumption comes from analyses showing that U.S. students who delay college entry after high school for at least seven months performed significantly lower on standardized tests, they had previously dropped out of high school, and had lower odds of eventual bachelor degree completion (Bozick and DeLuca 2005). If students who return to college differ significantly in the personal traits that predict BMI, then it is possible that these traits determine BMI levels and not a college degree *per se*.

A final reason that a delayed education may not lead to lower BMI levels is that young adults in the U.S. may not desire lower body mass levels and they may not consider overweight or even obese status as undesirable. Social desirability of a health outcome is a necessary prerequisite for a health disparity to form, according to the fundamental cause perspective, because people in the upper social strata will not use their higher levels of resources to gain advantages in health outcomes that are not considered important. As the entire population has become substantially heavier in recent decades norms have shifted so that young adults who are overweight or obese are now more likely to believe that they are within appropriate weight parameters (Burke, Heiland, and Nadler 2010; Kaltiala-Heino et al. 2003), and consequently lower BMI levels may be less important among the general population than they were in the past. Lack of concern about high body mass levels is especially possible among men, given a clash between cultural ideals of masculinity and the medical definitions of overweight as a BMI over 25 (Monaghan 2007).

Research to date provides evidence both for and against the hypothesis that a delayed college degree improves health. On the one hand, recent analyses based on a nationally-representative cohort show that attainment of a college degree after age 25 is associated with significantly fewer depressive symptoms and better self-rated health in comparison to people who did not receive a college degree by mid-life (Walsemann, Bell, and Hummer 2011). These results suggest that a delayed college education can have an influence on health independent of individual characteristics and that it can overcome health behavior trajectories set early in the life course, although the study did not include body mass index among its analysis outcomes.

On the other hand, analyses focusing specifically on the outcomes of overweight consistently point to the importance of family socioeconomic background, suggesting that trajectories of BMI are largely set into place by adolescence or early adulthood. Analysis based on the first three waves of the Add Health cohort study indicates that family socioeconomic position plays a substantial and lasting role in the prediction of adult BMI, suggesting that health behaviors affecting BMI may be set into place early in the life course (Yang et al. 2008). Analyses of other cohorts support the conclusion that family socioeconomic status plays a substantial role in adult BMI status (Baltrus et al. 2005; Kestilä et al. 2009; Power et al. 2005).

The Present Study

We hypothesize that a college degree improves health by providing resources to graduates that they would otherwise not have had. To test his proposition we center the empirical investigation around the following hypotheses:

Hypothesis 1: Respondents with a college degree (either delayed or non-delayed) will have a BMI advantage that grows as the cohort ages. The counter hypothesis is that college does not provide resources to improve health, that no divergence will occur, and that any difference in adult BMI levels across college degree status was pre-existing before college.

Hypothesis 2: BMI advantages that accrue to respondents with a college degree are not explained by individual level characteristics present before college attendance.

Hypothesis 2a: Divergence in BMI trajectories across college degree status remains after controlling family socioeconomic background.

Hypothesis 2b: Divergence in BMI trajectories across college degree status remains after controlling individual attributes such as scholastic ability, ambition to attend college, race/ethnicity, desire to attend college, perceived likelihood of attending college in the future, high school grade point average, self-reported impulsivity as measured at the baseline survey, and teen parenthood.

Hypothesis 3: The divergence in BMI trajectories across college degree status is explained by behaviors and resources fostered by college attendance.

Hypothesis 3a: The psychological characteristic of "mastery", which is a measure of personal control, will explain much of any observed divergence in BMI trajectories by college degree status.

Hypothesis 3b: Resources other than "mastery", such as gym attendance or participation in individual sports like running or swimming, will also explain much of any observed divergence in BMI trajectories by college status.

Data and Methods

Data

The Add Health Study was based initially on a nationally representative sample of youth in grades 7 through 12 in the United States. The National Quality Education Database provided the sampling frame with its list of all high schools in the United States (N=26,666). From this frame 80 schools were selected. The sample was stratified by region, suburban/urban/rural, school type (whether public, private, parochial), ethnic mix, and size. Fifty-two of the 80 schools agreed to participate, and 28 replacements schools were selected based on the stratifying variables. Each of the 80 schools was paired with a middle school (based on its contribution to the high school student body). A total of 145 of the schools agreed to host a confidential in-school survey, which focused on adolescent health and friends. This first wave yielded 90,118 students from grades 7 to 12 (in 1994).

From the school rosters, students were randomly selected for a one and one-half hour interview, conducted in the home. Approximately 200 students were recruited from schools in each school pair, regardless of size. This procedure resulted in a self-weighting sample. A total of 20,745 adolescents in grades 7 through 12 (ages 11 through 19) were interviewed at home. This in-home wave of interviews with target child and parent was carried out in 1995, between April and December. These students have since been followed three times, in the years 1996, 2001-2002, and 2007-08 (in the last wave n=15,701). The analysis pool for this study consists of respondents who provided information on their educational attainment in the last survey wave (2007-08) and responded to at least two other waves, for a total sample size of 12,540. Details of Add Health's sampling design, response rates, and data quality are available at: http://www.cpc.unc.edu/projects/addhealth.

Measures

Body Mass Index (BMI) is based on self-reported height and weight at each wave. It is calculated as weight (in kilograms) divided by height (in meters) squared.

