Higher Child Body Mass Index Is Associated with Greater School-Based Health Center Utilization

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Abstract

Background: Children with overweight status and obesity seek care for acute illnesses more often than normal weight peers. School-based health centers (SBHCs) have a role in acute and chronic disease management; however, little is known about SBHC use by children with overweight status and obesity. This study compared SBHC utilization by student body mass index (BMI) category and investigated whether SBHC visit diagnoses varied by BMI category.

Methods: We performed a retrospective analysis of students ($n=1161$) in grades K-8 enrolled in a large SBHC for 2 years. Negative binomial regression models were used to test the independent association between BMI category as defined by BMI percentile [normal/underweight (BMI percentile $<85\%$) and overweight/obesity (BMI percentile $\geq 85\%$), either overweight ($85\% \leq \text{BMI percentile} < 95\%$) or obesity (BMI percentile $\geq 95\%$)], and the number of SBHC visits (nurse, clinician, and total visits) for the 2-year interval. Top five diagnoses based on ICD-10 visit codes were compared.

Results: Students in the overweight/obesity category (BMI percentile $\geq 85\%$) had higher visit rates than normal/underweight peers after adjusting for age and gender, but only total visits were statistically significant [nurse: incident rate ratio (IRR) 1.42 (95% CI 0.94–2.15); clinician: 1.27 (95% CI 0.93–1.75); total: 1.45 (95% CI 1.02–2.07)]. Visit diagnoses were similar by BMI category.

Conclusions: Students with higher BMI percentiles, categorized as overweight/obesity, had higher SBHC utilization than normal/underweight peers, but visit diagnoses were similar. This higher utilization may provide an as-yet untapped opportunity to expand school-based obesity prevention and management.

Keywords: BMI; childhood obesity; health care utilization; school-based health center

Background

Obesity is one of the most prevalent chronic diseases of childhood. Moreover, there are marked racial/ethnic and socioeconomic disparities in obesity prevalence.^{1,2} Non-Hispanic Black children of ages 2–19 years have an obesity prevalence of 22%, compared with 14% among non-Hispanic white children of the same age.³ In addition, children of ages 2–19 years in households with income $\leq 130\%$ of the federal poverty limit have an obesity prevalence of 18.9%, compared with 10.9% among peers in households with income $>350\%$ of the federal poverty limit.⁴ Children with overweight status and obesity are at greater risk of comorbid health complications than their peers with normal weight, and previous research has shown

a linear relationship between increasing BMI in childhood and morbidity.^{5–7}

High BMI in childhood is also associated with high health care utilization. Studies have demonstrated that children with overweight status and obesity use more acute or urgent care-related services than their normal weight peers.^{8–12} A 2009 study of data from a primary care clinic in Israel found that children with obesity had more hospitalizations and longer lengths of stay than their normal weight peers.⁸ Additional research has demonstrated greater use of both community outpatient and emergency room visits, as well as prescription medications.^{9,11}

At the same time, children with overweight status and obesity are less likely to obtain child care from their pediatricians.^{10,13} Estabrooks and Shetterly showed that

children with overweight status use more sick visits at their primary care office and have fewer scheduled visits than normal weight children.¹⁰ Taken together, the literature shows that children with overweight status and obesity are seen more on an as needed basis rather than at scheduled visits dedicated to health maintenance topics or chronic disease, including obesity. However, to date, no prior studies have examined school-based health center (SBHC) use among children with overweight status or obesity.

SBHCs serve as a complement to traditional primary care settings—providing services to children where they spend a majority of their day, in school. SBHCs have been increasingly recognized for their role in addressing health care gaps, especially for racial/ethnic minority students, students from low-income communities, and underserved populations.¹⁴ There is strong evidence for SBHCs' association with improved educational outcomes, in addition to better health outcomes, such as vaccination rates and reduced asthma complications.¹⁴

Nationwide, the majority of visits to SBHCs are for respiratory symptoms, mental health complaints, and sexual health in children and adolescents.¹⁵ However, SBHCs are also ideally suited for chronic disease management given the immediate and consistent availability of services, especially for students who might not otherwise seek them out in primary care offices.¹⁶ This is particularly true for children with overweight status and obesity, which are frequently not recognized by parents and, therefore, may not be prioritized as an urgent health care need.¹⁷ A recent systematic review by Wang et al. demonstrated that schools are important settings for childhood obesity management.¹⁸ SBHCs are, therefore, well situated to play a critical role in preventing and managing childhood obesity.

