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Pricing and Availability Intervention in Vending Machines at Four Bus Garages

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Abstract

Objective—To evaluate the effects of lowering prices and increasing availability on sales of healthy foods and beverages from 33 vending machines in four bus garages as part of a multi-component worksite obesity prevention intervention.

Methods—Availability of healthy items was increased to 50% and prices were lowered at least 10% in the vending machines in two metropolitan bus garages for an 18-month period. Two control garages offered vending choices at usual availability and prices. Sales data were collected monthly from each of the vending machines at the four garages.

Results—Increases in availability to 50% and price reductions of an average of 31% resulted in 10-42% higher sales of the healthy items. Employees were most price-responsive for snack purchases.

Conclusions—Greater availability and lower prices on targeted food and beverage items from vending machines was associated with greater purchases of these items over an eighteen-month period. Efforts to promote healthful food purchases in worksite settings should incorporate these two strategies.

Introduction

Food Environment, Food Choices and Obesity

During the past twenty years, the prevalence of obesity among US adults has increased markedly, from 22.9% in 1988 to 34% in 2006.^{1,2} Currently, seventy-two million U.S. adults are obese.² Environmental influences are widely recognized to be important contributors to excess weight gain and the development of obesity.³ Environmental influences on food choices include the pervasive availability of energy-dense foods in almost every setting in which people live and work. Energy-dense foods are also inexpensive and marketed in ways that highlight “value,” including low prices and large portion sizes.³

Worksite Environmental Strategies to Promote Healthy Food Choices

The worksite is an important environment in which the majority of the adult population spends a significant portion of their day over a period of years.⁴ Intervention strategies that change worksite environmental factors related to food, such as the types of foods available and their

prices, have been examined in previous worksite nutrition intervention studies.⁵⁻¹⁰ In both school and worksite settings, pricing, alone or in combination with availability, had a strong, dose-response effect on sales of healthy snacks from the vending machines.

Transportation Workers and Environmental Nutrition Interventions

Transportation workers comprise about 190,488 employees and thus represent a large U.S. employee population.¹¹ In comparison with people in other occupations, transportation workers are at higher risk with respect to poor dietary intake and obesity.¹²⁻¹⁵ Transportation workers, such as bus operators, have limited opportunities for healthful eating during their workday (on the route) and often have irregular work hours that may pose additional barriers to establishing and maintaining healthful eating behaviors.

Despite their high risk for obesity and poor dietary behaviors, few interventions have targeted transportation workers. The lack of empirical research evaluating nutrition intervention strategies in transportation workers is not surprising, given the difficulty of intervening with a worker population whose worksite is in motion and changes on a daily basis. However, because this worker population is at such high risk for obesity and its health-related morbidities, intervention strategies need to be developed and evaluated that could potentially promote and sustain healthful eating behaviors that could prevent excess weight gain and obesity.

The present paper reports the details of one component of a multi-component worksite environmental intervention to prevent obesity among bus operators. The combined effects of availability and pricing strategies in vending machines on changes in sales of healthy vending foods and beverages was examined over the 18-month intervention period. It was hypothesized that the combined effects of increasing the availability and decreasing the prices of healthy food and beverage choices in vending machines at the bus garages would increase the sales of these healthy choices.

Methods

Study Overview

Data for the present study were collected as part of a multi-component worksite obesity prevention intervention (Route H). Results from the main trial are reported elsewhere.¹⁵⁻¹⁶ The Route H study was conducted in collaboration with the Metro Transit Council of Minneapolis, Minnesota. Four garages in the metropolitan Minneapolis-St Paul area were selected to take part in the study. The four bus garages were paired on physical characteristics (urban location; number of employees) and then randomized within pairs to intervention or comparison conditions by the toss of a coin. The two intervention garages received an 18-month intervention to increase the availability of healthy foods and physical activity opportunities at the worksite. Intervention components included increasing availability and lowering prices of healthy vending machine items, improvements in the garage fitness room facilities, periodic group-based behavioral programs such as healthy eating challenges, group-based walking programs, group-based self-weighing programs, and fitness classes such as yoga, personal training and strength/flexibility programs. The control garages received no intervention. Measurements completed at baseline and two-year follow-up included measures of body weight, food choices and physical activity behaviors. Vending machine sales were reported monthly during the 18-month intervention. The study obtained approval from the University of Minnesota IRB Human Subjects Protection Program.

