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The Sequencing of a College Degree during the Transition to Adulthood: Implications for Obesity*

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Abstract

In this study we consider the health implications of the sequencing of a college degree vis-à-vis familial roles during the transition to adulthood. We hypothesize that people who earned a college degree before assuming familial roles will have better health than people who earned a college degree afterwards. To test this hypothesis, we focus on obesity and use data from the National Longitudinal Study of Adolescent Health. Results show that marriage before completion of college was associated with a 50% higher probability of becoming obese when compared with marriage after completion of college. Parenthood before college completion was associated with a greater-than two-fold increase in the probability of becoming obese when compared to parenthood afterwards for Black men. These findings suggest that the well-established association of education with health depends on its place in a sequence of roles.

Introduction

Role sequencing is a central concept in the life course perspective (Elder and Shanahan 2006; Mayer 2009). According to this perspective, the order of social roles matters: different people who progress through the same social roles but in different sequences experience different life outcomes (Jackson 2004; Pearlin, Schieman, Fazio, and Meersman 2005). Yet very few empirical studies have examined this possibility with respect to health (for important exceptions see Barban 2013; Jackson 2004). In this paper, we examine whether the order in which people complete college degrees vis-à-vis familial roles (parenthood and marriage) makes a difference for health. Specifically, we hypothesize that the physical health benefits associated with a college degree are greater among young adults who first complete a college degree and then enter familial roles, in contrast to people who complete degrees after these transitions. To examine this issue we focus on the health outcome of obesity.

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The present study examines in new detail the often-observed relationship between education and health (Adler, Boyce, Chesney, Cohen, Folkman, Kahn, and Syme 1994; Link and Phelan 1995; Mackenbach, Stirbu, Roskam, Schaap, Menvielle, Leinsalu, and Kunst 2008), and suggests that the role-context of educational completion moderates this association. The hypothesis is particularly important because it lies at the intersection of three growing, long-term trends: the growing rate of U.S. college completion, which is now at a record high of 30% (U.S. Census Bureau 2012), the growing variety in role sequencing during the transition to adulthood (Fussell 2002; U.S. Department of Education 2002), and the increasing rate of U.S. obesity and its health consequences (Flegal, Carroll, Kit, and Ogen 2012; Reilly and Kelly 2011). Data for the project comes from the National Longitudinal Study of Adolescent Health (Add Health), which is a nationally-representative, longitudinal panel study. The data are well suited for this research because they include people whose lives reflect these trends, and the data include measures of body mass before the panel was of college age (average age 16) and into the start of adulthood (average age 28).

Below we develop the rationale for this hypothesis. In brief, (1) college promotes health behaviors that decrease the likelihood of obesity; (2) healthy behaviors established during the transition to adulthood are long-lasting; and (3) people who have a college degree before familial transitions will have more resources and better health habits to help them avoid the increase in body mass associated with the initial transition to the roles of spouse and parent.

Background

The sequence through which an individual passes through major social roles can have an association with health above and beyond the influence of the individual social roles involved (Elder and Shanahan 2006). An individual's history of prior social roles serves as the context in which role transitions take place and this context can amplify or diminish the health impact of each transition. For example, women who follow "normative" transitions into family life, such as marriage and then childrearing, have better self-reported overall health as well as lower levels of depression, smoking, and drinking than women who follow non-normative family transitions (Barban 2013). To date, however, much remains unknown about the role of sequencing for education and physical health, which is surprising given that education is such a powerful predictor of many dimensions of health.

Obesity and a College Education

Obesity is concentrated among U.S. adults with low levels of education, a finding present among women, men, African-Americans, and Whites (Ljungvall and Zimmerman 2012; Zhang and Wang 2004). These disparities appear to have attenuated somewhat in recent years (Zhang and Wang 2004) but nonetheless remain substantial. Adults with less than 12 years of education have a probability of obesity that is about 60% higher among women and 40% higher among men, in contrast to adults with a college degree (Ljungvall and Zimmerman 2012). This distribution of obesity across educational strata is thus a good case study for the analysis of education and health.

It would be surprising if obesity were *not* concentrated among people with lower education, given that almost all preventable health conditions are negatively associated with education

(National Center for Health Statistics 2012). In general, individuals with a college degree have greater resources that promote healthy lifestyles and thereby prevent morbidity and delay mortality (Link and Phelan 1995). “Learned effectiveness” is one individual-level resource that links higher levels of education to health and, specifically, to the outcome of low obesity (Mirowsky and Ross 2003). College increases the learned effectiveness of individuals, defined as higher levels of personal control, internalized control, and self-efficacy. These factors are, in turn, all associated with a healthier lifestyle and lower levels of body mass (Mirowsky and Ross 2003).

Four additional mechanisms link a college education to lower levels of obesity (reviewed in Pampel, Krueger, and Denney 2010). First, people with higher education levels are less likely to use physical inactivity as a stress coping mechanism (Krueger and Chang 2008). Second, people with higher education levels are better aware if they are overweight or obese (Paeratakul, White, Williamson, Ryan, and Bray 2002) and also more aware of the health risks associated with obesity (Bleich, Blendon, and Adam 2007). Third, people with more education are more likely to live in neighborhoods with recreational resources (Giles-Corti and Donovan 2002; Powell, Slater, Chaloupka, and Harper 2006). Finally, time use studies show that individuals with higher levels of education devote more time to physical activity and, further, devote a greater percentage of their leisure time to physical activity (Mullahy and Robert 2010).

