Journal of Adolescent Health 52 (2013) 64–69

ELSEVIER

JOURNAL OF ADOLESCENT HEALTH

www.jahonline.org

Original article

The Association of Obesity and School Absenteeism Attributed to Illness or Injury Among Adolescents in the United States, 2009

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Article history: Received December 21, 2011; Accepted April 13, 2012
Keywords: Body mass index; Obesity; School absenteeism; School attendance; Adolescents

A B S T R A C T

Purpose: School attendance can impact academic performance. Childhood obesity-related physical and psychosocial consequences are potentially associated with school absenteeism. Thus, we examined the association between school absenteeism attributed to illness or injury and obesity among adolescents aged 12–17 years.

Methods: We used a weighted sample of 3,470 U.S. adolescents from the 2009 National Health Interview Survey. School absenteeism was measured from the parent-reported number of sick days taken in the preceding 12 months. Body mass index was calculated from parent-reported weight and height. Weight status was classified based on the sex-specific body mass index-for-age percentile defined by the CDC growth charts. Poisson regression was conducted to examine the association between school absenteeism and weight status, controlling for selected sociodemographic characteristics and disease status.

Results: The mean number of annual sick days was 3.9 days overall; 3.4 days among normal-weight, 4.4 days among overweight, and 4.5 days among obese adolescents. Obese adolescents had a higher proportion of missing ≥4 days of school per year than adolescents of normal weight. Our multivariate analyses found that compared with adolescents of normal weight, overweight and obese adolescents had greater than one-third more sick days annually (rate ratio = 1.36 for overweight and 1.37 for obese adolescents).

Conclusions: Overweight and obese adolescents had 36% and 37% more sick days, respectively, than adolescents of normal weight. The results suggest another potential aspect of obesity prevention and reduction efforts among children and families is to improve children's school attendance.

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IMPLICATIONS AND CONTRIBUTION

The finding that obesity is associated with school absenteeism attributed to illness or injury among adolescents adds to concerns about the negative consequences of obesity. This further underscores the importance of implementing effective obesity prevention and control initiatives in multiple settings to prevent obesity among adolescents.

The United States has increasingly recognized that childhood obesity is a major health problem among the nation's youth. Using measured weight and height, the National Health and Nutrition Examination Survey (NHANES) documented tripling of the prevalence of obesity among adolescents aged 12–19 years, increasing from 5.0% to 18.1% between 1976–1980 and 2007–2008. The sharpest increase in prevalence occurred between 1976–1980 and 1999–2000, with no significant increasing trend from 1999–2000 to 2007–2008 [1–3].

Childhood obesity can affect physical and psychosocial health. For example, obesity is related to reduced quality of life and comorbidities, such as diabetes, hypertension, and metabolic syndrome, among children and adolescents [4–7]. In addition, childhood obesity may cause negative psychological and social consequences, such as depression, lower self-esteem, social isolation, and stigmatization [8–11]. These comorbidities and consequences may affect other aspects of children's lives,

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

1054-139X/$ - see front matter Published by Elsevier Inc. on behalf of Society for Adolescent Health and Medicine.
http://dx.doi.org/10.1016/j.jadohealth.2012.04.003

such as increasing their school absenteeism, which could lead to lower academic performance [12–14]. Given the high obesity prevalence, many U.S. children and adolescents may be at risk for these negative consequences.

At least three previous studies have examined the relationship between school attendance and obesity among young children or with local-level samples. One cohort study of a nationally representative sample of U.S. children entering kindergarten in 1998 and followed through the third grade found that overweight boys experienced more absences from schools than boys of normal weight [15]. One study conducted in 2002 demonstrated that severely obese children and adolescents aged 5–18 years who were referred to pediatric gastroenterology or nutrition clinics at the Children's Hospital and Health Center in San Diego missed more school days than their normal-weight peers [7]. Another study published in 2007 that was conducted among fourth to sixth graders from nine elementary schools in Philadelphia noted that obese children were absent significantly more than children of normal weight [16]. However, there are limited recent national studies, to our knowledge, that have examined this association among the general U.S. adolescent population. Therefore, the purpose of our study was to examine the association between school absenteeism attributed to illness or injury (sick days) and obesity among U.S. adolescents aged 12–17 years using a nationally representative sample. Confirmation of this association could help highlight the importance of obesity prevention among adolescents to improve their school attendance.