The goals of this study were (1) to compare SBHC utilization rates [for SBHC nurse, clinician, and total visits (nurse and clinician)] among students with normal/underweight (BMI percentile <85%) and overweight/obesity (BMI percentile ≥85%), either overweight (85% ≤ BMI percentile <95%) or obesity (BMI percentile ≥95%); and (2) to determine whether the reasons they seek care at school vary by BMI category. Understanding patterns of SBHC use by BMI category can inform efforts to best address the needs of students with overweight status and obesity, as well as to inform prevention efforts and interventions to support healthy weight among school-aged children.

Methods

We performed a retrospective analysis of students in kindergarten through eighth grade who attended two colocated urban public charter schools during both the 2016–2017 and 2017–2018 school years. Together, the two schools serve >1500 students in one building. The student population is 99% African American and >80% are enrolled in Medicaid. Students have access to a comprehensive SBHC; 77% of students are enrolled.

SBHC-enrolled students can see a clinician (pediatrician or nurse practitioner) for acute sick visits, health maintenance visits, or chronic disease management. Both walk-in and scheduled appointments are available throughout the day on all school days. Students can also see an SBHC registered nurse for case management/care coordination or medication administration. Visit data are maintained in the SBHC electronic health record (EHR).

The study was approved by the Johns Hopkins Medicine Institutional Review Board as a part of an evaluation of SBHC services. Parents consenting for their child to be enrolled in the SBHC are provided with a written notification of program evaluation activities and may decide to opt out of any or all components. Children of parents who opted out of having their medical record used for evaluation purposes were excluded from this study.

Measures

BMI category. All students received BMI screening at least once a school year during physical education class as part of the FitnessGram® program (The Cooper Institute, Dallas, TX), a school-wide wellness initiative. Height and weight were measured by trained staff using calibrated scales and stadiometers. Age- and gender-specific BMI values were calculated using Centers for Disease Control growth charts for children of ages 2 years and older in the United States.³

Standardized BMI z-scores, percentiles, and categories were calculated using Stata code (zanthro), using age, gender, height, and weight.¹⁹ BMI categories, as defined by BMI percentiles, were classified as normal/underweight (BMI percentile <85%) or overweight/obesity (BMI percentile ≥85%). The overweight/obesity category was further divided into either overweight (85% ≤ BMI percentile <95%) or obesity (BMI percentile ≥95%). For the purposes of this analysis, BMI measurements were averaged for the 2-year study period when more than one measurement was available.

SBHC utilization. SBHC utilization, drawn from the SBHC EHR, included visit type (SBHC nurse visit or clinician visit), visit date, and visit diagnoses (based on ICD-10 codes). Visits coded with a diagnosis of weight management made up a small proportion of total visits (3.8%) and were excluded to avoid bias.

Student characteristics. Student characteristics, including age, gender, and SBHC enrollment date, were extracted from the student's EHR or school record.

Statistical Analysis

Differences in student characteristics and SBHC visits by BMI category [normal/underweight, overweight/obesity (overweight or obesity)] were described and tested using chi-square for categorical variables and two-tailed paired *t*-tests, ANOVA, or Kruskal–Wallis tests for continuous variables.

Negative binomial regression models were used to calculate predicted visit counts and to test the independent association between number of SBHC visits for the three visit types [nurse, clinician, and total (nurse and clinician)] and BMI category, controlling for student age and gender. Because students can enroll in the SBHC at any point during the school year, the log of enrollment duration (in weeks from date of initial enrollment to the end of the study period) was used as a linear offset. Coefficient estimates and 95% confidence intervals were exponentiated to yield incidence rate ratios for reporting. Incident rate ratios (IRRs) ≥ 1 imply greater SBHC visits over the study period for students in the overweight/obesity category compared with the reference group of normal/underweight students. Statistical significance was defined as $p < 0.05$.

