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Changes in a Middle School Food Environment Affect Food Behavior and Food Choices

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ABSTRACT

Increasing rates of obesity among children ages 12 to 19 years have led to recommendations to alter the school food environment. The purpose of this study was to determine whether there are associations between an altered school food environment and food choices of middle school students both in and outside of school. In a midsized western city, two of six middle schools allowed only bottled water in vending machines, only milk and fruit on à la carte menus, and offered a seasonal fruit and vegetable bar. Three years after the intervention was initiated, seventh- and eighth-grade students attending the two intervention schools and four control middle schools were surveyed about their food choices. A total of 2,292 surveys were completed. Self-reported frequency of consumption for nine food groups in the survey was low; consumption was higher outside than in school. Boys consumed more milk than girls although girls consumed more fruits and vegetables. Significant socioeconomic differences existed. Compared with students who paid the full lunch fee, students qualifying for free and reduced-price meals consumed more milk and juice in schools but less outside school; more candy and energy drinks in school; and more sweet drinks, candy, pastries, and energy drinks outside school. Students in intervention schools were 24% more likely to consume milk outside school, 27% less likely to consume juice in school, and 56% less likely to consume sweet pastries in school. There were no differences in fruit and vegetable consumption reported by children in control and intervention schools. Overall, there was a positive association between a modified school food environment and student food behavior in and outside school. Policies related to the school food environment are an important strategy to address the obesity epidemic in our country.

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During the past 20 years the rate of overweight among 12- to 19-year-olds has more than tripled (1), and nearly one in three children in the United States is now overweight or obese (2). Overweight in adolescence is a greater predictor of risk for hyperlipidemia, hypertension, diabetes, and osteoporosis than overweight in adulthood, making adolescence a crucial time to encourage healthy food and physical activity habits (3). Because of their continuous and intensive contact with children during the first 2 decades of their lives, schools provide an ideal setting for obesity-related interventions (2,4-9). Most schools offer US Department of Agriculture (USDA) School Lunch and Breakfast Programs (9) and some form of competitive à la carte food options (ie, food sold outside the purview of a USDA meal program). Competitive foods tend to be high in energy from fat and/or sugar and low in nutrients (9) and their availability has a negative influence on nutrient consumption (8,10), particularly among students from low-income families. Availability of these foods is associated with reduced participation in USDA meal programs (2,11).

The school food environment, which for this study included all foods available to students in school during the school day, was targeted as a place in which to reduce adolescent obesity. Several studies have reported that restricting less-healthy foods in cafeterias and vending machines reduced consumption of low nutrient, high-energy foods (2,6,12). However the duration and effect of changes has been studied for a relatively short period of time, often <1 year (3).

The purpose of this research was to examine the relationships between changes in the school food environment and food choices made by early adolescents. This study extends beyond others in that the intervention reduced vending machine beverages to water only, limited à la carte offerings, extended changes in the school food environment to 3 years, and assessed adolescent food consumption both in school and outside of school.

METHODS

Participants

The study population was 4,113 students (grades seven and eight) enrolled in six middle schools in a midsized western city. Two schools served as intervention schools (total enrollment 1,406); one had a large proportion of students receiving free and reduced-price meals (71.3%), whereas the other had a smaller proportion receiving free

and reduced-priced meals (46.2%). Four schools served as control schools (total enrollment 2,707); two control schools had a large proportion of students receiving free and reduced-price meals (81.1%), and two had a smaller proportion receiving free and reduced-price meals (37.6%). High numbers of students eligible for free and reduced-price meal status determined the study variable for low-income status.

In the two intervention schools, modification of the school food environment was initiated during fall of the 2007-2008 school year and continued through the 2008-2009 and 2009-2010 school years. A food behavior survey was administered to middle-school students in seventh and eighth grades in intervention and control schools during the 2009-2010 school year during fitness and health classes.

More than 90% of students in this school district are white. To protect the identity of nonwhite students, race was not included in the analysis. Personal identifiers were removed and a unique study-specific identification number was assigned to each participant by the school district. Approval for the project was granted by the school district Assessment Review Committee and the Washington State University Institutional Review Board. Dichotomous classification of a student's socioeconomic status was determined by qualification for free or reduced-price meals as a part of the USDA school meal program.

