Schoolwide Food Practices Are Associated With Body Mass Index in Middle School Students

Martha Y. Kubik, PhD, RN; Leslie A. Lytle, PhD, RD; Mary Story, PhD

Objective: To examine the association between body mass index in young adolescents and schoolwide food practices such as foods used in school fundraising and in the classroom as incentives and rewards.

Design: Using a cross-sectional study design, we collected data from both the schools and the students. School administrators provided information on schoolwide food policies and practices. Eighth-grade students provided self-reported heights and weights.

Setting: Sixteen middle schools in the Minneapolis–St Paul metropolitan area.

Participants: The study included 3088 eighth-grade students. Students were participants in a school-based dietary intervention study.

Main Outcome Measures: Body mass index was calculated from self-reported height and weight data. A 7-item schoolwide food practices scale (Cronbach α = 0.83) was created using data collected from school administrators.

Results: The mean number of food practices permitted by a school was 3 (range, 0-7). The most prevalent food practices were the use of food as incentives and rewards (69%) and in classroom fundraising (56%). Body mass index of the students increased 10% for every additional food practice permitted in their school (P < .03).

Conclusions: Schoolwide food practices that supported frequent snacking and the consumption of foods and beverages high in calories and low in nutrients by students throughout the school day were common and adversely associated with body mass index of the students. Prevention of overweight in childhood must include attention to the nutrition integrity of schools, and school nutrition policies that consistently support and promote healthy dietary practices among young adolescents are urgently needed.

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Obesity has become one of the more complex and challenging public health issues of this decade, affecting two thirds of adults and almost one third (30%) of children,1,2 and recent data indicate no decline in prevalence of obesity among either adults or children.3 Most agree that efforts to halt this burgeoning epidemic must start in childhood and target important lifestyle behaviors that include dietary practices. Factors that influence the adoption of healthy dietary practices are numerous and include individual and environmental influences.4

In recent years, there has been a growing awareness of the powerful influence of certain environments and prevalent environmental factors. For young adolescents, the school environment is recognized as an influential setting, and school environmental factors have been implicated in the rising rates of childhood obesity. For example, the pervasiveness of school a la carte and vending programs that sell foods and beverages that are high in calories and low in nutrients is well documented.5 Moreover, studies demonstrate an association between the presence of these programs and dietary practices that likely contribute to overweight in young adolescents.6 Other school food practices that may contribute to the development of childhood obesity include the use of foods high in calories and low in nutrients in school and classroom fundraising and as rewards and incentives for students. Descriptive data suggest that these school practices may be as prevalent as vending and a la carte programs.7,8 However, to our knowledge, there are no studies evaluating the association between these practices and overweight among young adolescents.

The present study was undertaken to examine the association between selected schoolwide food practices and body

Author Affiliations: School of Nursing (Dr Kubik) and School of Public Health, Division of Epidemiology (Drs Lytle and Story), University of Minnesota, Minneapolis.
SAMPLE AND SETTING

School districts located within a 30-mile radius of the Minneapolis–St Paul metropolitan area and with a minimum of 20% of students approved for the free or reduced-cost lunch program were eligible to participate in TEENS. Schools were required to have both seventh and eighth grades in 1 building and enroll at least 30 students in each of these grades. (TEENS student-level outcomes were assessed in a cohort of seventh-grade students observed for 2 years). Fourteen districts (33 schools) were eligible, and 9 districts (20 schools) agreed to participate. One of the 20 schools was chosen to pilot evaluation and intervention materials, and 3 schools were judged ineligible because of scheduling conflicts. The remaining 16 schools formed the school sample for the study.

OUTCOME MEASURES

Independent Variable

Body mass index was calculated from self-reported height and weight data. Among adolescents, self-reported height and weight correlates well with measured BMI ($r=0.92$). $^{16}$ Students with a BMI between the 85th percentile and less than the 95th percentile were classified as at risk for overweight; those with a BMI greater than or equal to the 95th percentile were classified as overweight. $^{11}$

DEPENDENT VARIABLE

A cross-sectional design was used. School-level data were collected from 16 schools in the St Paul–Minneapolis, Minn, metropolitan area. Student-level data were obtained from a sample of eighth-grade students attending these schools. Data were collected in spring 2000.

STUDY DESIGN

School districts located within a 30-mile radius of the Minneapolis–St Paul metropolitan area and with a minimum of 20% of students approved for the free or reduced-cost lunch program were eligible to participate in TEENS. Schools were required to have both seventh and eighth grades in 1 building and enroll at least 30 students in each of these grades. (TEENS student-level outcomes were assessed in a cohort of seventh-grade students observed for 2 years). Fourteen districts (33 schools) were eligible, and 9 districts (20 schools) agreed to participate. One of the 20 schools was chosen to pilot evaluation and intervention materials, and 3 schools were judged ineligible because of scheduling conflicts. The remaining 16 schools formed the school sample for the study.

