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Are School Vending Machines Loaded with Calories and Fat: An Assessment of 106 Middle and High Schools

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Abstract

Background—The purpose of this study was to describe the extent to which vending offerings in 106 schools in the St. Paul-Minneapolis, Minnesota metropolitan area met criteria for types of beverages, fat and calories based on selected criteria offered by the Institute of Medicine.

Methods—Schools where youth participants were attending for the 2006-2007 school year were identified and invited to participate in the study (n=143); 81% of schools (n=116) agreed to participate.

Results—Of the 116 schools, 106 had vending machines. Across schools with vending machines (n=106), 5085 food and 8442 beverage items were offered. Overall, only 18% of beverage items met criteria for calories and type of beverage; significantly more items in public schools met the criteria as compared to private schools (19% vs. 12%; p<0.01). This difference was also significant for high schools as compared to middle schools (18% vs. 22%; p<0.01). For food items, 41% met calorie criteria, 45% met fat criteria, and 22% met both fat and calorie criteria. Significantly more food items met both criteria in public than private schools (22% vs. 18%; p=0.01), while high schools (22%) and middle schools (21%) were similar. A very small proportion of foods (<5%) would have met the full criteria suggested by the Institute of Medicine for competitive foods..

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Conclusion—Overall, foods and beverages offered in vending machines continue to be high in fat and calories. Public schools are doing a slightly better job of providing healthy foods as compared to private schools.

INTRODUCTION

The school food environment influences youth food choices by providing access to foods throughout the school day and by modeling healthy food choices [1-4]. Broadly defined, the school food environment includes foods available as part of the United States Department of Agriculture's (USDA) reimbursable breakfast and lunch programs as well as foods available through vending, a la carte, school stores, fundraisers, and foods used as incentives [5]. Foods offered outside of the USDA's reimbursable meals are often referred to as competitive foods [1,3].

School vending is a common source of competitive foods. National data from the School Health Policies and Programs Study 2006 (SHPPS) [1, 3] found that 62.4% of middle schools and 85.8% of high schools had at least one vending machine available to students. Other studies have documented that the majority of vending machines are typically stocked with low nutrient, energy dense foods and beverages [6-8]. Kubik et al [2] showed that the number of snack vending machines in a school was negatively associated with fruit consumption. Additionally, students who report using vending machines consume more sugar-sweetened beverages [9].

Many initiatives at the local, state, and national levels have attempted to positively influence the healthfulness of school food including vending offerings. Two important federal policy initiatives are the USDA Child Nutrition and Women, Infants and Children Reauthorization Act of 2004 [10] and the 2007 Institute of Medicine (IOM) report on "Nutrition Standards for Foods in Schools" [1]. The Child Nutrition and WIC Reauthorization Act of 2004 [10] stipulated that by 2006 school districts receiving federal funding for the National School Lunch or School Breakfast Program must have a wellness policy that addresses nutritional standards for all foods offered at school, including competitive foods. However, no specific nutritional standards, or criteria for identifying "healthy" foods and beverages, were offered in the Child Nutrition and WIC Reauthorization Act of 2004. In 2007, the IOM report defined "healthy" foods and beverages in schools and also recommended that, when available, access to competitive foods be limited [1]. Specifically, the report stipulated that only fruits, vegetables and whole grain foods should be offered as competitive foods and competitive foods as offered must have 200 calories per portion as packaged; 35% of calories from fat; <10 percent of calories from saturated fats; zero trans fat; 35% of calories from total sugars; and <200 mg of sodium per portion as packaged [1]. Beverages that meet the IOM criteria are limited to water without additives, carbonation, caffeine or flavoring; low-fat (1%) and non-fat milk; flavored milk with 22 grams of total sugar per 8 oz. portion size; and 100% fruit juice (4 oz. package size for elementary/middle schools, 8 oz. package size for high schools) [1].

