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# Adolescent Obesity, Educational Attainment, and Adult Earnings<sup>1,2</sup>

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## Abstract

We estimate the effects of being obese during adolescence on the likelihood of high school graduation, post-secondary educational attainment, and labor market earnings as an adult (over 13 years later). We use longitudinal data from the National Longitudinal Survey of Adolescent Health (Add Health), conducted by the Carolina Population Center of the University of North Carolina at Chapel Hill. This is a nationally representative sample of students in grades 7 through 12 for the 1994-95 first wave survey. Three subsequent waves of follow-up interviews occurred in 1996, 2001-02, and finally in 2007-08, when the sample was aged 25-31. Probit and linear regression models with a large set of controls (to minimize any bias that may result from omitting factors related to both adolescent obesity and adult outcomes) are fitted to carry out analyses separately by gender or racial groups. Pathological body weights are most notably present among males, blacks and Hispanics, suggesting possibility that diverging obesity effects may be found across race and gender groups. Unlike some prior research, we find no significant effects of adolescent obesity on high school graduation, but for some demographic groups negative effects are found on college graduation and future income. Policy implications are discussed.

JEL Codes: I10, I24, J1, J31 Adolescent Obesity, Educational Attainment, and Adult Earnings

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## **1. Introduction**

Childhood obesity has become increasingly prevalent in the United States with recent estimates suggesting that 18.4% of adolescents are obese (Fryar et al., 2012) and a further 13.8% overweight (Ogden et al., 2010). With this dramatic rise has come increasing attention from researchers and policy analysts on the effects of obesity on individuals' health, longevity, employment, and other outcomes. Much of the economics research on obesity has focused on the health and current labor market outcomes associated with adult overweight or obesity (Baum and Ford, 2004; Cawley, 2004; Pagan and Davila, 1997). Depending on the research method and the data used, results range from finding substantial negative effects of obesity on current earnings or employment to the absence of labor market penalties.

Since obesity is itself a chronic condition that incubates and compounds other health conditions (e.g., clinical depression, all cancers, cardiovascular diseases, premature mortality, coronary heart disease, etc.) and behaviors (Hu, 2008), being obese as a child or adolescent can have adverse effects that reach far into adulthood. This might be the case if early obesity affects human capital acquisition and productivity. Indeed, research has found negative effects of obesity on youth academic performance (Datar, 2004; Mo-suwan et al. 2009), high school graduation rates (Sabia, 2007; Okunade et al. 2009), and the probability of attending college (Crosnoe, 2007). Since education is strongly and positively associated with lifetime earnings and other quality of life indicators, child or adolescent obesity may therefore affect adult earnings and other outcomes indirectly, even if no direct relationship exists.

The study goal is to investigate the extent to which obesity at the time of adolescence can predict multiple future adult outcomes that are relevant to the economic well-being of the individual. Our focus on adolescents stems from research indicating that the obesity problem among young people is most pronounced in this age group (e.g., Fryar et al., 2012; Grunbaum et al., 2004; Ogden et al., 2010). In addition, adolescence is the time period in which many

future educational opportunities are determined. In particular, we extend prior studies that investigate educational attainment or performance by considering, for the same longitudinal sample, the effects of obesity on multiple academic attainment thresholds. These include: whether the individual graduated on-time (in four years) from high school; conditional on high school graduation, whether s/he attended college; conditional on college attendance, whether s/he obtained a college degree; and conditional on obtaining a college degree, whether s/he attended graduate school. Finally, we also study the impact of adolescent obesity on adult income. As far as we know, ours is the first study to estimate these multiple outcomes in adult life from early childhood obesity using one dataset.

The balance of our work proceeds as follows. Section 2 discusses the data and the study methods, section 3 presents the results and section 4 offers some concluding comments and that policy implications.

## **2. Data and Empirical Methodology**

The goal of this paper is to determine whether obesity at the time of adolescence can predict future adult outcomes that are relevant to the economic well-being of the individual, namely the sequentially measured academic attainments and earnings. To do this, we use longitudinal data from the National Longitudinal Study of Adolescent Health (Add Health, hereafter), conducted by the Carolina Population Center of the University of North Carolina at Chapel Hill. This is a survey of a nationally representative sample of students in grades 7 through 12 for the 1994-95 first wave survey. Three subsequent waves of follow-up interviews occurred in 1996, 2001-02, and finally in 2007-08, when the sample was aged 25-31. Important for our purposes, the data contain a wealth of information on an individual's health, behaviors, academic attainment and performance, and family background.

