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# Obesity and other predictors of absenteeism in Philadelphia school children.

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Obesity and Other Predictors of Absenteeism in Philadelphia School Children

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**ABSTRACT**

**Background:** Limited data indicate that obese children are absent from school more than their normal-weight peers. We analyzed administrative data from a large urban school district to investigate the association of obesity and student sociodemographic characteristics with absenteeism.

**Methods:** We analyzed 291,040 records, representing 165,056 unique students (grades 1-12). Obesity status was classified according to CDC age- and sex-specific percentiles for body mass index (BMI) and analyses were based on negative binomial regression.

**Results:** Overall rates of overweight and obesity were 17% and 20%, respectively, and the estimated absence rate was 17 absences per 180 student-days. Obesity was weakly associated with increased school absences. The association was present mainly among the most obese students (BMI >99th percentile), who had an 11% greater absence rate compared to normal-weight students. Compared to white students, Hispanics and African

Americans had higher absence rates (14% and 10%, respectively), and Asians had lower absence rates (43%). Students eligible for free or reduced-cost meals had 24% higher absence rates than those who were not eligible.

**Conclusions:** Overweight and obesity do not seem strongly associated with school absence, except among extremely obese children. Race and poverty appear to affect absences to a greater extent and additional research is needed to investigate the contribution of contextual factors in schools and neighborhoods. This study suggests that data routinely collected in schools could be used to track childhood obesity and to efficiently evaluate public health interventions designed to decrease childhood obesity.

**Keywords:** childhood obesity; school absenteeism; body mass index; administrative data; public health.

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National surveys indicate that poor and minority youth are at increased risk for obesity,<sup>1</sup> but these surveys provide limited insight into the causes and consequences of obesity in this important subgroup. Previous reports have identified an association between obesity and poor school performance<sup>2</sup> and limited data indicate that obese children are absent from school more often than their normal weight peers.<sup>3-5</sup> However, studies conducted to date involved small and highly selected groups of children or were limited to children in a few grades.<sup>3-5</sup>

The School District of Philadelphia (SDP), which serves predominantly poor and minority children, maintains an administrative database of student information that includes measured heights and weights and individual-level sociodemographic and school attendance data. The present study uses this large population-based dataset to describe the prevalence of obesity and to investigate its relationship with school absence.

## **METHODS**

The SDP electronic database<sup>§</sup> of all public school students enrolled in grades K through 12 contains multiple records for each student, one for each school year of enrollment. Records for each child can be linked via a unique identifying number. The database contains dates of attendance, school and grade, sociodemographic characteristics (sex, date of birth, race, eligibility for free or reduced-cost meals), serial measurements of height and weight, and number of days of absence from school during each school year.

In 2009, we analyzed data from the SDP database for three academic years, 2004-05, 2005-06, and 2006-07. We excluded records that had missing or invalid data for a student's date of birth, sex, or race, and records with implausible or inconsistent information on height or weight.<sup>6</sup> Since kindergarten attendance is not mandatory, we analyzed only records from students enrolled in grades 1 through 12. Under a limited data use agreement with Thomas Jefferson University, the SDP provided de-identified data for the analyses.

Absence rates, defined as the number of school days absent divided by the number of school days enrolled in the district's schools, are reported as number of absences per 180 student-days enrolled (the standard length of a school year). Each student could contribute up to three records (one for each school year). Body mass index (BMI) was categorized according to the standard definitions based on CDC age and sex-specific growth charts (underweight = BMI <5<sup>th</sup> percentile; normal weight = BMI ≥5<sup>th</sup> and <85<sup>th</sup> percentile; overweight = BMI ≥85<sup>th</sup> and <95<sup>th</sup> percentile; and obese = BMI ≥95<sup>th</sup> percentile).<sup>7</sup> Obesity was further sub-classified in three categories which correspond approximately to obesity Class I, II, III in adults<sup>8</sup> (BMI percentile ≥95<sup>th</sup> and <98<sup>th</sup>; ≥98<sup>th</sup> and <99<sup>th</sup>; and ≥99<sup>th</sup>). Statistical analyses were based on negative binomial regression; the robust

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variance was used to account for the correlation of each student's repeated measurements over time. Analyses were conducted in SAS 9 (SAS Institute Inc., Cary, NC) and Stata 10 (StataCorp, College Station, TX).