Methods

Sample

We used data from the 2009 National Health Interview Survey (NHIS), which has monitored the health of the United States since 1957. Conducted by the National Center for Health Statistics (NCHS), CDC [17], the NHIS is an ongoing, cross-sectional, in-person interview survey of the civilian noninstitutionalized U.S. population based on a multistage sampling of households. Basic health and sociodemographic data were collected for all household members, and more extensive data were collected for each family by randomly selecting one sample adult and one sample child for further query. An adult from the household, typically a parent or guardian, served as the proxy respondent for the child [17]. In the 2009 NHIS, the total household-level response rate was 82.2%, the conditional response rate for the family component was 99.3%, and the conditional response rate for the sample child component was 89.9% [17]. The NHIS was approved by the NCHS Research Ethics Review Board.

We used a sample of 4,026 U.S. adolescents aged 12–17 years. We excluded adolescents whose parents did not respond to the question about the number of school days missed (n = 53), and adolescents whose parents responded "refused," "not ascertained," "not available," or "unknown," as well as those missing values for height or weight (n = 503), which yielded a final sample for analysis of data on 3,470 adolescents.

School absenteeism, weight status, and other covariates

Our outcome of interest was school absenteeism attributed to illness or injury, which was measured from the number of parent-reported sick days based on the following question: "During the past 12 months, that is since {12-month reference date}, about how many days did {child's name} miss school because of illness or injury?" The number of sick days was a continuous variable with a value ranging from 0 to 240.

Our key exposure variable, weight status, was classified based on the sex-specific body mass index (BMI)-for-age percentile defined by the CDC growth charts [18]: obesity, ≥95th percentile; overweight, 85th–<95th percentile; normal weight, 5th–<85th percentile; and underweight, <5th percentile. BMI (weight [kg]/height [m^2]) was calculated from parent-reported child's current weight and height. Because of concerns about the considerable parental reporting bias on weight and height information for children aged <12 years [19,20], the 2009 NHIS limited data on child's weight and height to children aged 12–17 years [17]. An internal consistency check for the weight and height was added to the survey instrument to improve data quality. The interviewers verified data entry and repeated the weight and height questions to parents who reported extreme values. Furthermore, the highest and lowest 1.5% of the weight and height values were recoded by NCHS as "not available" in 2009 survey data [17].

Other exposure variables included sociodemographic characteristics and disease status. Sociodemographic characteristics were classified as follows: age groups (12–13, 14–15, and 16–17 years), sex, racial/ethnic groups (non-Hispanic white, non-Hispanic black, and Hispanic). The category "other racial/ethnic group" was included in our analyses, but not reported, because it is difficult to interpret the meaning of this variable. We used four levels of family poverty-to-income ratio (PIR): <1.00, 1.00–1.99, 2.00–3.99, and ≥4.00. Approximately 11% of data on PIR were missing. To increase sample size and precision of our income estimates, we merged the original NHIS Family, Person, and Child data files with five imputed income data sets provided by NCHS. Among the various diseases/conditions possibly related to school attendance, we excluded a number of factors, including mental retardation, autism, diabetes, heart disease, diarrhea/colitis, anemia, seizure, and limitation in walk/run/play, from our analyses owing to small sample size (n < 50). We created dichotomous (yes/no) variables for the following diseases: having respiratory allergy or eczema, or any kind of skin allergy, during the 12 months preceding survey; and having ever been diagnosed with attention deficit hyperactivity disorder (ADHD).

Statistical analyses

We used SAS-Callable SUDAAN (version 9.2; SAS Institute, Cary, NC) for our statistical analyses. The estimates were adjusted to the NHIS complex multilevel sampling design to represent the civilian noninstitutionalized U.S. population.

