The Relationship Between Relative Weight and School Attendance Among Elementary Schoolchildren

Andrew B. Geier,* Gary D. Foster,‡ Leslie G. Womble,‡ Jackie McLaughlin,† Kelley E. Borradaile,‡ Joan Nachmani,§ Sandy Sherman,¶ Shiriki Kumanyika,† and Justine Shults†

Abstract

GEIER, ANDREW B., GARY D. FOSTER, LESLIE G. WOMBLE, JACKIE MCLAUGHLIN, KELLEY E. BORRADAILE, JOAN NACHMANI, SANDY SHERMAN, SHIRIKI KUMANYIKA, AND JUSTINE SHULTS. The relationship between relative weight and school attendance among elementary schoolchildren. *Obesity.* 2007;15:2157–2161.

Objective: To determine the relationship between relative weight and school attendance among elementary schoolchildren.

Research Methods and Procedures: A total of 1069 fourth to sixth graders from nine elementary schools in the inner city of Philadelphia, PA, were part of an ongoing randomized control trial to assess prevention strategies for obesity. The mean rate of students eligible for free/reduced meals was $82.9 \pm 11.5\%$. Weight was measured in the second semester of the academic year. Absentee data for the entire academic year were recorded by homeroom teachers. Participants were classified into relative weight categories described by the Institute of Medicine: underweight, normalweight, overweight, and obese.

Results: ANOVA showed that overweight children were absent significantly more than normal-weight children (12.2 ± 11.7 days vs.10.1 ± 10.5 days) ($p < 0.05$). Linear regression showed that the obese category remained a significant contributor to the number of days absent even after adjusting for age, race/ethnicity, and gender.

Discussion: These data suggest that in addition to the medical and psychosocial consequences of being overweight, heavier children have greater risk for school absenteeism than their normal-weight peers. As the rate of childhood obesity increases, parallel increases in school absenteeism should be expected.

Key words: childhood obesity, education, ethnic groups, gender

Introduction

Excess weight among children and adolescents in the United States is a prevalent and serious problem. In 1980, 5% of 12- to 19-year-olds and 6.5% of 6- to 11-year-olds were overweight (BMI $\geq$95th percentile for age and gender) (1). By 2004, this prevalence tripled to 17.4% for 12 to 19 years of age and 18.8% for ages 6 to 11 years of age (2). Obesity appears to be disproportionately prevalent among minorities, particularly Mexican American and non-Hispanic black children (2).

The increasing prevalence of overweight children has been linked to parallel increases in the medical comorbidities associated with excess weight, such as type 2 diabetes, hypertension, and the metabolic syndrome (3–6). Severely overweight children and adolescents report health-related quality of life comparable to children diagnosed with cancer (7). Overweight children also experience negative psychosocial ramifications such as peer rejection, bullying, and behavior problems (8–11).

Previous studies suggest that overweight or obese children (grades K through Grade 12) have poorer academic outcomes (12). Previous studies have also demonstrated a negative association between number of absences and academic performance (13,14). The direct link between obesity

in children and school attendance, however, has not been examined. Studies in adults have demonstrated a link between obesity and work absence (15–17). Tucker and Friedman (15) found that obese employees were 1.74 and 1.61 times more likely than lean employees to experience high and moderate levels of absenteeism, respectively, even after controlling for age, gender, family income, length of workweek, and cigarette smoking. Burton et al. (16,17) found that missed workdays, medical claims, and healthcare costs all increased as BMI increased.

We are not aware of any studies specifically designed to examine the relationship between relative weight and school attendance in children. However, a sub-analysis from a study on health-related quality of life (7) found that severely obese children and adolescents missed more school days than their normal-weight peers. Participants in this study, however, self-reported school absences.

The purpose of this study was to examine the association between relative weight and absenteeism in 1069 fourth to sixth graders from nine K through Grade 8 public schools in an urban area. We hypothesized, based on the existing adult data, that higher relative weight would be associated with greater school absences.

Research Methods and Procedures

Participants

Participation was limited to fourth to sixth grade students ($N = 1126$) in nine of ten inner-city Philadelphia schools that were part of an ongoing randomized control trial to assess prevention strategies for obesity in low socioeconomic samples. (There were insurmountable logistical barriers to collecting attendance data in 1 of the 10 schools.) To be a participating school in this randomized control trial, at least 50% of the students had to be eligible for free/reduced lunch. The mean ± standard deviation eligibility for free/reduced lunch across the schools was 82.9 ± 11.5%. To be a participating student, both parental consent and child assent were required. The average consent rate from all schools was 71.1 ± 15.5%. This study was approved by the University of Pennsylvania's Institutional Review Board.

