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Research Article

Testing a Beverage and Fruit/Vegetable Education Intervention in a University Dining Hall

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ABSTRACT

Objective: To test the effect of a nutrition intervention that included education and 2 labeling components on students' food choices.

Design: Repeat cross-sectional study taking place on 6 dinner occasions before and 6 afterward.

Setting: The study was conducted during dinner meals in a buffet-style dining hall in a university campus residence, where students paid a set price and consumed all they cared to eat.

Participants: University students (n = 368 to 510) visited the cafeteria on each of the data collection dates.

Intervention: Fruit and vegetable consumption were encouraged; sugar-sweetened beverage consumption was discouraged using physical activity calorie equivalent labeling.

Main Outcome Measures: Beverage choices and vegetable/fruit bar visits.

Analysis: Logistic regression was used to compare the proportion of student who selected each beverage, fruit, or vegetable before and after the intervention, while controlling for menu and gender as covariates.

Results: There was a significant decrease in the proportion of students selecting a sugar-sweetened beverage before vs after the intervention (49% vs 41%, respectively; $P = .004$) and an increase in students choosing water (43% vs 54%, respectively; $P < .001$). There was a significant increase in students who took fruit after the intervention (36%; $P < .001$) vs before (30%). The number of students visiting the vegetable bar significantly increased from 60% to 72% ($P < .001$).

Conclusions: This intervention may be a way to encourage healthy dietary choices in campus dining halls.

Key Words: cafeteria, fruit, vegetable, sugar-sweetened beverages, university students, physical activity calorie equivalent label (*J Nutr Educ Behav*. 2017;49:457–465.)

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INTRODUCTION

The diets of university students have been shown to be low in fruits and vegetables[1-3] and high in calories, sugar, fat, and sodium,[3-5] and do not meet nutrient recommendations.[6,7] Young adults/adolescents on average consume 230 cal from sugar-sweetened beverages each day.[8] Furthermore, the transition from high school to a university has been identified as a critical period for weight gain.[9-15]

In recent years, there has been a shift toward buffet-style dining halls in universities to give students greater flexibility and more food choices.[16] In these unstructured eating environments, the traditional cafeteria lineup, which often dictates a choice from each food group, has been replaced with a food court–style setup that gives students freedom and flexibility in their food choices. Such settings override many of the barriers (such as cost, lack of access, and convenience) that prevent individuals from consuming fruits and vegetables.[17] However, students cite the readily available abundance of food in their campus dining halls as a major cause of weight gain.[16]

University students have little knowledge about nutrition[18] and are often completely unaware of the calorie content of their beverages.[19] Efforts to educate university students about nutrition in classroom[20-24] and online settings[25-27] have produced significant changes in dietary habits. However, it is unrealistic to expect all students to participate in a nutrition program or course. Thus it has been suggested that educational programs that aim to encourage healthy food choices should take place in settings where food selection actually occurs, such as cafeterias or dining halls.[28]

Educational interventions have the potential to influence food choices in

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cafeteria settings.[29-34] In particular, interventions that direct consumers to a preferred choice without requiring comparisons or interpretations may be beneficial because they constitute an environmental nudge toward a preferred choice.[29,30,35,36]

Young people have said that shocking educational messages are needed to reduce their consumption of sugar-sweetened beverages.[19] Physical activity calorie equivalent (PACE) labeling illustrates the calorie content of a food according to the minutes of physical activity required to burn the calories in that food. Health practitioners also suggested that introducing activity-equivalent calorie labeling on food products is important to help individuals change behavior.[37]

To date, only 4 studies tested the effect of PACE labeling on consumer food choices; 3 of those studies used Web-based methodologies.[38-41] The only non-Web-based study, a randomized study in a metabolic kitchen and graduate student residence, found that PACE labels led to a 139-cal decrease in calories ordered compared with the control group (no labels); however, the researchers found no difference between PACE and calorie labels.[41]

The current study had 2 objectives. The first was to the test the effect of PACE labeling, combined with messaging encouraging students to drink water when they were thirsty, on students' beverage choices in a university cafeteria. The second objective was to test the effect on student's food choices of messaging that encouraged them to fill half their plate with fruits and vegetables alongside a banner giving students 100 reasons to eat fruits and vegetables. The researchers hypothesized that the intervention would lead to fewer students choosing sugar-sweetened beverages and more visits to the fruit/vegetable bar.

METHODS

Study Setting

This was a repeat cross-sectional design to measure the effects of an intervention implemented in Burwash Dining Hall, a buffet-style cafeteria in a campus residence, supplied by Gordon Food Services, at the University of Toronto. The study protocol was approved by the research ethics board at the University of Toronto.