Modifications to School Food Environment

Three school years before this study, the school district implemented a wellness policy in all schools that eliminated sugared beverages and only allowed 100% juice products and flavored nonenergy-providing water to be sold during the school day. Competitive à la carte items were limited to 250 kcal and 9 g fat.

The intervention reported here further modified the school food environment in two middle schools by removing juice products and allowing only nonflavored bottled water in vending machines, restricting à la carte items to only milk and fruit and removing all other items, and making a seasonal fruit and vegetable bar available to all students. The research hypothesis was that when compared to middle school students in control schools, the middle school students in the intervention schools with altered school food environments would report healthier food choices.

Measures of Food Behaviors

A revised beverage and snack questionnaire developed by Neuhouser and colleagues (13) was used to assess the previous week's food choices of students in school and outside of school. The food frequency questionnaire was originally developed to assess the food behavior of middle school students in Washington State and to evaluate the effectiveness of school district wellness policies. The previously established validity coefficients for the individual food items ranged from 0.56 to 0.87. The original 19 food items were reduced to a total of nine food categories that focused on items commonly found in the school environment. The revised survey instrument was selected and modified to ensure completion within 5 to 7 minutes and to identify food frequency differences between intervention and control schools. The nine food categories included on the revised instrument were juice, milk, sweet-drink, energy drinks, chips, candy, pastries, vegetables, and fruits. In the modified version of the survey used in this study, reliability was confirmed with Cronbach's α, which ranged from .55 to .79. Food and beverage consumption during the previous week both in school and outside of school were assessed. Students chose among seven consumption frequency options from "zero servings per week" up to "four or more servings per day." Responses were condensed in the analysis to three categories: high (at least two to three servings per day), medium (five or six servings per week or one serving per day), and low (at most four servings per week) consumption, to avoid low cell counts while preserving the monotonicity of the responses.

Statistical Analyses

Wilcoxon matched-pairs signed rank test was used to evaluate whether there were differences in frequency of consumption of various food and drink products in school and outside school. Kruskal-Wallis equality-of-populations rank test was used to evaluate whether there were sex differences and income differences in frequency of consumption of various food and drink products in school and outside of school. To determine whether consumption of the various food products and drinks, both in and outside of school, varied between intervention and control schools, ordered logistic regression analyses were conducted. Covariates in the regression models included sex and income status of the students. In addition, while conducting the analysis for the consumption patterns in school, the consumption behavior outside school was controlled to capture individuals' overall preference for certain food items. The number of observations in the ordered logistic regression model was 1,975.

RESULTS AND DISCUSSION

A total of 2,292 surveys (response rate 55.6%) were returned from seventh- and eighth-grade students in intervention and control schools. Intervention schools represented 26% of respondents, whereas the control schools (four of six middle schools) represented 74%. Response rates for control (87.4%) and intervention (82.4%) schools were similar. Boys (51%) and girls (49%) were equally represented among respondents.

Overall, students self-reported low consumption for all nine categories of food on the food frequency survey and reported higher frequency of food consumption outside school than inside school (Table 1). This is consistent with reports that children in this age group under-report food consumption (14) and consume more food outside school than in school (1). The food most frequently consumed was milk; however, only one fourth reported at least two servings of milk per day outside of school; 14% reported consuming at least two servings of milk daily in school. Sweetened drink consumption was lower in this survey than reported in other studies (1,2): medium to high

Table 1. Seventh- and eighth-grade children's differences in food choices in and outside school, by sex and meal status[a]