We examined the characteristics of the study sample and mean sick days using descriptive statistics. We used χ^2 test to compare the weighted percentages of sociodemographic characteristics and sick days among normal-weight, overweight, and obese adolescents. Underweight adolescents were not included for comparison because this population subgroup may have low school attendance and confound our results. The statistically significant level was set as $p < .05$. Because the outcome variable—the number of school days missed—is a count, we used Poisson regression to examine the association between school absenteeism and obesity, controlling for sociodemographic characteristics and disease status. We calculated rate ratios (RRs) corresponding to the relative difference in mean school days

Table 1
Sample descriptive statistics, overall and by weight status,[a] National Health Interview Survey, 2009

Characteristics	Overall n = 3,470 n (%)[b]	Underweight n = 159 n (%)	Normal weight n = 2,258 n (%)	Overweight n = 640 n (%)	Obese n = 413 n (%)	p^c
Age-group (years)						
12–13	1,047 (34)	64 (48)	617 (32)	215 (37)	151 (39)	
14–15	1,174 (33)	49 (34)	781 (32)	207 (33)	137 (37)	.0098
16–17	1,249 (33)	46 (18)	860 (36)	218 (30)	125 (24)	
Sex						
Girls	1,769 (51)	78 (45)	1,196 (53)	291 (46)	136 (36)	.0001
Boys	1,701 (49)	81 (55)	1,062 (47)	349 (54)	277 (64)	
Race/ethnicity						
White, non-Hispanic	1,627 (60)	83 (66)	1,140 (64)	265 (50)	139 (47)	
Black, non-Hispanic	544 (14)	15 (10)	335 (13)	107 (16)	87 (20)	<.0001
Hispanic	989 (19)	32 (14)	582 (17)	222 (26)	153 (27)	
Family PIR						
<1.00	567 (16)	23 (14)	338 (14)	96 (16)	109 (28)	
1.00–1.99	768 (23)	32 (22)	439 (20)	176 (28)	121 (27)	<.0001
2.00–3.99	1,100 (32)	45 (26)	736 (33)	205 (31)	114 (27)	
≥4.00	1,019 (29)	59 (38)	734 (32)	158 (24)	68 (17)	
Number of sick days (day)						
0	976 (26)	44 (23)	641 (27)	177 (26)	114 (24)	
1–3	1,375 (40)	59 (37)	919 (42)	242 (37)	155 (34)	.0412
≥4	1,119 (34)	56 (40)	698 (31)	221 (37)	144 (42)	

PIR = poverty-to-income ratio; BMI = body mass index.
[a] Defined by sex-specific BMI-for-age percentile based on the 2000 CDC growth charts: underweight, BMI at <5th percentile; normal weight, BMI at 5th–<85th percentile; overweight, BMI at 85th–<95th percentile; obese, BMI at ≥95th percentile.
[b] Weighted percentage, the column percentages in each category may not add up to 100% because of rounding or missing data.
[c] p value for χ^2 test to compare the weighted percentages of sociodemographic characteristics and school days missed among normal-weight, overweight, and obese adolescents.

missed for obese adolescents, compared with adolescents of normal weight and adjusting for all other variables in the models. In addition, we conducted bivariate analyses by including only one sociodemographic or disease variable in the model to examine the association between school absenteeism and the single exposure. To increase precision of our estimates, we chose to use the five imputed income data sets provided by NCHS, with demographic and health-related variables incorporated during imputation. We analyzed all five imputed data sets together by conducting separate analyses, one on each of the five imputed data sets. These analyses were then combined following the standard multiple imputation combining rules [21].

During our multivariate Poisson model selection process, we did not find any collinear variables that changed the standard error of the coefficient for obesity by >10%. We also excluded asthma because asthma is possibly in the causal chain between obesity and sick days, based on previous studies [22–24], although we did not find a collinear relationship between obesity and asthma. Our full model included weight status, age, sex, race/ethnicity, family PIR, maternal education level, number of kids in the family, region, ADHD, respiratory allergy, eczema/skin allergy, food/digestive allergy, as well as all the interaction terms between weight status and other covariates. We used the backward elimination procedure to eliminate interaction terms and exposures that were not significant. Age and weight status were forced to stay in the model. None of the interaction variables were identified as significant effect modifiers. As part of our final model selection process, we compared the RR estimates for obesity in full and reduced models. We did not find any confounders among the nonsignificant sociodemographic and disease variables based on the criterion that the difference between the adjusted RRs of the two models for the association between weight status and absenteeism was <10%. Our final multivariate Poisson regression model included weight status, age, sex, race/ethnicity, PIR, ADHD, respiratory allergy, and eczema/skin allergy.

