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Adolescent Obesity and Future College Degree Attainment

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Abstract

The current impact of adolescent obesity on educational attainment is not clear. The objectives of our study were to determine whether adolescent obesity is associated with college degree attainment and how this association may have changed over time. We used data from a contemporary national cohort of over 4,000 persons who were adolescents (aged 14–18) in 1997 to assess the relationship between adolescent obesity and education. To assess for changes in this relationship over time, we also analyzed an older, similarly structured cohort of over 3,000 persons who were adolescents (aged 16–18) in 1981. Our primary outcome was college degree completion. We found that in the older cohort (adolescents in 1979), there were no differences in college degree attainment by adolescent weight status before and after adjustment. However, unadjusted analysis of the contemporary cohort (adolescents in 1997) demonstrated that those who were normal weight as adolescents had a higher prevalence of college degree attainment at follow-up compared to obese adolescents (24% vs. 10%). After adjustment for socio-demographic variables (age, sex, race, height, parental income-to-poverty ratio, parental education, aptitude test scores), obese adolescents were less likely to have attained a college degree compared to normal weight peers (adjusted risk ratio 0.61 95% confidence interval 0.38–0.83). Expectations for a future college degree did not vary by weight status and did not explain this observation. In conclusion, adolescent obesity is associated with lower likelihood of college completion. This relationship was not observed in an older cohort of adolescents.

Introduction

The increasing prevalence of obesity in the United States in recent years has affected most segments of our society, including children and adolescents (1). It is well recognized that obesity is associated with medical morbidity such as diabetes, sleep apnea and increased cardiovascular risk (2,3). However, in addition to significant medical risks, obesity can exact substantial socioeconomic consequences (2).

Previous research has found evidence of socioeconomic consequences of obesity existing in many contexts that could affect a person's well-being (4). For example, several studies have found that weight status may influence a person's employment opportunities. In experimental and observational studies, obese persons are less likely to be recommended for hire (5,6) may be perceived more negatively (7,8) and make lower salaries than their normal weight peers (4,9,10). Furthermore, prior studies have found evidence that the economic impact of obesity is likely to be greater in women (11,12). It has been posited that the social consequences of obesity are primarily mediated by weight-related bias and discrimination,

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DISCLOSURE

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exerted by individuals and institutions (13). However, there may be other mechanisms, possibly biological or genetic, that could contribute to this relationship. For example, obesity may be associated with increased risk of depression (14) which could partially mediate the poorer socioeconomic standing associated with obesity.

The socioeconomic adversities associated with obesity are not only relevant to a person's functioning in society, but could also be reflected in physiologic health. In particular, education provides substantial value and benefit to individuals and is an important influence on several outcomes, including health (15). Those with more education report higher levels of self-reported health (15) and better physical functioning (16). Moreover, lower educational attainment is associated with higher prevalence of health risk factors, higher rates of cardiovascular disease, and infectious disease and higher mortality rates (17). Therefore, the physiological health risks associated with the obese state may be amplified by the health risks associated with lower educational attainment.

As noted in a recent review article, there has been relatively little work on the impact of adolescent obesity on educational attainment (18). Additionally, results from previous work have been conflicting (19-22). Three previous longitudinal studies found that adolescent obesity was negatively associated with educational level completed (19-21) whereas another did not (22). Only one of these studies by Gortmaker *et al.* was conducted on a US cohort (19). This study found that for US youth who were adolescents in the 1970s, adolescent obesity was associated with lower years of education attained in women, but not men; however, college degree attainment was not associated with adolescent obesity in either men or women.

Building upon the prior work of Gortmaker *et al.* and others, the primary aim of this study was to determine whether obesity in adolescence is associated with educational attainment in a similar, but more contemporary, longitudinal cohort. Additionally, although obesity has been thought of as an extremely stigmatizing condition, the increasing prevalence of obesity and changing societal norms related to body weight in recent years may have provided a more normative environment for obesity. Thus, we hypothesized that the higher prevalence of obesity may have mitigated obesity-associated stigma and any possible associations of obesity with socioeconomic adversity. Accordingly, we secondarily sought to determine how this association may have changed over time by conducting a reanalysis of an older, similarly structured cohort.