Little is known about how the Child Nutrition and WIC Reauthorization Act of 2004 has influenced foods offered in vending in schools or how current practices conform to criterion standards for foods in schools. Nor have differences in vending offerings that may exist by school characteristics (public versus private; middle school versus high school) been adequately explored. Examining such differences by school type may help us understand the unique challenges that some schools face in offering healthful foods and also help target intervention strategies by school type. Criteria for calories, fat and portion size may be particularly important when considering the obesogenic environment of schools. Therefore, the purpose of this study was to describe the extent to which vending offerings in 106

schools in the St. Paul-Minneapolis, Minnesota metropolitan area meet criteria for types of beverages, fat and calories based on selected criteria offered by the IOM. Cost and feasibility of collecting data on the complete IOM nutrient criteria (including saturated fat, trans fat, sugar, and sodium) were prohibitive. Therefore, as our primary study is the etiology of childhood obesity, we chose to evaluate how foods available in vending met the IOM criteria related to calories (no more than 200 calories or less per portion packaged) and proportion of calories from fat (no more than 35% of total calories from fat). The products available in machines are described and differences in the vending environment by school characteristics are compared.

METHODS

Subjects

These analyses use data from the Transdisciplinary Research on Energetics and Cancer – Identifying Determinants of Eating and Activity (TREC-IDEA) study. TREC-IDEA is a 3-year cohort study examining the influence of home, school, and neighborhood environments on unhealthy weight gain in youth [11]. The TREC-IDEA study included 349 youth participants. To study the larger environmental influences these youth are exposed to, youth identified their school for the 2006-2007 school year and those schools were invited to participate in the study; 81% of schools (n=116) agreed to participate. In the present analysis, schools are the unit of analysis.

Participating schools were located in the Twin-Cities Metropolitan area and represented several districts and counties. Schools were, on average, 78.6% White, had 19.5% of students who qualified for free/reduced price lunch, and were larger schools (mean number of students=1,263). Schools were more likely to be suburban (n=88) as compared to urban (n=18). Compared to private schools, public schools had significantly fewer White students (76.6% vs. 87.1%), more students who qualified for free/reduced price lunch (22.9% vs. 5.6%) and were larger (1,417 students vs. 639) ($p<0.05$). Middle schools were significantly smaller than high schools (906 students vs. 1,454 students) ($p<0.05$). Middle schools and high schools did not differ by percent White or percent receiving free/reduced priced lunch.

Instruments

School participation included school personnel completing self-administered surveys and study staff collecting observational data of vending, a la carte, and school store food/beverage offerings. Of the 116 schools, 106 had vending machines; our analyses are limited to those 106 schools.

Procedure

Trained research staff went to each school and collected information on vending machines that were accessible to students and recorded the type of machine (beverage, food or both), the total number of slots in the machine, the number of slots filled in the machine at measurement, and hours of operation for each machine. Finally, in each vending machine, staff noted all products, including their brand name, price, and package size.

Additional information about number of servings per package, calories per serving, and fat grams per serving were recorded for each product. This information was: 1) recorded directly from the package if visible through the vending machine; 2) recorded from nutrition information listed on product websites (e.g., www.fritolay.com); or 3) recorded from nutrition information found in online nutrition databases (e.g., www.thedailyplate.com). Any information that was unreadable in the vending machine and was not accessible from these sources was considered missing. Data collection at the schools required approximately 50

minutes per school on average and filling in missing information from websites required approximately 1 hour 15 minutes per school. To set up the missing information database, 75 hours of staff time was used. While other nutritional information was available via websites, the time cost and actual cost of collecting this data were deemed to be prohibitive.

Data Analysis

Descriptive analyses of the school vending environment were conducted using SAS version 9.1 (SAS Institute Inc., Cary, NC). Beverage and food data were coded as meeting or not meeting established criteria. For beverages, we based our criteria on the IOM criteria for beverages that include recommendations on the types of beverages offered, portion sizes for some beverages and recommended calorie levels as previously described; caffeine content of beverages was not assessed. Analyses examined the prevalence of types of beverages and foods offered in schools, the proportion meeting the established criteria for the total sample of schools and stratified by school characteristics (private versus public; middle versus high school). T-tests were conducted to examine differences by school types.

RESULTS

Overall

Of the 106 schools with vending, 80.2% were public schools and 65.1% were high schools. Across all schools, there were 829 vending machines; 79% were beverage machines, 18.5% were food machines, and 2% were combination beverage and food vending machines (see Table 1). The mix of beverage, food and combination machines was nearly identical across school types, with the exception of middle schools where 87% of the vending offered was beverage vending as compared to 78% in high schools. The median number of vending machines across all schools was 6.5. Overall, high schools and public schools had more vending machines than middle and private schools.