Education is divided into three categories. **Some college** is coded 1 for respondents who have attended college but have not completed a bachelor's degree by the fourth wave of data collection. **College +** is coded 1 for respondents who have a bachelor's degree by the fourth wave of data collection and who report that their first year of full time employment in the labor force was in the same year or after their college completion. **Delayed college education** is coded 1 for respondents who report a bachelor's degree by the fourth wave that was obtained after their first year of full time employment in the labor force, and 0 otherwise. The reference category in the analyses is people who have never attended college by the fourth wave of the survey.

Female is coded 1 for women and 0 for men. **Black** is coded 1 for black, non-Hispanic respondents and 0 otherwise, and **Hispanic** is coded 1 for Hispanic study members and 0 otherwise. **Parent with college degree** is coded 1 for respondents whose main caregiver has a college degree and 0 otherwise. Main caregivers were typically mothers, but if the mother was not in the household then this variable is coded on the basis of the in-residence adult who serves this role (such as the stepmother or father). **Low parental income** indicates that the study member's family income at the baseline interview was in the bottom 25th percentile (less than or equal to $20,000). **High parental income** indicates that the study member's family income at the baseline interview was in the top 25th percentile (greater than or equal to $60,000).

The **picture vocabulary score** is the respondent's standardized score on the Add Health picture vocabulary test at the first wave, which is an abridged version of the Peabody vocabulary test-revised. **College aspirations** is respondents' self-ranking at the baseline interview of their desire to go to college, on a scale of 1 to 5 (where 5 is a strong desire). **College expectations** is respondents' self-ranking at the baseline interview of their probability that they will go to college, on a scale of 1 to 5 (where 5 is strong probability). **Mastery** was measured at the fourth wave and is the combination of responses to the following questions on a 5 point scale (5 represents strongly disagree): "There is little I can do to change the important things in my life," "Other people determine most of what I can and cannot do," "There are many things that interfere with what I want to do," "I have little control over the things that happen to me," and "There is really no way I can solve the problems I have." **Individual sport** was measured at the fourth wave and is the number of self-reported days in the past week that respondents indicated that they had participated in "individual sports such as running, wrestling, swimming, cross-country skiing, cycle racing, or martial arts." **Gym attendance** was measured at the fourth wave and is respondents' answer to the question "On the average, how many times per week do you use a physical fitness or recreation center in your neighborhood?," a question that was top-coded at 7.

In models not presented in the paper (but reported in the text), the analyses also considered the influence of high school grade point average (gpa) and impulsivity. **High school gpa** comes from school transcripts, for which about 92% of respondents in Wave 3 (which translates to about 70% of Wave 1 respondents) signed Transcript Release Forms that allowed the study to obtain official transcripts from the schools. **Impulsivity** is measured at the baseline interview as the average of responses to the four questions "When you have a problem to solve, one of the first things you do is get as many facts about the problem as possible", "When you are attempting to find a solution to a problem, you usually try to think of as many different ways to approach the problem as possible", "When making decisions, you generally use a systematic method for judging and comparing alternatives," and "After carrying out a solution to a problem, you usually try to analyze what went right and what went wrong." Each of these questions was asked on five point scale ranging from "strongly agree" to "strongly disagree." Finally, information on **teenage parenthood** is derived from the fourth survey wave, and is defined as subjects who report that they have a child that was born when the respondents were age 20 or younger.

Analytic Strategy

This study uses Hierarchical Linear Models (HLM) (Raudenbush et al. 2004) to model BMI trajectories across the four waves of the study. The analysis stratifies the analysis by sex, in light of evidence that the predictors of BMI are substantively for men and women (Hedley et al. 2004). The analyses include an initial model that includes only college education status as a predictor variable of BMI trajectories across the four waves , and subsequent models that include additional variables and consider the mediating and moderating factors of race/ethnicity, family background, and individual characteristics such as ambition to go to college and expectation of college attendance.

The analysis consists of the two-level model:

Level-1 model:

$$\text{Body Mass Index}_{ti} = \pi_{0i} + \pi_{1i}(\text{Age}_{ti}) + \pi_{2i}(\text{Age}_{ti}^{2}) + e_{ti}$$

Level-2 model:

$$\pi_{0i} = B_{00} + B_{0e}(\text{Education Variables}_i) + B_{0d}(\text{Demographic Variables}_i) + B_{0f}(\text{Family Background}_i) + B_{0a}(\text{Scholarly Aspirations and Ability}_i) + B_{0m}(\text{Mastery}_i) + B_{0b}(\text{Health Behaviors in Adulthood}_i) + r_{0i}$$

$$\pi_{1i} = B_{10} + B_{1e}(\text{Education Variables}_i) + B_{1d}(\text{Demographic Variables}_i) + B_{1f}(\text{Family Background}_i) + B_{1a}(\text{Scholarly Aspirations and Ability}_i) + B_{1m}(\text{Mastery}_i) + B_{1b}(\text{Health Behaviors in Adulthood}_i) + r_{1i}$$

$$\pi_{2i} = B_{20} + r_{2i}$$

where body mass index at each wave is the Level-1 unit of analysis and individual characteristics of the respondents are the Level-2 unit of analysis; the variable Age represents the age of the respondent centered at age 15, and the terms e_{ti}, and r_{0i}- r_{2i} represent random effects with a mean of 0 and an assumed normal distribution.

In brief, the Level-1 equation predicts trajectories of BMI for each respondent in the survey as a function of and intercept, age, and age squared. The variable π_{0i} is an intercept term that estimates the extent to which BMI trajectories differ at baseline, and in these models is a function of variables such as education (attained by the last wave), and demographics. The variable π_{1i} is a slope term that estimates the degree to which BMI trajectories grow over the course of the survey, and in these model is also a function of such factors as education and demographics. Finally, the variable π_{0i} is a curvature term that takes into account the leveling off of BMI at older ages. This curvature term was not significantly associated with any of the covariates (analyses not shown).

