

The role of poverty status and obesity on school attendance in the U.S.

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Abstract:

Purpose: Several studies have shown that obesity influences school performance. Little is known about the joint effect of poverty and obesity associated with school attendance.

Methods: Data are from the National Survey of Children's Health (N = 93,151), a nationally representative sample of U.S. youth aged 10–17 years. Our dependent variable was ≥ 11 days of school days missed per year. Body mass index was classified as normal, overweight, and obese using age- and sex-specific criteria. Federal poverty level (FPL) was classified as $< 200\%$, $200\%–399\%$, and $\geq 400\%$ (high income). Covariates included gender, age, child's race or ethnicity, maternal physical and mental health, child's health, family composition, and household tobacco use. Logistic regression models and prevalence ratios were estimated, accounting for the complex survey design.

Results: The odds of missing ≥ 11 days of school among overweight youth was 1.5 times that of normal-weight youth (95% confidence interval (CI) = 1.22–1.85) and 1.7 (95% CI = 1.35–2.13) times among obese youth in fully adjusted models. In joint effects models, the probability of missing school was significantly greater for obese youth in both the $< 200\%$ FPL group (prevalence ratio = 1.78, CI = 1.36–2.34) and the $\geq 400\%$ FPL group (prevalence ratio = 2.88, CI = 1.91–4.35), when compared with their normal-weight, higher income peers. Predicted probabilities revealed sharper gradients for higher income youth.

Conclusions: Obesity influences school absenteeism across all income categories. Nonetheless, there may be distinct reasons for missing school for lower and higher income youth, and the long-term consequences of school absences may also differ for these populations.

Keywords: Obesity | Poverty level | School attendance

Article:

The prevalence of obesity has increased more than three-fold among youth aged 12–19 years in the United States over the past 30 years [1], [2]. A growing body of research has demonstrated the deleterious health effects of obesity on childhood health status [3], [4], [5], [6] and across the life course [7], [8]. Moreover, obesity is likely to influence all aspects of children's development, including schooling. Given that the United States ranks 22 of 27 on upper secondary education graduation rates among industrialized nations [9], the obesity epidemic among adolescents may further contribute to the pressing school challenges facing the nation.

Studies conducted to date generally show that obesity is associated with worse school indicators [10], [11], [12], [13], [14], [15], [16]. However, previous research has neglected potential synergistic influences of poverty and obesity on school performance, thus missing the true impact of obesity for the most vulnerable of children. For example, in the education literature, poverty has been consistently associated with increasing school absences, often resulting in poor academic performance and problems with social and cognitive development [17], [18], [19], [20], [21]. The extent to which poverty exacerbates the role of obesity on school indicators has not been established. Most work to date has largely examined their independent effects. Using data from children enrolled in public schools in Philadelphia during the 2004–2006 academic years, Rappaport et al. [22] found that only the most obese youth (body mass index [BMI] >99th percentile) were more likely to miss school than youth of normal-weight status. In this study population, the authors also found that school absence was 24% greater among children who qualified for a reduced price on school lunches than those who did not qualify for the program, suggesting that poverty was an important predictor of school attendance.

In the present study, we directly investigate if poverty and obesity jointly pattern school attendance. We hypothesized that poverty would modify previously observed obesity–school associations, with poor obese youth showing stronger associations than other youth because of the added health and social consequences resulting from living in poverty. We tested this hypothesis using data from the 2003 and 2007 National Survey of Children's Health (NSCH), a nationally representative sample of U.S. youth containing data on school absences, BMI, and several measures of health status of the child and the mother.

Methods

Study population

Our study population included youth sampled in the NSCH [23]. This survey is conducted by the National Center for Health Statistics and sponsored by the Maternal and Child Health Bureau, Health Resources and Services Administration, U.S. Department of Health and Human Services. The NSCH is a representative sample of U.S. youth aged <17 years. Households with at least one child aged ≤ 17 years are sampled using random digit dialing (RDD) in each of the 50 states and the District of Columbia. In households with more than one child, a child was chosen at random to be the subject of the study. Interviews were performed with parents or guardians who were the most knowledgeable about the child's health. In the present study, we combine data from 2003 and 2007 to increase the stability of estimates obtained on number of school days missed. The 2003 survey was conducted between January 2003 and July 2004 and gathered data from 102,353 respondents with a weighted response rate of 55.5%. The 2007 survey was conducted

between April 2007 and July 2008 among 91,642 participants, with a 46.7% weighted response rate among households with children.