Using reported data on height and weight, we computed the Body Mass Index, BMI, (defined as 'Body weight in kilograms / height in meters squared') for each person in the

sample at the time of the first survey wave. We then used these measures to classify individuals as obese, using the 95 percentile cutoff for classification of being obese, which is appropriate for adolescents since they are not yet adults.<sup>6</sup>

The outcomes in our analysis are determined from subsequent survey waves. In particular, we focus on the following educational attainment outcomes: whether the individual graduated from high school on-time (in four years); conditional on high school graduation, whether they attended college; conditional on college attendance, whether they obtained a college degree; and conditional on obtaining a college degree, whether they attended graduate school. We also compare our findings to annual incomes reported in the fourth survey wave that took place 13 years after the first survey, when respondents were aged 24 to 36.

Because obese adolescents are likely to differ from their non-obese peers in many ways that may be related to subsequent academic and economic, it is important to control for these potential confounding factors. Fortunately, the AddHealth data provide a large set of controls. Specifically, as reported in the initial survey, we were able to control for demographics (age, gender, multiple race indicator variables, regional variables); family environment (whether the mother works, whether the father works, number of siblings, mother's education, and measures of how close the individual feels to their mother and father); prior academic success or difficulties (grade point average, whether they skipped or repeated a grade, whether they have an attention problem, whether they attend a private school); behavioral variables (how much television they watch, whether they play sports, how often they play computer games, how often they hang out with friends, and indicator variables for reporting having smoked, used alcohol, used drugs, and had sex); self-reported characteristics of the individual's

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<sup>6</sup> Actual cutoffs, which depend on age, can be found in Carriere (2003). See, also, Hu (2008).

neighborhood environment; and measures of the individual's general and mental health. Appendix Table 1 provides a description of the variables included in our analysis.

Table 1 contains descriptive statistics of these variables and our sample at the time of the initial survey wave. The degree of obesity (8.7%) and overweight (18.5%, not reported) in our sample is substantial. Pathological body weights are most notably present among males, blacks and Hispanics, suggesting the possibility that diverging effects of obesity may be found across race and gender groups. We thus carry out our analyses separately by gender or racial groups.<sup>7</sup>

Our empirical methodology involves the use of probit regressions in the cases of each binary educational attainment threshold as the dependent variable, and linear regression in the case of earnings as the dependent variable. With the use of a large set of control variables, our hope is to minimize any bias that may result from omitting factors that are related to both adolescent obesity and adult outcomes.

### **3. Results**

Table 2 presents the regression model estimates from each of our models, separated by subsample of the AddHealth dataset. The first row includes all individuals in the sample. Overall, we find no evidence of an effect of adolescent obesity on on-time high school graduation. Further, while the point estimate in the college attendance regression suggests a small negative relationship between adolescent obesity and the likelihood of attending college (for the sample who graduated from high school), the estimated coefficient is not statistically significant. The relationship between being obese as an adolescent and ultimately obtaining a college degree, however, is strong and negative. Obese adolescents who go on to attend college are about 9 percent less likely to graduate compared to their non-obese peers.

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<sup>7</sup> Sample sizes did not permit identification of heterogeneous effects by gender and race simultaneously.

(The marginal effect of the obesity coefficient in each probit regression is shown in brackets in Table 2.) However, conditional on college degree attainment, being an obese adolescent does not appear to affect the odds of attending graduate school. Finally, obese adolescents earn 7.5 percent less as adults, on average, than do non-obese adolescents. This earnings differential is observed, depending on the cohort, when individuals were aged 25-31 years, 13 years after the first survey wave, when the obesity measure was taken.

Interestingly, we find that the results derived from the entire sample are masking some heterogeneity in the effects. The remaining rows of table mimic our initial analysis on race or gender subgroups. These results show that the negative effect of obesity on college degree attainment is concentrated primarily among females and whites. Obese adolescents in both of these groups are about 12 percent less likely to complete a college degree than non-obese adolescents.<sup>8</sup> Other research has found, for females but not males, a negative relationship between adolescent obesity and high school performance (Sabia, 2007) and on-time graduation (Okunade et al., 2009). In contrast, our results suggest that the negative effects of obesity on academic attainment for females occur primarily at the level of the college degree.

Despite finding no effects of adolescent obesity on graduate school attendance for the full sample, a small *positive* effect (2 percent) was found for the black subsample.<sup>9</sup> Finally, the negative effects of adolescent obesity on future earnings appears to be mostly concentrated among females and blacks, with obese blacks earning almost 12 percent less in future wages, compared to their non-obese peers.