Attendance data were missing for 57 of the 1126 study participants. These participants were consequently excluded from the analyses in the current study. As reported in Table 1, the resulting sample included 1069 participants (53.9% girls and 46.1% boys) with a mean (± standard deviation) age of 11.2 ± 1.0 years, weight of 45.1 ± 14.5 kg, height of 146.2 ± 8.9 cm, BMI of 20.8 ± 5.1 kg/m², and BMI z-score of 0.66 ± 1.14. The sample was comprised of 38.7% blacks, 23.6% Asians, 21.8% Hispanics, 12.0% whites, and 3.9% other (American Indian/Alaskan Native, Native Hawaiian/Other Pacific Islander, more than one race, and Unknown). The only significant difference among ethnic groups in BMI was that the mean BMI for Asians (20.0 ±

Table 1. Sample descriptive statistics ($N = 1069$)

Variable	Value
Gender (%)	
Female	53.9
Male	46.1
Race/ethnicity (%)	
Black	38.7
Asian	23.6
Hispanic	21.8
White	12.0
Other	3.9
Weight status (%)	
Obese	22.9
Overweight	17.0
Normal-weight	57.9
Underweight	2.2
Age (yrs) (mean ± SD)	11.15 ± 1.0
Weight (kg) (mean ± SD)	45.14 ± 14.5
Height (cm) (mean ± SD)	146.19 ± 8.9
BMI (kg/m²) (mean ± SD)	20.78 ± 5.1
BMI z-score (mean ± SD)	0.66 ± 1.1

SD, standard deviation.

5.1 kg/m²) was significantly lower than that for whites (21.7 ± 6.0 kg/m²) ($p < 0.05$).

Each participant was classified into one of four weight categories as described by the Institute of Medicine: underweight: BMI-for-age <5th percentile ($n = 23$; 2.2%); normal-weight = BMI-for-age 5th to 84.9th percentile ($n = 619$; 57.9%); overweight = BMI-for-age 85th to 94.9th percentile ($n = 182$; 17.1%); and obese = BMI-for-age ≥95th percentile ($n = 245$, 22.9%). Thus, nearly 40% of children were overweight or obese (i.e., ≥85th percentile).

Procedure

Weight was measured in the second semester of the academic year with a digital scale to the nearest 0.1 kg, and height was measured twice at one time with a wall-mounted stadiometer to the nearest 0.1 cm by trained research assistants. Absentee data for both semesters of the same 180-day academic year were recorded by home room teachers first thing each morning. If a student arrived to school later in the day, before third period, their recorded absence was changed to a lateness and was not categorized as an absence.

Statistical Analyses

One-way ANOVA was used to identify significant differences in mean levels of: 1) number of days absent

(NDA)[1] across relative weight categories and 2) NDA across racial/ethnic categories. If significant differences were found, follow-up comparisons were conducted to identify the categories responsible for the differences. Bonferroni's correction was used to control for the multiple comparisons in these analyses. NDA was skewed, so a log transformation was performed on the data. The results were similar to those obtained without the transformation. However, 59 participants (5.5%) had an NDA value of zero and, therefore, could not be included in a log transformation. Kruskal-Wallis, the non-parametric analog to the ANOVA, was also used to account for the skew in NDA. Again, the results were similar to those obtained from the ANOVA. We report the untransformed ANOVA results here for ease of interpretation.

Next, we conducted a linear regression analysis to examine the relative contribution of BMI, age, race/ethnicity, and gender to NDA. We repeated this regression using BMI z-scores (a continuous variable) rather than relative weight categories. The z-scores were calculated using Centers for Disease Control and Prevention software Epi Info, version 3.3.2 (18). Goodness of fit of the models was assessed via R^2 and the overall F test. Model assumptions were checked graphically and via multicollinearity diagnostics such as variance inflation factors. A Poisson regression was also used to account for the skew in NDA. Results were similar to those obtained from the linear regression, which we report here for ease of interpretation. Analyses of BMI as a continuous and categorical variable also yielded similar statistical conclusions. The categorical data (i.e., weight classifications) are reported here.

To account for the non-independence of children nested within schools, school was included as a fixed effect in each model. All analyses were performed using Statistical Package for the Social Sciences (SPSS for Windows, version 13; SPSS, Inc., Chicago, IL), SAS 9.1.3 (SAS Institute, Inc., Cary, NC), and Stata 9.0 (StataCorp LP., College Station, TX) with two-sided tests of hypotheses and a p value <0.05 as the criterion for statistical significance.

Results

Mean NDA Across Subgroups

Race/Ethnicity. Whites were absent the greatest mean number of days ($\pm$ standard deviation) (14.4 $\pm$ 13.8 days), followed by blacks (11.9 $\pm$ 11.7 days), Hispanics (11.3 $\pm$ 9.2 days), other (11.7 $\pm$ 8.7 days), and Asians (6.0 $\pm$ 6.5 days). The only significant differences among groups were that Asians were absent significantly less than all other groups (all p < 0.05) after controlling for school (Table 2).

Weight Category. Those in the underweight category were absent a mean ($\pm$ standard deviation) of 7.5 $\pm$ 10.6

Table 2. Means by race and weight category ($N = 1069$)

Variable	N	No. of Days Absent
Race		
Asian	252	6.0 $\pm$ 6.5[a]
Black	414	11.9 $\pm$ 11.7[b]
Hispanic	233	11.3 $\pm$ 9.2[b]
White	128	14.4 $\pm$ 13.8[b]
Other	42	11.7 $\pm$ 8.7[b]
Weight category		
Underweight	23	7.5 $\pm$ 10.6[a,b]
Normal-weight	619	10.1 $\pm$ 10.5[a]
Overweight	182	10.9 $\pm$ 9.5[a,b]
Obese	245	12.2 $\pm$ 11.7[b]

Values within a variable category with different superscript letters are statistically significant at p < 0.05.