Methods and Procedures

Study population

We used two longitudinal cohorts for our analysis: the National Longitudinal Survey of Youth 1979 (NLSY79) and the National Longitudinal Survey of Youth 1997 (NLSY97). Both cohorts are sponsored by the US Bureau of Labor Statistics, and were initiated to gain information on youth transition to the work force, labor experiences and educational experiences. The NLSY79 was initiated in 1979 and is composed of (i) a cross-sectional sample of 6,111 respondents designed to be representative of the noninstitutionalized civilian segment of youth living in the United States in 1979 and born between 1 January 1957 and 31 December 1964; (ii) a supplemental sample of 5,295 respondents designed to oversample Hispanics, blacks, and economically disadvantaged white youth living in the United States born during the same time frame as the primary sample; (iii) a sample of 1,280 respondents designed to represent the population born between 1 January 1957 and 31 December 1961 who were enlisted in one of the four branches of the military. The military subsample was not interviewed after 1984, and is not included in our study. Of the remaining participants, the 4,019 respondents eligible for this analysis were 16–18 years

when weight and height were first assessed in 1981. We excluded 27 participants whose weight or height data were not available for this initial assessment, 355 participants without available educational outcomes and four participants with “mental retardation” at baseline.

The NLSY97 is similar to the NLSY79 and was initiated in 1997 to gain more contemporary information on youth training and work experiences. This cohort is composed of: (i) a cross-sectional sample of 6,748 participants, representative of people living in the United States in 1997 and born between 1 January 1980 and 31 December 1984; and (ii) a supplemental sample of 2,236 respondents, designed to oversample Hispanics and blacks born during the same period as the cross-sectional sample. For this analysis, eligible participants were those who were aged 14–18 years at the inception of the study, and thus would have been old enough to attain a college degree at the time of last available data collected in 2005 ($n = 6,009$). We excluded 215 without baseline weight or height data, 946 without educational outcomes data, 32 who reported being pregnant at baseline and 21 with “mental retardation.”

Both the NLSY79 and the NLSY97 are ongoing longitudinal studies. Participants in the NLSY79 were interviewed in-person annually from inception through 1994; since 1994, the cohort has been followed biennially. The NLSY97 has been interviewed in-person, annually since inception.

This study was submitted for review and exempted by the Committee on Clinical Investigation, Beth Israel Deaconess Medical Center, Boston, Massachusetts.

Educational attainment

Our primary outcome of interest is attainment of a bachelor’s degree. Data are collected yearly about educational experiences in both cohorts, and includes information about the highest grade level attended, the highest grade level completed, and degrees attained. In addition to our main outcome, we analyzed the number of years of school completed as a secondary outcome. For both cohorts, outcome was assessed 8 years after the baseline assessment of height and weight: in 2005 for the NLSY97 and 1989 for the NLSY79.

Weight status

Our primary factor of interest is BMI percentile for age and sex. Self-reported weight and height was used to calculate BMI at the beginning of the period of observation of both cohorts. Participants were then grouped into weight categories according to the age/sex-specific 2000 Center for Disease Control growth charts to determine the corresponding BMI-for-age/sex percentile (23,24). Youth are classified as (i) “obese” if their BMI-for-age/sex percentile is ≥ 95 percentile; (ii) “overweight” if their BMI corresponds to >85 percentile and <95 percentile of BMI-for-age/sex; (iii) “normal weight” if their BMI percentile was <85 for age/sex. Baseline weight and height was collected in 1981 for the NLSY79 cohort and in 1997 for the NLSY97 cohort.

Other variables of interest

The NLSY also collects information on other factors that may influence educational attainment and weight status and thus may confound any observed relationship between obesity and educational attainment. We included these factors in all of our multivariable models: age (years), sex, race (black, Hispanic, nonblack/non-Hispanic), height (meters), parental income-to-poverty ratio (quintiles), highest educational year completed for both the mother and father of the participant (less than high school, high school degree, some advanced education), participant aptitude test scores (quintiles).

Statistical analysis

We used descriptive statistics to characterize participant's demographic and clinical characteristics at baseline. We first examined the unadjusted association between adolescent weight status and educational attainment.

