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Impact of the HEALTHY Study on Vending Machine Offerings in Middle Schools

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Abstract

Purpose/Objectives—The purpose of this study is to report the impact of the three-year middle school-based HEALTHY study on intervention school vending machine offerings. There were two goals for the vending machines: serve only dessert/snack foods with 200 kilocalories or less per single serving package, and eliminate 100% fruit juice and beverages with added sugar.

Methods—Six schools in each of seven cities (Houston, TX, San Antonio, TX, Irvine, CA, Portland, OR, Pittsburg, PA, Philadelphia, PA, and Chapel Hill, NC) were randomized into intervention (n=21 schools) or control (n=21 schools) groups, with three intervention and three control schools per city. All items in vending machine slots were tallied twice in the fall of 2006 for baseline data and twice at the end of the study, in 2009. The percentage of total slots for each food/beverage category was calculated and compared between intervention and control schools at the end of study, using the Pearson chi-square test statistic.

Results—At baseline, 15 intervention and 15 control schools had beverage and/or snack vending machines, compared with 11 intervention and 11 control schools at the end of the study. At the end of study, all of the intervention schools with beverage vending machines, but only one out of the nine control schools, met the beverage goal. The snack goal was met by all of the intervention schools and only one of the four control schools with snack vending machines.

Applications to Child Nutrition Professionals—The HEALTHY study's vending machine beverage and snack goals were successfully achieved in intervention schools, reducing access to less healthy food items outside the school meals program. Although the effect of these changes on student diet, energy balance and growth is unknown, these results suggest that healthier options for snacks can successfully be offered in school vending machines.

INTRODUCTION

Vending machines are common in middle and secondary schools in the United States. In 2006, vending machines were reported by 21.4% of elementary, 62.4% of middle, and, 85.8% of high schools (O'Toole, Anderson, Miller, & Guthrie, 2007). The most common foods offered in and purchased from vending machines were high in fat and added sugars (Nollen et al., 2009; O'Toole et al., 2007). High school students with no access to school vending machines reported consuming 43 kilocalories (kcal) per day less than students who had access to vending machines (Briefel, Crepinsek, Cabili, Wilson, & Gleason, 2009). The availability of low-nutrient and energy-dense items, such as sugar-sweetened beverages and high-fat, high-sugar dessert or snack foods, has been associated with higher body mass index (BMI) z-scores for middle school students (Fox, Dodd, Wilson, & Gleason, 2009).

In response to concerns about child health and obesity, a 2007 Institute of Medicine report recommended eliminating all sugar-sweetened beverages and restricting snack foods and beverages sold in school venues outside of the federal breakfast and lunch programs

(Committee on Nutrition Standards for Foods in Schools, 2007). A major concern about setting nutrition standards for foods and beverages sold in vending machines is the potential loss of school nutrition program sales revenue due to less availability of preferred items (Brown & Tammineni, 2009; Cullen et al., 2007; Finkelstein, French, Variyam, & Haines, 2004; Samuels et al., 2009). Despite this concern, some states have developed and implemented nutrition standards for vending machine items and other competitive foods and beverages sold in schools outside of federal school meal programs (Samuels et al., 2009; Blum et al., 2007). As a result, there was a significant reduction in high-fat and high-sugar items offered in vending machines and other competitive food venues in schools between 2004 and 2007 (Terry-McElrath, O'Malley, Delva, & Johnston, 2009).

The HEALTHY study examined the effects of a three-year, multicomponent, randomized and controlled primary prevention trial of a middle school-based intervention to reduce risk factors for the development of type 2 diabetes among children whose race, ethnicity, and socioeconomic status placed them at high risk for developing obesity and type 2 diabetes (Hirst et al., 2009). The intervention consisted of four integrated components: nutrition; physical activity; behavioral knowledge and skills; and communications and social marketing (Hirst et al., 2009). The nutrition intervention component was designed to modify the total school food environment, including foods and beverages offered in vending machines, and to improve student dietary intake (Gillis et al., 2009). At the end of the study, there was a decrease in the primary outcome, combined prevalence of overweight and obesity, in both intervention and control schools, with no difference between groups (Foster et al., 2010). However, the intervention schools had greater reductions in the secondary outcomes of BMI z-score, percentage of students with waist circumference at or above the 90th percentile, fasting insulin levels ($P = 0.04$ for all comparisons), and prevalence of obesity ($P = 0.05$). Similar reductions were observed among students who were at or above the 85th percentile for BMI at baseline.