All analyses use the survey-provided weights to take into account oversampling and make the results nationally-representative. In the growth curve analyses missing data were replaced with the mean or mode value and flagged with dummy indicators (Little and Rubin 1987). None of the dummy indicators were statistically significant.

Results

Table 1 presents descriptive statistics separately by sex. The first three rows present information on college degree status. About 8% of both men and women who had a delayed college degree and entered the labor force full time before they completed their college education. The total percentage of the sample with college degrees was about 35% for women (the 8% with a delayed college degree plus the 27% non-delayed) and 28% for men (8% plus 20%). For both women and men, the status of some college education but no college degree was common and was 36% for women and 32% for men.

-- Table 1 About Here --

Table 1 shows the expected increase in BMI with the increasing age of the cohort. Both women and men had average BMI scores of about 22 at the baseline survey, and by adulthood the average BMI for both sexes was in the ‘overweight’ category of 28.2.

The other variables are consistent with national data and are similar for men and women. About 15% of the sample is black and 11% Hispanic, the mean parental income is about $40,000, and during adolescence about 22% of the sample had a main caregiver with a college degree. The two variables for which women and men differ are individual sport participation, for which women score 40% lower than men, and regular attendance at a gym, for which women score 17% lower than men.

Figure 1 is a graph of predicted BMI trajectories for women over the whole survey as a function of college degree status at the last survey wave. This graph is a visual depiction of the results that appear in Model 1 of Table 2.

-- Figure 1 About Here --

-- Table 2 About Here --

The results provide preliminary support for hypothesis 1 and indicate that respondents with college degrees, either delayed or non-delayed, had a BMI advantage that grew larger over time in comparison to respondents without a college degree. Among all educational groups the average BMI increased with advancing age, but the rate of growth was slower for those who earned a college degree. In Figure 1 the widening disparity is depicted by a growing distance across the education groups with advancing age.

Respondents with a delayed college degree had a slower increase in BMI over time that was .0977 points lower per year on average than it was among respondents with no college experience (Model 1 of Table 2). Consequently, over the 15 years of the survey the difference in BMI scores among those with a delayed college degree in comparison to those with no college experience grew an additional 1.47 points (1.47=15*.0977) from its baseline status. In total the BMI disparity grew more than 150% from the beginning of the survey (when the BMI difference was .912) to the last survey wave (when it was .912+1.47=2.38).

We considered whether length of the delay in obtaining a college degree had an independent influence on the BMI trajectories. In analyses not shown we divided the "Delayed College" variable into the two variables of "Delayed college 3 years or less" and "Delayed college 4 years or more" (4 years was the median level of delay). The coefficients for these two variables as predictors of both the intercept and slope of the BMI trajectories had similar magnitudes and did not significantly differ from each other. Consequently, in these and subsequent analyses we used a single "Delayed College" indicator.

Respondents with a non-delayed college degree realized the most BMI benefits over the survey. Compared to respondents with no college experience, those with a non-delayed college degree had a slower increase in BMI growth that was 0.162 points lower per year over the survey. This resulted in an additional 2.43 BMI difference over and above the BMI differences across these groups that was present at baseline (2.43=.162*15). The end result is that the BMI disparity for people with non-delayed college degrees in comparison to those with no college experience grew 160% (from 1.50 at baseline to 3.93 15 years later).

Acquisition of a college degree was the key educational marker in the prediction of BMI trajectories over time. Among those who had less than a college degree educational disparities across different educational levels did not change relative to each other over the course of the survey. Figure 1 and Model 1 of Table 2 show no divergence or widening of BMI disparities over time across respondents with no college experience in comparison to those who had some college experience but no college degree. Similarly, BMI levels of respondents who had less than a high school degree or a high school degree also did not significantly diverge or narrow over time in comparison to those with some college experience (analyses not shown).

The analysis turned next to consider the second hypothesis and examined whether the BMI advantages across college degree status persisted after taking into account pre-college characteristics. In sum, the results supported hypothesis 2a, which predicts that the growing advantage in BMI across college degree status would persist after taking into account family socioeconomic status. The results also supported hypothesis 2b, which predicts that the growing advantage in BMI across college degree status would persist after taking into account individual attributes such as scholastic ability and ambition to attend college.

Model 2 of Table 2 builds on Model 1 and tests the role of family socioeconomic background. Both parental income and parental education had an independent influence on changes in BMI over time. The increase in BMI with age was .0556 units slower per year for respondents whose main caregiver had a college education in comparison to those who caregiver did not, which amounts to .834 BMI units over the course of the survey (.834=.0556*15). In addition to this influence, the increase in BMI with age was also .033 units slower per year for respondents from families that had incomes in the top 75th percentile, which amounts to .495 BMI units over the course of the survey (.495=.033*15). Taking into account these effects partly diminished the overall influence of a college degree on changes in BMI over time. The influence of a delayed college degree on changed in BMI over time diminished 17% from -0.0977 to -0.0836 and for a non-delayed college degree it diminished 19% from -0.162 to -0.136 (compare Models 1 and 2).