Enduring Influence of Health Behaviors during the Transition to Adulthood

The influence of a college degree on behaviors that help prevent obesity would be expected to be especially strong and long-lasting during the transition to adulthood, when people explore new lifestyles and new “adult” risk behaviors (Schulenberg, Maggs, and Hurrelmann 1997). Often during this period individuals can settle on a pattern of health behaviors that is long-lasting. Evidence for this proposition comes both from the life course literature as well as from a separate literature on physical activity.

In a synthesis of life course literature on health, Harris et al. (2010, p. 1107) note that “patterns of health behaviors, including diet, physical inactivity, drinking, and smoking may be set during this period [the transition to adulthood]” and present empirical evidence showing how long-term health trajectories are set into place during this life stage. Using a life course perspective, Bauldry and his colleagues (2012) show that health behaviors predict self-rated health but that this association strengthens from adolescence to young adulthood. Further, the overall impact of a college degree, the majority of which are earned before students enter adult roles, is to significantly alter and improve both trajectories of physical activity and also trajectories of diet over the life course (Cleland, Ball, Magnussen, Dwyer, and Venn 2009; Lake, Mathers, Rugg-Gunn, and Adamson 2006). Possessing a college degree during the transition to adulthood is therefore expected to put individuals on track for better, long-lasting health behaviors in comparison to individuals who did not have a college degree in this life stage.

Additional evidence for an enduring influence of health patterns established during adolescence and the transition to adulthood comes from the research literature on physical activity (Telama 2009). People who entered the transition to adulthood with a history of

participation in endurance sports had a higher probability of participating in these same types of activities 17 years later (Tammelin, Näyhä, Hills, and Järveline 2003). In addition, physical activity during this life stage appears to promote general physical fitness in adulthood, as the number of activities participated in during the transition to adulthood is more important for later physical activity than participation in any specific activity (Kjønnisken, Torsheim, and Wold 2008). In general, research on physical activity supports the “ability and readiness hypothesis,” which is that experiences of physical activities and sports and of the basic skills connected with them facilitate the maintenance of physical activity or restart it after a possible break (Telama 2009, p. 193). These studies therefore suggest that individuals who possess a college degree during the transition to adulthood will be more likely to establish healthy habits that are long-lasting, with health benefits that can be observed many years or decades later.

Obesity and the Transition to Adult Social Roles

The resources and healthy behaviors associated with a college degree should provide a distinct advantage to young adults when they negotiate the transition to adult social roles. This transition is associated with significant weight gain. Longitudinal evidence suggests that an increased probability of obesity can occur almost entirely during the initial transition to marriage and then plateau and persist (Sobal, Rauchenbach, and Frongillo 2003). This pattern reflects, in part, long-lasting behavior changes that are associated with entry into marriage, such as more regular meals (Craig and Tuswell 1988), less individualistic exercise and sport (Craig and Truswell 1990), and smoking cessation that can lead to weight gain, particularly among people with lower education (Filozof, Pinilla, and Fernandez-Crux 2004).

The transition to parenthood follows a similar pattern and, among women, childbirth is associated with a threefold increase in the incidence of obesity during early adulthood, a finding present among Whites, Blacks, and Hispanics (Davis, Zyzanski, Olson, Stange, and Horwitz 2009). About 50% of women do not return to their pre-pregnancy weight one year after childbirth, and childbirth-related weight gain is frequently still present many years (Gore, Brown, and West 2003; Gunderson and Abrams 2000; Lipsky, Strawderman, and Olson 2012) or even decades later (Linné, Dye, Barkeling, and Rössner 2004). Increases in body mass associated with becoming a biological parent also extend to men (Umberson, Liu, Mirowsky, and Reczek 2011) because living with minor children can increase body mass for both fathers and mothers as a result of young children disrupting regular exercise routines (Bellows-Riecken and Rhodes 2008; Nomaguchi and Bianchi 2004; Pereira, Rifas-Shiman, Kleinman, Rich-Edwards, Peterson, and Gillman 2007) and limiting the type of food prepared at the home (Devine, Bove, and Olson 2000). In addition, with parenthood comes social expectations that are associated with weight gain such as smoking cessation (Umberson, Pudrovska, and Reczek 2010).

Taken together, these considerations lead us to predict:

Hypothesis 1a: Young adults who complete a college degree and then marry will have lower levels of obesity than young adults who follow the opposite sequence.

Hypothesis 1b: Young adults will complete a college degree and then become a parent will have lower levels of obesity than young adults who follow the opposite sequence.

The links between education and health are strong, but at the same time they are numerous, change over historical time, are different for different individuals, and can act through different links in different contexts (Chang and Lauderdale 2009; Link and Phelan 1995; Lutfey and Freese 2005; Miech, Pampel, Kim, and Rogers 2011). In this paper we therefore focus on the potential moderating effects of sequencing on the association between education and health, which, if established, can serve as motivation for future study of the underlying mechanisms at work.

