The Effects of Timing and Duration of Adolescent and Early Adulthood Obesity on College Enrollment and Completion

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We estimate the effects of current obesity status as well as of obesity duration on the probabilities of entering college and completing a bachelor's degree for U.S. youth. We conjecture that the relatively well-established effects of obesity at one point in time are just the tip of the iceberg and that they vastly underplay the real effects of obesity that are mostly driven by the timing of onset and duration of obesity thus implying cumulative effects. We discuss the implications of these results: given past growing rates of obesity prevalence and progressively earlier onset of obesity among the U.S. youth, the estimates we obtain have ominous consequences for future educational success of all U.S. youth and particularly for females and racial and ethnic minorities.

THE PROBLEM

Since the late 1960s, the prevalence of obesity among adolescents has nearly quadrupled. According to the National Health and Nutrition Examination Survey (NHANES), between 1966-1970 and 2007-2008, obesity among adolescents aged 12 to 19 increased from 4.6 percent o to 18.1 percent (Ogden and Carroll, 2010). This rapid increase in BMI among young people has primarily affected Black girls and Hispanic boys (Williams et al., 2002; Lee et al., 2011; Ogden and Carroll, 2010).

Adolescent obesity is associated with increased risk of both premature mortality and adult morbidity, particularly increased risks of hypertension, adverse lipid profiles, type II diabetes, ischemic heart disease, stroke, and metabolic syndrome (Williams et al., 2002; Alley and Chang, 2010; Reilly and Kelly, 2011). Adolescent obesity is also associated with a wide array of educational and socioeconomic outcomes, including lower mathematic test scores (Krull, Gable, and Chang, 2012); lower rates of college enrollment (Crosnoe, 2007); lower likelihood of college graduation (Fowler-Brown at al. 2010); less years of completed postsecondary schooling, which in turns affects occupational standing (Glass, Haas, and Reither, 2000); lower earnings (Judge and Cable, 2010); higher rates of household poverty and lower likelihood of marriage (Gortmaker et al., 1993). Across all these outcomes, the consequences of obesity are less severe or even non-existent for men as compared to women.

As successive birth cohorts have become heavier at younger ages, recent cohorts are experiencing a longer duration of obesity over their lifetime (Lee et al., 2005). Research has recently examined not just the consequences of severity of body weight, but also the impact of the duration of obesity. Among adults, the duration of obesity is associated with increased metabolic risk (Janssen et al., 2004), increased risk of type II diabetes (Abdullah et al., 2011a) , and increased risk of all-cause and cause-specific mortality (Abdullah et al., 2011b). This last study showed that for every additional ten years lived with obesity, the risks of all-cause mortality, cardiovascular disease and cancer mortality more than doubled (Abdullah et al., 2011b). Among children and adolescents, the duration of obesity is associated with an increased in the risk of psychiatric disorder, specifically oppositional defiant disorder and (for boys) depression (Mustillo et al., 2003).

Although the relationship between adolescent obesity and educational attainment has been clearly documented, *there have been no prior analyses of the relationship between increasing duration of obesity and educational attainment.* This paper explores whether the *cumulative* exposure to excess weight during adolescence and young adulthood affects educational postsecondary outcomes. We extend previous research on the educational consequences of obesity and we ask whether the *presence* of obesity at some point in the life stage affects later educational attainment, but also whether the

duration of obesity at the same stage has effects above and beyond obesity status. We compare normal-weight youth to obese youth, but among those who are obese we also compare youth who became obese earlier in their adolescence to youth who became obese as young adults. We focus on two key educational outcomes: entering a four-year college and completing a bachelor's degree. In line with prior research on the prevalence and consequences of obesity, we pay special attention to gender and race and ethnicity differences. Based on research on the linkage between adolescent health and educational attainment (Palloni, 2006; Haas and Fosse, 2008; Jackson, 2009), we explore three potential pathways that may account for the association between obesity and obesity duration, on one hand, and educational attainment, on the other. We examine whether this association is mediated by other health-related conditions, by the accumulation of cognitive skills, or by the accumulation of socio-emotional skills.

DATA AND METHODS

Data

We use data from the National Longitudinal Survey of Youth 1997 (NLSY97). The NLSY97 is a nationally representative sample of 8,984 youths who were born between January 1, 1980 and December 31, 1984. The sample consists of a nationally representative sample of 6,748 respondents and an oversample of 2,236 Hispanic and non-Hispanic Blacks. Round 1 of the survey took place in 1997, when youth were 12-16 years old. In that round, both the eligible youth and one of that youth's parents received hour-long personal interviews. Youth have been interviewed annually since 1997. We use data from the first thirteen rounds. Respondents were 25 to 29 at the time of their round 13 interviews, which was fielded in 2009-2010. A little more than 84 percent (7,561) of the round 1 sample were interviewed in round 13.