All 4100 eighth-grade students were eligible to participate in the TEENS student survey. Letters of consent were mailed to parents, and those who did not want their child to participate in the student survey were asked to call the study’s evaluation coordinator. Letters returned undelivered and from families known to be unable to read English or any of the translated languages (Spanish, Hmong, and Croatian) were treated as though consent had not been given. The study was approved by the University of Minnesota Committee on the Use of Human Subjects in Research.

Surveys were completed by 3888 (88%) students; 157 (4%) students were missed owing to absence, 142 (3%) were excluded because of parent or student refusal, and an additional 213 (5%) were excluded because of scheduling and other conflicts. Of these students, 3088 (86%) provided self-reported heights and weights that were included in the analyses. Students whose heights or weights were identified as outliers based on visual inspection of a scatterplot and those with a calculated BMI less than or greater than 4 SDs from the mean were excluded from analysis.

STUDY DESIGN

A cross-sectional design was used. School-level data were collected as part of the Teens Eating for Energy and Nutrition at School study (TEENS), a school-based dietary intervention trial that sought to promote healthful dietary practices among young adolescents to reduce future cancer risk. $^{9}$ It was hypothesized that student BMI would be positively associated with the number of food practices permitted by a school.

METHODS

DESIGN

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SAMPLE AND SETTING

School districts located within a 30-mile radius of the Minneapolis–St Paul metropolitan area and with a minimum of 20% of students approved for the free or reduced-cost lunch program were eligible to participate in TEENS. Schools were required to have both seventh and eighth grades in 1 building and enroll at least 30 students in each of these grades. (TEENS student-level outcomes were assessed in a cohort of seventh-grade students observed for 2 years). Fourteen districts (33 schools) were eligible, and 9 districts (20 schools) agreed to participate. One of the 20 schools was chosen to pilot evaluation and intervention materials, and 3 schools were judged ineligible because of scheduling conflicts. The remaining 16 schools formed the school sample for the study.

STATISTICAL ANALYSIS

Mixed-model analysis of variance techniques were used to evaluate the association between student BMI and the schoolwide food practices scale. By including school in the model as a random effect, this statistical method accounts for the additional component of variance anticipated when a cluster-sampling design is used and observations obtained from students in the same school are likely to be correlated. $^{12}$ This method also incorporates hierarchical linear analysis techniques, which allow school-level predictors to be accurately modeled as group-level covariates, with the denominator degrees of freedom determined from the school component of variance. $^{13}$

General linear mixed modeling was used to test the study hypothesis. First, a crude model was fit to assess the bivariate
association between the independent (schoolwide food practices scale) and dependent (student-level BMI) variables. Next, a model containing simultaneous adjustments for potential confounders (age, sex, race/ethnicity, socioeconomic status as measured by participation in the free or reduced-cost lunch program, number of parents living in the home, highest level of education for mother and father, and number of parents working full time) was fit. The final model included adjustments for potential confounders and all 2-way interactions between gender, race/ethnicity, and socioeconomic status. Because data were collected after completion of the TEENS intervention, a fourth model was assessed that included an adjustment for treatment condition. However, because the treatment condition was not a significant covariate, it was excluded from the final model. Analyses were conducted using SAS/STAT software version 8.2.14

### RESULTS

Most students (70%) were white, 51% were boys, 20% participated in the free or reduced-cost lunch program, 68% lived in 2-parent households, 53% reported that both parents worked full time, and 49% had at least 1 parent who completed college. Mean (SD) age of the students was 14.2 (0.4) years (age range, 11.9–16.1 years), and their mean (SD) BMI was 21 (3.7) (range 12.9–37.9). Fifteen percent of students were classified as at risk for overweight and 8% were classified as overweight.

Table 1 lists the scale items and prevalence of food practices by school. The mean food practices score was 3 (range, 0–7).

Table 2 lists the results of the multivariate analysis. In this sample of eighth-grade students, the schoolwide food practices scale was positively associated with students’ BMI. Results indicated that for every additional food practice allowed by a school, student BMI increased by 10% (P = .03).

### COMMENT

Food choice at school includes more than the foods and beverages offered as part of school meal programs, a la carte, and in vending machines. Similarly, opportunities for eating during the school day extend well beyond the school lunchroom and breakfast and lunch. This study, like others, found that the use of food in classroom and school fundraising and as reward and incentive for students are common practices. Several schools also allow students to have food and drinks in hallways and classrooms, practices that have not been previously reported. However, the most important study finding was the positive association between these school food practices and student BMI, with BMI increasing 10% for every additional food practice allowed. Although most of our young adolescent sample were categorized as having normal weight, our results suggest that continued exposure to these common food practices places all students at risk for weight gain.

There are several reasons why the school food practices assessed in this study would be adversely associated with BMI. Prevalence data indicate that these are common practices; thus, students are likely to be exposed to more than 1 practice. In our sample of 16 middle schools, the mean number of practices allowed by a school was 3. Most practices represented opportunities to eat and drink. In schools that allowed students to have food and beverages in hallways and classrooms, it would be possible for students to eat and drink as often as they like throughout the school day. Among our school sample, 2 schools allowed students to have food and beverages in hallways and classrooms, 1 school permitted food in hallways and classrooms and beverages in classrooms, and another school allowed beverages in hallways and classrooms and food in hallways (data not shown).