Alternative hypotheses

Two alternative hypotheses predict an opposite pattern of findings from the expectations of this study. First, research on social roles finds that, in general, additional social roles are associated with better health (reviewed in Umberson, Crosnoe, and Reczek 2010). For example, the transition into marriage is associated with lower mortality for both men and women (Waite and Gallagher 2000), in part because it is associated with a reduction in risky behaviors such as problem drinking and drug use (Bachman, O'Malley, Schulenberg, Johnston, Bryant, and Merline 2002; Chilcoat and Breslau 1996), as well as higher levels of social support to reduce the impact of stress on health (Cohen, Gottlieb, and Underwood 2004). Consequently, the health benefits of adult social roles could theoretically be predicted to extend to obesity. However, within the social roles literature, the outcomes of body mass and obesity are recognized as important exceptions to the general association of better health with marriage and parenthood (Umberson, Crosnoe, and Reczek 2010).

A second and related competing hypothesis points to the high levels of unhealthy behavior associated with college, especially the higher levels of binge drinking (O'Malley and Johnston 2002). College students who are married would be expected to be less likely to have the time or inclination to engage in the "singles' lifestyle" of a college student that is associated with heavy alcohol use and other risky behaviors (O'Malley and Johnston 2002). In fact, young married couples may be significantly less likely to report "drunkenness" than their age mates who are unmarried (Uecker 2012). To the extent that individuals who attended college after marriage should be less likely to drink heavily and suffer the associated weight gain (Sayon-Orea, Martinez-Gonzalez, and Bes-Rastrollo 2011), a factor that works against the hypothesis of this study. Nevertheless, drinking is only one factor associated with body mass and obesity, and in this study we test our expectation that the sum total of all factors at work during the transition to adulthood will favor lower rates of obesity among individuals who complete college and then transition to adult social roles, rather than vice-versa.

Race, Gender, Sequencing, and Obesity

Whether associations of sequencing and obesity differ by race and gender is not known and an issue we examine in this study. Sequencing effects are expected to be smaller in demographic groups that have less inclination to deploy their resources for obesity prevention. Members of these demographic groups are expected to have high levels of

obesity regardless of whether college completion is sequenced before or after the adoption of adult social roles. For example, body images among Black adults have more room for obesity and being heavy is not necessarily damaging to self-esteem or considered unattractive (Dorsey, Eberhardt, and Ogden 2009; Fitzgibbon, Blackman, and Avellone 2000; Kumanyika 2008). Consequently, Black adults with a college degree have less pressure/motivation to deploy their resources to prevent obesity. Similarly, men are less likely than women to be evaluated on the basis of their body fat and they experience relatively lower levels of obesity-related stigma (reviewed in Puhl and Heuer 2009). Men therefore also have less pressure/motivation to deploy their resources to prevent obesity and among adults with a college education men are expected to have high rates of obesity regardless of whether their college degree preceded or followed the adoption of adult social roles.

It is possible that specific demographic groups such as black women or white men have unique associations between sequencing and obesity. Intersectionality theory (Collins 1998) draws attention to cases where race and gender interact in unique ways in the prediction of health and may therefore require theory development and analysis tailored for a specific demographic group. This analysis takes a first step toward examination of intersectionality by analyzing the central issue of whether race and gender have additive or non-additive associations with sequencing as it impacts obesity. Evidence that race and gender have a non-additive association would provide strong evidence that future analysis of this topic would benefit from an intersectionality perspective.

Potential Confounding Influences

Any association between sequencing and obesity may potentially be spurious and/or result from self-selection influences. This would occur if an individual-level characteristic that influences obesity has greater prevalence in one sequencing group as compared to another. While it is difficult to rule out all potential confounders when using a non-experimental design, our models adjust for major sources of possible confounds.

First, body mass levels in adolescence, at the first wave of the study, are controlled. This rules out the possibility that levels of obesity across different sequencing groups in adulthood were pre-existing before respondents were of college age. Pre-existing differences are possible to the extent that the sequencing groups significantly differ across unobserved characteristics that may be associated with body mass, such as personality traits. Controlling pre-college body mass therefore helps take into account unobserved factors that are associated both with sequencing and also with obesity and may therefore confound the study results. This includes unobserved factors associated with individuals who enter early into marriage and/or parenthood, a group that is included in the sequencing groups that enter adult social roles before college completion.

The second prospective confounder in the analysis is parental education, which is a measure of parental socioeconomic status. Parent's education predicts both college graduation (Hertz, Jayasundera, Piraino, Selcuk, Smith, and Verashchagina 2007; Sewell and Hauser 1975) and offspring's obesity (Miech, Kumanyika, Stettler, Link, Phelan, and Chang 2006), making it an important factor to control.^{1,2}

In a more exploratory fashion the analyses also considers three potential confounders measured at the last survey wave. These are smoking, complacency toward obesity, and pregnancy status (among women). All these factors are related to obesity (Chiolero, Faeh, Paccaud, and Cornuz 2008; Linné, Barkeling, and Rössner 2002; Schwartz and Borwnell 2004), and may act as confounders to the extent that they also aid or detract from college completion (Crosnoe 2007; Hoffman, Foster, and Furstenberg 1993; Maralani 2014). The examination of these factors is exploratory because they are measured at the last wave of the study and may themselves potentially be influenced by college attendance or obesity status. Analyses of these factors can therefore provide stronger evidence to disconfirm, as compared to confirm, their potential confounding influence. That is, a finding that these factors do little to account for different obesity levels across sequencing groups would strongly disconfirm the potential confounding effect of these factors. In contrast, a finding that these factors do in fact substantially account for obesity differences across sequencing groups would highlight them for further investigation, ideally with prospective measures to mitigate potential, endogenous effects.