At Burwash Dining Hall, the majority of students were enrolled in a meal plan administered by the university; therefore students simply swiped their card and could consume however much they chose, with no external factors such as price or convenience to influence their decisions. Each dinner cost $12.00. Students eating in the dining-hall lived in residence, were generally aged 18–23 years, and came from a wide range of academic programs. The population was 69% female and 31% male and ethno-culturally diverse.

At each dinner the dining hall offered a number of entrées (such as chicken, lasagna, or fajitas), including at least 1 vegetarian option or halal option (such as Szechwan tofu or spinach sauce with rotini), a daily soup (such as mulligatawny, minestrone, black bean, or cream of leek), a salad bar (including various kinds of lettuce, fresh vegetables, and dressings), and a selection of fruits (apples, oranges, and bananas) and breads, along with multiple side dishes, beverages, and desserts. Foods served during the study collection dates are described in Supplementary Material 1.

The beverage cups in the dining hall held 8 fl oz ounces (when filled approximately 0.5 cm below the brim) and were transparent. Students were free to take as many cups of as many beverages as they wished. The 19 different beverage options available at the cafeteria are listed in Table 1. Ice was available but was not accounted for in these analyses. As for fruit, fresh apples, bananas, and oranges were available daily. Pears were occasionally available. A fresh vegetable bar offering

Table 1. Calorie Content of Beverages at Cafeteria and Estimated Minutes of Jogging Using Physical Activity Calorie Equivalent Labeling

Beverage Category	Beverage	Calories /8-oz Cup	Estimated Min of Jogging to Burn Calories[a]
Water	Water	0	0
Diet soft drinks	Coke Zero	0	
	Diet Coke	0	
Coffee and tea[b]	Coffee and tea	0	
Soft drinks	Ginger ale	87	16
	Sprite	95	
	Orange pop	100	
	Coke	104	
Juice	Orange juice (from concentrate)	95	16
	Lemonade (from concentrate)	95	
	Cranberry cocktail	104	
	Peach juice	109	
	Apple juice (from concentrate)	114	
Flavored coffee/hot chocolate	Swiss mocha cappuccino	149	25
	French vanilla coffee	162	
	Hot chocolate	162	
Chocolate milk	Chocolate milk	170	27
Plain milk[c]	2% milk	123	Not available

[a]Calculated minutes of jogging were based on a general jogging Metabolic Equivalent of Task value of 7 and the mean weight of a Canadian adult (75.6 kg), according to the Canadian Health Measures Survey (2009–2011).[42]; [b]Milk and sugar that may have been added to coffee and tea were not accounted for because these additions were available at a separate station and could be assessed by the data recorder; [c]Regular (plain) milk was not labeled in the intervention as a means to avoid discouraging or encouraging milk consumption.

Note: Physical activity calorie equivalent labeling illustrates the calorie content of a food according to the minutes of physical activity required to burn the calories in that food. Preliminary research demonstrated that such labeling can deter energy consumption.[38,39]

various types of lettuce and salad toppings (cucumbers, peppers, carrots, etc) as well as cooked vegetable options at an adjacent hot food bar were available each day.

The Intervention

The study took place between September, 2014 and April, 2015. The pre phase lasted from October 1 to January 31 and the post phase lasted from February 1 (when the intervention was implemented) to April 30. Foodservice inventory data were also collected each month from October to April and direct observational data were collected on 6 menu occasions at dinner during the pre phase and on 6 matched-menu occasions during the postintervention phase.

Beverage Education (PACE Labeling)

The first part of the intervention was a beverage education campaign that encouraged students to drink water when they were thirsty (via a 3 × 2.5-ft poster) (Figure 1E) and used labeling that illustrated the number of minutes of jogging it took to burn calories in the different beverage options offered in the dining hall (via a 1 × 6-ft poster) (Figure 1D).

This idea was adapted from an infographic (illustrating the number of packets of sugar in different beverages) produced by a public health nongovernmental organization–led campaign was not previously evaluated.[42] However, in this study, instead of packets of sugar, minutes of jogging, a form of PACE labeling,[39,43] was used combined with a positive message to drink water when you are thirsty.

The minutes of jogging on the poster were based on the total calories in each beverage according to the manufacturers' data provided by Gordon Food Services. On the poster and in the study analysis, the 19 beverages were categorized into the following groups: juice, soft drinks, chocolate milk, flavored coffee/hot chocolate, diet soft drinks, coffee/tea, and plain water (Table 1). Regular (plain) milk was not labeled, to avoid discouraging or encouraging milk consumption. Minutes of jogging for each beverage category were averaged and estimated using the Metabolic Equivalent of Task equation (1 MET = kcal/[kilograms/hour]).[44] The calculation was based on a general jogging MET value of 7 and the mean weight of a Canadian adult, 75.6 kg, according to the Canadian Health Measures Survey (2009–2011).[45]

Because the water came out of a tap, signs that said *Did you know this water is filtered?* (10 × 30 in) were installed in September, 2014, before the study began. They were present throughout the pre and post phase to ensure that fear of tap water did not deter water consumption during the study.