The hours of operation of vending machines varied by school, with some available all day and others only available during after school hours. According to principal reports vending machine availability was most common after school (84% of schools), before school (67%), starting first period until lunch (36.8%), at the end of lunch until the end of the school day (33%), and during lunch (29.2%). Funds from the vending machine sales went to the school administration (58.5% of schools), school clubs (42.5%), soft drink bottler (34.9%), the athletic department (28.3%), and the school food service program (21.7%). Over 70% of the vending machines were owned by Coca-Cola Enterprises Inc or Pepsi Bottling Group. Almost 60% of the vending machines were located in or near the cafeteria, other locations included in hallways or other common areas (26.4%), by the gym (12.8%), and in other school areas (2.1%).

Beverage Vending

Together, sugar-sweetened beverages and sports drinks represented half of the beverages available in the 657 beverage vending machines in the schools (see Table 2). Only 17% of the beverages offered were plain water and 10% were other healthy beverage choices such as 100% fruit juice and low-fat milk. The distributions of beverage types offered were similar in public, private, middle and high schools. Middle schools offered the highest proportion of sugar-sweetened beverages and sports drinks (57% of offerings) and high schools offered the lowest proportion (49%).

Overall, only 18% of beverages met the established criteria for healthy beverages. Private schools had significantly fewer beverages meeting the criteria than public schools (12% vs.

19% respectively, $p<0.01$). Middle schools had significantly more beverages meeting the selected criteria than high schools (22% vs. 18% respectively, $p<0.01$).

While 100% fruit juice meets the IOM criteria, only 6% of juices offered met the criteria for portion size. On average, the portion size for 100% fruit juice in middle schools and high schools was 13.0 and 12.1 ounces, respectively. In high schools only 7% of schools offered 100% fruit juice in 8 oz. packages or less, meeting the criteria based on the IOM. None of the middle schools met the criterion for 100% fruit juice in 4 oz. packages or less. Low-fat, unflavored milk was rarely observed in vending, and only 39% of the low-fat flavored milk met the criteria, due to the sugar content or the portion size offered.

Food Vending

Salty snacks, candy bars and baked goods represented 93% of the foods offered across all schools (see Table 3). Salty snacks were the most commonly offered food items across school types except for private schools where candy bars made up 40% of offerings and salty snacks made up 32% of offerings. Only 22% of food vending items across all schools met the established criteria for both calories and fat. Fruits and vegetables had the highest proportion of items meeting criteria (93%) but fruits and vegetables only accounted for about 2% of offerings in schools. Frozen desserts had the lowest proportion of offerings meeting the criteria for both calories and fat (9%).

Public schools had the highest proportion of foods meeting both the calorie and fat criteria established by the IOM while private schools had the lowest proportion of foods meeting both criteria. Public schools had a greater proportion of foods meeting the criteria for fat than private schools (46% vs. 40% respectively, $p=0.004$). Public schools also had a greater proportion of items meeting both fat and calorie criteria than private schools (22% vs. 18% respectively, $p=0.02$). There was no difference in the proportion of items meeting the calorie criteria by school characteristics.

Products within Categories Meeting the Established Criteria

Within each category of food and beverage items, numerous products met the criteria for calories and fat based on the IOM guidelines. For salty snacks, the products most likely to meet the criteria were plain pretzels and baked chips with 89.6% and 86.3%, respectively, meeting both criteria. Within the cookies and baked goods category, at least 95% of animal crackers, graham crackers and Rice Krispie Treats™ met the criteria for fat and calories. Within the candy and candy bar category, 96% of hard candies met both criteria, while none of the chocolate candy bars met both criteria. Within the gummy fruit category, 100% of the fruit leather or gummy animals met both fat and calorie criteria while only 31.3% of fruit snacks met both criteria for calories and energy from fat (data not shown).

DISCUSSION

This research is among the first to examine a large sample of schools soon after the USDA Child Nutrition and WIC Reauthorization Act of 2004 became law and prior to widespread dissemination of the IOM standards for foods in schools. This research is also one of the first to use observational data to examine competitive foods in schools and to examine differences between public and private schools. Our findings indicate that during the 2006-2007 school year few foods and beverages available in this sample of middle and high schools met selected criteria for calories, fat and beverages as suggested by the IOM. We also found that private schools offered a lower proportion of healthy foods as compared to public schools. This finding may suggest that fewer regulations around food exist in private schools. Private schools may not have to adhere to the standards set by state level policies as

they are not supported by state monies. Still, assessing the healthfulness of competitive foods in private schools is likely important information for private school stakeholders who are concerned about the healthfulness of their school environments