Methods

Data

Data for this study come from the National Longitudinal Study of Adolescent Health (Add Health), which was based initially on a nationally representative sample of youth in grades 7 through 12 in the United States. In the first wave a total of 20,745 adolescents in grades 7 through 12 (ages 11 through 19) were interviewed at home in 1995. These students have since been followed three times, in the years 1996, 2001–2002, and 2007–08 (in the last wave $n=15,701$). In the last wave the average age of the panel is 28, with more than 90% between the ages of 26 and 31. The analysis pool for this study consists of respondents who participated in the baseline survey and also provided information on their educational attainment and body mass at the last survey wave (2007–08), for a total sample size of 13,980. 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. **Obesity at Wave IV** is coded 1 for respondents with a self-reported BMI score ≥ 30 at Wave IV and 0 otherwise. **Adolescent BMI** is the average body mass score of the respondents at waves 1 and 2, when the average age of the panel was 15 to 16.

¹In analyses not shown we considered the mediating influence of household income, which is strongly associated with college completion. As expected, higher income was associated with lower probability of obesity, but at this life stage the effect was not particularly strong. A \$10k increase in income was associated with a 3% lowered probability of obesity, an effect significant at $p=.048$ (two-tailed). None of the other coefficients in the model changed significance levels. These results suggest that it is the many benefits of a college education, in addition to income, that are driving the study's results. We do not include income in the main results because it has a high level of missing information (25% in the analysis pool) and is not a focus of this study.

²In analyses not shown we considered the possibility that obesity predicts early marriage. If true, then instead of sequencing leading to body mass, the opposite causal sequence could be at work and our theoretical explanations would not apply to the study results. We could not find existing literature to support or refute this hypothesis and therefore ran our own models. Limiting our analysis to never-married respondents at wave 3 ($n=8774$, average age 22) we found that body mass was not a predictor of marriage or age of marriage.

A **College degree** is indicated by respondents who report that they have “completed college” (bachelor’s degree). Among respondents with a college degree marital and parenting roles are coded in relation to whether they started before or after college degree completion. **Had first child before earning degree** is coded 1 for respondents whose first child was born before college degree completion and 0 otherwise. **Had first child after earning degree** is coded 1 for respondents whose first child was born after college degree completion and 0 otherwise. **No children by Wave IV** is coded 1 for respondents with a college education who had no children by Wave IV and 0 otherwise. **Wave IV married status began before college degree** is coded 1 for respondents whose marriage at Wave IV began before they earned a college degree and 0 otherwise. **Wave IV married status began after college degree** is coded 1 for respondents whose marriage at Wave IV began after they earned a college degree and 0 otherwise. **Not married at Wave IV** is coded 1 for respondents with a college degree who were not married at Wave IV and 0 otherwise. **College degree, not parent or spouse at Wave IV** is coded 1 for respondents with a college degree who were not parents or spouses at Wave IV, and 0 otherwise.

Control variables include **no college degree** which is coded 1 for respondents without a college degree at Wave IV and 0 otherwise. **Male** is coded 1 for male respondents and 0 for female respondents. **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. **Regular smoker** is coded 1 for respondents who report at Wave IV that they are regular smokers and 0 otherwise. **Age at Wave IV** is respondent’s age at the fourth survey wave. **Unconcerned about own high body mass** is coded 1 for respondents who have a BMI score of 25 or more at Wave IV but self-report that they are “about the right weight” or underweight when asked “How do you think of yourself in terms of weight?”

Analytic Strategy

The analysis consists of descriptive statistics as well as logistic regressions and takes into account the complex survey design of the data using STATA 12. The analysis handles missing data using multiple imputation (Rubin 1996), for which the analysis imputed five data sets and used the chained equations algorithm (Raghunathan, Lepkowski, Van Hoewyk, and Solenberger 2001).³ The final analyses exclude cases with imputed values for the dependent variable of obesity as well as cases with imputed values for educational attainment at the final wave of data collection. All results use survey-provided weights for longitudinal analysis so that the results are representative of the U.S. population of the same age.

The analysis first presents observed levels of incident obesity for different sequencing, with “incident obesity” defined as respondents who were not obese in adolescence (Waves 1 and 2), but were obese in adulthood (at Wave 4). We then perform multivariable analysis to examine whether the observed differences across sequencing groups remain net of each

³In analyses not shown we ran the main analyses in Table 3 with 10, 15, 20, and 25 imputed data sets. The results were remarkably similar, and all coefficients that were significant at the .05 level or less remained significant and in the same direction. Changing the number of imputed data sets did not alter the substantive conclusions of this study.

other and net of major, potential confounding influences. In these multivariable analyses obesity at Wave IV is the dependent variable and the model controls for body mass level (as measured by BMI) in adolescence.

The analysis includes a three-way interaction term of **Black*Male*(First child born before college degree)**. For proper specification the model that includes this interaction term also includes the single, constituent variables as well as every possible two-way interaction term: **Male*Black, (First child born before college degree)*Male, and (First child born before college degree)*Black.**

Results

Table 1 presents descriptive statistics for the overall sample and by demographic groups. The first six rows present the prevalence of different sequences of college degree completion and social roles. For example, in the overall sample (which includes respondents both with and without a college degree) about 2% first became married and then earned a college degree. Calculation of the percentage of college graduates who followed this sequence is accomplished by dividing the percentage by 0.29, given that college graduates comprise 29% of the overall sample (as indicated in Table 1: 71% of the overall sample did not have a college degree, and by extension 29% did). Consequently about 7% (.02/.29) of college graduates followed this sequence.