Vending Machine Intervention

The vending machine intervention was implemented for the entire 18-month study period. The two key components of the vending intervention were to increase the availability and to lower

the prices of healthier food and beverage choices in the vending machines at the two intervention garages. These two strategies were selected because they have been shown in previous research, separately and combined, to have strong effects on food and beverage purchases⁵⁻¹⁰ and were implemented in tandem. The strategies are especially effective when implemented in settings in which the food environment is constrained and the population is somewhat captive, such as at a bus garage, school or worksite cafeteria or in vending machines. In the present study, the bus garages' only onsite source of food was the vending machines. Limited cooking facilities were available, including a microwave, toaster, and hot plate, in the break room area. Employees could bring food from home and store it in refrigerators in the garage break room. At the two urban garages only, restaurants, fast food chains and convenience stores were within walking distance.

The researchers worked in close collaboration with the vending machine service company to implement the vending intervention. Prior to the start of the intervention, inventories were completed of every machine in intervention and control garages. Research staff identified potential healthier foods and beverages that could be substituted into the vending machines to increase the availability of healthy vending choices in the intervention garages' vending machines. Taste-testing activities were conducted with the garage advisory groups prior to the selection of the new vending products. In addition, suggestion boxes were placed in the garage vending machine areas to solicit driver input about vending choices throughout the intervention period. Suggestions were used to identify preferred healthy choice items, but did not influence the ratio of healthy to less healthy items available in the machine.

Healthy vending choices were defined separately for the different types of foods and beverages available in the vending machines (i.e. beverages, snacks, entrees). All vending machine foods and beverages were classified as healthful or not according to nutrition criteria for calories (snacks 150 calories or fewer; entrees 400 calories or fewer; beverages 50 calories or fewer); fat (30% or fewer calories from fat); and sugar (35% or less by weight). Examples of healthy and not healthy items include: 1) entrees: turkey lean pocket versus pepperoni hot pocket; 2) snacks: NutriGrain bar versus Snickers bar; and 3) beverage: diet soft drink versus regular soft drink. Other examples of healthy vending choices included bagels, fresh fruit, baked chips, 100 calorie wheat snack cracker packet, and lower-calorie frozen entrees.

Plans for reconfiguring the vending machines in the intervention garages were devised prior to the start of the intervention. Control garage vending machines continued to offer the same items as before the study, and did not change items during the intervention period. Planagrams (product placement maps for each machine) were created for both intervention and control garage vending machines. Vending machine service personnel were trained by the research staff to stock the machines according to the specific planagram for each vending machine. Vending machine service personnel were instructed to stock the control garage vending machines according to the control machine planagrams to ensure that the control garage vending machines continued to offer the same items throughout the intervention and to prevent contamination of the vending machine intervention across garages.

The number of rows in each machine for healthy products was negotiated in advance with the vending machine service company and remained constant for the 18-month period. Prices for the healthy food and beverage items were also programmed into the machines at the start of the study and remained constant throughout the intervention period. The goal of the vending intervention was to make 50% of the available vending offerings meet healthy criteria, and to price these items 10% lower than the usual price for the item. Fifty-percent availability was chosen based on our previous successful school-based cafeteria intervention in which healthy food availability was increased by 50%.⁹ Ten percent price reduction was chosen based on our

previous vending machine pricing interventions in which a 10% price reduction was sufficient to increase sales of healthy vending choices.⁵

Sales data were collected from the vending service company on a monthly schedule and included data from intervention and control garages. Sales data were collected by the vending service staff by using a handheld computer that logged sales and fills for every machine each time the vending staff person serviced the machine. Therefore, the sales data were very accurately collected using the most modern vending sales tracking technology available. Fidelity to the vending machine planogram for healthy food availability and prices was measured weekly by in-person site visits by trained research staff who observed the machines using the specific planogram for each machine. Visits were made to both intervention and control garages to ensure that additional healthy snacks were not inadvertently placed in the vending machines at the control garages. Vending route service staff received a small monthly financial incentive for maintaining accurate product placement in the garage vending machines for which they were responsible for servicing. Accuracy of placement was extremely high, with only occasional misplaced items. When research staff observed a misplaced item, vending service staff were contacted immediately and the misplaced item was removed at the earliest possible date (usually within one to two days).