Fruit and Vegetable Education

This part of the intervention was a nutrition promotion campaign promoting fruit and vegetable consumption. It was composed of posters hung at the entrance of the dining hall (not shown), at the fruit station (4 × 5 ft in size) (Figure 1C), and posted on top of the vegetable bar (8.5 × 11 in) (Figure 1A). In addition, a banner giving students 100 reasons to eat fruits and vegetables was hung in the entranceway to the serving area (2 × 20 ft) (Figure 1B). The position of the messages within the dining hall was strategically selected to make the information attention-grabbing and maximize exposure to the intervention, so that they were immediately visible to everyone entering the dining hall.[29]

Figure 1. Images of the beverage, fruit. and vegetable intervention: (A) Harvard's Healthy Eating Plate infographic displayed on top of the vegetable bar (8.5 × 11 in); (B) large banner giving students 100 reasons to eat fruits and vegetables at the entranceway to the cafeteria (2 × 20 ft); (C) Harvard's Healthy Eating Plate sign at the fruit station (4 × 5 ft); (D) Sign illustrating physical activity calorie equivalent labeling illustrating the number of minutes of jogging it takes to burn the calories in each beverage option offered (1 × 6 ft); (E) View of the beverage station including sign encouraging students to *Drink water when you are thirsty* (3 × 2.5 ft).

To encourage students to eat more fruits and vegetables, text stating *Fill half your plate with fruits and vegetables* and *This is what a balanced meal looks like* was posted alongside a Harvard's Healthy Eating Plate infographic.[46] The content of the posters was based on principles from the literature showing that positive health messages (eat this) framed in terms of the benefits are more effective than negative messages (don't eat that) when the target population is university students who eat on campus.[47,48]

Intervention Outcomes

Two primary outcomes were measured: beverage choices and fruit and vegetable choices. The intervention aimed to decrease consumption of sugar-sweetened beverages as well as increase fruit and vegetable consumption.

Data Collection

Directly measured observational data collection. In-person, direct observational data collection took place during dinner from 4:30 to 7:30 PM on 6 specific menu occasions before the intervention and on the same 6 menu occasions after it. The dining hall has a 5-week rotating menu cycle; therefore, data collection dates (listed in Supplementary Material 2) were selected to ensure that data were collected on days when the same foods were being served before and after the intervention (matched menus). Data were collected on Tuesday and Wednesday evenings (because these were the most highly attended weekdays) during 3 of the 5 menu cycles.

A 2-person data collection team, including the lead author (MJS) and a research assistant trained by MJS, was stationed in the dining hall for the duration of dinner on the 12 data collection dates. One surveyor was stationed in the beverage area. Using a clipboard and a pencil, this surveyor recorded the gender and beverage choice of every student who selected a beverage, in addition to the measured cup volume (measured visually in quarter-cup intervals, eg, full cup, three-quarter cup, half-cup, one-quarter cup) of beverage taken. This observer was conspicuously located beside the beverage station; thus, students were aware that a study was taking place. When students inquired about the study (<1% of students inquired throughout the entire study), they were told that the study was investigating food waste. Multiple visits by the same student were recorded as separate, independent visits.

The second data collector was stationed near the fruit and vegetable bar to record fruit and vegetable choices. Using a clipboard and pencil, this surveyor recorded the frequency of students taking each whole fruit (eg, apples, bananas, oranges, pears) as well as the frequency of students taking vegetables from the fresh or cooked vegetable station. The surveyor also recorded the gender of each student taking fruits or vegetables. The denominator for fruit and vegetable analyses was based on the total number of students visiting the cafeteria at each dinner during which data were collected. This information was provided by cafeteria staff who routinely recorded the number of attendees.

A description of direct observational data collection dates included in the final analysis can be found in Supplementary Material 2. Direct observational data collection for fruit on February 11 was excluded from the final analysis because a Valentine's Day dessert buffet confounded students' fruit selections on that date. In addition, fruits and vegetables selected during the first 2 data collection dates were collected using a different methodology and thus were excluded for consistency. Rate of fruit disappearance (ie, number of fruits present at the start vs the end) was the original data collection method; however, it yielded inaccurate results and was thus changed to directly measured observation.