Study measures

Our dependent variable was the number of school days missed and main independent variables included BMI and poverty status. Based on categories created by the NSCH, we used the category of ≥ 11 days of school days missed per year to represent a “high” number of school absences. The NSCH obtained weight and height of children through parental report and BMI is calculated only for children ≥ 10 years. Children were classified as normal weight, overweight, or obese if their BMI percentile was $\leq 85\%$, $85\%–94\%$, or $\geq 95\%$, respectively, using age- and sex-specific percentile classifications established by the Centers for Disease Control and Prevention [24]. The federal poverty level (FPL) of the home in which the child lived was based on federally established thresholds of income and number of family members per household. Using categories commonly applied in the literature and by the NSCH, we classified youth as living $<200\%$ of the FPL, $200\%–399\%$ of the FPL, and $\geq 400\%$ of the FPL. Additional covariates included gender, age, race or ethnicity, maternal physical and mental health (classified as excellent or very good; good; or fair or poor), the child's overall health status (excellent or very good; good; or fair or poor), family composition (two-parent household, single-parent, and other), and tobacco use in the household (yes or no).

Statistical analysis

Percent distributions and means were calculated for all study participants and by FPLs. We fit logistic regression models (odds ratios [OR]) to examine the association between BMI and the number of school absences and included potential confounders based on the literature and measures we considered relevant to our study question. Model 1 included BMI of the child as a main predictor, model 2 included BMI, age, gender, and child's race or ethnicity, model 3 included variables in model 2 plus FPL, model 4 additionally adjusted for physical and mental health of the mother, child's health, tobacco use, and family composition. We fit models estimating prevalence ratios (PR) and predicted probabilities to test for the joint effect of poverty and BMI to avoid potential biases introduced by use of OR when testing for interaction [25]. We calculated the joint effect of BMI and poverty status by creating a nine-level variable combining across categories of BMI and FPL: $<200\%$ FPL with normal weight; $200\%–399\%$ FPL with normal weight; $\geq 400\%$ FPL with normal weight; $<200\%$ FPL with overweight; $200\%–399\%$ FPL with overweight; $\geq 400\%$ FPL with overweight; $<200\%$ FPL and obese; $200\%–399\%$ FPL and obese; and $\geq 400\%$ FPL and obese. Children with normal weight and $\geq 400\%$ of FPL served as the referent group. We also conducted post hoc pairwise comparisons of these groups. Our final analytic data set includes 94,639 children aged 10–17 years. All analyses were performed in SAS version 9.2 (SAS Institute Inc., Cary, NC) and SAS-callable SUDAAN 11.0.0 (Research Triangle Institute, Research Triangle Park, NC) to account for the complex survey design of NCHS. The study was approved by the authors' institutional review board.

Results

Table 1. Characteristics of the study population (weighted) by FPL, NSCH, 2003–2007

Characteristic	Household FPL				
	N	Total	<200% FPL	200%–399% FPL	>400% FPL
Age of child, mean (SE)	94,639	13.49 (.02)	13.40 (.03)	13.51 (.03)	13.59 (.03)
Gender of child, %					
Male	49,019	50.70	50.17	51.33	50.67
Female	45,505	49.30	49.83	48.67	49.33
Race and ethnicity of child, %					
Hispanic	10,116	17.11	28.56	12.34	7.55
Black, non-Hispanic	9,340	15.19	23.48	12.26	7.67
Other, non-Hispanic	7,009	7.19	7.12	6.29	8.30
White, non-Hispanic	66,686	60.52	40.84	69.11	76.48
School days missed, %					
0 days	20,196	24.12	27.69	22.99	20.84
1–5 days	55,799	57.85	51.83	59.51	63.67
6–10 days	11,779	12.16	12.90	12.28	11.06
≥11 days	5,546	5.88	7.58	5.23	4.43
BMI of Child, %					
Normal weight	64,475	68.90	60.58	70.13	77.51
Overweight	13,873	15.49	17.63	15.52	12.89
Obese	12,460	15.61	21.79	14.35	9.60
Child overall health status					
Excellent or very good	81,689	82.53	70.70	87.63	92.14
Good	10,378	13.58	22.03	10.17	6.45
Fair or poor	2,541	3.89	7.26	2.20	1.41
Physical health status of mother					
Excellent or very good	57,682	61.78	44.30	66.78	78.05
Good	20,117	25.37	32.75	24.56	17.06
Fair or poor	9,233	12.85	22.95	8.66	4.90
Mental and emotional health status of mother					
Excellent or very good	63,885	69.42	54.63	74.21	82.52
Good	17,572	22.74	31.21	20.77	14.36
Fair or poor	5,523	7.85	14.15	5.02	3.12
Tobacco and derivatives used in household					
No	66,459	70.66	62.76	70.98	80.61
Yes	27,446	29.34	37.24	29.02	19.39
Family Structure					
Two parents (biological, adoptive, and/or stepparent)	68,161	70.59	53.77	76.39	85.65
Single mother, no father present	18,539	23.13	38.71	17.26	9.78
Other family type	6,223	6.27	7.53	6.35	4.57