Vending Data Coding and Computation

Vending sales data were summarized into the broad categories “Healthy” and “Unhealthy” for the purpose of analysis. Counts of the number of items sold and sales dollars were summed across items and machines within machine type. For example, the number of healthy snack items sold within snack machines was summed across the one or more snack vending machines within a given garage. Proportion of healthy snack sales was computed by dividing the number of healthy items by the sum of the healthy and unhealthy items. These were summed across the 18-month intervention period for the purpose of analysis.

Survey Measures and Data Collection

Evaluation data were collected on site at each of the four garages at baseline and follow-up (two years). All garage employees who worked at each of the four garages were eligible to complete the evaluation measures. Participants were recruited using a variety of methods, including paycheck distribution fliers, signs posted in the garages, fliers distributed at health fair events, information in employee newsletters and instant text messaging on the buses. Participants received a \$20 incentive for completing the behavioral measurement survey and for having their height and weight measured by trained research staff. The average survey participation rate across the four garages was 78% at baseline and 74% at follow-up.

The surveys included self-report measures of food choices and the frequency of use of the garage vending machines. The food choices instrument was adapted from two existing instruments for which validity has been evaluated.^{17,18} Participants reported their past month frequency of consumption of foods targeted by the intervention, such as fruits and vegetables (3 items), high fat snack foods (9 items), and sugar sweetened beverages (2 items). Vending machine frequency of use was measured using three questions about frequency of use of each type of vending machine during the past month (cold beverage, cold food, snack food). Response options were once a month or less, 2-3 times a month, 1-2 times a week or three or more times a week. Responses to the vending frequency of use were dichotomized for analysis to any or no use during the past month.

Statistical Analysis

All analyses were conducted using SAS (16, SAS Inc. Cary, NC).¹⁹ Vending machine changes in the intervention garages began immediately and sales data are averaged over the 18 months of the intervention. With no baseline data from which to calculate sales changes, we used control garage sales as the reference and calculated the difference between the intervention and the control garages in the percent of healthy food items purchased. Similarly, we calculated the percent difference in the dollars paid for healthy foods. The ratio of these differences indicates how responsive purchases of healthy food items are to price differentials between intervention and control garages. Within food type (i.e., entrée, snack, beverage), the price of unhealthy foods is taken as the standard.

Analyses of the survey data included data from any employee who worked at the garage and completed the survey. For drivers contributing data at both baseline and year 2, the effect of the intervention was estimated using a baseline-adjusted mixed model of drivers nested in garages. A two-stage analysis of adjusted garage means was conducted on employees with data from only one time-point. The nested cohort and two stage estimates were pooled, with weights inverse to the variance. All analyses were adjusted for age, gender, education, income, marital status, race, and smoking status. Means presented in Table 2 below are drawn from the entire cross-sectional sample at each time point.

Results

Demographic Characteristics of Transportation Workers

Seventy-three percent of the employees who completed the surveys were bus drivers; 16% were bus maintenance staff; 8% other jobs (such as dispatchers); and 3% were managers. Seventy-nine percent of the employees were men, with an average age of 47 years (age range 19 – 79 years). Sixty-three percent were white. Forty-nine percent had completed high school/vocational school or had less education, and 43% reported annual household incomes before taxes of less than \$50,000. Most workers had been employed with the transit company six or more years; about one-third had been working with the transit company 15 years or longer. Overall, the prevalence of obesity among the transit workers was very high. The average BMI was 32.3 kg/m² and 56% were obese (BMI \geq 30 kg/m²).