	In School				Outside School			
Self-reported intake frequency	**Boys (n=1,176)**	**Girls (n=1,116)**	**Paid meals (n=997)**	**Free/reduced-price meals (n=1,022)**	**Boys (n=1,176)**	**Girls (n=1,116)**	**Paid meals (n=997)**	**Free/reduced-price meals (n=1,022)**
	← % →							
Milk								
Low	42.77	55.00	60.83	39.13	47.59	52.48	45.27	52.58
Medium	40.12	33.66	28.90	44.44	27.11	26.51	27.87	26.19
High	17.11	11.34	10.27	16.43	25.30	21.01	26.86	21.23
Rank test	37.10**		87.46**		7.03**		12.55**	
Fruits								
Low	59.59	57.72	59.44	58.04	45.67	38.94	40.60	43.18
Medium	27.20	30.43	30.62	27.94	33.05	35.25	35.18	34.49
High	13.21	11.85	9.94	14.02	21.29	25.81	24.44	22.33
Rank test	0.25		1.67		11.77**		1.63	
Vegetables								
Low	67.95	69.90	71.60	67.29	47.21	40.27	42.71	44.46
Medium	22.37	22.28	20.75	22.99	36.11	40.36	38.99	38.02
High	9.68	7.82	7.65	9.72	16.68	19.37	18.30	17.52
Rank test	1.44		4.81*		10.33**		0.61	
Juice								
Low	71.20	76.98	80.30	68.73	61.60	64.90	62.47	63.24
Medium	19.15	18.08	15.38	21.63	21.65	21.15	23.04	20.85
High	9.65	4.94	4.32	9.64	16.75	13.95	14.49	15.91
Rank test	12.60**		38.14**		3.39		0.003	
Sweet drinks								
Low	81.21	86.43	84.72	83.20	70.54	73.78	76.48	68.78
Medium	12.30	8.89	11.86	9.63	18.09	16.94	16.78	18.53
High	6.49	4.68	3.42	7.17	11.37	9.28	6.74	12.69
Rank test	11.36**		1.55		3.35		18.11**	
Chips								
Low	85.36	85.35	84.21	85.74	78.07	78.58	79.12	77.21
Medium	11.22	11.77	13.48	10.82	15.74	14.94	15.76	15.76
High	3.42	2.88	2.31	3.44	6.19	6.48	5.12	7.03
Rank test	0.003		0.69		0.06		1.42	
Candy								
Low	88.24	89.40	91.84	86.21	82.46	79.84	84.82	78.04
Medium	7.64	7.37	6.14	8.67	11.26	13.50	10.35	14.05
High	4.12	3.23	2.02	5.12	6.28	6.66	4.83	7.91
Rank test	0.84		17.04**		2.35		15.7**	
Pastries								
Low	89.77	94.32	93.74	90.72	85.97	86.13	88.99	83.70
Medium	7.05	4.06	4.84	6.22	9.44	9.91	7.88	11.43
High	3.18	1.62	1.42	3.06	4.59	3.96	3.13	4.87
Rank test	16.03**		6.62*		0.02		11.89**	
Energy drinks								
Low	93.91	95.96	96.87	93.61	89.41	92.07	94.27	88.50
Medium	3.18	2.69	1.52	3.83	6.02	5.59	3.42	7.53
High	2.91	1.35	1.61	2.55	4.57	2.34	2.31	3.97
Rank test	5.17*		11.49**		5.17*		20.74**	

[a]The numbers of observations reported in the second row are approximate because they might vary due to missing data across different food items. Results are from Kruskal-Wallis equality-of-proportions rank tests. Low=0-4 servings/wk (less than 1/d); Medium=5-6 servings/wk (1/d); High=2-3 servings/d.

*$P<0.05$.

**$P<0.01$.

Table 2. Consumption differences by seventh- and eighth-grade children (n=2,000) between intervention and control schools[ab]

	In School			Outside School		
Dependent variable[a]	Odds ratio	Standard error	*P* value	Odds ratio	Standard error	*P* value
Milk	0.97	0.10	0.77	1.24	0.13	0.04
Fruit	1.01	0.12	0.95	1.21	0.13	0.09
Vegetables	1.08	0.14	0.56	0.94	0.10	0.58
Juice	0.73	0.10	0.02	0.82	0.10	0.10
Sweet drinks	0.87	0.15	0.77	0.94	0.13	0.64
Chips	0.87	0.15	0.41	1.17	0.17	0.29
Candy	0.97	0.20	0.88	0.99	0.16	0.96
Pastries	0.44	0.12	0.00	1.40	0.25	0.06
Energy drinks	1.03	0.35	0.92	0.84	0.20	0.48