#### **4. Discussion and Policy Implications**

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<sup>8</sup> Additional results (not shown) suggest that the negative relationship between adolescent obesity and college degree attainment is strongest among white females (14 percent). No significant effects are found for minority females, and a somewhat smaller negative effect (9.4 percent) is found for white males.

<sup>9</sup> Significant positive effects were found for both black males and black females (not shown).

With the high adolescent obesity rates in the United States and a growing adolescent obesity epidemic in other countries, public policy makers, economists, and school administrators are increasingly interested in understanding the influence of obesity of adolescents on their future educational and labor market outcomes. In this paper, using a nationally representative, longitudinal sample, we have contributed to the relevant growing body of research by investigating the effects of adolescent obesity on adult earnings and the likelihood of reaching multiple educational attainment thresholds, from high school graduation up to graduate school attendance. To our knowledge, no other researchers have investigated the relationship between adolescent obesity (a health status measure) and higher education outcomes, despite the increasing importance of advanced degrees in determining labor market success.

Unlike some other studies, we find no evidence that adolescent obesity affects the likelihood of high school graduation. While we also find no evidence of effects of obesity on college attendance, we do find that adolescent obesity, conditional on college enrollment, negatively affects the likelihood of obtaining a college degree, in particular for females and whites. Obese adolescents also generally earn less as adults than non-obese adolescents, especially females and blacks. On the other hand, blacks who were obese during adolescence are slightly *more* likely to attend graduate school after obtaining a college degree.

The results of this study suggest that youth obesity can have long lasting effects on the economic well-being of individuals. Furthermore, the heterogeneous effects we find for some outcomes have implications for growing racial and gender disparities in education, earnings, wealth and perhaps intergenerational wealth transfers. Thus, our results underscore the importance of designing targeted policies aimed at curbing adolescent or child obesity, especially for those groups most susceptible to long-term adverse impacts. However, recent evidence suggests that policies designed to reduce levels of adolescent overweight and



obesity often tend to be very ineffective (e.g., Amis et al., 2012). Our work pinpoints a likely reason for this. That is, there is a need for policymakers to better appreciate that not only do obesity rates vary among different demographic groups, but also that the impact of obesity on the behavior of members of different groups also varies. Policymakers must therefore have a more fine-grained understanding of the context in which policy is enacted, and craft policy accordingly.

While our analysis included many variables related to an adolescent's academic ability, home and school environment, and health, the possibility remains that obese and non-obese adolescents differ in other ways that may influence education and earnings outcomes. Therefore some caution should be taken when interpreting our estimates as precise causal effects. Further research should focus on identifying potential causal pathways leading to these differential outcomes.

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Table 1. Descriptive Statistics

	Mean	Std. Dev.
Obese	0.087	(0.282)
Age	16.014	(1.683)
Males	0.472	(0.499)
White	0.569	(0.495)
Black	0.208	(0.406)
Asian	0.080	(0.271)
Hispanic	0.152	(0.359)
Other race	0.000	(0.023)
Siblings	1.608	(1.422)
Mother's educ.	5.410	(2.410)
Mother works	0.724	(0.446)
Father works	0.677	(0.467)
Closeness to mother	4.331	(1.212)
Closeness to father	3.116	(2.056)
School skipped	1.930	(6.924)
Grade repeated	0.188	(0.391)
Attention problem	1.245	(1.093)
Watch TV	15.571	(14.585)
Play sports	0.464	(0.498)
Play comp games	2.679	(6.346)
Hangs with friends	1.985	(0.989)
Private school	0.073	(0.261)
Urban	0.277	(0.447)
Rural	0.175	(0.380)
West	0.248	(0.432)
South	0.365	(0.481)
Northeast	0.125	(0.331)
Midwest	0.260	(0.438)
Caring neighbor	0.732	(0.442)
Safe neighborhood	0.892	(0.309)
Happy neighborhood	3.942	(1.004)
Mental health 1	11.054	(7.520)
GPA	2.771	(0.832)
Smoke	0.175	(0.380)
Alcohol	0.393	(0.488)
Drugs	0.257	(0.437)
Sex	0.362	(0.480)
General health	3.915	(0.894)
N	11308	