Model 3 of Table 2 examines the influence of race/ethnicity on female BMI trajectories. Both Hispanic and Black women had higher baseline BMI scores at age 15 than the other respondents, with Hispanics on average 0.838 points higher and Blacks 1.77 points higher. Over time the BMI of Black women grew 0.107 points faster per year than it did among the reference group of non-Hispanic whites, so that over the course of the survey the BMI disparity for Black v. non-Black women grew an additional 1.64 points (1.64=0.109*15). Taking into account race/ethnicity had little impact on the influence of college degree status on changes in BMI over time (compare Models 2 and 3).

Model 4 of Table 2 examines the influence of individual-level characteristics that may potentially confound the association of education with BMI trajectories. These results directly evaluate hypothesis 2b, which is that differences in BMI trajectories across college degree status will remain after controlling pre-college, individual attributes. The results indicate that college aspirations, expectations to go to college, and scholastic aptitude as measured by the Peabody Picture Vocabulary score did not significantly predict either baseline BMI levels or changes in BMI over the course of the survey. In analyses not shown the analysis also considered the influence of high school grade point average, self-reported impulsivity (both measured at wave 1), and teen parenthood. None of these variables were significantly related to either the intercept or the slope of the BMI trajectories after taking into account family socioeconomic status. Lack of association with the BMI trajectories precludes all these factors from playing a mediating role.

The analysis turned next to an examination of hypothesis 3a, which is that differences in BMI trajectories across college status are explained in part by the psychological concept of mastery. This hypothesis did not receive support. Model 5 of Table 2 shows that mastery was not significantly related to baseline BMI or changes in BMI as the cohort aged.

Model 6 of Table 2 assesses hypothesis 3b, which is that resources other than psychological mastery partly explain the divergence of BMI trajectories by college degree status. Model 6 examines the extent to which BMI trajectories are associated with gym attendance and participation in individual sports, such as running and swimming, in the fourth wave of the survey. Both individual sport participation and gym attendance were associated with a slower growth of BMI levels over time, so that the per-year growth in BMI scores was .024 points lower for participants in individual sports and .0123 points lower for women who regularly attended a gym. Taking these factors into account reduced the influence of a delayed college degree on changes in BMI over time by 21% and the influence of a non-delayed college degree by 16% (compare Models 5 and 6).

Table 3 presents results parallel to those of Table 2 and focuses on the BMI of male respondents, and the results of Model 1 are graphed in Figure 2. The results indicate that for males the BMI trajectories across college education status widened less over the course of the survey than they did for females. The effect of a delayed college degree on changes in BMI over time was not statistically significant. Among men the protective effect of a non-delayed college degree on changes in BMI levels over time was more than 3.5 times smaller than it was among women and amounted to -.0452 points per year (in comparison to -.162 points per year for women).

-- Table 3 About Here --

Model 1 of Table 3 also shows that BMI disparities by college degree, either delayed or non-delayed, were in part pre-existing before the cohort was of college age. Men who eventually earned a college degree, either delayed or non-delayed, had significantly lower BMI scores than those who did not attend college of about 1 point at baseline when they were age 15. Unlike women, the results also indicate that male respondents who attended college but did not receive a college degree over the course of the survey actually had *higher* BMI increases over the course of the survey of about 0.0292 points per year in comparison to those who never attended college.

Model 2 of Table 3 examines the influence of family socioeconomic background on men's BMI trajectories. Parental income was significantly related to baseline BMI levels at age 15 as well as changes in BMI levels over the course of the survey, while parental education was not related to either. After taking into account family socioeconomic background the influence of a non-delayed college degree on changes in

BMI levels over time reduced by 59% (from -.0452 to -.0285) and was no longer statistically significant.

Model 3 of Table 3 considers the role of race/ethnicity on BMI baseline levels and changes in BMI levels over time. The results indicate that among Hispanic men the per-year growth in BMI levels was .0436 points higher than among non-Hispanic men. Black men did not significantly differ from the reference group in terms of their baseline BMI or per-year changes in BMI levels over the course of the survey. Race/ethnicity did not interact with the education variables.

Models 4 and 5 of Table 3 examine the influence of individual level characteristics that may potentially confound associations of college education and BMI trajectories. Changes in BMI levels over time were not associated with any of the characteristics considered, which consisted of college aspirations, college expectations, scholastic ability as measured by the Peabody picture vocabulary test, and mastery.

Model 6 of Table 3 examined the influence of individual sport participation and gym attendance on BMI trajectories. Those who participated in an individual sport such as running or swimming had lower per-year growth in BMI levels as compared to those who did not. Men who regularly attended a gym had slightly *higher* per-year growth in BMI levels as compared to those who did not, an effect opposite that among women. Participation in individual sports and gym attendance did not significantly predict baseline BMI levels for men.

DISCUSSION

In recent decades the life course of U.S. workers has undergone a substantial change as a return to school in mid life has become increasingly normative. To the extent that education is associated with better health, this trend could potentially improve population health, although little work to date has examined this possibility. In this study we investigate whether a delayed college degree improves health by examining its influence on the outcome of body mass index (BMI). We analyzed trajectories of BMI in early adulthood, using a longitudinal survey of a nationally-representative cohort before the age of college entry and afterwards, for a total of four survey waves from 1995 to 2008.

The results indicate that a delayed college degree improves BMI, at least for women. Women with a college degree, either delayed or non-delayed, had a BMI advantage that grew substantially larger as the cohort aged. The finding that delayed college degrees led to slower growth in BMI supports the proposition that college can overcome health habits practiced up to and during early adulthood. It also supports the proposition that the health benefits of college accrue to a student group that, in general, has a poorer scholastic record than traditional college students.