To characterize SBHC utilization, the top five primary ICD-10 codes were tabulated and ranked by percentage of visits for each visit type (nurse and clinician). Students in the overweight/obesity category were compared with the reference group of those with normal/underweight status.

All analyses were performed in Stata, version 15.1 (Stata Corp, LLC, College Station TX).

Results

The final study population included 1161 SBHC enrollees for whom ≥ 1 BMI measurement was available, representing 82% of all SBHC enrollees ($n = 1418$) over the study period. Students with missing BMI data ($n = 257$) were younger at the start of the study period compared with the analytic sample (Supplementary Table S1), explained, in part, by fewer measurements for kindergarten students in the Fitnessgram program.

Table 1 summarizes student characteristics and SBHC visits for the overall sample and by BMI category. Nearly half of the sample had a BMI percentile $\geq 85\%$, either overweight (19.9%, $n = 231$) or obese (29.7%, $n = 345$). Most students were enrolled for a majority of the two school years analyzed. Age, gender, and SBHC enrollment duration were similar across BMI categories. There was no

Table 1. Demographic Characteristics and School Health Care Visits by BMI Category

	Normal/ underweight (BMI percentile <85%)	Overweight/ obesity (BMI percentile $\geq 85\%$)	p^*	Overweight (85% $\leq$ BMI percentile <95%)	Obesity (BMI percentile $\geq 95\%$)	p^{**}	All students
n (%)	585 (50.4)	576 (49.6)	—	231 (19.9)	345 (29.7)	—	1161 (100)
Age, years, mean (SD)	9.65 (2.52)	9.69 (2.52)	0.76	9.83 (2.50)	9.60 (2.52)	0.55	9.67 (2.52)
Male, n (%)	279 (47.7)	281 (48.8)	0.71	123 (53.2)	158 (45.8)	0.20	506 (48.2)
SBHC enrollment duration, weeks, mean (SD)	80.4 (25.7)	79.2 (27.6)	0.47	79.0 (27.1)	79.3 (28.0)	0.76	79.8 (26.7)
BMI, kg/m^2 , mean (SD)	17.1 (1.91)	24.7 (5.68)	<0.01	20.8 (2.32)	27.3 (5.80)	<0.01	20.9 (5.68)
BMI z-score, mean (SD)	0.08 (0.71)	1.86 (0.53)	<0.01	1.34 (0.18)	2.21 (0.36)	<0.01	0.97 (1.09)
Nurse visits							
Mean (SD)	0.82 (1.86)	1.10 (2.10)	0.02	1.08 (2.03)	1.11 (2.15)	0.26	0.96 (1.99)
Median (IQR; min–max)	0 (0–1; 0–15)	0 (0–1; 0–14)	0.09	0 (0–1; 0–12)	0 (0–1; 0–14)	0.09	0 (0–1; 0–15)
Zero visits, n (%)	388 (66.3)	357 (62.0)	0.12	151 (65.4)	206 (59.7)	0.12	745 (64.2)
Clinician visits							
Mean (SD)	1.38 (2.24)	1.45 (2.29)	0.56	1.43 (2.35)	1.47 (2.24)	0.06	1.41 (2.26)
Median (IQR; min–max)	1 (0–2; 0–18)	1 (0–2; 0–14)	0.97	1 (0–2; 0–14)	1 (0–2; 0–13)	0.95	1 (0–2; 0–18)
Zero visits, n (%)	263 (45.0)	274 (47.6)	0.37	112 (48.5)	162 (47.0)	0.63	537 (46.3)
Total visits							
Mean (SD)	2.19 (3.23)	2.55 (3.53)	0.08	2.43 (3.47)	2.73 (3.68)	0.37	2.37 (3.40)
Median (IQR; min–max)	1 (0–3; 0–22)	1 (0–3; 0–20)	0.21	1 (0–3; 0–20)	1 (0–4; 0–19)	0.17	1 (0–3; 0–22)
Zero visits, n (%)	219 (35.8)	196 (34.0)	0.54	99 (36.1)	87 (31.5)	0.41	405 (34.9)

p -Value tests differences by normal/underweight and overweight/obesity categories (*) and differences by normal/underweight, overweight, and obesity categories (**) using χ^2 for categorical variables and two-tailed paired t -tests, ANOVA, or Kruskal–Wallis tests for continuous variables. SBHC, school-based health center.

change in BMI category for any student between the two school years studied (data not shown). Mean visit counts for all visit types increased with each increase in BMI category level (normal/underweight, overweight, and obesity). Median visit counts reflected a high number of students with zero visits to the SBHC.