## RESULTS

The SDP database for the three academic years included 588,181 records, representing 252,277 unique students. We excluded 297,141 records because of missing height or weight data (82%), implausible or longitudinally inconsistent height or weight (5%), missing or invalid data for other variables (3%), inactive students (1%), or kindergarten students (9%). Analyses were based on 291,040 records from 285 different schools (range = 21 to 7,640 records per school, median = 849). These records represented 165,056 unique students, of whom 74,480 (45%), 55,168 (33%), and 35,408 (21%) respectively had records for one, two, or three school years.

The average BMI Z-score was 0.64 (standard deviation = 1.09). Approximately 17% of the recorded BMIs were in the overweight range and another 20% were in the obese range (including 5% that were  $\geq 99^{\text{th}}$  percentile). Rates of overweight were 16.9% in 2004-05, 17.0% in 2005-06, and 17.2% in 2006-07; corresponding obesity rates were 20.5%, 20.1%, and 20.3%, respectively.

The median number of absences in a school year was 12 (interquartile range = 6 to 23). During each of the 3 school years, approximately 4% of students had zero absences. The estimated mean absence rate across all three years was 17.4 days per 180 school days enrolled. There was no appreciable difference across the four main BMI categories in the number of days enrolled. However, the absence rate showed a clear gradient with obesity: 16.2 absences per 180 school days enrolled for underweight children, 17.1 for children with normal weight, 17.5 for overweight children, and 18.2 for all obese children ( $p = 0.001$ ).

**Table 1. Descriptive summary of School District of Philadelphia data and associations of student characteristics with absences (N = 291,040 records).**

	N	(%)	Absence Rate <sup>a</sup>	RR <sup>b</sup>	(95% CI <sup>b</sup> )	P
Year						0.001
2004-05	90,296	(31.0)	17.8	1.00	Ref	
2005-06	101,153	(34.8)	17.8	0.99	(0.98, 1.00)	0.002
2006-07	99,591	(34.2)	16.6	0.93	(0.92, 0.94)	0.001
Age						
6-11	130,109	(44.7)	13.6	1.00	Ref	
12-20	160,931	(55.3)	20.4	1.55	(1.54, 1.56)	0.001
Sex						
Female	143,184	(49.2)	17.1	1.00	Ref	
Male	147,856	(50.8)	17.7	1.05	(1.04, 1.06)	0.001
Race						
White, non-Hispanic	45,930	(15.8)	16.1	1.00	Ref	
Hispanic	43,787	(15.0)	18.4	1.14	(1.13, 1.17)	0.001
Black	179,820	(61.8)	18.3	1.10	(1.08, 1.11)	0.001
Asian	18,675	(6.4)	9.6	0.57	(0.55, 0.58)	0.001
Other	2,828	(1.0)	13.6	0.93	(0.89, 0.97)	0.002
Free/Reduced Meal						
No	141,881	(48.7)	15.9	1.00	Ref	
Yes	149,159	(51.3)	18.8	1.24	(1.23, 1.25)	0.001
Special Education						
No	232,961	(80.0)	17.3	1.00	Ref	
Yes	58,079	(20.0)	18.0	0.98	(0.97, 0.99)	0.002
Obesity						0.001
Underweight	6,445	(2.2)	16.2	1.01	(0.98, 1.03)	0.721
Normal	175,693	(60.4)	17.1	1.00	Ref	
Overweight	49,696	(17.1)	17.5	1.01	(1.00, 1.02)	0.283
Obese I <sup>c</sup>	28,565	(9.8)	17.6	1.01	(1.00, 1.02)	0.204
Obese II <sup>c</sup>	16,376	(5.6)	17.8	1.02	(1.00, 1.04)	0.038
Obese III <sup>c</sup>	14,265	(4.9)	19.8	1.11	(1.09, 1.13)	0.001

<sup>a</sup> Expressed as the mean number of absences per 180 student-days enrolled in the SDP schools.

<sup>b</sup> RR: rate ratio (simultaneously adjusted for all variables shown); 95% CI: 95% confidence interval.

<sup>c</sup> Obese I = BMI percentile  $\geq 95^{\text{th}}$  and  $< 98^{\text{th}}$ ; obese II = BMI percentile  $\geq 98^{\text{th}}$  and  $< 99^{\text{th}}$ ; obese III = BMI percentile  $\geq 99^{\text{th}}$ .