BMI = body mass index; FPL = federal poverty level; NSCH = National Survey of Children's Health; SE = standard error.

Table 1 presents descriptive characteristics of the study participants. The mean age of participating youth was 13.5 years, which was similar across all categories of poverty. Slightly more than half of study participants were male and 60.5% of youth were non-Hispanic white, 17.1% were Hispanic, 15.2% were non-Hispanic black, and 7.2% were other, non-Hispanic. Overall, nearly 6% of youth missed ≥11 days of school per year. Youth living in households at <200% of the FPL had the highest percentage of school absences at 7.6% compared with 4.4% of youth in higher income categories. Eight percent of Hispanic and non-Hispanic black youth were living in the highest income category (≥400% FPL) compared with 76.5% of non-Hispanic white youth. Overall, 16% of youth were obese, which increased to 21.8% for youth living in

households <200% the FPL. Most youth were in excellent or very good health (82.5%) and most mothers were also in either excellent or very good physical and mental health, although this varied across poverty levels with worse health experienced among those living at <200% FPL.

Table 2. Associations between BMI, household poverty, and other correlates of school days missed, NSCH, 2003–2007

Characteristic	Model 1	Model 2	Model 3	Model 4
	Odds ratio 95% CI	Odds ratio 95% CI	Odds ratio 95% CI	Odds ratio 95% CI
BMI of child				
Overweight	1.50 (1.24–1.81)	1.59 (1.31–1.93)	1.52 (1.25–1.84)	1.50 (1.22–1.85)
Obese	1.90 (1.59–2.27)	2.12 (1.76–2.56)	1.94 (1.59–2.37)	1.69 (1.35–2.13)
Normal weight	1.00	1.00	1.00	1.00
Age of child				
10–12 years		.66 (.55–.78)	.65 (.54–.78)	.72 (.59–.87)
13–15 years		.86 (.73–1.00)	.85 (.73–1.00)	.86 (.72–1.01)
16–17 years		1.00	1.00	1.00
Gender of child				
Female		1.22 (1.07–1.39)	1.21 (1.06–1.38)	1.22 (1.06–1.40)
Male		1.00	1.00	1.00
Race or ethnicity of child				
Hispanic		1.04 (.82–1.31)	.86 (.67–1.10)	.75 (.56–1.00)
Black, non-Hispanic		.62 (.51–.74)	.51 (.43–.61)	.42 (.34–.52)
Other, non-Hispanic		.93 (.76–1.15)	.87 (.70–1.07)	.85 (.68–1.05)
White, non-Hispanic		1.00	1.00	1.00
Household FPL				
<200% FPL			1.96 (1.63–2.35)	1.16 (.93–1.44)
200%–399% FPL			1.19 (.98–1.44)	.98 (.80–1.20)
≥400% FPL			1.00	1.00
Children overall health status				
Fair or poor				4.81 (3.64–6.36)
Excellent, very good, or good				1.00
Physical health status of mother				
Fair or Poor				1.50 (1.21–1.86)
Excellent, very good, or good				1.00
Mental health status of mother				
Fair or Poor				1.38 (1.10–1.73)
Excellent, very good, or good				1.00
Tobacco and derivatives used in household				
Yes				1.73 (1.49–1.99)
No				1.00
Family composition				
Single parent				1.83(1.50–2.22)
Other living situation				.68 (.36–1.27)
Two parents (biological, adoptive, or stepparent)				1.00

BMI = body mass index; CI = confidence interval; FPL = federal poverty level; NSCH = National Survey of Children's Health.