College degree completion before marriage and/or parenting was more common than college degree completion afterwards, a finding present in the overall sample and all demographic groups. In the overall sample, marriage after college degree completion was about five times more common than the opposite sequence (.11 v..02), and having a first child after degree completion was about four times more common than the opposite sequence (.061 v..016).

The remaining rows present descriptive statistics of control variables in the analysis. Prevalence rates for these factors are consistent with national data.

Table 2 presents observed rates of incident obesity from adolescence to Wave IV by different sequencing groups without controls for possible confounders. Consistent with Hypotheses 1a and 1b, the results based on the overall sample present evidence for sequencing of spousal and parental roles vis-à-vis college degree completion as a predictor of incident obesity. Among respondents with a college degree, incident obesity was significantly higher among those who married before (versus after) earning a college degree, at 24% and 17%, respectively. Further, among respondents with a college degree incident obesity was higher among those who gave birth to a child before, in contrast to after, earning a college degree, at 26% and 20%, respectively (statistically significant for a one-tailed test).

Results from Table 2 suggest potentially important differences in sequencing patterns across demographic groups. For non-Black men the sequencing of college and marriage makes practically no difference in rates of incident obesity (a rate of 22% as compared to 21% among non-Black men who married before as compared to after college completion). Non-Black men differ from all other demographic groups for which marriage before versus after college completion is associated with higher, incident obesity, although these differences are

not always statistically significant within demographic groups as a result of sample sizes. For non-Black men birth of first child before as compared to after college completion also appears to make little difference in incident obesity (23% v. 22%). Among Black women, sequencing actually works opposite its predicted direction and incident obesity is lower among women who had a child before (as compared to after) college completion (the incident obesity rate is 28% and 39%, respectively). To examine these potential differences across demographic groups further, the analysis next turned to multivariable analyses to take into account potential controls and sequencing effects net of each other.

Table 3 presents results from multivariable models that predict obesity at Wave IV as a function of college degree sequencing, taking into account body mass in adolescence and other controls. In all models, obesity at Wave IV was the dependent variable and adolescent BMI was a predictor, so that the analysis examines changes in body mass over the course of the survey. The reference group for these analyses are respondents who followed the traditional sequences of completing college before entering the role of spouse or parent. This reference group is theoretically appropriate because the main emphasis of the study is a comparison of this group to respondents who become spouses or parents before college completion. The reference group is also empirically appropriate in light of the findings in Table 2 showing that the rate of incident obesity is similar for respondents who (a) completed college before marriage and (b) completed college before first child, suggesting that the obesity levels of these two groups are suitable to be combined into one reference group.

Model 1 of Table 3 indicates that respondents who married before earning a college degree were 65% more likely to become obese ($e^{.50}=1.65$) in comparison to respondents who married or had a first child after college completion (the reference group). These results are consistent with the findings presented in Table 2, which remain after adjusting for parental college degree status and age.

Model 2 of Table 3 indicates that obesity levels of respondents who had a first child before earning a college degree did not significantly differ from those who followed the opposite sequence. These results indicate that the findings of a marginally significant difference between the two groups in Table 2 do not persist in more detailed models.

Model 3 of Table 3 examines sequencing patterns net of each other. The results indicate that the sequencing of college completion and marriage continues to be associated with becoming obese, while the sequencing of college completion and birth of first child does not. Specifically, in this full model respondents who marry before as compared to after college completion are 58% ($e^{.46}=1.58$) more likely to become obese.

Model 4 of Table 3 examines potential differences in sequencing effects across demographic groups. The model includes a three-way interaction term of sex, race, and college-parenting sequencing, as well as all two-way interactions of these variables, and indicator variables for the three interaction components. The reference group for this model is non-Black women because the model includes indicator variables for male and Black respondents.

Consistent with previous results, Model 4 of Table 3 indicates that sequencing of college completion and marriage is associated with becoming obese. The coefficient of 0.5 indicates that among non-Black women the odds of becoming obese over the study period were 65% higher ($e^{.5}=1.65$) for women who married before (vs. after) college completion. In separate models (not shown) the analysis tested and did not find evidence for the possibility that the influence of this sequence on obesity was significantly higher or lower across different demographic groups. The test consisted of multiplicative interaction terms of the marriage-college sequence with sex and with race, as well as a three-way interaction. None of these interaction terms was statistically significant.

Model 4 of Table 3 shows that the sequencing effects of parenting and college completion vary significantly by demographic groups. For the reference group of non-Black women, the odds of becoming obese were not different in comparison to the reference group that followed the opposite sequence, as indicated by the near-zero coefficient for the variable “First child born before college degree.” In contrast, this sequence is strongly associated with becoming obese for Black men, as indicated by the significant, three-way interaction term of parent-child sequencing, male, and Black. The positive, significant coefficient of 2.40 indicates that the sequencing of first child born and college completion is strongest for Black males, among whom those who become parents before college completion have much higher rates of becoming obese than those who followed the opposite sequence. This result is consistent with the observed results in Table 2.