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days, followed by normal-weight 10.1 $\pm$ 10.5 days, overweight 10.9 $\pm$ 9.5 days, and obese 12.2 $\pm$ 11.7 days. Obese children were absent significantly more than normal-weight children (p < 0.05) after controlling for school (Table 2). We collapsed the obese and overweight categories into one group and the normal-weight and underweight categories into a second group. The heavier children missed significantly more days of school (11.7 $\pm$ 10.9 days) than the lighter children (10.0 $\pm$ 10.5 days; p < 0.05) after controlling for school.

Table 3. Regression predicting number of days absent in fourth through sixth graders ($N = 1069$)

Variable	b	SE	p
Intercept	2.22	3.86	0.57
Obese	1.92	0.77	<0.05
Overweight	1.04	0.86	0.23
Underweight	-1.41	2.21	0.52
Black	-2.19	1.11	<0.05
Asian	-7.50	1.22	<0.0001
Hispanic	-1.68	1.19	0.16
Other	-2.36	1.86	0.21
Female	-0.06	0.63	0.92
Age	1.10	0.32	<0.001
$R^2 = 0.11$			

b, beta; SE, standard error.

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[1] Nonstandard abbreviations: NDA, number of days absent; SES, socioeconomic status.

Linear Regression

We conducted a linear regression analysis to examine the relative contribution of BMI, age, race/ethnicity, and gender to NDA (Table 3). BMI was examined using the four weight categories: underweight, normal-weight, overweight, and obese.

The R^2 was 0.11, so that weight category, race/ethnicity, gender, age, and school explained 11% of the variance in NDA. There was no main effect of gender on NDA, and there were no statistically significant interactions between weight category and either gender or race/ethnicity. Being obese was associated with ~2 (1.92) more NDA than being normal-weight after controlling for age, race/ethnicity, and school ($p < 0.05$). An increase in age by one year was associated with an increase in NDA of 1.10 after controlling for weight category, race/ethnicity, and school ($p < 0.001$). Finally, black participants had ~2 (2.19) fewer NDA, while Asian participants had 7.5 fewer NDA, than white participants after controlling for weight category, age, and school.

Discussion

This study's principal finding is that obese children were absent (12.2 ± 11.7 days) significantly more than the normal-weight children (10.1 ± 10.5 days). After combining participants in the obese category with those in the overweight category and combining participants in the normal-weight category with those in the underweight category, the heavier children were absent significantly more than the lighter children (11.7 ± 10.9 days vs. 10.0 ± 10.5 days). These findings suggest that heavier children are at greater risk for being absent from school than their normal-weight peers.

The second principal finding is that the obese category (BMI for age >95th percentile) remained a significant contributor to NDA even after adjusting for age, race/ethnicity, and gender in a low socioeconomic status (SES) population (83% eligible for free and reduced lunch). Being obese was associated with 1.9 more NDA after controlling for age, gender, race/ethnicity, and school.

There are several possible reasons that obese children attend school less frequently. Studies have found that obese children are more likely to experience social difficulties and behavior problems compared with their normal-weight peers (8,10,11,19). Obese children may fear being embarrassed and ostracized by their peers. For example, they may avoid school on days that they have physical education. It could be more difficult for them to perform physically exerting tasks such as running and jumping. Another potential reason for greater NDA among obese children is the increased number of medical conditions, such as asthma, associated with obesity, although the link between obesity and medical conditions is less pronounced among children

than it is among adults. Previous data have shown that students who are chronically ill consistently miss more school (20,21).

Although the present study found that obese children have statistically greater NDA than their normal-weight peers, it is unclear whether this difference in NDA is clinically significant. Future studies could identify the amount of absences required to seriously impact academic performance and whether overweight children exceed that number.

One limitation of the present study is that it was cross-sectional. Longitudinal studies are better able to examine causal relationships between overweight in children and absenteeism. A second limitation is that our regression model accounted for only 11.0% of the variance in NDA, suggesting that factors other than BMI, age, race/ethnicity, and gender must contribute to NDA. A third limitation was our inability to assess SES at the participant level. While we controlled for school level SES, it is likely that this variable is representative of more than SES alone. Future studies would be enhanced by examining parent educational level, as well as household income, in understanding the relationship between overweight children and absenteeism.

The increasing prevalence of overweight children is paralleled by increasing medical and psychosocial ramifications. This study demonstrates that obese children experience additional consequences, such as more school absences, even after adjusting for race/ethnicity, age, and gender. These findings highlight the importance of examining attendance in school-based studies that are interventions for childhood and adolescent obesity, particularly since those who would benefit the most from the interventions may be least present to receive them.

Acknowledgment

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