Availability and Price of Healthy Vending Food and Beverages During Intervention Period

Prior to the intervention, both the intervention and the control garages offered very few food or beverage choices that met the healthy criteria used for the study. At the beginning of the intervention period, the 33 vending machines were reconfigured as shown in Table 1. Table 1 shows the availability and price of healthy and unhealthy food and beverage items in the intervention garages (top panel) and control garages (bottom panel). In the intervention garages, the percent of healthy items available in the vending machines was within the target range set by the intervention (50% healthy items) and ranged from 46-61%. Average prices for the healthful vending foods in the intervention garages were 31% lower than the unhealthy foods. In the control garages, the availability of healthy vending machine selections was similar to that available prior to the intervention and ranged from 32% for cold beverages, to 0% for cold foods. In control garages, average prices for healthy and unhealthy foods were similar to each other. Thus, the intervention target price reductions of -10% and increased availability of +50% for healthy foods were successfully implemented in the intervention garages and no changes were made in the control garage vending availability or prices.

Sales of Healthy Vending Food and Beverages During Intervention Period

Sales data during the 18-month intervention showed that the percent of healthy food items purchased was higher in the intervention garages compared to control garages. Employee purchases were considerably more price-responsive for snack purchases compared to cold beverage purchases or frozen food purchases. For example, during the 50% price reduction period, sales of the healthy snacks in the intervention garages were 48% of the total snack items purchased. Sales of healthy snacks in the control garages, where no price reductions were in effect, were only 6% of the total snack items purchased. Thus, the comparative healthy snack purchase ratio (intervention versus control) was about 5. Healthy cold beverage sales, by contrast, comprised about 54% of the total beverage sales in the intervention garages and 40% in the control garages. The comparative healthy cold beverage purchase ratio was 0.5. Healthy frozen foods comprised 24% of total frozen food sales in the intervention garages and 14% in the control garages, for a ratio of 0.78 for healthy frozen food purchases.

Frequency of Vending Machine Use Reported By Bus Operators

Table 2 shows the self-reported survey frequency of vending machine use reported by bus operators at baseline and after the 18-month intervention in the intervention and control garages. Overall, vending machine use was modest. At baseline, 32% reported using the snack food vending machine three or more times per week during the past month (17% reported 5-7 days per week); and 34% reported using the cold beverage vending machine three or more times per week (19% reported 5-7 days per week). Only 8% reported using the cold food vending machine three or more times per week (3% reported 5-7 days per week). Frozen food vending machine use was not queried on the survey.

At follow-up drivers in both intervention and control garages reported less frequent vending machine use compared to baseline. No significant differences were observed between the intervention and control garages in the percent of drivers who reported using the vending machines three or more times per week. Changes in self-reported sugar-sweetened beverages, snack food and fruits and vegetables were similar among drivers in intervention and control garages.

Discussion

This study showed that the proportion of sales of healthy food and beverages from vending machines in metropolitan bus garages was higher when the availability of healthy foods and beverages in the machines was increased and the prices lowered. Sales of healthy foods at the intervention garages were on average about double that of the control garages (55% of items sold at intervention garages compared with 19% at control garages). These findings are consistent with previous studies in worksite settings that used pricing and availability to promote healthful vending choices.

The inconsistency between the aggregate sales data and the individual survey self-reported behavior is similar to the results found in a recent school-based cafeteria environmental intervention to promote healthful food choices through increases in availability.⁹ In that study, sales of healthful foods increased when healthy foods were increased in availability, but student surveys of food choices did not show changes in reported food choices.

Several reasons may explain the apparent inconsistent findings between the aggregate vending sales data and the individual driver self-reported food choices. First, the vending machines are located in the bus garages, and only a small proportion of bus drivers use the vending machines frequently. Second, dietary recall data from this study (not presented here) show that only about 90 kcals per day are obtained at the vending machines, so the overall impact of changes in the

vending machine choices will be small, at best. Most drivers obtain the food that they consume at work from sources other than the vending machines.