Figure 1 graphs the three-way interaction to aid in its interpretability. The graph shows a strong association between obesity and child/college sequencing for Black men but not for any of the other demographic groups. Specifically, for Black men the prevalence of obesity at Wave 4 is about 60% if they followed a sequence of having a child and then completing college and about 20% if they followed the opposite sequence. The confidence intervals for the obesity prevalence of these two groups do not overlap, indicating that they significantly differ. Among all other demographic groups Wave IV obesity levels do not differ by the sequencing order of college degree completion and birth of first child.

Analyses not shown considered the potential confounding influence of factors measured at Wave IV of the survey and found no evidence for confounding. In the total sample the Wave IV factors (a) unconcerned about own high body mass, (b) current pregnancy status (among women) and (c) regular smoking did not significantly differ across the sequencing groups of becoming married before as compared to after college degree completion. Further, these factors did not differ across the sequencing groups of becoming a biological parent and college completion. This lack of association precludes confounding due to these variables (as measured), and the difference in obesity levels across the sequencing groups did not change when these variables were included in the model.

Discussion

This paper examines the extent to which the life course concept of sequencing can contribute to the literature on education and health. The central idea of sequencing is that individuals who have completed the same social roles may have different outcomes depending on the

order in which they complete them. Applied to the literature on education and health, this suggests that the sequence in which people complete education vis-à-vis other social roles like parent and spouse can make a difference. Specifically, we hypothesized that individuals who complete college before making major social transitions will have better health, as measured by odds of becoming obese, than individuals who complete the same roles in the opposite order.

The analysis provides strongest evidence for Hypothesis 1a, which focuses on sequencing vis-à-vis college completion and marriage. As predicted, in the overall sample respondents who first married and then completed college had odds of becoming obese that were 65% higher than respondents who followed the opposite sequence, after taking into account respondents' body mass levels in adolescence. Multivariable analysis of interaction terms indicated that this association did not differ across demographics groups, although the observed data suggest that it is not very strong among non-Black males.

The analysis also provides more limited evidence for Hypothesis 1b, which focuses on sequencing vis-à-vis college completion and birth of first child. As predicted, respondents in the total sample whose birth of first child occurred before college completion were more likely to become obese than respondents who followed the opposite sequence, although this difference was only marginally significant. Multivariable analysis that took into account potential confounds and potential differences across demographic groups indicated that this sequencing association seemed to be driven largely by Black males. A three-way interaction term indicated that the sequence had the predicted association with obesity for Black males but not for other demographic groups.

As for demographic differences, the analysis documents stronger sequencing effects for Black respondents as compared to White respondents, at least among males. As we discuss in more detail below, these findings point to the importance of an intersectionality perspective that takes into account factors specific to demographic groups.

Implications

These findings provide new theoretical insight into how education maintains a long-lasting association with better health. As predicted, sequences in which college degree completion preceded the transition to a major social role were generally beneficial for health, as measured by odds of becoming obese, and for no transition was prior possession of a college degree significantly detrimental. This study lends insight into how a handful of years spent in college can lead to a substantial advantage in health that lasts for decades and suggests that a college education shapes the initial transitions to familial roles so that they lead to long-lasting trajectories of better health. Future research could profitably examine forms of physical capital – for example, eating behaviors, health knowledge, exercise patterns, and preventive care -- that accrue to college-educated young people who enter familial roles after they complete their education.

These results suggest that in many cases individuals who earn a college degree after they transition to an adult social role are less successful in deploying the college-related resources they earn in the service of better health. These results therefore suggest that the strong

association of education and health can be blocked by social context, defined here as the history of previous role transitions. These types of moderating effects on the association of education and health have received much less attention than mediating effects, and the results of this study motivate and justify future analyses to examine the specific moderating factors at work, as well as other potential moderators of education and health.

The results across demographic groups provide both support and opportunities for intersectionality theory. The analyses provide evidence that the sequencing association of college completion and birth of first child is substantially different for black males as compared to the other demographics groups. This finding underscores the key point in intersectionality theory that multiple systems of stratification such as sex and race may interact in unique ways that require detailed understanding of specific demographic groups and may not simply represent the sum of a “gender” effect and a “race” effect.

A sequencing association specific to Black males was not predicted and warrants further examination. The three-way statistical interaction noted in the analyses is based on small sample sizes, and ideally should be examined in other data sets to establish that it is robust. If so, the results of this study suggest that Black males whose first birth of a child occurs before they earn a college degree may encounter more obstacles than White males in using their resources to prevent obesity, obstacles such as lower availability of stores that sell healthy food (Franco, Roux, Glass, Caballero, and Brancati 2008), as well as fewer opportunities for physical activity due to relatively lower prevalence of parks, green spaces, and public pools (Powell, Slater, and Chaloupka 2004). This finding is consistent with the substantial literature on the poorer return on investment that Black adults receive on college education than Whites (Hout 2012). Why the sum effect of all factors affecting Black males who have children before attending college results in high levels of obesity is not clear, and both quantitative and qualitative work on sequencing and obesity offers a unique opportunity to further develop and apply intersectionality theory to identify the specific forces at work.