SBHC Utilization

Table 2 summarizes predicted visit counts and associations between SBHC visit rates and BMI category. In unadjusted models, overweight/obesity status (BMI percentile $\geq 85\%$) was significantly associated with higher nurse and total (nurse and clinician) visit rates. After controlling for age and gender, overweight/obesity status was only significantly associated with higher total visit rates. Students in the overweight/obesity category had total visit rates one and half times greater than normal/underweight peers (IRR 1.45; 95% CI 1.02–2.07). Among those in the overweight/obesity category, the effect size was greatest for nurse visits by students with obesity with an IRR of 1.42 (95% CI 0.85–2.38) and total visits by students with overweight status (IRR 1.54; 95% CI 0.94–2.54), although neither were statistically significant.

Visit Diagnoses

Table 3 gives the top five diagnoses by percentage of visits to SBHC nurses and clinicians. Students in the overweight/obesity category were compared with the reference group of normal/underweight peers. Asthma (including both sick visits and well visits) and pharyngitis were the first- and second-most common reasons, respectively, which students sought care from SBHC clinicians, regardless of BMI category. Students were also commonly seen for allergic rhinitis and vaccines, regardless of BMI category. Attention deficit hyperactivity disorder ranked as the fourth most common complaint for students with normal/underweight status, but did not make the top five reasons for visits among students with overweight/obesity.

Like clinician visits, the top two reasons that students sought care from SBHC nurses, headaches and dysmenorrhea, were the same by BMI category. Students frequently sought care from nurses related to toothaches, pain (either generalized or specific to a body part), and pharyngitis. Although the rank order varied slightly, the top five diagnoses for each visit type were the same.

Discussion

The goals of this study were to compare SBHC utilization by student BMI category [normal/underweight (BMI percentile $< 85\%$) and overweight/obesity (BMI percentile $\geq 85\%$), either overweight ($85\% \leq \text{BMI percentile} < 95\%$) or obesity (BMI percentile $\geq 95\%$)] and to determine whether the reasons for SBHC visits varied by BMI category. Our results demonstrate that students with higher BMI percentiles, categorized as overweight/obesity, have higher SBHC utilization, as measured by total visit rates (nurse and clinician) compared with normal/underweight peers.

Students in the overweight/obesity category used the SBHC more, but for the same reasons as peers with normal/underweight status. To our knowledge, this is the first study to examine differences in SBHC utilization by student BMI category.

Previous literature has shown a similar pattern of greater community-based urgent care and emergency room visits for children with overweight status and obesity compared with their normal weight peers.^{8,9,11,20} Our results add to that body of work. Nonetheless, the reasons for this high utilization remain unclear. It is possible that children's excess weight exacerbates or worsens their co-morbid conditions, such as asthma, or lowers their physical conditioning such that they exhibit a lower threshold for reporting complaints. Several studies have demonstrated worse complications or outcomes in children with obesity compared with normal weight peers, both in the emergency room and critical care settings.^{21,22}

It is also possible that students with overweight status and obesity learn patterns of health care utilization from their parents, who are more likely to be obese themselves and utilize greater health care resources.²³ Moreover, particularly for medically underserved children, access to services outside of school may be limited by factors such as limited transportation or parent work conflicts; in school, however, these students have the ability to independently access and receive care on any school day free from those barriers.

Finally, students with overweight status and obesity are at greater risk for bullying compared with normal/underweight peers.²⁴ They may seek care in the SBHC to avoid the classroom setting or other periods during the day, such as gym class, recess, and lunch. This may be a driver of their higher use, whether purposeful or not, especially for nursing visits with minor complaints. A nursing visit is required to obtain over-the-counter medications such as ibuprofen through the SBHC. This unique policy likely has an influence on our findings that students are seen the most for pain-related complaints during nursing visits. Our results make it clear that more research is needed to better explain higher SBHC utilization for children with overweight/obesity status, especially given the similar nature of complaints compared with their normal/underweight peers.