For men, the association of BMI and college degree status was much smaller than it was among women, and was explained in large part by family socioeconomic background. As we discuss in detail below, taken as a whole these results both provide support for theories that posit a causal, positive influence of a college degree on health but also highlight challenges to efforts aimed at extending the sociological health disparities literature to new outcomes such as BMI.

The results present a pattern of findings that provide substantial empirical support for a positive impact of a college degree on BMI among women. If a college degree leads to a BMI advantage then this advantage should be above and beyond any that was present before a cohort entered college. In support of this proposition, the results show that among women with a delayed college degree about 60% of their BMI advantage in young adulthood (1.5 BMI points) developed over the course of the survey and was above and beyond the other 40% (0.9 BMI points) that was already present at age 15. For women these results strongly support the first study hypothesis that people with a college degree as compared to those who do not will have a BMI advantage that grows as the cohort ages.

If a college degree leads to a BMI advantage then this advantage should remain present after controlling individual level characteristics present before college attendance such as family socioeconomic background and scholastic ability, a prediction that is the second hypothesis of this study. Among women the association of a college degree (either delayed or non-delayed) persisted after controlling family socioeconomic background, race/ethnicity, scholastic ability (as measured by the Peabody picture vocabulary test at the baseline interview), desire to attend college, perceived likelihood of attending college in the future, high school grade point average, self-reported impulsivity as measured at the baseline survey, and teen parenthood. These are some of the major contenders that could potentially confound the association of college degree status and BMI.

While the results provide substantial support for the hypothesis that a delayed college degree improves health, at the same time they point out that substantial theoretical work remains to be done in order to specify the underlying processes at work. Extending current theoretical explanations of health disparities to new outcomes such as BMI will consist of more than simply including additional health outcomes in disparities analyses. The study results show that one of the major theoretical explanations for health disparities – that a college degree increases personal control, which in turn improves health – was not supported. When personal control was measured with the construct of 'mastery' it was not significantly related to BMI in any of the models, precluding it from a mediating role. An explanation of how a college degree affects BMI will require some other explanatory factor or factors.

The sex differences in this study also presents a challenge to many theoretical explanations of health disparities. Most current theories in the field explain health disparities as the result of general processes that, in theory, should affect both women and men alike. For example, the stress paradigm (Turner and Lloyd 1999) posits that greater exposure to social stressors, such as physical violence or financial hardship, is the underlying reason for poorer health in the lower as compared to the upper social strata. It is not immediately clear why greater exposure to social stressors would lead to poor health among women but not men for the outcome of BMI. Similarly, the 'relative deprivation' perspective posits that poorer health in the lower as compared to the upper social strata is ultimately the consequence of invidious comparisons made by disadvantaged members of the lower social strata (Wilkinson 1996). Again, it is not immediately clear why these comparisons would affect women but not men for the outcome of BMI. The results of this study suggest that expansion of the health disparities literature to new outcomes provides an opportunity to test and refine theories in the field, and potentially specify important moderating influences.

The 'fundamental cause' perspective provides the flexibility to consider new mechanisms that link education and health, although it provides only general guidance and future work is needed to motivate investigation of specific candidate mechanisms. A key premise of the fundamental cause perspective is that people in the upper social strata use their higher levels of resources to gain advantage in health outcomes considered medically and socially desirable. The perspective therefore directs research to investigate both (a) resources that lead to health advantages and (b) the desirability of specific health outcomes (a topic much less studied).

The third hypothesis of this study set out to specify resources that link a college degree and a growing disparity in BMI. As mentioned above, the analysis did not find support for the expected resource of personal control, at least as measured by the 'mastery' construct. In the analysis of women we provide an initial test of the resources of gym membership and individual sport participation – factors outside the typical purview of sociological studies of health disparities – and find preliminary support. Among women both of these factors accounted for more of the BMI disparities at the last wave of the survey than the baseline survey, a finding consistent with the idea that they were fostered and/or augmented by a college education. A fuller and more detailed accounting of the mechanisms that link a college degree and BMI among women warrants a separate analysis, which we hope this study will help motivate.

To explain the lack of support among men for an association of a college degree and a growing BMI disparity one topic of investigation consistent with the fundamental cause perspective is that men may place less importance in low BMI than women. If so, then men would be expected to expend fewer resources to achieve lower BMI values. Consistent with this hypothesis, results from national studies indicate that men's ideal body type is substantially heavier than it is for women (Lynch et al. 2009).

If desirability of health outcomes is confirmed by future studies to be an important determinant of health disparities it would present an interesting challenge to current theories of health disparities. For example, it would suggest that the influence of social stressors on health are not entirely external to the individual and they are somehow filtered through individual perceptions of what health outcomes are desirable and which are not. Similarly, the negative health impact of relative deprivation for people in the lower social strata would somehow be buffered for health outcomes that are not considered culturally important.

Limitations and Conclusion

This study has two main limitations that qualify the study results. First, currently the Add Health data follows respondents into early adulthood and not beyond. Consequently, while we estimate that about 60% of the association between college degree status and BMI developed during adulthood, this estimated proportion will most likely change in analysis of populations at older ages. We expect that over time the proportion will grow larger as the health advantages of college degree status cumulate, although it is an open, empirical question whether the BMI advantages peak at some age.

A second limitation is that the analysis focuses only on college degree status and does not use a more finely graded measure of educational attainment. We examined educational levels such as a high school degree or less than a high school degree, but for this population these educational levels did not contribute significant, further information to the prediction of BMI changes over time. Analysis of different populations may yield different results.