Results

The characteristics of our study population, overall and by weight status, are described in Table 1. The study population was approximately evenly distributed among three age-groups; approximately 49% of our weighted sample was composed of boys; and 60% were non-Hispanic whites. About 16% had a PIR <1.00, and 11% of adolescents were obese. Compared with adolescents of normal weight, obese adolescents had a higher proportion of boys and minorities and a lower family income ($p < .01$). In addition, obese adolescents had a lower proportion of missing 0–3 days of school and a higher proportion of missing ≥4 school days than their normal-weight peers ($p < .05$). Based on χ^2 tests, the sick days were not significantly different among underweight or overweight adolescents compared with normal-weight adolescents.

The mean overall school days missed owing to illness or injury was 3.9 d/yr (Table 2). When stratified by weight status, the mean number of school days missed was 3.4 d/yr among normal-weight, 4.4 d/yr among overweight, and 4.5 d/yr among obese adolescents. The estimate for underweight adolescents was not shown because this estimate is not reliable owing to small sample size (relative standard error ≥30%).

Our bivariate analyses found that adolescents with the following weight or disease status had significantly increased RRs for school absenteeism: overweight, 1.29; obese, 1.33; ADHD, 1.43; respiratory allergy, 1.47; and eczema/skin allergy, 1.39. In contrast, adolescents in the following population subgroups had significantly decreased RRs: non-Hispanic blacks, .74; Hispanics, .75; PIR 2.00–3.99, .80; and PIR ≥4.00, .77.

Table 2
Mean school days missed owing to illness or injury and Poisson regression results among U.S. adolescents aged 12–17 years, National Health Interview Survey, 2009

Characteristic/disease	Mean days[a]	Unadjusted rate ratio[b] (95% CI)	Adjusted rate ratio[c] (95% CI)
Overall	3.9		
Weight status			
Underweight	–[d]	–[d]	–[d]
Normal weight	3.4	1.00	1.00
Overweight	4.4	**1.29 (1.05, 1.57)**	**1.36 (1.10, 1.68)**
Obese	4.5	**1.33 (1.08, 1.64)**	**1.37 (1.11, 1.69)**
Age-group (years)			
12–13	3.6	1.00	1.00
14–15	3.9	1.08 (.87, 1.34)	1.12 (.89, 1.41)
16–17	4.0	1.11 (.94, 1.31)	1.20 (.99, 1.44)
Sex			
Girls	4.1	1.00	1.00
Boys	3.6	.87 (.74, 1.02)	**.79 (.66, .95)**
Race/ethnicity			
White, non-Hispanic	4.3	1.00	1.00
Black, non-Hispanic	3.1	**.74 (.60, .91)**	**.62 (.49, .77)**
Hispanic	3.2	**.75 (.62, .91)**	**.66 (.53, .82)**
Family PIR			
<1.00	4.3	1.00	1.00
1.00–1.99	4.6	1.08 (.80, 1.45)	1.00 (.75, 1.34)
2.00–3.99	3.5	**.80 (.65, .99)**	**.71 (.57, .88)**
≥4.00	3.3	**.77 (.62, .96)**	**.66 (.52, .84)**
ADHD			
No	3.6	1.00	1.00
Yes	5.2	**1.43 (1.15, 1.78)**	**1.30 (1.02, 1.66)**
Respiratory allergy			
No	3.6	1.00	1.00
Yes	5.3	**1.47 (1.22, 1.78)**	**1.38 (1.15, 1.67)**
Eczema/skin allergy			
No	3.7	1.00	1.00
Yes	5.1	**1.39 (1.13, 1.71)**	**1.34 (1.09, 1.65)**

CIs for bolded estimates do not include 1.
CI = confidence interval; PIR = poverty-to-income ratio; ADHD = attention deficit hyperactivity disorder.
[a] Weighted mean.
[b] Calculated from Poisson regression, model included the characteristic or disease variable in this category as the only predictor.
[c] Calculated from Poisson regression, model included all the variables listed in the table.
[d] Data not reliable owing to small sample size; relative standard error ≥30%.