In Table 2, we present crude and adjusted associations between BMI, household poverty level, other covariates, and school absence. The odds of missing ≥11 days of school among overweight youth was 1.5 times that of normal-weight youth (95% CI = 1.2–1.9) and among obese youth the OR was 1.9 (95% CI = 1.6–2.3) in unadjusted models (model 1). This association remained fairly consistent after adjusting for age, gender of the child, and child's race or ethnicity (model

2). Model 2 also shows that non-Hispanic black youth had a significantly lower odds of missing school (OR = .62, 95% CI = .51–.74) compared with non-Latino white youth.

Model 3 additionally adjusts for federal poverty status and indicates that the association between obesity and overweight and school absence remained the same. For poverty status, the odds of a high number of school days missed was 1.96 times (CI = 1.63–2.35) that of youth living in the lowest poverty level (<200% FPL) and 1.19 times (CI = .98–1.44) greater among those at 200%–399% FPL compared with the highest income group. The significant association between poverty status, BMI, and school absence remained in model 4, which additionally adjusts for health status of the child and mother, family composition, and use of tobacco in the home. Also, this final model shows higher odds of missing school for youth in poor health, youth with mothers in poor health, or those living in homes where tobacco is consumed.

Table 3 and Figure 1 present joint effect results and the predicted probability of missing school by obesity and poverty status. Youth who were in the <200% FPL category (i.e., the poorest category) and obese were significantly more likely (PR = 1.78, CI = 1.36–2.34) to miss school than their normal-weight peers and higher income peers (referent category). Obese and higher income (i.e., ≥400% FPL) youth were nearly three times more likely to miss school when compared with the referent category (PR = 2.88, CI = 1.91–4.35). Figure 1 presents these results using predicted probabilities. Results show gradients in missing school by BMI status for all income groups, with the sharpest gradient observed for youth in the higher income category. Furthermore, the predicted probability of missing school among poor obese youth was .08, whereas for higher income obese youth it was .13. Post hoc pairwise comparisons revealed that both of these groups were significantly different ($p < .01$ for each) when compared with their normal-weight, higher income peers but not significantly different from each other ($p = .07$).

Table 3. Joint effect estimates of BMI and poverty status on school days missed, NSCH, 2003–2007

FPL	BMI of the child		
	Normal	Overweight	Obese
<200%	1.35 (1.11–1.64)	1.88 (1.44–2.4)	1.78 (1.36–2.34)
N	15,318	4,407	5,075
200%–399% FPL	1.12 (.94–1.33)	1.63 (1.07–2.49)	1.60 (1.12–2.28)
N	23,073	5,010	4,311
≥400% FPL	1.0	1.42 (1.08–1.86)	2.88 (1.91–4.35)
N	26,084	4,456	3,074

Prevalence ratios shown with their respective lower and upper 95% limits. Normal BMI and ≥400% FPL is the reference group. Estimates are adjusted for children's overall health status, gender of the child, age, physical and mental health status of the mother, race or ethnicity, tobacco used in the house, and family composition. BMI = body mass index; FPL = federal poverty level; NSCH = National Survey of Children's Health.

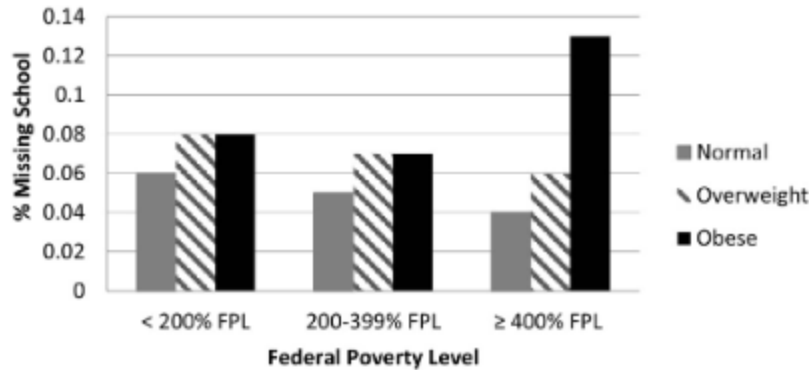


Figure 1. Predicted probability of missing school by weight and poverty status, NSCH, 2003–2007. Predicted probabilities modeled from logistic regression model outlined in Table 3 (adjusted for children's overall health status, gender of the child, age, physical and mental health status of the mother, race or ethnicity, tobacco used in the house, and family composition) using probabilities obtained for each category of BMI and poverty status.