In conclusion the results of this study indicate that a college degree improves BMI, at least among women. Women who obtain a college degree subsequently had slower rates of BMI growth in comparison to those without a degree, and this advantage accrued to women regardless of whether they entered the labor force before attending college. These results suggest that the outcome of female BMI is a good candidate for sociological analyses of health disparities by education, both for analyses looking at the social determinants of health in adulthood as well as analyses examining the social determinants of health in childhood and adolescence. In terms of policy, a college degree stands out as a weight loss/management strategy that actually works, at least for women, and it is rare to find a program that actually lowers body mass over a sustained period of time (Katz 2005). In addition, these results suggest that the substantial increase in the number of workers returning to college later in life should have a positive impact on population health, at least for the outcome of BMI.

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Table 1: Descriptive Statistics of Analysis Sample: Weighted Means and Standard Errors

	------ Women ------			------ Men ------		
	N	Mean	Standard error	n	Mean	Standard error
Delayed college	6642	0.078	0.00516	5898	0.0834	0.00589
College degree	6642	0.272	0.0166	5898	0.195	0.0146
Some college	6642	0.357	0.0106	5898	0.319	0.00971
BMI, wave 1	6531	22.2	0.117	5852	22.6	0.124
BMI, wave 2	5230	22.7	0.138	4684	23.1	0.124
BMI, wave 3	5858	25.5	0.159	5112	25.9	0.137
BMI, wave 4	6577	28.2	0.196	5876	28.2	0.133
Black	6642	0.157	0.0209	5898	0.148	0.02
Hispanic	6642	0.112	0.0170	5898	0.115	0.017
High parental income	5020	0.263	0.0177	4603	0.255	0.0188
Low parental income	5020	0.235	0.0161	4603	0.225	0.0183
Parent w/ college deg.	5715	0.219	0.0164	5158	0.23	0.0162
College aspirations	6631	0.739	0.00997	5884	0.67	0.0138
College expectations	6626	0.605	0.0134	5882	0.486	0.0146
High school grade point average (from transcript, centered at 2.6)	4887	0.245	.0357	4225	-.0655	.0308
Impulsivity	6642	.190	.0116	5898	.168	.0123
Teenage parenthood	6642	.206	.0117	5898	.0923	.0066
Picture vocabulary score (standardized and divided by 100)	6642	0.0145	0.00573	5898	0.0267	0.00542
Mastery (centered at 20)	6631	-0.296	0.063	5888	-0.662	0.0672
Individual sport at wave 4	6636	0.587	0.0304	5892	0.822	0.0305
Gym attendance at wave 4	6633	0.884	0.042	5843	1.03	0.0448

Table 2: Two-Level Hierarchical Linear Models Predicting Women's Trajectories of Body Mass Index, n=6642 (standard errors in parentheses)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Predictors of intercept (π_{0i})						
Delayed college degree	-0.912** (0.272)	-0.690* (0.277)	-0.667* (0.276)	-0.641* (0.283)	-0.619* (0.283)	-0.604* (0.283)
Non-delayed college degree	-1.50** (0.182)	-1.12** (0.200)	-1.00** (0.199)	-0.977** (0.219)	-0.959** (0.22)	-0.916** (0.222)
Some college	-0.585** (0.195)	-0.490* (0.195)	-0.442* (0.194)	-0.422* (0.197)	-0.412* (0.199)	-0.413* (0.199)
No college	reference	reference	reference	reference	reference	reference
High parental income		-0.303 (0.156)	-0.279 (0.156)	-0.281 (0.157)	-0.282 (0.157)	-0.270 (0.156)
Low parental income		0.460* (0.209)	0.204 (0.207)	0.208 (0.207)	0.203 (0.207)	0.210 (0.207)
Parent w/ college degree		-0.603** (0.184)	-0.512** (0.184)	-0.525** (0.185)	-0.523** (0.185)	-0.507** (0.186)
Hispanic			0.838** (0.228)	0.876** (0.234)	0.883** (0.235)	0.864** (0.234)
Black			1.77** (0.201)	1.83** (0.206)	1.84** (0.206)	1.78** (0.206)
College aspirations				-0.242 (0.194)	-0.239 (0.195)	-0.241 (0.194)
College expectations				0.00302 (0.182)	0.0125 (0.183)	0.0188 (0.183)
Picture vocabulary score				0.553 (0.571)	0.592 (0.574)	0.566 (0.572)
Mastery					-0.0207 (0.0301)	-0.0200 (0.0300)
Individual sport						-0.218** (0.0487)
Gym attendance						0.0656 (0.0443)
π_{00}	22.9** (0.147)	22.9** (0.174)	22.5** (0.179)	22.6** (0.209)	22.6** (0.214)	22.7** (0.215)
Predictors of slope (π_{1i})						
Delayed college degree	-0.0977** (.0271)	-0.0836** (0.0273)	-0.082** (0.0273)	-0.0777** (0.0279)	-0.0809** (0.0281)	-0.0667* (0.0282)
Non-delayed college degree	-0.162** (0.0169)	-0.136** (0.0181)	-0.131** (0.0181)	-0.127** (0.0199)	-0.129** (0.0201)	-0.111** (0.0202)
Some college	-0.0108 (0.0178)	-0.00540 (0.0178)	-0.00337 (0.0178)	-0.00190 (0.0182)	-0.00331 (0.0183)	-0.000146 (0.0183)
No college	reference	reference	reference	reference	reference	reference
High parental income		-0.0330* (0.0147)	-0.0320* (0.0147)	-0.0308* (0.0147)	-0.0306* (0.0147)	-0.0297* (0.0146)
Low parental income		-0.00311 (0.0190)	-0.0182 (0.0192)	-0.0198 (0.0193)	-0.0191 (0.0193)	-0.0213 (0.0193)
Parent w/ college degree		-0.0556** (0.0165)	-0.0519** (0.0165)	-0.0494** (0.0168)	-0.0496** (0.0169)	-0.0411* (0.0168)
Hispanic			0.0121 (0.0210)	0.00794 (0.0218)	0.00670 (0.0218)	0.00653 (0.0218)
Black			0.109** (0.0185)	0.106** (0.0191)	0.104** (0.0191)	0.0946** (0.0191)
College aspirations				0.0238 (0.0185)	0.0235 (0.0185)	0.0261 (0.0184)
College expectations				-0.0232 (0.0169)	-0.0248 (0.0171)	-0.0251 (0.0169)
Picture vocabulary score				-0.0250 (0.055)	-0.0308 (0.0550)	-0.0339 (0.0548)
Mastery					0.00310 (0.00274)	0.00418 (0.00273)
Individual sport						-0.0240** (0.00432)
Gym attendance						-0.0123** (0.00386)
π_{10}	0.608** (0.0198)	0.620** (0.0212)	0.601** (0.0217)	0.595** (0.0240)	0.599** (0.0243)	0.615** (0.0245)
Curvature (π_{2i})						
π_{20}	-.00718**(.00108)	-.00717** (.00108)	-.00718** (.00108)	-0.00710** (.00108)	-.00709** (.00108)	-0.00713** (.00108)