The nutrition component goals specific to vending machines were to: serve only dessert and snack foods with = 200 kcals per single-serving package; and to eliminate 100% fruit juice and beverages with added sugar, with the exception of flavored non-fat or 1% milk in volumes of 12 fluid ounces or less (Gillis et al., 2009). The availability of 100% fruit juice was restricted in vending machines to encourage consumption of fruit at meals and to reduce excess fruit juice consumption (Gillis et al., 2009). This paper reports the impact of the HEALTHY study school vending machine intervention, specifically the study hypothesis that the proportion of vending machines meeting the HEALTHY study goals would be significantly higher in intervention schools than in control schools at end of the study.

METHODOLOGY

Subjects

Each of seven field centers across the country (Houston, TX, San Antonio, TX, Irvine, CA, Portland, OR, Pittsburg, PA, Philadelphia, PA, and Chapel Hill, NC) recruited six middle schools serving high ethnically diverse minority and low-socioeconomic status populations. The 42 schools were randomized to control or intervention arms of the study (Hirst et al., 2009). Consented students ($n = 4,603$) were followed from the sixth through the eighth grade, beginning in the fall of 2006. Details of the methods and primary study results are described elsewhere (Foster et al., 2010). The research for the vending machine study was conducted with the approval of the Institutional Review Boards at all the participating institutions.

Intervention Procedures

Research dietitians worked with school nutrition programs at each intervention school to identify acceptable vending items that met the two study goals. All food and beverage items available for purchase in vending machine slots were tallied twice at baseline, in the fall of 2006, and twice at the end of the study, in the spring of 2009.

A slot was defined as a single compartment within a vending machine that held only one type of item. A given slot could hold any number of a specific item, from zero for an empty slot to many for a machine that had just been filled. Information on the numbers of each item sold from a given machine was requested from the school officials or vendors at each time point; however, the vending machines often did not have the capability to transmit detailed sales data. Vendors filling the machines did not capture individual item sales for specific time periods. Although school districts received periodic revenues checks from vending sales, itemized sales reports that detailed the type and amount of each food and beverage item sold were not provided. Therefore, sales volume and revenue data were not available; this paper reports information obtained by examining the items available to students in the slots at all intervention and control schools at baseline and the end of the study. In order to determine whether the nutrient content of vending machine items met the goals, product labels were used.

Only vending machines available to students were evaluated. Data were collected as closely as possible to machine restocking to gain a better understanding of the variety of foods and beverages available for student purchase.

Data analysis

Characteristics of schools with vending machines were compared to those schools without vending machines at baseline. Baseline demographic characteristics of students enrolled in schools with vending machines are presented by control and intervention group. Using averaged data from both evaluation days at each data collection period, the number of vending machine slots allocated to each food/beverage group category (beverages with added sugar, water, milk, 100% fruit juice, artificially-sweetened beverages, and snack foods) was summed and the percentage of total slots for each category was calculated.

The differences in proportions of vending slots designated for each category of food and beverage were compared between intervention and control schools at the end of the study with Pearson chi-square test statistics. For the analysis, each slot was considered an independent observation. Because a few types of beverages and snacks were not offered in the vending machines at the end of the study, p-values could not be computed. Although baseline descriptive values for the intervention and control schools were generated, formal comparisons using baseline data were not conducted because fewer schools in both the intervention and control groups had vending machines at the end of the study.

RESULTS AND DISCUSSION

At baseline, 30 of the 42 schools enrolled in the HEALTHY study had vending machines; six intervention and six control schools had no vending machines (Table 1). Therefore, the 30 study schools with vending machines provided the baseline data presented in this paper. The average student enrollment was similar between intervention and control schools, as was the distribution of students by racial and ethnic group and the percentage of students eligible to receive free or reduced priced meals (Table 1). During the three-year period of the study, minimal changes occurred in school enrollment, demographics, and federal meal participation patterns (Foster et al., 2010). Individual vending machines offered either only beverages or only snacks; no machine offered both snacks and beverages (Table 1).

However, some schools had both types of vending machines. Characteristics of schools with and without vending machines were similar at baseline (Foster et al., 2010).

Intervention and control schools with vending machines had an average of four machines per school, with an average of three beverage machines and one snack machine (Table 1). Most vending machines were available to students throughout the day. At the end of the study, eight schools (four intervention and four control) had eliminated vending machines from campuses, leaving 22 schools with vending machines available to students.