In our multivariate analyses, controlling for sociodemographic characteristics and certain disease status, overweight and obese adolescents took greater than one-third more sick days than adolescents of normal weight (RR = 1.36 for overweight and 1.37 for obese adolescents) (Table 2). In addition, we found that boys missed an average of 21% fewer school days than girls. Compared with non-Hispanic whites, non-Hispanic blacks took 38% fewer and Hispanics took 34% fewer sick days. Adolescents with a family PIR ≥2.00 missed approximately 30% fewer school days than those with a PIR <1.00 (RR = .71 for adolescents with a PIR 2.00–3.99 and .66 for those with a PIR ≥4.00). Furthermore, our study demonstrated that adolescents with certain diseases were absent ≥30% more days of school than those without these diseases (RR = 1.30 for ADHD, 1.38 for respiratory allergy, and 1.34 for eczema/skin allergy) (Table 2).

Discussion

Our results show that obese adolescents aged 12–17 years had a higher proportion of taking ≥4 sick days per year than adolescents of normal weight; furthermore, overweight and obese adolescents, on average, were absent greater than one-third more school days owing to illness or injury than their normal-weight peers.

We found similar association between school absenteeism and obesity as previous studies [7,15,16]; however, the magnitude of our estimates was different. For example, the locally based study among severely obese children in California found that obese children and adolescents missed many more school days than nonobese children and adolescents (4.2 d/mo vs. .7 d/mo) [7]. The mean school days missed among obese adolescents was much higher than the estimate in our study (4.2 d/mo vs. 4.5 d/yr [.4 d/mo]). This is likely because of differences in study populations. The previous study included a wider age range (5–18 years) and was conducted only among severely obese children who were referred by their physicians to specialists for evaluation of obesity; thus, those children had at least one recent doctor's appointment counted as 1 or more additional school day missed. Another study that examined school attendance among nine elementary schools in Philadelphia reported a smaller relative difference in mean school days missed than our study [16]. They found that obese children were absent 21% more than children of normal weight (crude mean: 12.2 d/yr vs. 10.1 d/yr, $p < .05$), and obesity remained a significant contributor to school absenteeism even after adjusting for age, sex, and race/ethnicity. Unlike our study, they investigated school absenteeism among fourth to sixth graders with student records as their source of data. Additionally, their absence data included any school days missed, not just absenteeism attributed to illness or injury, leading to a higher estimate of mean school days missed than our study. Despite these differences, similar to our results, they found that white adolescents were absent more than black or Hispanic adolescents.

Unlike a previous study of younger children [15], we did not find any significant gender difference in the association between school absenteeism and obesity. Datar and Sturm, who investigated childhood overweight and elementary school outcomes with measured weight and height using longitudinal data, noted that third-grade boys only who had been overweight since kindergarten experienced more school absenteeism than boys of normal weight [15]. Future studies among adolescents based on measured data may be needed to explore the difference across population subgroups.

Our finding of a positive association between obesity and school absenteeism, if confirmed, has important implications. School attendance is likely to be associated with school performance and school academic achievement [12–14]. One study using the Pittsburgh public school eleventh-grade student cohort found that school attendance was positively associated with the students' standardized test performance and their academic achievement [12]. Another study in a Baltimore public elementary school with a larger minority enrollment reported similar findings [13]. Additional research has suggested a direct link between obesity and school performance [15,25–27]. Therefore, obesity prevention and control among school-aged children and adolescents may play a role in increasing both their school attendance and academic achievement.

There are at least two possible pathways by which childhood obesity affects school attendance. First, overweight and obese children and adolescents are more likely to develop certain diseases, such as diabetes, hypertension, and metabolic syndrome [4–6]. For example, adolescents with type 2 diabetes mellitus are almost always obese [6], and almost one in three overweight

and obese children have metabolic syndrome based on the NHANES III [4]. Because of associated morbidity, obese children and adolescents may have more sick days. Second, obese children may have higher rates of depression and low self-esteem [8,10]. For example, obese children show decreased levels of self-esteem, and lower self-esteem is associated with sadness, loneliness, and nervousness [10]. All of these negative psychosocial consequences may lead to psychological diseases and potentially compromise school attendance. Further studies are needed to explore the relationship between school absenteeism and obesity-related psychosocial consequences.