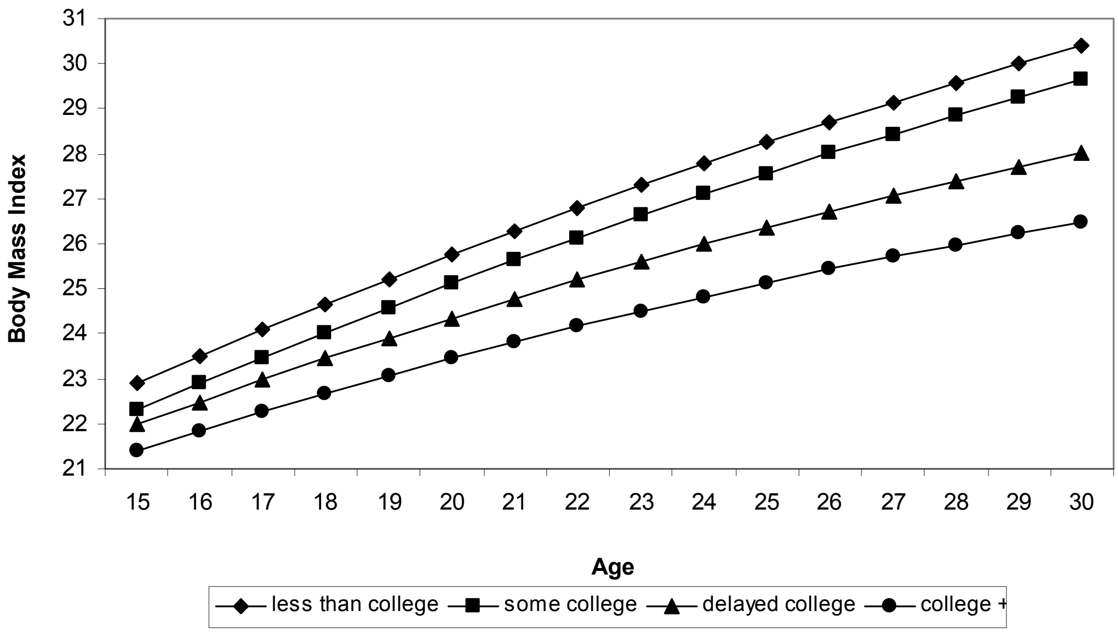
* $p<.05$; ** $p<.01$

Table 3: Two-Level Hierarchical Linear Models Predicting Men's Trajectories of Body Mass Index, n=5898 (standard errors in parentheses)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Predictors of intercept (π_{0i})						
Delayed college degree	-.890** (.262)	-0.763** (0.266)	-0.755** (0.267)	-0.816** (0.273)	-0.842** (0.274)	-0.826** (0.280)
Non-delayed college degree	-.954** (.192)	-0.735** (0.208)	-0.723** (0.210)	-0.780** (0.229)	-0.809** (0.230)	-0.794** (0.234)
Some college	-.0299 (.195)	0.0485 (0.199)	0.0477 (0.199)	0.0106 (0.208)	-0.00700 (0.208)	-0.00278 (0.211)
No college	reference	reference	reference	reference	reference	reference
High parental income		-0.338* (0.170)	-0.341* (0.170)	-0.346* (0.169)	-0.343* (0.170)	-0.343* (0.169)
Low parental income		0.219 (0.229)	0.196 (0.231)	0.237 (0.233)	0.242 (0.233)	0.240 (0.233)
Parent w/ college deg.		-0.160 (0.176)	-0.147 (0.176)	-0.179 (0.177)	-0.180 (0.177)	-0.176 (0.177)
Hispanic			0.214 (0.244)	0.328 (0.251)	0.323 (0.250)	0.324 (0.250)
Black			0.0791 (0.220)	0.212 (0.226)	0.207 (0.226)	0.218 (0.226)
College aspirations				-0.225 (0.196)	-0.230 (0.196)	-0.225 (0.196)
College expectations				0.0353 (0.185)	0.0295 (0.185)	0.0293 (0.186)
Picture vocabulary score				1.37* (0.641)	1.32* (0.642)	1.300* (0.642)
Mastery					0.0252 (0.0268)	0.0251 (0.0268)
Individual sport						0.0356 (0.0448)
Gym attendance						-0.0394 (0.0400)
π_{00}	22.7** (.135)	22.8** (0.163)	22.7** (0.173)	22.8** (0.200)	22.9** (0.203)	22.9** (0.207)
Predictors of slope (π_{1i})						
Delayed college degree	-.0179 (.0189)	-0.00729 (0.0193)	-0.00729 (0.0193)	-0.00118 (0.0200)	-0.00362 (0.0200)	0.000934 (0.0203)