We then used multivariable generalized linear equations using Poisson distribution and a log link to estimate unadjusted and adjusted probability of attaining a bachelor's degree by weight status. In contrast to logistic regression which yields odds ratios as the measurement of effect; Poisson regression can be used to analyze dichotomous outcomes and yields risk ratios as the estimate of effect (25). Risk ratios are more appropriate measures of effect than odds ratios when estimating nonrare outcomes (26).

To estimate the association of adolescent weight status with years of education completed, we used multivariable linear regression. Interaction terms were used in models to test for effect modification by race and sex.

For all multivariable models, we included the baseline factors that could affect the measurement of the relationship between weight and education. Because some variables had significant numbers of missing values, we ran models to determine whether our estimates of association were sensitive to the missing values. We ran models on the subset of participants with no missing baseline characteristics; one with all of the covariates included and one without including the variables with missing values. There was very little difference between the estimate of association between our outcome variable and main predictor variable between the two models. Thus, participants with missing variables were included in the models employing indicator variables for the missing values. To examine whether the relationship between weight status and achieving a bachelor's degree changed over time between the two cohorts, we created a model combining the two cohorts and tested for an interaction between weight status and cohort year. The interaction models used the same regression procedures as our primary analysis and were also adjusted for the same relevant confounders.

To better understand why there might be an inverse association of adolescent obesity with attainment of a college degree in our contemporary cohort, we explored the association of weight status and adolescents' future expectations. In approximately half of our sample of the 1997 cohort, data were available regarding their personal expectations related to future college degree attainment. This subset of participants was asked at baseline, "What is the percent chance that you will have a four-year college degree by the time you turn 30?" We considered those who responded that they estimated a 90% chance or better as having "high expectations" for college degree attainment. We used multivariable generalized linear equations to estimate the adjusted prevalence of having high expectations for obtaining a college degree by weight category. To determine the extent to which expectations for college may explain any differences in college degree attainment by weight, we constructed models including the expectations for college variable.

Because, the NLSY cohorts were assembled using a complex sampling strategy, all analyses were weighted to adjust for unequal sampling fractions. We corrected the variances of estimators derived under simple random sampling assumptions by dividing the test statistic by measures of the design effect, as recommended by the NLSY technical report (27). This strategy was employed for all reported statistical models to approximately correct the test statistics for clustering induced by sampling design. All analyses were conducted using STATA statistical software (version 9; STATA, College Station, TX).

RESULTS

The baseline characteristics of both samples are described in Table 1. The baseline age for the 1979 cohort was older than that of the 1997 cohort. Obesity was more prevalent in the 1997 group (9.7%) vs. the 1979 group (3.3%). Additionally, college graduation was slightly more common in the 1997 cohort (22% vs. 21%).

To assess for temporal changes in the relationship between education and adolescent weight status, we first conducted analyses on the older cohort of persons who were adolescents in 1981 (NLSY79). In both unadjusted and adjusted analyses, there was no difference by adolescent weight status in college degree attainment, our main outcome of interest (Table 2). In unadjusted analyses, those who were obese in the 1979 cohort completed fewer years of education than their normal weight peers, however, this relationship was no longer significant after adjustment (Table 2). We did not find any evidence for effect modification by race or sex in these analyses.

We then conducted similar analyses on those who were adolescents in 1997. We observed an inverse relationship between weight status and college degree attainment. In unadjusted analysis, the prevalence of college graduation in the normal weight was more than twice that of the obese group (Table 2). In the multivariable-controlled models using the 1997 cohort, we found that those who were obese as adolescents were significantly less likely to have a college degree 8 years later, compared to those who were classified as overweight and normal weight (Table 2). We did not find any difference by weight status in years of education attained (Table 2). Additionally, we did not detect any significant evidence for effect modification by sex or race in these analyses. The observed difference across cohort year in the relationship between obesity and achievement of a college degree reached statistical significance ($P = 0.008$ for interaction between weight status and cohort year).