Limitations and Conclusion

This study has six main limitations that qualify the study results. First, currently the Add Health data follows respondents into early adulthood and not beyond. The college educated respondents are entering the prime of their childbearing years and associations of parenting/college sequence with body mass may develop further in subsequent years. Associations of sequencing with body mass will most likely change (a) at older ages when different social roles such as widow or grandparent become relatively more salient, and (b) among future birth cohorts as norms and ideas about body mass continually shift and change. Second, 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.

Third, the analysis focuses only on the outcome of obesity. This outcome is particularly strategic for the purposes of this study in light of prior evidence that obesity is sensitive to entry into major social roles. Other health outcomes are likely to have different associations

with education and sequencing into major social roles. A related, fourth limitation is that this study relies on self-reported weight and height to calculate BMI scores. BMI scores tend to underestimate obesity (Shah and Braverman 2012), and thereby make the results of this study conservative. BMI scores can reflect muscle mass and not adiposity, although to our knowledge trained, lean athletes do not receive BMI scores of 30 or higher, which would be required for this study to classify them as obese.

Fifth, this study does not present results stratified by Hispanic ethnicity. In analyses (not shown) using interaction terms, we found that Hispanic respondents did not differ even marginally from Whites in terms of sequencing consequences for the outcome of obesity. While Hispanic respondents may differ from White respondents in terms of the predictors and prevalence of obesity, the two groups do not differ in terms of sequencing consequences, the main focus of this study.

Finally, this study does not identify specific intervening mechanisms that account for the association of sequencing with obesity. It may well be the case that sequencing associations documented in this study operate through different mechanisms for different individuals. If so, attempts to reduce sequencing to a handful of key mechanisms would meet with frustration. It remains for future research to determine how sequencing translates into odds of obesity, keeping in mind that sequencing may act as a moderator of education, the “fundamental cause” (Link and Phelan 1995) that has the potential to act through a large spectrum of pathways.

In conclusion, the results indicate that the sequencing of college degree completion in relation to other social roles serves as an independent predictor of body mass. Sequences in which college completion precedes the transition to major social roles such as parent or spouse are associated with lower body mass independent of the effects of the social roles involved. These findings suggest that education maintains a long-lasting association with health, in part, by shaping the initial transitions to major social roles so that they lead to long-lasting trajectories of better health.

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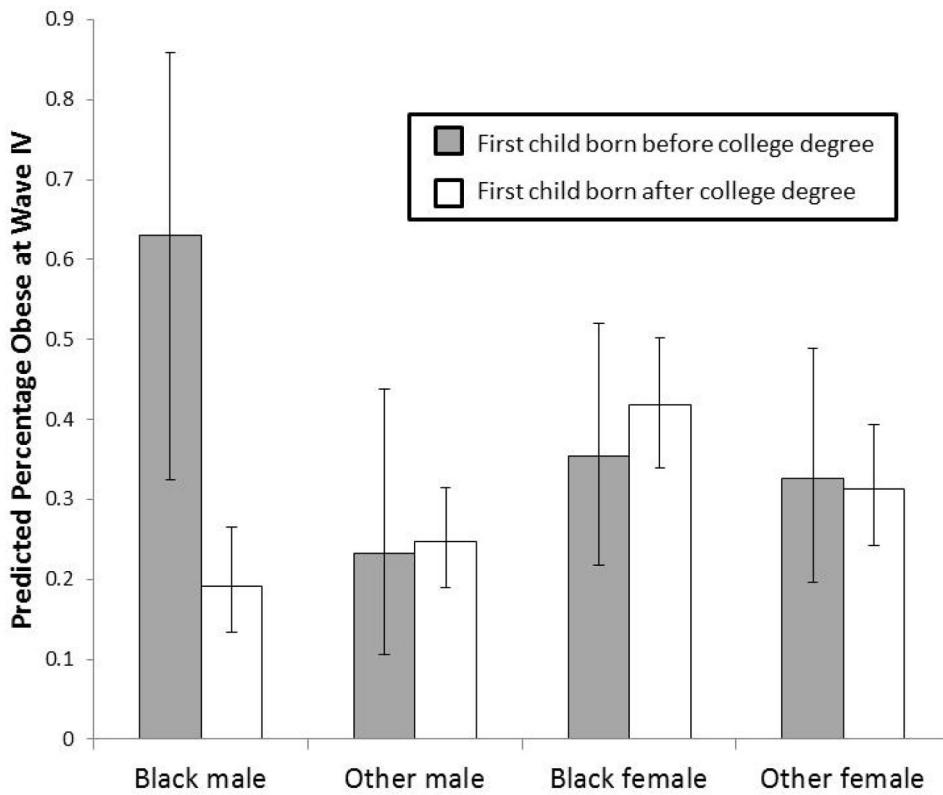


Figure 1. Graph of Three-Way Interaction: Obesity at Wave IV as a Function of Child/College Sequencing by Sex and Race, with 95% Confidence Intervals

Notes: Graphs plotted for unmarried college graduates who are age 28 at Wave IV, had a BMI of 23 in adolescence, and have parents with no college education.