Poor diet and physical inactivity potentially affect school attendance because they are risk factors for many chronic diseases/conditions, including obesity, undernutrition, iron deficiency, eating disorders, inadequate bone health, and metabolic syndrome [28–30]. Therefore, promoting healthy eating and physical activity may be an important strategy for preventing school absenteeism.

Study strengths and limitations

This study has two major strengths: it is based on a nationally representative sample, and has high response rates.

The findings in this study are subject to at least three limitations. First, the school absenteeism measure is subject to recall bias. The potential reporting bias could lead to overestimation or underestimation of mean school days missed. Second, the sample child's weight and height used to calculate BMI were reported by an adult respondent, typically a parent. Despite the high correlations between measured and parent-reported weight, height, and BMI among adolescents, mean weight is typically underestimated from reported data, with a larger difference between reported and measured data for female than male adolescents [19,31–34]. Some studies demonstrated that reported data have high specificity (92%–99%). However, the sensitivity of self-reported data to detect obesity has ranged from 45% to 76% [19,32,33]. This low sensitivity likely accounts for the lower prevalence of obesity that we observed compared with NHANES. For example, whereas NHANES 2007–2008 found that 18.1% of adolescents aged 12–19 years were obese [1], our obesity prevalence estimate from NHIS 2009 was 17.1% among adolescents aged 12–17 years, which was 1% lower than NHANES finding. The underestimation of obesity prevalence and misclassification of weight status are likely to lead to a bias toward the null hypothesis. Therefore, our study may have underestimated the true effect of obesity on school absenteeism. Third, this study was based on a cross-sectional survey; thus, school absenteeism was not assessed by tracking each obese individual over time, so we were not able to draw conclusions about cause and effect.

Despite these limitations, this study has important findings and implications, if confirmed in longitudinal studies. The finding that obesity is associated with school absenteeism attributed to illness or injury among adolescents adds to concerns about the negative consequences of obesity. This further underscores the importance of implementing effective obesity prevention and control initiatives, including increasing healthy food choices and physical activity opportunities, in multiple settings where youth spend their time (e.g., home, school, child care, and community) to prevent overweight and obesity among adolescents.