For beverages, there are issues related to both the types and portion sizes of beverages offered. Sugar-sweetened beverages still make up a large portion of the beverages offered in vending, despite the fact that sugar-sweetened beverages offer no nutritional value, carry excessive calories, and have been linked to weight gain and obesity [12]. The finding that approximately 35% of all of the beverages offered across all school types were sports drinks or flavored water may reflect a belief among school decision makers that sports drinks and flavored water are healthful beverages to offer in school vending while both contain few nutrients and provide added sugars. As for the more healthful beverages, the 100% fruit juice that is typically offered exceeds portion size recommendations and higher fat milk with added sugars are offered in greater proportions as compared to low-fat, unflavored milk. To improve the healthfulness of beverages offered in vending, persuading school decision-makers that plain water is an acceptable choice and working with food manufactures to produce and/or stock 100% fruit juice in recommended portion size is an important next step. While flavored low-fat and 2% milk may be student favorites, offering them occasionally rather than everyday may be an acceptable change.

Food vending is also problematic. If the full IOM criteria had been strictly applied, the proportion of foods meeting IOM criteria would have dropped dramatically since fruits and vegetables made up only 2% of the offerings and few of the baked products would have met the whole grain criteria. Therefore, increasing the availability of fresh fruit and vegetables, whole grain products and low-fat dairy products such as string cheese or yogurt would go a long way in offering healthful, nutrient-rich snack options for youth at school. The observation that some packaged products were offered that meet the IOM criteria for calories and fat, such as low-fat, appropriately packaged animal crackers, graham crackers and baked chips, suggests that it is possible to produce and stock healthier food products. It is important to have healthier products available in vending machines, and to make sure they are competitively priced and promoted to improve the healthfulness of food options in schools. Intervention research in schools suggests that school administration and food service can positively change the nutrient quality of competitive foods and that student preferences for the healthier items follows that positive change [8].

Strengths of this study include 1) use of direct observation to document items and nutrient content, 2) a good response rate among study schools and 3) a school sample that allows comparison across public and private and middle and high schools.

Limitations

The limitations of this research include its external validity and that it considers only foods and beverages available in vending at one point in time. Also, the complete IOM criteria were not evaluated in this study. Locating reliable nutrient information on packaged foods is a formidable task requiring a great deal of resources and should not be underestimated. We chose to look at energy and fat since our primary study was of the obesity epidemic in children. Including all nutrient criteria included in the IOM guidelines would have resulted in fewer foods and beverages meeting the criteria. This research does not look at the broader scope of competitive foods offered in school nor does it relate the environmental observations with health behaviors or outcomes of student or staff. Research that examines the influence of an obesogenic school environment on the prevalence of obesity and body mass index of students within the school is also needed. Despite these limitations, this research provides insights into the type of food and beverage vending items offered in schools and the extent to which those foods and beverages are meeting selected criteria.

Conclusions

Overall, these findings suggest that competitive foods available in schools, even after the USDA Child Nutrition and WIC Reauthorization Act of 2004, are higher in fat, calories and sugars than is recommended. Much additional work is needed to improve the nutritional quality and appropriate portion size of foods and beverages offered in these settings.

Implications for Schools

Schools provide an opportunity to create healthy environments for youth. School vending is one such environment where simple changes may have a tremendous impact on the health of children. The results of this study show that many schools currently have vending machines with very high calorie, high fat foods and beverages. However, there may be foods and beverages which are lower in calories and fat that can be placed in vending machines to help reduce the risk of obesity. School officials can use this information to review their school's vending offerings and determine if there are products that can be replaced with healthier products. In addition, schools can review school vending contracts and work with vendors to stock vending machines with healthier products. If possible, schools should try to limit vending machines or access to vending as much as possible.

Human Subjects Approval Statement

This study was approved by the University of Minnesota Institutional Review Board.