Despite limitations (described below), vending machine interventions can still be an important component of a multi-component worksite intervention package. While it is unrealistic to expect a single vending machine intervention to change overall dietary intake, vending machine interventions that are combined with a package of strategies implemented at the worksite may be effective in significantly impacting dietary intake and food choices. Vending machine interventions also may have effects on other important mediators of dietary behavior, such as perceived norms, social support, perceived environmental opportunities and knowledge and attitudes about healthful eating.¹⁵⁻¹⁶

Strengths of the present study include the careful implementation and monitoring of the vending machine changes during a lengthy intervention period. Research staff monitored the vending machines during the intervention with weekly site visits to garages to observe the vending machines. Accurate and complete data were collected for the entire study period by working closely with the vending machine service company drivers and managers. Thus, the vending intervention was implemented with high fidelity and the sales data quality was high.

Limitations of the study were that only aggregate sales data are available. It was not possible to know whether the vending intervention influenced individuals to change their vending food and beverage choices, or whether the intervention attracted new patrons who were self-selected in terms of their interest in healthy eating. Self-report survey data on vending machine frequency of use showed overall decreases in the vending machine frequent users. However, the objective sales data did not show such temporal declines in total vending sales (data not shown). Sales data also reflect the vending use behavior of the drivers who are physically at the garages and therefore have access to the vending machines. The survey data, by contrast, represent a much broader range of bus operators, some of whom do not spend time at the garage and thus have little exposure to the vending machines.

In conclusion, pricing and availability interventions in worksite vending machines promote sales of the targeted healthy food and beverage items as part of a multi-component environmental intervention, and may contribute to change in overall dietary intake. However, worksite nutrition interventions that target the physical food environment at the worksite may be less effective in changing overall food choices among mobile worker populations, such as bus operators, compared to worker populations that spend most of the work day at the worksite, such as in office settings.

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Table 1
Number and Proportion of Healthy and Unhealthy Food and Beverages By Vending Machine Type

Machine Type	Intervention Garages (n=2)				Price Difference % (healthy-unhealthy)/healthy mean
	Healthy %	Healthy Price (\$)	Unhealthy Price (\$)	Unhealthy Price (\$)	
Cold Beverage	8	53	0.73	0.81	-10
Cold Food	2	56	0.65	2.08	-69
Frozen Food	2	46	1.63	1.65	-1
Snack	3	61	0.63	1.14	-45
Control Garages (n=2)					
Machine Type	Healthy %	Healthy Price (\$) <td>Unhealthy Price (\$) <td>Unhealthy Price (\$) <td>Price Difference % (healthy-unhealthy) mean</td> </td></td>	Unhealthy Price (\$) <td>Unhealthy Price (\$) <td>Price Difference % (healthy-unhealthy) mean</td> </td>	Unhealthy Price (\$) <td>Price Difference % (healthy-unhealthy) mean</td>	Price Difference % (healthy-unhealthy) mean
Cold Beverage	9	32	0.84	0.86	-2
Cold Food	3	NA *	NA *	NA *	NA *
Frozen Food	2	8	1.55	1.40	+11
Snack	4	16	0.53	0.60	-12

* NA- Cold food vending not available at control garage

Table 2
Self-Reported Vending Machine Use and Food Choices Among Metropolitan Bus Operators

	Intervention (n=2)		Control (n=2)		Intervention Effect*
	Garages	Garages	Garages	Garages	
N surveys	BL	FU	BL	FU	
Garage Vending Machine Use (past month: % any use)	554	513	540	552	
	85.8	80.7	88.4	85.4	-3.5
Fruits/Vegetables (servings per day; 4 items)	2.2	2.2	2.0	1.9	0.25
Snacks/Sweets (servings per day; 9 items)	1.2	1.0	1.3	1.1	-0.12
Sugar-Sweetened Beverages (servings per day; 2 items)	0.6	0.5	0.6	0.5	0.04

* Pooled intervention effect: Inverse variance weighted effects for cohorts and cross-sectional participants. The value is not a simple net difference. See ref 16.