Non-delayed college degree	-.0452** (.0143)	-0.0285 (0.0155)	-0.0269 (0.0155)	-0.0191 (0.0169)	-0.0215 (0.0171)	-0.0166 (0.0173)
Some college	.0292* (.0136)	0.0358** (0.0139)	0.0353* (0.0139)	0.0393** (0.0146)	0.0378** (0.0146)	0.0406** (0.0147)
No college	reference	reference	reference	reference	reference	reference
High parental income		-0.0177 (0.0122)	-0.0184 (0.0122)	-0.0180 (0.0123)	-0.0178 (0.0122)	-0.0164 (0.0122)
Low parental income		0.0285 (0.0164)	0.0265 (0.0166)	0.0261 (0.0167)	0.0267 (0.0167)	0.0276 (0.0166)
Parent w/ college deg.		-0.0134 (0.0131)	-0.0109 (0.0132)	-0.00954 (0.0133)	-0.00963 (0.0133)	-0.00989 (0.0133)
Hispanic			0.0436* (0.0183)	0.0440* (0.0185)	0.0436* (0.0185)	0.0445* (0.0184)
Black			-0.00672 (0.0160)	-0.00505 (0.0164)	-0.00557 (0.0163)	-0.00898 (0.0162)
College aspirations				-0.0118 (0.0142)	-0.0122 (0.0142)	-0.0111 (0.0142)
College expectations				-0.00978 (0.0134)	-0.0103 (0.0133)	-0.0115 (0.0133)
Picture vocabulary score				0.0129 (0.0468)	0.00845 (0.0469)	0.0104 (0.0469)
Mastery					0.00218 (0.00196)	0.00254 (0.00196)
Individual sport						-0.0180** (.00342)
Gym attendance						0.00627* (0.00305)
π_{10}	.588** (.0171)	0.584** (0.0182)	0.580** (0.0184)	0.589** (0.0200)	0.592** (0.0202)	0.599** (0.0203)
Curvature (π_{2i})						
π_{20}	-.0116** (.000987)	-.0116** (.000990)	-.0116** (.000990)	-.0116** (.000998)	-.0116** (.000997)	-.0116** (.000996)

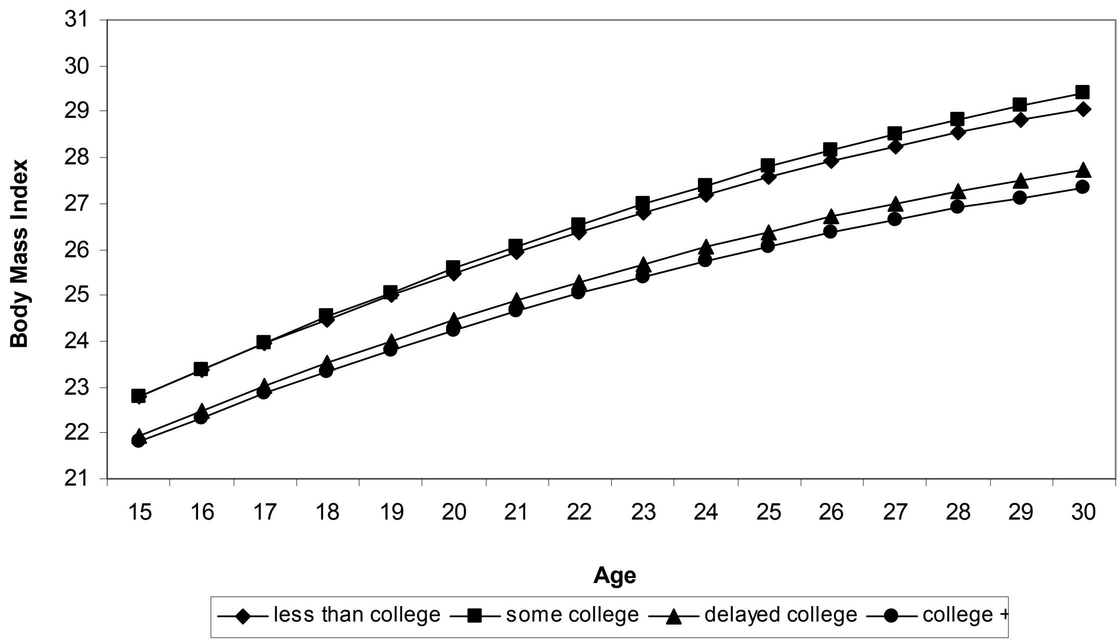
* p<.05; **p<.01

Figure 1: Female BMI Trajectories by Educational Attainment at Last Wave of Add Health



Note: This Figure graphs the results of Model 1, Table 2

Figure 2: Male BMI Trajectories by Educational Attainment at Last Wave of Add Health



Note: This Figure graphs the results of Model 1, Table 3