More opportunities to eat and drink at school may also promote consumption of more foods and beverages high in calories and low in nutrients, or “junk food.” In many schools, junk food is readily available. Numerous studies have documented the high fat and sugar content of the snacks offered and sold to students from school stores, a la carte programs, and vending machines.6,7,15–17 Similarly, most beverages available to students through these venues are sweetened drinks.6,7,17 Restricted operating hours limit when students can purchase snacks and drinks; however, students may purchase snacks and drinks for later consumption. We recognize that some students may not purchase or have access to junk food at school. Nevertheless, school policies that allow eating and drinking at will throughout the school day might encourage extra calorie consumption among these students as well.

The most prevalent school food practice reported in this study was the use of food as a reward or incentive for students. We have previously reported that more than 70% of teachers in the TEENS middle schools used candy as a student incentive or reward.6 Cookies and doughnuts, sweetened drinks, and pizza were also commonly used; healthful items (bagels, pretzels, fruits, vegetables, water, and low-fat milk) were used less often.6 These results are consistent with national data that indicate that only 23%...
of schools prohibit or discourage faculty and staff from using food as a reward for good behavior or academic performance.\(^7\) Other prevalent food practices reported by our school administrators included the use of food in classroom and school fundraising. Nationwide, more than 80% of schools sold food at school or in the community to raise money, and the most popular food items for sale were chocolate candy, other candy, baked goods (not low in fat), and sweetened drinks.\(^7\)

School food practices that encourage eating by students whenever they want and consumption of foods and beverages high in calories and low in nutrients are commonplace and, as our study indicates, adversely associated with student BMI. These are concerning findings that require urgent attention, and school policies that restrict or limit these practices are clearly needed. However, policy implementation must consider the need to increase awareness among school administrators, teachers, and parents of the prevalence and health implications of these practices, as well as a method to monitor policy enforcement. Data suggest that nutrition policy is not a priority for many schools,\(^17,18\) especially middle schools and high schools.\(^19\)

These findings have limitations. Cross-sectional studies cannot establish causality. However, an ecological approach provides a “snapshot” of the school food environment and its potential influence on the day-to-day dietary practices of students. Data from both the schools and the students were self-reported and subject to response bias. Our convenience sample of schools and students may not be representative of other schools and students, thus limiting the generalizability of the study findings.

In summary, to our knowledge, this is the first study to demonstrate an adverse association between prevalent school food practices and BMI in young adolescents. Our results lend further support to the notion that schools are influential environments and that school-level factors require targeted attention from researchers and the school community. Adolescence is a critical period for the development of obesity that persists into adulthood.\(^20\) Prevention of overweight in children must therefore include careful attention to the nutrition integrity of our schools.\(^21\) School nutrition policies that consistently promote and support healthy dietary practices among young adolescents are urgently needed.

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Correspondence: Martha Y. Kubik, PhD, RN, School of Nursing, 6-101 Weaver Densford Hall, University of Minnesota, 308 Harvard St SE, Minneapolis, MN 55455 (kubik002@umn.edu).

REFERENCES

found almost identical results (ie, no statistically significant relationships).

On the basis of these results, there appears to be little, if any, basis for believing that risk compensation is a phenomenon that influences the behavior of children using PE. Although this finding does not necessarily relegate RHT to the realm of myth, at least for children it does not seem to be a significant reality. The practical and important public health implication of this conclusion is that efforts must continue to persuade children to protect themselves by whatever means possible. Our results indicate that doing so will not result in greater risk taking and more injuries.16

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Correspondence: I. Barry Pless, MD, Montreal Children's Hospital, 2300 Tupper St, Room F-259, Montreal, Quebec, Canada H3H 1P3 (barry.pless@mcgill.ca).
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Correction

In the article titled “Schoolwide Food Practices Are Associated With Body Mass Index in Middle School Students,” by Kubik et al published in the December 2005 issue of the ARCHIVES (2005;159:1111-1114) the estimated regression coefficient in the model was incorrectly interpreted as representing a 10% increase in body mass index (BMI) for every additional food practice permitted in a school. As described in the article, the dependent variable in the model was specified as BMI, calculated as weight in kilograms divided by the square of height in meters. Therefore, the estimated regression coefficient of β=0.10 would be correctly interpreted as a 0.10 BMI unit increase for every additional food practice a school permitted. In the abstract on page 1111, right-hand column, “Results” section, the third sentence should have read as follows: “Body mass index (BMI) of the students increased a 0.10 BMI unit for every additional food practice permitted in their school (P<.03).” On page 1113, left-hand column, “Results” section, paragraph 2, the last sentence should have read as follows: “Results indicated that for every additional food practice allowed by a school, student BMI increased by a 0.10 BMI unit (P<.03).” Also on page 1113, bottom left-hand column and upper right-hand column, “Comment” section, first paragraph, the fifth sentence should have read as follows: “However, the most important study finding was the positive association between these school food practices and student BMI, with BMI increasing a 0.10 BMI unit for every additional food practice allowed.”

REFERENCES