**Table 2: Estimates of Effects of Adolescent Obesity on Academic Attainment and Adult Earnings**

	<b>HS grad on time</b>	<b>College attendance</b>	<b>College degree</b>	<b>Grad school</b>	<b>Income</b>
All	0.007 [0.001] (0.053)	-0.078 [-0.025] (0.050)	-0.224** [-0.089] (0.064)	-0.150 [-0.003] (0.194)	-0.075** (0.029)
<b>N</b>	11261	9775	6826	5048	7715
Females	-0.071 [-0.012] (0.079)	-0.058 [-0.017] (0.073)	-0.309** [-0.122] (0.090)	-0.077 [-0.002] (0.281)	-0.087** (0.043)
<b>N</b>	5939	5316	3908	2741	3951
Males	0.071 [0.016] (0.073)	-0.092 [-0.033] (0.071)	-0.127 [-0.050] (0.094)	-0.200 [-0.002] (0.281)	-0.060 (0.038)
<b>N</b>	5322	4459	2916	2307	3764
Whites	0.011 [0.001] (0.083)	-0.077 [-0.024] (0.074)	-0.302** [-0.120] (0.095)	-0.490 [-0.006] (0.307)	-0.057 (0.041)
<b>N</b>	6306	5610	3985	2876	4459
Blacks	-0.065 [-0.015] (0.101)	-0.046 [-0.016] (0.098)	-0.137 [-0.053] (0.117)	0.741** [0.019] (0.379)	-0.119** (0.059)
<b>N</b>	2318	2012	1339	773	1495
Hispanics	0.038 [0.0011] (0.112)	-0.182 [-0.069] (0.115)	-0.062 [-0.023] (0.171)	--	-0.020 (0.071)
<b>N</b>	1784	1492	934		1216

Notes: Each estimate is derived from a separate probit (for educational outcomes) or OLS (for earnings). Std. Errors are reported in parenthesis and marginal effects in brackets. \*\* and \* indicate coefficient is statistically significantly different from zero at the 5 and 10 percent levels, respectively. Covariates include all variables in Table 1.

**Appendix Table 1: Variable Definitions**

<b>Dependent Variables</b>	<b>Definitions</b>
HS grad on time	On-time high school graduation relative to not graduating or delayed graduation
College attendance	Ever attended college, as reported by Wave IV
College degree	Whether has college degree conditional on attending college, by Wave IV
Grad school	Whether attended grad school conditional on having a college degree, by Wave IV
Income	Total personal income (in logs) before taxes in Wave IV
<b>Independent Variables</b>	
Obese	BMI greater than equal to the 95th percentile
Age	Age in Wave I
Male	Dummy variable indicating males
Black	Dummy variable indicating Black
Asian	Dummy variable indicating Asian
Hispanic	Dummy variable indicating Hispanic, non-white
Other race	Dummy variable indicating other races (non-white)
Siblings	Number of siblings, Wave I
Mother's education	Mother's education level
Mother works	Mother's employment status
Father works	Father's employment status
Closeness to mother	On a scale of 1-5, how close to mother (1: least, 5: most), Wave I
Closeness to father	On a scale of 1-5, how close to father (1: least, 5: most), Wave I
School skipped	Number of times skipped school without excuse, Wave I
Grade repeated	Ever repeated a grade, Wave I
Attention problem	In current year, # of times had problems paying attention (0: never... 4: everyday)
Watch TV	Number of hours per week watch TV, Wave I
Play comp games	Number of hours per week play computer games, Wave I
Hangs with friends	In past week, number of times hung out with friends (0: never... 3: 5 or more times)
Play sports	Whether participates in school sports, Wave I
Private	Dummy variable indicating private school
Urban	Dummy variable indicating whether school is in urban location
Rural	Dummy variable indicating whether school is in rural location
West	Dummy variable indicating whether school is in the West
South	Dummy variable indicating whether school is in the South
Northeast	Dummy variable indicating whether school is in the Northeast
Caring neighbor	Whether people in neighborhood look out for each other, according to respondent, Wave I
Safe neighborhood	Whether respondent feels safe in neighborhood, Wave I
Happy neighborhood	How happy living in neighborhood (1: not at all... 5: very much), Wave I
GPA	Average of student's self-reported grades in math and english/language classes, Wave I
Smoke	Whether smoked every day for 30 days, Wave I
Alcohol	Whether ever consumed alcohol when not with parents/adults, Wave I
Drugs	Whether ever used drugs (marijuana or cocaine), Wave I
Sex	Whether ever engaged in sexual activities, Wave I
General Health	Self-reported health indicator (1: poor ... 5: excellent), Wave I