Higher utilization among students with overweight/obesity status may be an as-yet untapped opportunity to enhance the diagnosis and management of obesity in the school setting. This is especially important for racial/ethnic minority and low-income students, who have a high prevalence of obesity but may also have greater access to health care through SBHCs. However, official recommendations for clinical interventions for weight management have mostly centered on the primary care office.²⁵ Traditional primary care visits may be limited by inconsistent follow-up, time constraints, and inadequate system resources (*i.e.*, staff availability and community referral programs).^{26,27}

SBHCs can reduce barriers seen in the primary care setting. They are accessible to students on a daily basis for a majority of the year, allowing for consistent follow-up

Table 2. Unadjusted and Adjusted School-Based Health Center Predicted Visit Counts, Visit Count Differences, and Incident Rate Ratios for Nurse, Clinician, and Total (Nurse and Clinician) Visits by BMI Category						
BMI category	Unadjusted			Adjusted ^a		
	Total No. of visits ^b (95% CI)	Difference in total No. of visits (95% CI)	IRR (95% CI)	Total No. of visits ^b (95% CI)	Difference in total No. of visits (95% CI)	IRR (95% CI)
Nurse visits						
Normal/underweight	0.82 (0.68–0.96)	Ref.	Ref.	0.81 (0.60–1.02)	Ref.	Ref.
Overweight/obesity	1.10 (0.92–1.28)	0.27 (0.05–0.50)	1.64 (1.01–2.65)	1.14 (0.73–1.56)	0.34 (–0.10–0.78)	1.42 (0.94–2.15)
Overweight	1.08 (0.80–1.36)	0.26 (–0.06–0.57)	1.64 (0.84–3.22)	1.14 (0.58–1.69)	0.33 (–0.25–0.91)	1.41 (0.83–2.41)
Obesity	1.11 (0.87–1.34)	0.28 (0.10–0.56)	1.64 (0.93–2.88)	1.15 (0.59–1.70)	0.34 (–0.22–0.91)	1.42 (0.85–2.38)
Clinician visits						
Normal/underweight	1.38 (1.21–1.55)	Ref.	Ref.	1.67 (1.37–1.97)	Ref.	Ref.
Overweight/obesity	1.45 (1.27–1.63)	0.08 (–0.17–0.32)	1.27 (0.92–1.74)	2.12 (1.51–2.73)	0.45 (–0.18–1.09)	1.27 (0.93–1.75)
Overweight	1.43 (1.15–1.71)	0.06 (–0.27–0.38)	1.37 (0.82–2.32)	2.29 (1.10–3.47)	0.62 (–0.57–1.81)	1.37 (0.81–2.33)
Obesity	1.47 (1.23–1.70)	0.09 (–0.20–0.38)	1.20 (0.87–1.66)	2.02 (1.44–2.60)	0.35 (–0.27–0.98)	1.21 (0.88–1.67)
Total visits						
Normal/underweight	2.20 (1.95–2.45)	Ref.	Ref.	2.90 (2.32–3.48)	Ref.	Ref.
Overweight/obesity	2.55 (2.26–2.84)	0.35 (–0.03–0.73)	1.51 (1.04–2.19)	4.20 (2.81–5.60)	1.30 (–0.11–2.72)	1.45 (1.02–2.07)
Overweight	2.52 (2.07–2.96)	0.32 (–0.20–0.83)	1.60 (0.94–2.72)	4.47 (2.33–6.61)	1.57 (–0.58–3.73)	1.54 (0.94–2.54)
Obesity	2.57 (2.20–2.95)	0.37 (–0.07–0.82)	1.45 (0.94–2.25)	4.02 (2.38–5.66)	1.55 (–0.53–2.78)	1.39 (0.91–2.13)

^aAdjusted for age,gender.

^bTotal number of visits = total predicted number of visits for a 2-year study period.
CI, confidence interval; IRR, incident rate ratio.