One control and one intervention school met the vending machine beverage goal at baseline (Table 2). Almost 40% of the vending machine slots in both intervention and control schools offered beverages with added sugar; only 24% and 33% of the slots in intervention and control schools, respectively, offered water (Table 2). At the end of the study, all of the intervention schools, but only one (11%) of the control schools with beverage vending machines met the beverage goal. Also at the end of the study, a significantly higher proportion of slots contained water in the intervention schools (73%) compared to the control schools (53%) ($p < 0.001$). No energy-containing beverages were available in the intervention schools. The proportion of slots offering artificially-sweetened beverages was significantly higher in the intervention school beverage vending machines compared to the control schools at the end of the study.

At baseline, none of the schools met the vending machine goal of offering only snack food items with 200 kcal or less per package (Table 3). The most popular items were baked goods and granola-type bars that were available in 38% of intervention and 21% of control school vending machine slots. Reduced-fat chips were offered in 22% of intervention and 21% of control school vending machine slots. Both low-fat, (13% and 16%) and regular-fat ice cream (5% and 14%) were available in intervention and control school vending machine slots, respectively. At the end of the study, the foods in the vending machines at all of the intervention schools (six) and only one (25%) of the control schools met the snack goals (Table 3).

As part of the comprehensive nutrition intervention, the HEALTHY Study implemented two ambitious vending machine goals: to eliminate 100% fruit juice and all added-sugar beverages, and to limit snack food items to 200 kcals or less in single serving packages. These goals were successfully implemented, with the snacks and beverages in the vending machines at 100% of the intervention schools meeting both the beverage and snack food goals, while only 11% of the control schools with beverage vending machines met the beverage goals and 25% of the control schools with snack vending machines met the snack food goals.

Improvements in the control school vending machines were likely related to the implementation of local school wellness policies during the course of the study (Longley & Sneed, 2009). The HEALTHY study began in the fall of 2006, the date by which all school districts, nationwide, were required to establish local school wellness policies that addressed the school food environment, nutrition education, as well as physical education and activity (Longley & Sneed, 2009). At the beginning of the study, 29 of the 42 schools had state- or district-level school food and beverage policies in place that met the HEALTHY snack food goal, and new policies were implemented at two additional schools at the beginning of the 2008–2009 school year. Therefore, by the end of the study, the majority of both intervention and control schools (74%) were operating according to either state or district policies and had placed limitations on snack food items offered to students.

A small pilot study in 12 middle schools in three states was conducted prior to this study (Cullen et al., 2007). Three of the 13 nutrition intervention goals implemented in the pilot

study pertained to vending machines beverages: to make soda unavailable during meals, to increase the number of slots designated for water, and to reduce the volume of all sugar-sweetened beverages to 12 ounces or less per container. In Cullen's pilot study, average adherence was 73% for the three vending machine goals at the end of six weeks; a major barrier to implementation was the incompatibility of many of the beverage vending machines to hold and dispense 12-ounce beverage containers (Cullen et al., 2007). This barrier was not evident in the HEALTHY intervention study reported in this paper.

CONCLUSIONS AND APPLICATION

Recent studies document the adoption of state and school district wellness policies, including nutrition guidelines and requirements. In April, 2007, a national random sample of school nutrition directors reported that 80% of districts had placed limitations on beverage portion size and 66% had policies limiting the energy content of packaged food in a la carte service lines (Longley & Sneed, 2009). More obesity prevention policies for school nutrition programs were adopted at the state level (49%) than physical activity policies (38%) (Nanney et al., 2010). In California high schools, adherence to state beverage vending machine standards was 64.4% (Samuels et al., 2009); in Maine high schools, adherence was 69.2% for low-fat/low-sugar and portion-controlled nutrition guidelines in four Maine high schools (Blum et al., 2007). The HEALTHY study achieved 100% adherence for both beverage and snack food items in the intervention schools, adding to the literature on the ability of schools to improve the school vending machine environment. The improvements seen in the control schools corroborate data on the adoption of school wellness policies since 2006.

The HEALTHY study's vending machine intervention goals to eliminate 100% fruit juice and beverages with added sugar, and to offer snack-food items with only 200 kcal or less per single-serving package, were successful due, in part, to the cooperation of the local school districts, the support of the local school nutrition staff, and the support of the HEALTHY intervention staff. Study goals are also supported by the change in norms about permissible foods in school vending as a result of the adoption of local school wellness policies.

Unfortunately, a major limitation of this study was that the impact of these changes on student dietary intake could not be assessed. The nutritional content of items in vending machines available to the students improved, but, as noted previously, the amount of vending machine food and beverage items purchased by students was not available for analysis. However, previous research has documented that the foods and beverages available to students influence student food selections (Cullen et al., 2007; Hartstein et al., 2008) and consumption (Cullen, Watson, & Zakeri, 2008). The adoption of policies governing the school food environment by many districts and states may have resulted in control school improvements by the end of the study. Changes in vending machine revenue could not be assessed to determine the true impact on school finances. Future research should assess the impact of vending machine interventions on changes in student dietary intake, energy balance, and school finances.