Relevant outcomes and subpopulations

We estimate the effect of current obesity and obesity duration on two postsecondary outcomes: (1) entry into a four-year college by age 21 and (2) attainment of a bachelor's degree by age 25. Relying on the NLSY97's event history series on college enrollment, we identify respondents who enroll in a 4-year college before or during the month of their twenty-first birthday. We define college completion as having reported completing a four year college degree before or during the round in which the respondent turns 25.

We refine the measures of educational outcomes used in the most recent study of the effect of obesity on college attainment (Fowler-Brown at al. 2010) on two counts. First, we define college enrollment and completion in terms of a specific age, rather than in terms of a specific survey wave. As NSLY97 youth have different ages at the inception of the study, it is important to define the outcome similarly for all respondents. Based on current median ages of college entry and completion, we specify a standard age for each outcome: 21 years old for college entry and 25 years old for college completion. Second, we define a relevant eligible population for each outcome. To enroll in a four-year college by age 21, youth need to have graduated from high school by at least age 21, either via a regular high school diploma or a GED. The eligible population for attaining a bachelor's degree by age 25 corresponds to youth who have enrolled in a four-year college by age 25.

The analyses focus on two subpopulations. First, the eligible sample at risk of enrollment in a four-year college corresponds to respondents who have attained a high school diploma or GED by age 21: 3,031 females and 3,121 males. Second, the eligible sample at risk of attainment a bachelor's degree corresponds to respondents who have enrolled at least once in a four-year college by age 25: 1,860

females and 1,530 males. The case completed samples for the analysis of college entry and college completion are the subset of about 75 percent of respondents in the eligible samples that have valid data in all covariates. To ascertain the degree of uncertainty in the estimation due to missingness we use alternative strategies and evaluate the robustness of results by identifying the range of estimates associated with each strategy. Thus, we produce estimates with the case-completed sample, with a completed sample completed with mean imputation of missing variables, and a completed sample after multiple imputation under different model specifications.

Methods

We assess the chances of entering and completing college for (i) youth who had normal BMI throughout the years before entering and completing college; (ii) youth who became overweight but not obese; (iii) youth who became obese sometime before they turn 18 years old; and (iv) youth who became obese some time after they turn 18 years old.

We use logistic regression to estimate the association between obesity and obesity duration on college entry and college completion, separately for males and females. For each educational outcome and gender, we estimate five different models. The first model only includes the obesity variables. The second model adds a set of sociodemographic covariates, including race and ethnicity; whether respondent lived in an urban area at age 12; family income; and a dummy variable for whether the respondent is in the lowest income quartile. This second model constitutes the base model for the last three models, which test the extent to which cognitive skills, other health-conditions, and socio-emotional skills mediate the association between obesity and educational attainment. Model three corresponds to the base model plus two measures of cognitive skills: high school GPA and percentile scores in the *Armed Services Vocational Aptitude Battery*, a test that measures abilities in mathematical knowledge, arithmetic reasoning, word knowledge, and paragraph comprehension. The fourth model adds to the base model three health-related measures: parent-reported health of the respondent, an asthma indicator variable, and a sensory problem indicator variable. Model 5 adds to the base model two measures of socio-emotional skills: mental health inventory, and the behavioral and emotional problems scales, similar to those found in Achenbach's *Youth Self Report*.

The aforementioned estimates have a rather obvious hypothetical implication that can be expressed in the following question: what is the education-impact of obesity trends over the past ten years for current cohorts of high-school graduates? Could these trends reverse and derail consistent improvements in educational attainments of successive cohorts? And to what an extent is the impact differential by gender and by race? To answer this question we combine estimates of obesity in the population aged 10-25 over the past ten years and the estimated effects obtained before and will compute for each pertinent cohort the fraction expected to attain a given educational marker conditional on their obesity status and duration. Data on the distribution of cohort by obesity status and duration at any given will be obtained from national data sets with suitable aggregate information (NHANES, NLSY as well as the BRFSS).