Table 1 summarizes characteristics of the analysis sample and associations of key variables with the absence rate. Compared to children aged 6-11, children aged 12-20 had 55% higher absence rates. Hispanics and African Americans had higher absence rates than non-Hispanic whites, by about 14% and 10%, respectively. Asians had almost half the absence rate of whites. The absence rate was 24% higher among children eligible for free or reduced-cost meals than among those not eligible.

After adjusting for other factors, compared to children of normal weight, underweight and overweight children had comparable absence rates, while all obese students had a 4% higher absence ( $p = 0.001$ , data not shown). This was mostly due to the most obese subgroup which had an 11% higher absence rate than children of normal weight (Table 1).

## DISCUSSION

The National Health Interview Survey collects parental reports of the number of days of school that a child missed because of illness or injury during the previous 12 months and provides the percent distributions for such absences for children age 5-17 years. Among all children, 29% of US children had no school absences for illness or injury and 5% missed 11 or more days of school. Among poor children, 30% had no absences and 9% missed 11 or more days.<sup>9</sup> These interview data are not comparable to directly collected data from the SDP administrative database which captures all absences, not only those for illness or injury. However, absence rates for students in the SDP, where only 4% had no recorded absences and 25% of students missed 23 or more days of school during a particular school year, appear to be higher than absence rates as estimated in a national sample of school children.

Prior studies have reported a small but statistically significant increase in school absenteeism in obese children relative to those of normal weight.<sup>3 5</sup> Our analyses showed similar differences in absence rates of 1-2 days per school year. However, after accounting for a number of student characteristics, only the most severely obese students, who represent approximately 5% of the student population, seem to have a meaningful increase of absence rates.

In adults, the association between chronic medical conditions such as diabetes, pulmonary and cardiovascular disease, and musculoskeletal disorders is well established and likely contributes to the observed relationship between obesity and absence from work.<sup>10</sup> Medical co-morbidities associated with obesity are less prevalent in children than in adults but do increase with increasing degree of obesity.<sup>11 12</sup> Thus an increased frequency of co-morbidities could contribute to the greater absence rates among the severely obese children.

## Conclusions

Our analysis of a large population-based urban school database does not support a strong association between relative weight and school absenteeism. Rather, it finds an association only for the most severely obese students. Childhood obesity does, however, have important adverse medical and psychosocial consequences.<sup>12</sup> This, plus its high prevalence,<sup>1</sup> make it a pressing public health issue. Growth data routinely collected in schools can be utilized to track childhood obesity and may also represent an efficient means for evaluating the effectiveness of public health interventions to reduce the prevalence of obesity in youth.

## Limitations

Although we controlled for several sociodemographic factors in our analyses, we cannot exclude residual confounding. For example, we had only a dichotomous proxy measure for poverty and we lacked information on student's health, family structure, and parents' educational level.<sup>9</sup> We also had no information on factors that could mediate the impact of obesity on attendance, such as behavioral disorders, social

stigmatization and bullying, and poor self-esteem.<sup>3-5</sup> Finally, we could not evaluate contextual factors within the schools<sup>13</sup> or in neighborhoods that could also affect absence rates.

Our analyses of data from a large urban school district that serves predominantly poor and minority students cannot be generalized to school systems with different demographic characteristics. Further research on individual and contextual factors that may affect school attendance and academic achievement could inform the development of programs to mitigate the impact of such risk factors on school absenteeism.

## IMPLICATIONS FOR SCHOOL HEALTH

Frequent school absence affects school performance and increases the risk of school drop-out.<sup>13</sup> The finding that extremely obese students are at the highest risk for absenteeism may prompt teachers and school health professionals to pay closer attention to such students and to devise approaches to help these students maintain regular school attendance. Information regarding the impact of sociodemographic factors on absenteeism could also guide school administrators, teachers and school health professionals in identifying high-risk students and in developing individual or system-wide interventions.

Many school systems have electronic databases similar to the one used for the analyses reported here but may lack resources to analyze their data. By partnering with academic centers or public health agencies with the capacity to conduct data analyses, school systems can use their administrative databases as cost-effective tools for evaluating the effects of policy and program changes on critical outcomes such as obesity rates and school absenteeism.

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## DISCLOSURE

The authors have no conflicts of interest associated with this work.

**Human Subjects Approval Statement:** The study was approved by the Institutional Review Board of Thomas Jefferson University.

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