The support of all school staff is needed for improvement in the school food environment. Attention to each component within the school food environment may contribute to healthy student food choices, both in school and outside of school, and to positive student health outcomes. These are important areas for further research. School staff should promote school wellness initiatives, such as healthy vending machine choices, and participate in creating, monitoring, and evaluating related policies and actions.

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HEALTHY intervention materials are available for download at <http://www.healthystudy.org/>.

REFERENCES

- Blum JW, Davee AM, Devore RL, Beaudoin CM, Jenkins PL, Kaley LA, Wigand DA. Implementation of low-fat, low-sugar, and portion-controlled nutrition guidelines in competitive food venues of Maine public high schools. *Journal of School Health*. 2007; 77(10):687–693. [PubMed: 18076414]
- Briefel RR, Crepinsek MK, Cabili C, Wilson A, Gleason PM. School food environments and practices affect dietary behaviors of U.S. public school children. *Journal of the American Dietetic Association*. 2009; 109(Suppl.)2:S91–S107. [PubMed: 19166677]
- Brown DM, Tammineni SK. Managing sales of beverages in schools to preserve profits and improve children's nutrition intake in 15 Mississippi schools. *Journal of the American Dietetic Association*. 2009; 109(12):2036–2042. [PubMed: 19942021]
- Stallings, VA.; Yaktine, AL., editors. Committee on Nutrition Standards for Foods in Schools. Nutrition standards for foods in schools: Leading the way toward healthier youth. Washington, DC: The National Academies Press; 2007.
- Cullen KW, Hartstein J, Reynolds KD, Vu M, Resnicow K, Greene N, White MA. Improving the school food environment: Results from a pilot study in middle schools. *Journal of the American Dietetic Association*. 2007; 107(3):484–489. [PubMed: 17324667]
- Cullen KW, Watson K, Zakeri I. Improvements in middle school student dietary intake after implementation of the Texas Public School Nutrition Policy. *American Journal of Public Health*. 2008; 98(1):111–117. [PubMed: 18048778]
- Finkelstein E, French S, Variyam JN, Haines PS. Pros and cons of proposed interventions to promote healthy eating. *American Journal of Preventive Medicine*. 2004; 27(Suppl.)3:163–171. [PubMed: 15450627]
- Foster GD, Linder B, Baranowski T, Cooper DM, Goldberg L, Harrell JS, Hirst K. A school-based intervention for diabetes risk reduction. *New England Journal of Medicine*. 2010; 363(5):443–453. [PubMed: 20581420]
- Fox MK, Dodd AH, Wilson A, Gleason PM. Association between school food environment and practices and body mass index of U.S. public school children. *Journal of the American Dietetic Association*. 2009; 109(Suppl.)2:S108–S117. [PubMed: 19166665]

- Gillis B, Mobley C, Stadler DD, Hartstein J, Virus A, Volpe SL, McCormick S. Rationale, design and methods of the HEALTHY study nutrition intervention component. *International Journal of Obesity*. 2009; 33(Suppl. 4):S29–S36. [PubMed: 19623185]
- Hartstein J, Cullen KW, Reynolds KD, Harrell J, Resnicow K, Kennel P. Impact of portion-size control for school a la carte items: Changes in kilocalories and macronutrients purchased by middle school students. *Journal of the American Dietetic Association*. 2008; 108(1):140–144. [PubMed: 18156001]
- Hirst K, Baranowski T, DeBar L, Foster GD, Kaufman F, Kennel P, Yin Z. HEALTHY study rationale, design and methods: Moderating risk of type 2 diabetes in multi-ethnic middle school students. *International Journal of Obesity*. 2009; 33(Suppl 4):S4–S20. [PubMed: 19623188]
- Longley CH, Sneed J. Effects of federal legislation on wellness policy formation in school districts in the United States. *Journal of the American Dietetic Association*. 2009; 109(1):95–101. [PubMed: 19103328]
- Nanney MS, Nelson T, Wall M, Haddad T, Kubik M, Laska MN, Story M. State school nutrition and physical activity policy environments and youth obesity. *American Journal of Preventive Medicine*. 2010; 38(1):9–16. [PubMed: 20117552]
- Nollen NL, Befort C, Davis AM, Snow T, Mahnken J, Hou Q, Ahluwalia JS. Competitive foods in schools: Availability and purchasing in predominately rural small and large high schools. *Journal of the American Dietetic Association*. 2009; 109(5):857–864. [PubMed: 19394472]
- O'Toole TP, Anderson S, Miller C, Guthrie J. Nutrition services and foods and beverages available at school: Results from the School Health Policies and Programs Study. (2006). *Journal of School Health*. 2007; 77(8):500–521. [PubMed: 17908105]
- Samuels SE, Bullock SL, Woodward-Lopez G, Clark SE, Kao J, Craypo L, Crawford PB. To what extent have high schools in California been able to implement state-mandated nutrition standards? *Journal of Adolescent Health*. 2009; 45(Suppl)(3):S38–S44. [PubMed: 19699435]
- Terry-McElrath YM, O'Malley PM, Delva J, Johnston LD. The school food environment and student body mass index and food consumption: 2004 to 2007 national data. *Journal of Adolescent Health*. 2009; 45(Suppl.)3:S45–S56. [PubMed: 19699436]