PRELIMINARY RESULTS

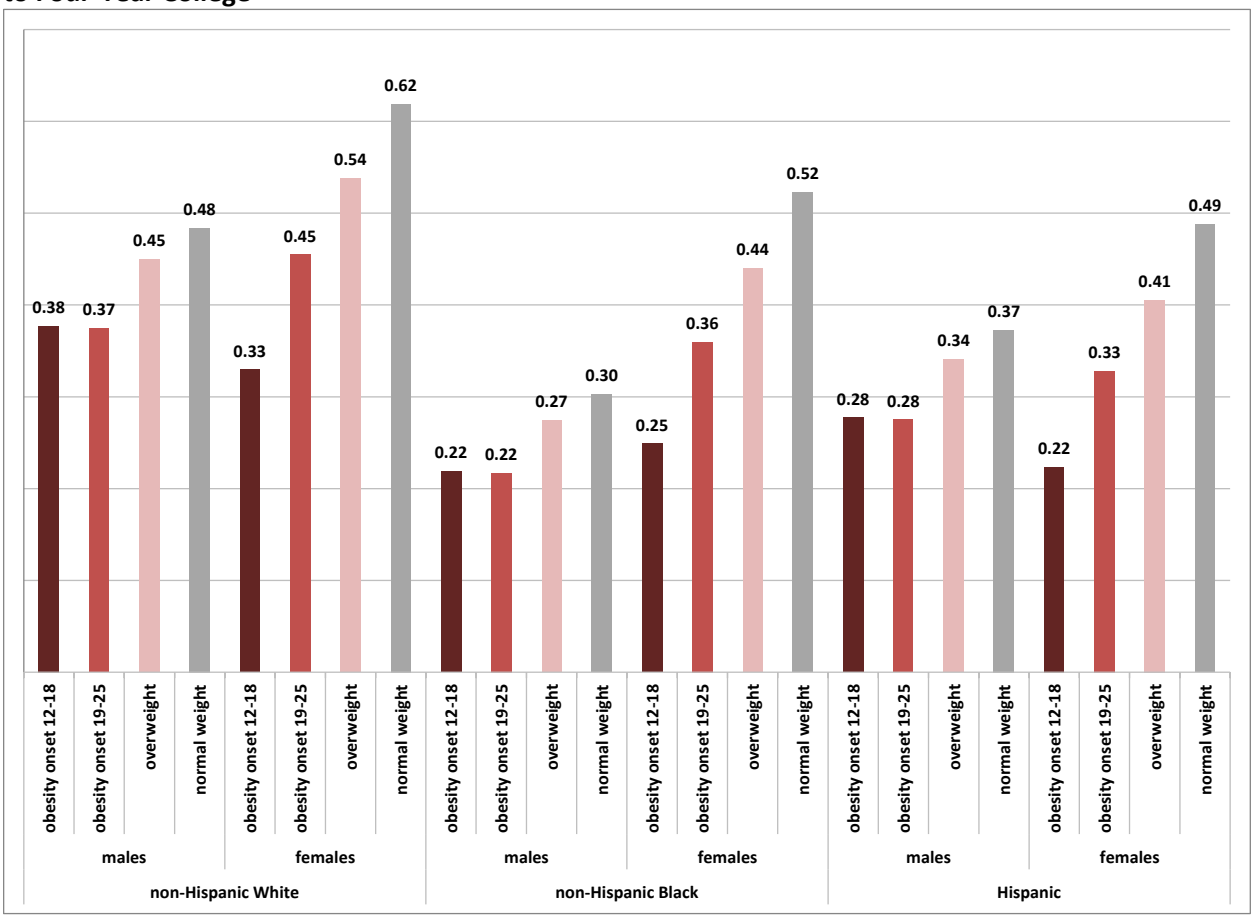
Results show a substantive and statistically significant educational penalty for obese women, but a negligible penalty for obese men. Once they have graduated from high school and accounting for sociodemographic characteristics, obese women are about half as likely as normal-weight women to enroll in a four-year college by age 21. Furthermore, even among women who enroll in a four-year college, obese women are about half as likely as normal-weight women to complete college by age 25. Results also show that beyond the presence of obesity, the timing and duration of obesity matter as

there is a clear a gradient in which normal weight women fare the best, followed by overweight women, then by women who became obese after age 18, and finally by women who became obese before they turn 18 years old. Women who became obese as adolescents fare the worst across all racial and ethnic groups, even taking into account a series of socioeconomic, cognitive, socio-emotional, and health conditions. This gradient is clearly observed in Figure 1, which displays the predicted probability of completing college by age 25, conditional on entering college, for youth of different race, ethnicity, and gender who lived in an urban area at age 12, have an average family income, and whose parent's highest grade completed is twelfth grade.

IMPLICATIONS

Consider the following facts: (a) obesity prevalence in the U.S. has jumped to an all-time high among very young children (3 to 8). We know this from multiple data sets but particularly form ECLS-K (Han, 2011); (b) early obesity is highly predictive of later obesity as the risk of becoming non-obese after being obese as a child are remarkably low, both among males and females (Li et al., 2007; Nonnemaker et al., 2000); (c) early obesity undermines the formation of cognitive and non-cognitive traits (Crosnoe, 2007). Combining these three facts to the findings we report in this paper suggests that the future educational attainment of some groups in this country, groups whose population is increasing by leaps and bounds, will be severely compromised with all the implications that these trends may have for aggregate social mobility and income inequality.

Figure 1: Predicted Probability of Bachelor's Degree Attainment by Age 25, Conditional on Attendance to Four-Year College



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