To understand better why there might be an inverse relationship between adolescent obesity and college degree attainment in our contemporary cohort, we analyzed the impact of future college expectations. In the subset of participants with this information available, unadjusted analyses found that adolescents who were overweight or obese were somewhat less likely to have high expectations for college, in a relationship that bordered on statistical significance (Table 3). However in adjusted analyses, weight status was no longer associated with expectation for college degree attainment (Table 3). Having a high expectation for college degree attainment was associated with a much higher probability of achieving a college degree (adjusted risk ratio 3.01, 95% confidence interval 2.39–3.80); however, the addition of college expectations to our adjusted models did not explain the inverse association of adolescent obesity with college degree attainment.

DISCUSSION

We found that obesity during adolescence is associated with lower likelihood of attaining a college degree in a contemporary US representative population but not in an older cohort. Our findings suggest that the adverse impact of obesity on achieving education may have intensified in recent years. Mean number of years of education, however, was not significantly associated with adolescent weight status in either the earlier or contemporary cohort.

An association between adolescent obesity and higher education in the US has been suggested in earlier studies. Canning and Mayer compared members of the 1964 graduating class of a suburban high school to students in the entering class of two prestigious colleges of the same year and found that the prevalence of obesity was much lower in the college cohort, compared to the high school cohort (28). However, among the high school students

there were no significant differences by weight with regard to academic criterion and application rates that would suggest an explanation for the lower prevalence of obesity adolescents in the college cohort. The authors conclude that “marked discrimination is exercised by teachers and college interviewers against obese adolescents.”

Longitudinal studies of adolescent obesity and education have been conflicting and have primarily studied non-US populations. One study of over 700,000 Swedish men born between 1952 and 1973 found that men who had a BMI ≥ 25 kg/m² at age 18 years, were less likely to complete 15 years of school (minimum requirement for college degree), compared to those with BMI <25 kg/m² at age 18 years (21). Sargent *et al.* studied a British cohort of men and women who were adolescents in the mid 1970s and found that at age 23 years, men and women who had been obese at age 16 years completed significantly fewer years of school, compared to those who did not have adolescent obesity (22). However, Viner and Cole using another British birth cohort found that in men and women born in 1970, there was no effect of obesity at age 10 years, on years of school completed at age 30 (20). The discrepant results between the British studies may be because obesity in the pre-adolescent period may have different influence on educational outcomes than obesity in older youth.

In the United States, Gortmaker *et al.* previously analyzed data from the NLSY79 to examine the association between adolescent weight status and several different socioeconomic outcomes (19). In sex-stratified multivariable-adjusted analyses, they found that adolescent obesity is associated with significantly fewer years of education (0.3 95% confidence interval 0.1–0.6) in women. Similar to our analysis of this cohort, they did not find a significant difference in college completion rate between obese and normal weight women. In men, they found no association between adolescent obesity and years of education or college completion. We reanalyzed this cohort for the purposes of comparison to the more contemporary cohort with similar results. In our study, we found that participants in the 1979 cohort who were obese as adolescents attained fewer years of education with a similar effect size; however, our results were not statistically significant likely because of differences in sample size since our analysis was restricted to include only adolescents aged 16–18 years in 1981 whereas Gortmaker *et al.* used the entire NLSY79 cohort aged 16–24 years in 1981. In another US study of adolescents, Crosnoe examined the relationship between adolescent obesity and enrollment in college (29). He found that obese girls were 50% less likely to enroll in college than their nonobese peers. Although, our study did not find significant differences the impact of weight status on college completion between boys and girls, previous work has suggested that the socioeconomic consequences of obesity is greater in females (11,12). For example, in the above mentioned study, Crosnoe, found that the rate of college enrollment for boys was not significantly associated with weight.

One of the aims of our study was to examine how the association of obesity with educational attainment has changed over time. The past 20 years has seen a marked rise in the prevalence of obesity in all demographic groups resulting in obesity being more normative. During the same time frame, many would argue that society has developed a greater tolerance of individual differences and diversity in personal behaviors (30). In this context, we hypothesized that we might see lessening of the impact of obesity on educational attainment over time. The importance of environmental context on the impact of weight on education has been suggested in the prior work by Crosnoe (29). Although he found that obese girls were less likely to enroll in college, subset analysis suggested that obese girls who matriculated in high schools with a high prevalence of obesity were just as likely to enroll in college as their nonobese peers. These data suggest that a higher prevalence of obesity in the school provides a local “normative” environment that may protect girls from

some of the educational consequences of obesity. In our study, despite the increasing national prevalence of adolescent obesity in recent years, any potential changes in societal norms over time do not appear to have mitigated the adverse educational consequences.