Table 3. Top Five Visit Diagnoses by Percentage of Visits for Students with Normal/Underweight Status (BMI Percentile <85%) vs. Students with Overweight/Obesity Status (BMI Percentile ≥85%) for School-Based Health Center Nurse and Clinician Visits

Nurse visits		Clinician visits	
Normal/underweight (% of nurse visits)	Overweight/obesity (% of nurse visits)	Normal/underweight (% of clinician visits)	Overweight/obesity (% of clinician visits)
1. Headache (49.1)	1. Headache (46.3)	1. Asthma (47.2)	1. Asthma (37.8)
2. Dysmenorrhea (18.0)	2. Dysmenorrhea (23.4)	2. Pharyngitis (11.5)	2. Pharyngitis (11.4)
3. Toothache (9.2)	3. Pain complaints (7.1)	3. Allergic rhinitis (10.0)	3. Allergic rhinitis (14.1)
4. Pain complaints (9.2)	4. Toothache (5.6)	4. ADHD (7.3)	4. Vaccination (8.2)
5. Pharyngitis (4.8)	5. Pharyngitis (5.0)	5. Vaccination (5.2)	5. Viral URI (6.0)

Gray shading highlights diagnoses present in top five lists for both BMI categories for nurse and clinician visits.
ADHD, attention deficit hyperactivity disorder; URI, upper respiratory infection.

that is required for successful engagement in weight management. In addition, SBHCs may allow for more time during visits to focus on individualized motivational interviewing and counseling.²⁸ This engagement is enhanced by the longitudinal relationship between students and SBHC staff, who often have insights into the psychosocial factors contributing to a child's health, such as social relationships, family dynamics, and academic challenges.

Finally, SBHCs have the benefit of sitting at the intersection of the education setting and clinical arena. Many studies have evaluated school-based obesity prevention and management programs that aim to influence a number of obesity-related risk factors—nutrition-focused, exercised-based, a combination of nutrition and exercise changes, with or without parent involvement, and during or afterschool.^{28–31} Coupling SBHC-based clinical interventions, particularly with nursing visits given the utilization patterns demonstrated here, with other school-based nutrition, physical activity and parent-engagement interventions could have a synergistic effect on weight management in school-aged children.

Limitations

The results of this study should be considered in light of several limitations. First, the results reflect students who access care at a single SBHC at an urban public charter school. The student population is homogeneous with 99% of students being African American and >80% enrolled in Medicaid. Therefore, our findings may not be generalizable to more racially and socioeconomically heterogeneous student population.

In addition, our final model does not account for several student-level variables that may contribute to residual confounding, including socioeconomic status, physical activity, diet, and other family or neighborhood factors. Insurance information was only available for a subset of

patients who reported it at SBHC enrollment or on their school registration form. In a sensitivity analysis, however, inclusion of Medicaid insurance status as a covariate produced similar results to those without the variable included (Supplementary Table S2).

Furthermore, up to 30% of the student population has a diagnosis of asthma—a chronic condition that impacts SBHC use. Models that controlled for student-reported asthma status produced higher estimated IRR for all visit types compared with those without the variable (Supplementary Table S3). However, asthma status was not included in the final model because the exact causal mechanism between obesity, asthma, and SBHC use is uncertain in this population.

Finally, the SBHC in this study offered full clinician staffing during the week, something that is not currently available in the majority of schools. This may influence the patterns of use for students. However, our findings from SBHC nursing visits may be applicable to more schools across the country.

Conclusions

This study suggests that students with higher BMI percentiles, categorized as overweight/obesity, used more SBHC resources than their peers. Students with overweight status and obesity, particularly those who are medically underserved, are an important group to target for health prevention and management efforts, which may be aided by the immediate availability and accessibility of SBHCs. High SBHC utilization by students with overweight/obesity status is an opportunity to identify and link them in to care for weight management. SBHC interventions may be most effective if implemented in close collaboration with school nurses, given their familiarity to students, and integrated with other evidence-based nutrition, physical activity, and parent-engagement programs deployed in schools.

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Author Disclosure Statement

No competing financial interests exist.

Supplementary Material

Supplementary Table S1

Supplementary Table S2

Supplementary Table S3

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