[a]The numbers of observations reported in the first row are approximate because they might vary due to missing data across different food items. Results are from ordered logistic regressions. The ordered logistic regression analysis was conducted using STATA 10 (2007, Stata Corp, College Station, TX).
[b]Independent variables in each regression analysis are sex, school meal status, and consumption of the same food item in the complementary location.

frequency of consumption of sweetened beverages was reported by 12% to 18% of students in school and 20% to 30% outside school. More than three fourths of students in this study reported low consumption (less than one serving per day) of chips, candy, pastries, and energy drinks; this may be a reflection of the school wellness policies that the school district implemented before our study.

For the combined control and intervention group clear sex differences in the frequency of self-reported food choices were identified (Table 1). Boys consistently reported more frequent milk consumption in and outside school compared with girls. In school 17.1% of boys consumed two or more daily servings of milk compared with 11.3% of girls, and outside school 25.3% of boys consumed two or more daily servings compared with 21.0% of girls. Girls reported more frequent consumption of fruits and vegetables than boys outside school. Nearly 26% of girls consumed at least two fruits per day outside school compared to 21.3% of boys, and 19.4% of girls consumed at least two vegetables per day outside school compared with 16.7% of boys. Boys consumed more juice, sweet drinks, and pastries at school than girls.

For the combined groups significant income differences were noted for student frequency of consumption of several food items in and outside of school (Table 1). Milk consumption by students receiving free and reduced-price meals was higher than that by students receiving fully-paid meals in school; however, students with fully-paid meals consumed more milk outside of school. Students receiving free and reduced-price meals reported consuming more juice at school than students who paid for their meals; they also consumed more candy and energy drinks in school and more sweet drink, candy, pastries, and energy drinks outside of school. This may support the conclusion drawn by Drewenoski and Darmon (15) that lower-income families choose foods that provide high energy return for the cost.

Significant differences were identified between intervention and control schools (Table 2). The ordered logistic regression that controlled for sex, meal status, and location of food item consumption showed that students in intervention schools were 56% less likely to consume pastries and 27% less likely to consume juice, which was the only energy-dense vended beverage in control schools. This demonstrates that modifying the school food environment likely has a positive influence on the foods that students consume. Students at intervention schools were 24% more likely to consume milk outside of school. It may be because the limited beverage options at intervention schools created a taste preference for milk at home. It was surprising that fruit and vegetable consumption reported by students at the intervention schools was not significantly better than those students in the control schools because seasonal fruit and vegetable bars were available to all students in intervention schools regardless of whether they purchased a school meal. Fresh fruits and vegetables were available to all students in control schools on the meal line. Van Cauwenberghe and colleagues (16) also reported that fruit and vegetable intake was not affected by changes in school food environment.

The findings of this study present a conundrum for school administrators. Findings demonstrated that healthful modifications in the school food environment are associated with positive food behaviors in early adolescents, but there was a cost associated with those changes. Each intervention school spent 49% more on produce per student than control schools during the 2008-2009 and 2009-2010 school years (spending about $2,500 more per school per year), and annually both schools together lost approximately $24,000 in gross school meal sales due to lost à la carte sales and a $9,000 annual loss in vending sales. The pressures to provide more nutritious, often more costly foods to students in the midst of shrinking budgets and unfunded mandates makes it difficult to eliminate profitable competitive foods.

CONCLUSIONS

This study identified a positive association between reported student food choices and a modified food environment. School food polices and the food environment can be part of a long-term solution to the youth obesity problem. Practitioners in school nutrition need to work with key decision makers to offer a healthful school food environment. Especially school meal programs in lower in-

come areas need to be encouraged and promoted because of the key nutrients provided by school meals.

Findings of this study are limited due to lack of ethnic/racial diversity among respondents, the fact that the study relied on self-reported frequency of food choices, and knowledge that it was administered in a health and fitness class. Future research should include more objective measures of food behavior. In addition, longitudinal research is needed to assess food behaviors before and after a school food environment intervention to determine the causal effect of changes in the school food environment on food behaviors among adolescents.

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