Our study suggests that the impact of adolescent obesity may reach well beyond direct medical complications, and have important implications for future wealth and social status, as educational achievement is intricately associated with future earning potential and financial resources, which in turn affects future health. Though we did not observe an impact of obesity on years of education completed, we found a negative effect of obesity on college completion. This may reflect the slightly different social constructs that these two outcomes represent. Although attainment of a college degree has a fairly narrow interpretation and would be viewed as a positive social outcome, higher number of years of education does not distinguish between modes of education (i.e., vocational training, community college) or whether an individual was held back in school which may have different social connotations.

The mechanism underlying the association between adolescent obesity with educational attainment is not clear. Our study adds to the previous literature by suggesting that expectations for college degree attainment do not appear to explain this association. We speculate that biases against obesity and the cultural standards of physical attractiveness that influence adolescent interpersonal interactions and self-esteem may have negative influences on scholastic achievement. Studies of children have found that discriminatory attitudes toward overweight peers can develop early. Richardson *et al.* conducted a landmark study in 1961 that measured prejudiced attitudes in children by asking them to rate line drawings of other children, including drawings of an obese child and children with disabilities (31). They found that the obese child was rated least likable. A more recent study using similar methods found that not only was the drawing of the obese child again ranked lowest, but the ratings of the drawing of the obese child were significantly lower than in 1960 (32). Moreover, other studies suggest that childhood and adolescent obesity is associated with lower self-esteem, social marginalization and body-image shame (33-35).

Adults may also harbor discriminatory attitudes toward obese adolescents and contribute to stigma that may impede the academic progress of obese adolescents. One study of school staff found that although most did not endorse negative attitudes toward obese persons, about 20% agreed that obese persons are usually untidy and are less likely to be successful than nonobese persons (36). Other work has found that obese youth are underrepresented in those who attend college and that obese women were less likely to receive financial support for college from their families, compared to nonobese peers (37,38).

Lastly, other factors, including biological and genetic factors, may covary with both weight status and academic potential and contribute to this relationship. Recent attention has been paid to the relationship between impaired insulin signaling and altered levels of cytokines, seen in obesity, with decreased cognitive functioning (39,40). Increased BMI is also associated with increased risk of sleep disturbance, including sleep apnea in children. Prior work has found that sleep disturbances can be associated with cognitive impairment in children (41-43). Further exploration of this relationship and potential mediators is warranted to understand and diminish the barriers to educational attainment that obesity may present.

There are several limitations of this study that should be considered. This study was conducted using data collected for purposes other than the particular aims of this work. The height and weight data are self-reported which may lead to some misclassification; because previous work suggests that obese participants are more likely to underreport weight than

thinner participants, misclassification would likely tend to bias the results to the null. Further, how this misclassification may have changed over time is not clear. We did not have information about pregnancy at baseline in the adolescents of the older NLSY79 cohort, however the numbers are likely to be extremely small. Additionally, variables used to control for socioeconomic status and scholastic aptitude were not available for a significant portion of the sample; however, sensitivity analyses conducted using statistical models including only those with no missing data did not alter our findings. The prevalence of obesity in the older, 1979 cohort was much lower than in the 1997 one, consistent with secular trends. The lack of measured association in the 1979 cohort between obesity and education may be a function of a smaller numbers of those with the factor of interest in this cohort. Lastly, there could be unknown, unmeasured or poorly measured confounding factors that could influence our assessment of the relationship between weight and our outcomes. For example, socioeconomic status is a potential confounder of our relationship of interest. Though we adjusted for several different measures of socioeconomic status in our models, this is a complex construct and residual confounding could remain.