Discussion

Our study was comparable to other studies that have shown that youth who are overweight or obese have higher odds of missing more school than their normal-weight peers. Furthermore, youth living in poor households, with health problems, or with mothers in poor health also had higher odds of missing more school. These crude associations remained in models that simultaneously adjusted for obesity, poverty, health status of the child and mother, family composition, and use of tobacco in the home. Joint effect models suggest that *both* poor and nonpoor obese youth missed school more often than their normal-weight, higher income peers.

The findings from the present study were consistent with prior work indicating that obese children are more likely to miss more school days than overweight or normal-weight peers. Using the 2007 NSCH database, Halfon et al. [3] showed that childhood obesity was associated with higher odds of activity restriction, grade repetition, and three or more missed school days, as well as a number of health conditions including higher rates of asthma, fair or poor dental health, allergies, and headaches. Li et al. [26] showed that overweight (OR = 1.61, CI: .52–4.97) and obese (OR = 2.14, CI = 1.01–4.55) children had higher odds of missing ≥ 12 school days than their normal-weight peers using National Health and Nutrition Examination Survey data from 2005 to 2008. Factors explaining this association have largely centered on the health status of the child and the comorbid conditions that accompany obesity [17]. In our study, we adjusted for the general health status of the child and the mother's physical and mental health and results remained virtually unchanged. However, at least some of the child's health status may be a direct consequence of obesity, and thus results would be “overadjusted” if the child's health is in fact a mediator.

Our results reveal important differences in the association between obesity and school absenteeism within and between poverty categories. First, in addition to the general obesity–school association, we replicated prior work indicating that youth in the poorest income category (<200% FPL group) had, on average, a higher probability of missing school than all other income groups, except for the higher income, obese group. Second, the sharpest gradient in

missing school by BMI category was observed for the higher income group ($\geq 400\%$ FPL category), with less-consistent gradients observed in the poorest and middle-income categories. Finally, our initial hypothesis of greater risk of missing school for obese, poor youth was not supported by the data, although they were significantly more likely to have higher school absenteeism when compared with their normal-weight, higher income peers. There may be distinct explanations for these findings. For example, higher income, obese youth may miss school for health care visits or interventions, which poor youth may not be accessing. Furthermore, higher income parents may be able to supplement instruction at home with private tutoring or other educational support mechanisms if their children miss school because of obesity-related care, thereby mitigating the long-term consequences of severe school absenteeism.

Another possible explanation for our findings is the role of stigma surrounding obesity in higher socioeconomic families. Multiple studies have shown that obese children are more exposed to negative stigmatization, bullying, or social isolation among peers, whereas some studies have additionally shown stigmatization among parents, school faculty, and the general public [27], [28], [29], [30]. Although processes of stigmatization can exist across all levels of income status, some studies suggest that there are distinct image-related pressures among youth from high-income families. Boyd et al. [31] found that girls whose mothers worked in professional occupations perceived themselves as overweight more often, and that girls from low-income families perceived themselves as overweight less often. Other research has shown that eating disorders are also greater among higher income youth, including racially or ethnically diverse populations [32], [33], [34]. Thus, the reasons for missing school and its potential impact on school performance may have substantively different explanations for poor and nonpoor youth, which we were not able to directly examine in the present study.

There are other potential limitations that should be considered when interpreting the results from our study. NSCH restricts BMI calculations to youth 10–17 years of age in part to reduce measurement error associated with parental report of BMI. Prior work has also shown that overall obesity estimates obtained in NSCH are comparable to other national samples that include measured height and weight [35]. Nonetheless, there may be substantial differences in parental report of BMI for particular groups of the population that may have biased our estimates, which we were not able to determine [36]. As a cross-sectional study, we were not able to examine the longitudinal effect of obesity and poverty status on school absenteeism, which would strengthen causal inferences overall as well as synergistic effects. In recent years, concern has been raised regarding the extent of sampling undercoverage bias for particular groups of the population when using landline-only RDD telephone sampling in national health surveys [37], as done for the 2003–2007 NSCH survey years. Although the 2011–2012 NSCH supplemented the landline RDD sampling design with cell phones, this survey year was not available when we began our analysis. Finally, we also did not have data on the reasons why children missed school and whether stigma or body weight perceptions were an important factor explaining our observed associations.

In conclusion, using a large nationally representative sample of U.S. youth, our study was able to test if obesity and poverty jointly influence school days missed. We found that poor and nonpoor obese youth both had significantly greater odds of missing schools than their normal-weight

higher income peers. Future studies should specifically examine why obese youth miss school and the potentially different pathways by which income modifies the emerging research linking obesity to children's school achievement.

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