References

[1] Ogden CL, Carroll MD, Curtin LR, et al. Prevalence of high body mass index in US children and adolescents, 2007–2008. JAMA 2010;303:242–9.
[2] Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999–2000. JAMA 2002; 288:1728–32.
[3] Ogden CL, Carroll MD, Flegal KM. High body mass index for age among US children and adolescents, 2003–2006. JAMA 2008;299:2401–5.
[4] de Ferranti SD, Gauvreau K, Ludwig DS, et al. Prevalence of the metabolic syndrome in American adolescents: Findings from the Third National Health and Nutrition Examination Survey. Circulation 2004;110:2494–7.
[5] Kaufman FR. Type 2 diabetes mellitus in children and youth: A new epidemic. J Pediatr Endocrinol Metab 2002;15(Suppl 2):737–44.
[6] Steinberger J, Daniels SR, American Heart Association Atherosclerosis, Hypertension, and Obesity in the Young Committee (Council on Cardiovascular Disease in the Young), American Heart Association Diabetes Committee (Council on Nutrition, Physical Activity, and Metabolism). Obesity, insulin resistance, diabetes, and cardiovascular risk in children: An American Heart Association scientific statement from the Atherosclerosis, Hypertension, and Obesity in the Young Committee (Council on Cardiovascular Disease in the Young) and the Diabetes Committee (Council on Nutrition, Physical Activity, and Metabolism). Circulation 2003;107:1448–53.
[7] Schwimmer JB, Burwinkle TM, Varni JW. Health-related quality of life of severely obese children and adolescents. JAMA 2003;289:1813–9.
[8] Erickson SJ, Robinson TN, Haydel KF, Killen JD. Are overweight children unhappy?: Body mass index, depressive symptoms, and overweight concerns in elementary school children. Arch Pediatr Adolesc Med 2000;154:931–5.
[9] Puhl RM, Latner JD. Stigma, obesity, and the health of the nation's children. Psychol Bull 2007;133:557–80.
[10] Strauss RS. Childhood obesity and self-esteem. Pediatrics 2000;105:e15.
[11] Strauss RS, Pollack HA. Social marginalization of overweight children. Arch Pediatr Adolesc Med 2003;157:746–52.
[12] Dunn MC, Kadane JB, Garrow JR. Comparing harm done by mobility and class absence: Missing students and missing data. J Educ Behav Statist 2003;28:269–88.
[13] Lamdin DJ. Evidence of student attendance as an independent variable in education production functions. J Educ Res 1996;89:155–62.
[14] Monk D, Ibrahim M. Patterns of absence and pupil achievement. Am Educ Res J 1984;21:295–310.
[15] Datar A, Sturm R. Childhood overweight and elementary school outcomes. Int J Obes (Lond) 2006;30:1449–60.
[16] Geier AB, Foster GD, Womble LG, et al. The relationship between relative weight and school attendance among elementary schoolchildren. Obesity (Silver Spring) 2007;15:2157–61.
[17] Centers for Disease Control and Prevention (CDC). 2009 National health interview survey (NHIS) public use data release: NHIS survey description. Hyattsville, MD: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, 2010. Available at: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2009/srvydesc.pdf. Accessed April 12, 2012.
[18] Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. Adv Data 2000;314:1–27.
[19] Akinbami LJ, Ogden CL. Childhood overweight prevalence in the United States: The impact of parent-reported height and weight. Obesity (Silver Spring) 2009;17:1574–80.
[20] Huybrechts I, De Bacquer D, Van Trimpont I, et al. Validity of parentally reported weight and height for preschool-aged children in Belgium and its impact on classification into body mass index categories. Pediatrics 2006; 118:2109–18.
[21] Centers for Disease Control and Prevention (CDC). Multiple imputation of family income and personal earnings in the national health interview survey: Methods and examples. Hyattsville, MD: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, 2010. Available at: http://www.cdc.gov/nchs/data/nhis/tecdoc4.pdf. Accessed April 12, 2012.
[22] Gilliland FD, Berhane K, Islam T, et al. Obesity and the risk of newly diagnosed asthma in school-age children. Am J Epidemiol 2003;158:406–15.
[23] Moonie S, Sterling DA, Figgs LW, Castro M. The relationship between school absence, academic performance, and asthma status. J Sch Health 2008;78: 140–8.
[24] von Mutius E, Schwartz J, Neas LM, et al. Relation of body mass index to asthma and atopy in children: The National Health and Nutrition Examination Study III. Thorax 2001;56:835–8.
[25] Datar A, Sturm R, Magnabosco JL. Childhood overweight and academic performance: National study of kindergartners and first-graders. Obes Res 2004;12:58–68.
[26] Taras H, Potts-Datema W. Obesity and student performance at school. J Sch Health 2005;75:291–5.

[27] Sigfúsdóttir ID, Kristjánsson AL, Allegrante JP. Health behaviour and academic achievement in Icelandic school children. Health Educ Res 2007;22:70–80.
[28] Centers for Disease Control and Prevention (CDC). Recommendations to prevent and control iron deficiency in the United States. Centers for Disease Control and Prevention. MMWR Recomm Rep 1998;47:1–29.
[29] Centers for Disease Control and Prevention (CDC). School health guidelines to promote healthy eating and physical activity. MMWR Recomm Rep 2011;60:1–76.
[30] Grundy SM, Cleeman JI, Daniels SR, et al. Diagnosis and management of the metabolic syndrome: An American Heart Association/National Heart, Lung, and Blood Institute scientific statement. Curr Opin Cardiol 2006;21:1–6.
[31] Brener ND, McManus T, Galuska DA, et al. Reliability and validity of self-reported height and weight among high school students. J Adolesc Health 2003;32:281–7.
[32] Davis H, Gergen PJ. The weights and heights of Mexican-American adolescents: The accuracy of self-reports. Am J Public Health 1994;84:459–62.
[33] Goodman E, Hinden BR, Khandelwal S. Accuracy of teen and parental reports of obesity and body mass index. Pediatrics 2000;106:52–8.
[34] Strauss RS. Comparison of measured and self-reported weight and height in a cross-sectional sample of young adolescents. Int J Obes Relat Metab Disord 1999;23:904–8.