In conclusion, our study demonstrates that adolescent obesity in a contemporary cohort is associated with lower likelihood of college graduation, more so than in an earlier, comparable US cohort. Furthermore, this association is not explained by lower educational expectations on the part of obese adolescents. Our study suggests that even with the increased prevalence of obesity in recent decades, the social consequences may be increasing.

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Table 1

Baseline characteristics

	Adolescents in 1979				Adolescents in 1997					
	Total (n = 3,634; 100%)	Obese (3.3%)	Overweight (10.2%)	Normal weight (86.5%)	P value	Total (n = 4,793; 100%)	Obese (9.7%)	Overweight (13.0%)	Normal weight (77.3%)	P value
Age at baseline, mean (s.d.), years	17.1 (0.02)	17.1 (0.09)	17.0 (0.05)	17.1 (0.02)	0.71	15.2 (0.02)	15.2 (0.05)	15.1 (0.04)	15.2 (0.02)	0.04
Male	51	67	58	49	<0.005	52	65	58	49	<0.005
Race										
Nonblack/Non- Hispanic	79	67	77	80	<0.005	73	61	69	75	<0.005
Black	14	21	16	14		16	25	18	14	
Hispanic	7	12	7	6		12	14	13	11	
Highest grade completed by mother										
<HS	33	40	40	32	0.03	14	17	19	13	<0.005
HS	46	44	46	46		38	47	35	37	
>HS	21	16	15	22		48	36	46	49	
Highest grade completed by father										
<HS	33	34	45	32	<0.005	16	21	20	15	<0.005
HS	37	41	31	37		37	44	40	36	
>HS	30	25	24	31		47	35	40	49	
Household income-to- poverty ratio, mean (s.d.)	269.4 (4.2)	235.8 (17.2)	247.4 (11.9)	273.3 (4.6)	0.02	348.6 (5.5)	293.5 (13.5)	316.7 (12.9)	360.9 (6.5)	<0.005
Participant aptitude test, mean (s.d.) ^a	429 (0.6)	41.3 (4.0)	38.6 (2.2)	43.4 (0.6)	0.03	54.2 (0.5)	47.5 (1.6)	51.1 (1.4)	55.5 (0.5)	<0.005
Height, mean, (s.d.) meters	1.7 (0.002)	1.7 (0.012)	1.7 (0.007)	1.7 (0.002)	0.53	1.69 (0.002)	1.71 (0.006)	1.69 (0.004)	1.69 (0.002)	<0.005
Rural residence	24	27	20	24	0.25	27	27	31	27	0.69

Data are given as weighted percentages unless otherwise noted.

^aDifferent scales used for aptitude test for each cohort. In models, test scores are included as quintile rank.

Table 2

Weight status in adolescence and educational attainment

	NLSY 1979				NLSY 1997			
	Years of education completed		Successful college degree attainment		Years of education completed		Successful college degree attainment	
	Unadjusted mean	Adjusted ^a mean	Unadjusted prevalence	Adjusted ^a likelihood	Unadjusted mean	Adjusted ^a mean	Unadjusted prevalence	Adjusted ^a likelihood
Normal weight	13.0	12.6	21.2%	1.00	13.7	13.5	23.8%	1.00
Overweight	12.6	12.5	15.8%	1.03 (0.70–1.37)	13.5	13.5	16.7%	0.85 (0.65–1.05)
Obese	12.8	12.6	18.0%	1.13 (0.61–1.65)	13.1	13.3	9.9%	0.61 (0.38–0.83) *
P value for trend	0.02	0.48	0.13	0.53	<0.005	0.6	<0.005	<0.005

^a Adjusted for age, height, sex, race, parental income and education, participant aptitude tests and rural residence.

* $P < 0.05$

Table 3
Association of weight status with expectations for college for those who were adolescents in 1997

	Percentage of adolescents with high expectations at baseline for future college degree attainment	
	Unadjusted	Adjusted ^b
Normal weight	51	50
Overweight	46	51
Obese	46	50
<i>P</i> value for trend	0.06	0.94

^aHigh expectations for future college degree attainment defined as having perceived that the chances that they will have a college degree by age 30 years are 90%.

^bAdjusted for age, height, sex, race, parental income and education, participant aptitude tests and rural residence.