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Table 1

Characteristics of 30 HEALTHY Study Schools with Vending Machines at Baseline

	Control (n=15)		Intervention (n=15)	
	Mean (SD)	Min-Max	Mean (SD)	Min-Max
Total Student Enrollment (students/school) ^a	851 (323)	400 – 1440	865 (230)	471 – 1235
Racial/Ethnicity Distribution				
% Hispanic	51 (37)	0 – 96	46 (31)	2 – 98
% Black	21 (26)	1 – 98	26 (23)	1 – 80
% White	23 (23)	0 – 70	22 (15)	1 – 54
% Other ^b	6 (8)	0 – 18	4 (4)	0 – 13
% of Students Receiving Free/Reduced-Priced Meals	78 (19)	49 – 100	76 (13)	47 – 100
Number of Vending Machines per School				
Beverage Only	3(2)	0 – 6	3(2)	0 – 9
Snack Only	1(1)	0 – 4	1 (1)	0 – 4

^aTotal student enrollment is at beginning of year.^bOther race includes Asian, Pacific Islander, American Indian, and mixed or multiple.

Table 2

Characteristics of Beverage Items Offered in Vending Machines at Baseline and End of the Study

	BASELINE		END OF STUDY	
	Control	Intervention	Control	Intervention
Number of schools with beverage vending machines	14	14	9	10
Total number of machines	39	43	18	19
Number of slots	794	977	501	440
Percent (N) of slots offering sugar-free beverages	49% (386/794)	29% (288/977)	56% (280/501)	100% (440/440)
Percent (N) of schools meeting the beverage goal	7% (1/14)	7% (1/14)	11% (1/9)	100% (10/10)
% of Slots by Beverage Type				
Water	33%	25%	53%	73% ***
Beverages with artificial sweetener	12%	5%	3%	27% ***
100% Fruit juice	13%	31%	42%	0% ^a
Beverages with added sugar	38%	39%	2%	0% ^a
Milk 1% fat	4%	0%	0%	0% ^a

^a Analysis not done; unable to calculate because of zeros in the formula.*
p<0.05**
p<0.01***
p<0.001

Table 3
 Characteristics of Snack Items Offered in Vending Machines at Baseline and End of the Study

	BASELINE		END OF STUDY		P value
	Control	Intervention	Control	Intervention	
Number of Schools Offering Snack Items	5	7	4	6	
Number of Snack Machines	9	11	8	11	
Number of Slots	337	474	308	450	
Percent (N) of Slots Offering Snack Items with 200 kcal	67% (225/337)	67% (317/474)	83% (256/308)	100% (450/450)	
Percent (N) of schools meeting the snack goal	0% (0/5)	0% (0/7)	25% (1/4)	100% (6/6)	
% of Slots by Snack Type					
Reduced-fat baked goods	0%	1%	0%	5%	^a
Regular baked goods	9%	20%	6%	1%	<.001
Granola or cereal bars	12%	16%	22%	20%	0.61
Reduced-fat chips	21%	22%	22%	33%	<.001
Regular chips	7%	0%	6%	0%	^a
Crackers, popcorn	5%	12%	8%	6%	0.26
Crackers with spread	0%	4%	0%	6%	^a
Nuts, seeds, trail mix	9%	0%	5%	1%	<.01
Candy	3%	0%	2%	0%	^a
Low-fat ice cream	16%	13%	10%	10%	0.78
Regular-ice cream	14%	5%	12%	4%	<.001
Other food	5%	6%	8%	14%	<.01

^a Analysis not done; unable to calculate because of zeros in the formula.