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Table 1

Vending Machine Prevalence Stratified by School Type

	All Schools (n=106)				Public Schools (n=85)				Private Schools (n=21)				High Schools (n=69)				Middle Schools (n=37)			
	Total	Median	Min	Max	Total	Median	Min	Max	Total	Median	Min	Max	Total	Median	Min	Max	Total	Median	Min	Max
All Vending	829	6.5	1	35	725	8.0	1	35	104	4.0	1	27	689	9.0	1	35	140	3.0	1	11
Beverage Vending	657	6.0	0	22	574	6.0	0	22	83	3.0	1	22	535	7.0	0	22	122	2.0	1	9
Snack Vending	153	1.0	0	13	136	1.0	0	13	17	1.0	0	3	135	2.0	0	13	18	0.0	0	2
Food & Beverage Vending ^a	19	0.0	0	2	15	0.0	0	2	4	0.0	0	2	19	0.0	0	2	0	0.0	0	0

^aVending machines contained both food and beverage items

Table 2
Beverage vending: Types of beverages and percent of beverage items meeting selected IOM criteria

	ALL Schools 8442 items offered in 106 schools			Public Schools 7298 items offered in 85 schools			Private Schools 1144 items offered in 21 schools			High Schools 7124 items offered in 69 schools			Middle Schools 1318 items offered in 37 schools		
	% of total items offered	% meeting IOM criteria	% of total items offered	% of total items offered	% meeting IOM criteria	% of total items offered	% of total items offered	% meeting IOM criteria	% of total items offered	% of total items offered	% meeting IOM criteria	% of total items offered	% of total items offered	% meeting IOM criteria	% of total items offered
Sugar Sweetened Beverage	30	0	30	30	0	33	28	0	40	0	0	40	0	0	0
Sports drinks	20	0	20	20	0	20	21	0	17	0	0	17	0	0	0
Water	17	100	18	18	100	11	16	100	22	100	100	22	100	100	100
Flavored water (including Propel)	15	0	15	15	0	12	16	0	11	0	0	11	0	0	0
Diet soda	8	0	7	7	0	10	8	0	5	0	0	5	0	0	0
100% juice (fruit or veggie)	5	6	5	5	8	8	5	7	5	7	7	5	0	0	0
2%/whole milk	3	0	3	3	0	2	3	0	1	0	0	1	0	0	0
Flavored low fat milk	2	39	2	2	48	3	2	39	<1	39	39	<1	0	0	0
Low fat milk	<1	83	<1	<1	25	1	<1	83	0	83	83	0	-	-	-
All Beverage Items		18			19 ^a			12 ^a		18 ^b	18 ^b		22 ^b	22 ^b	22 ^b

^aSignificantly different than private schools (p-value < 0.01.)

^bSignificantly different than middle schools (p-value < 0.01.)

Table 3

Food Vending: Types of foods and percent of food items meeting IOM criteria for kcal¹, fat², and both kcal and fat

Food Items	All Schools (n=106) # of items offered=5085				Public Schools (n=85) # of items offered=4523				Private Schools (n=21) # of items offered=562				High Schools (n=69) # of items offered=4494				Middle Schools (n=37) # of items offered=591			
	% of total items offered	% meeting IOM criteria	Kcal ^a	Fat ^b	Both ^c	% of total items offered	% meeting IOM criteria	Kcal ^a	Fat ^b	Both ^c	% of total items offered	% meeting IOM criteria	Kcal ^a	Fat ^b	Both ^c	% of total items offered	% meeting IOM criteria	Kcal ^a	Fat ^b	Both ^c
Salty Snacks	39	63	25	20	40	62	26	20	32	71	20	13	39	62	25	20	40	68	24	20
Candy bars	33	11	50	9	32	10	51	9	40	15	44	13	32	11	49	9	39	11	57	11
Cookies and baked goods	21	48	66	40	21	50	67	42	20	33	54	27	22	48	66	41	17	45	67	38
Gummy fruit	3	19	99	19	3	19	99	19	2	17	100	17	3	17	100	17	3	35	94	35
Fruits or vegetables	2	98	95	93	2	97	94	91	2	100	100	100	2	99	95	93	1	80	100	80
Frozen Desserts	1	23	11	9	1	23	13	11	2	20	0	0	1	23	11	9	0	-	-	-
Non-frozen dairy	1	40	38	28	1	49	33	33	1	0	0	0	1	39	26	26	0	100	100	100
Entrees	1	12	44	12	1	0	36	0	1	100	100	100	1	12	44	12	0	-	-	-
All Food Items		41	45	22		41	46 ^d	22 ^e		39	40 ^d	18 ^e		41	45	22		42	47	21

^a200 calories or less per portion as packaged

^bNo more than 35% of total calories from fat

^cMeets both IOM calorie and fat criteria

^dSignificantly different (p-value p=0.004)

^eSignificantly different (p-value p=0.01)