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Table 1

Means and Standard Errors of Analysis Variables (Standard Errors in Parentheses)^a

Variable	Overall		— Women —		— Men —	
	n=13,980	Black n=1,721	Non-Black n=5,673	Black n=1,319	Non-Black n=5,267	
Respondents with a College Degree:						
Married at Wave IV						
Married then college degree	.021 (.0019) [n=318]	.0055 (.0021) [n=9]	.03 (.0035) [n=189]	.0080 (.0033) [n=11]	.017 (.0024) [n=109]	
College degree then married	.11 (.0071) [n=1582]	.069 (.010) [n=142]	.15 (.010) [n=841]	.043 (.010) [n=80]	.092 (.0079) [n=519]	
Not married at Wave IV	.16 (.011) [n=2395]	.17 (.025) [n=379]	.16 (.011) [n=955]	.12 (.016) [n=179]	.17 (.015) [n=882]	
Has child as Wave IV						
Child then college degree	.016 (.0016) [n=280]	.039 (.0085) [n=84]	.019 (.0023) [n=125]	.017 (.0050) [n=19]	.0093 (.0019) [n=52]	
College degree then child	.061 (.0046) [n=932]	.064 (.011) [n=135]	.082 (.0061) [n=492]	.034 (.0070) [n=50]	.046 (.0057) [n=255]	
No children by Wave IV	.21 (.014) [n=3082]	.14 (.020) [n=311]	.24 (.016) [n=1368]	.12 (.018) [n=200]	.22 (.012) [n=1203]	
Controls						
Adolescent BMI (average age 15 to 16)	22.70 (.10)	23.97 (.20)	22.18 (.12)	23.05 (.26)	22.88 (.12)	
No college degree	.71 (.016)	.75 (.033)	.66 (.018)	.83 (.022)	.72 (.019)	
Parent has college degree	.34 (.017)	.24 (.024)	.34 (.020)	.30 (.033)	.35 (.019)	
Age at Wave IV	28.32 (.12)	28.43 (.199)	28.20 (.12)	28.64 (.23)	28.35 (.13)	
Controls measured at Wave IV						
Regular smoker	.25 (.0095)	.12 (.015)	.24 (.012)	.23 (.027)	.28 (.012)	
Pregnant at Wave IV	.03 (.0017)	.05 (.0055)	.06 (.0041)	n/a	n/a	
Unconcerned about own high body mass	.15 (.0046)	.11 (.011)	.06 (.0048)	.33 (.015)	.20 (.0075)	

^aMeans and standard errors are weighted, while sample sizes are not.

Percentage Incident Obesity from Adolescence (Average Age 16) to Wave IV (Average Age 28) by Selected Groups (Standard Errors in Parentheses)

Table 2

Variable	Overall	— Women —		— Men —	
		Black	Non-Black	Black	Non-Black
College Graduates					
Married at Wave IV					
Married then college degree ^a	24 (.032)	57 (.20)	22 (.041)	53 (.22)	22 (.051)
College degree then married	17* (.012)	37 (.057)	12** (.015)	19 (.050)	21 (.023)
Not married at Wave IV	17* (.012)	27 (.026)	18 (.018)	23 (.046)	15 (.016)
Has child at Wave IV					
Child then college degree ^a	26 (.037)	28 (.069)	23 (.046)	48 (.17)	23 (.075)
College degree then child	20 [‡] (.016)	39 (.062)	15 (.023)	20 (.075)	22 (.028)
No children by Wave IV	16** (.010)	27 (.032)	15** (.014)	20 [‡] (.043)	16 (.014)
College degree, not parent or spouse at Wave IV	16 (.012)	25 (.038)	17 (.018)	23 (.051)	14 (.016)

^aReference category for group

[‡]Value significantly differs from the group reference category, p<.05, one-tailed test

* Value significantly differs from the group reference category, p<.05, two-tailed test

** Value significantly differs from the group reference category, p<.01, two-tailed test

Table 3

Obesity at Wave IV (Average Age 28) as a Function of Adolescent Body Mass, College Degree Sequencing, and Selected Controls (n=13,980); Unexponentiated Coefficients

Variable	Model 1	Model 2	Model 3	Model 4
College Sequencing Indicators				
Marriage then college degree	0.50 [*]		0.46 [*]	0.50 [*]
First child born before college degree		0.33	0.19	0.06
College degree, no kids	-0.39 [*]	-0.37 [*]	-0.35 [*]	-0.29 [†]
College degree, not married	-0.0054	-0.09	-0.02	-0.02
Married and/or first child after college degree ^a	referent	referent	referent	referent
(First child born before college degree) [*] Male				-0.14
(First child born before college degree) [*] Black				-0.34
(First child born before college degree) [*] Male [*] Black				2.40 [*]
Controls				
Male				-0.33 ^{**}
Black				0.46 ^{**}
Male [*] Black				-0.79 ^{**}
Adolescent BMI	0.40 ^{**}	0.40 ^{**}	0.40 ^{**}	0.40 ^{**}
No college degree ^b	0.19 [†]	0.14	0.22 [*]	0.30 ^{**}
Parent has college degree	-0.13 [†]	-0.13 [†]	-0.13 [†]	-0.09
Age at Wave IV	-0.12 ^{**}	-0.12 ^{**}	-0.12 ^{**}	-0.12 ^{**}
Constant	-6.55 ^{**}	-6.50 ^{**}	-6.60	-6.81 ^{**}

^aSee text for rationale for this reference group. In Models 1–3 it refers to all respondents, and in Model 4 it refers to non-Black women (as a result of the included interaction terms).

^bReference group is “Married and/or first child after college degree”

^{*}p<.05, two-tailed test;

^{**}p<.01, two-tailed test