Cafeteria inventory data collection. Inventory data, representing long-term secular trends in the cafeteria's supply purchasing, were collected as a secondary data source. The inventory data analysis was originally intended to verify that the data collected via direct observation were not the result of social desirability bias. Inventory data were provided by dining hall staff via their suppliers on a monthly basis. Inventory data represented consumption during breakfast, lunch, and dinner for the entire study duration. The number of cases of beverages ordered each month from September, 2014 to April, 2015 was provided. The number of cases of fruit ordered each month during the study period was also collected. Inventory data for vegetables were not available. Data for September, December, and April were excluded from inventory data analyses because these months were not full academic months and were consequently under-attended; hence ordering was atypical.

Analysis

The total number of students choosing each beverage (eg, soft drinks, juice) was tabulated and calculated as a proportion of total visits to the beverage station. Beverage volume was converted from the cup measure (full cup, three-quarters cup, half cup, etc) to an approximated volume (milliliters) and further converted to calories for all caloric beverages. All analyses were conducted using SAS. (version 9.3; SAS Institute, Inc., Cary, NC; 2011). The analyses used logistic regression for primary analyses comparing the proportion of students selecting each beverage before and after the intervention, while controlling for covariates including gender and the menu served on each data collection date. In secondary analyses, data for all sugar-sweetened beverages (juice, soft drinks, chocolate milk, flavored coffee, and hot chocolate) taken before and after the intervention were aggregated and compared. When interpreting significance, Bonferroni adjustments were used to control for multiple comparisons. Average calories or milliliters (for noncaloric beverages) of each beverage taken by students before and after the intervention were calculated and compared using ANCOVA (proc glm) and Monte-Carlo simulation of the exact P (because data were not normally distributed) while controlling for gender and menu. The proportion of students visiting the salad bar and the proportion taking fruit before vs after the intervention were compared using logistic regression while controlling for menu and gender as a covariate, and adjusting for multiple comparisons using the Bonferroni method.

Inventory data for fruit were not transformed. Inventory data for beverages were converted into liters of beverage. The number of liters of each individual beverage ordered each month from suppliers was adjusted to a weekly average to account for missed weeks such as reading week, and final exams week when cafeteria attendance was lower than usual. Proc correlation was used to test agreement between the inventory and directly measured observational data.

RESULTS

A range of 368–510 students visited the dining hall for each dinner meal on the nights when data were collected (Supplementary Material 2). Overall, a total of 6,412 visits to the beverage station were recorded (3,232 pre and 3,180 post), totaling 8,570 cups filled with beverages (Table 2). In all, 56% of beverages was taken by females and 44% by males. A total of 3,668 visits to the vegetable bar were recorded, with 63% of visits made by females and 36% by males. A total of 954 visits to the fruit station were recorded, with 56% of visits made by females and 44% by males.

Inventory data for average liters of each beverage and number of cases of fruit ordered each month were included for the months of October, November, and January in the pre phase as well as February and March in the post phase of the intervention.

Beverages (Direct Observational Collection)

At baseline, the most popular beverage choices among students were water (40% of cups were filled with water), juice (18%), soft drinks (14%), and chocolate milk (8%) (Table 2). After the intervention was implemented, there was a small decrease in the proportion of students taking soft drinks, juice, chocolate milk, flavored coffee, and hot chocolate; however, this trend was not significant. When all sugar-sweetened beverages were combined, there was a significant decrease ($P = .004$) in the proportion of students selecting a sugar-sweetened beverage before vs after the intervention (49% vs 41%, respectively) (Figure 2). The average amount of calories or milliliters (for noncaloric drinks) of each beverage taken before vs after the intervention was not significantly different (Supplementary Material 3).

There was a significant increase ($P < .001$) in the proportion of students drinking water before vs after the intervention (43% vs 54%, respectively) (Figure 2).

Fruits and Vegetables (Direct Observational Collection)

There was a significant difference ($P < .001$) in the proportion of students taking fruit before vs after the intervention (30% vs 36%, respectively) (Figure 3). The proportion of students visiting the vegetable bar significantly increased from 60% to 72% ($P < .001$).

Inventory Data Results

Inventory data for beverages showed some trends toward decreases (among chocolate milk, apple juice, orange juice and flavored coffees); however, equally large increases were observed among other beverages, such as cranberry cocktail and lemonade (Table 3). Inventory data for the number of fruit cases ordered each month showed no discernable trend (Figure 4). With the exception of milk, inventory data for juices, chocolate milk, flavored coffee/hot chocolate, tea/coffee, apples, oranges, bananas, and pears were not correlated with direct observational data collection findings.

Table 2. Sample Characteristics at Baseline Including Visits to Beverage and Fruit Station and Frequency of Beverage and Fruit Consumption

Sample Characteristics	n
Total recorded visits to beverage station[a]	6,412
Visits preintervention	3,232
Visits postintervention	3,180
Total cups filled with each beverage	8,570
Proportion of cups filled with each beverage at baseline	
Water	1,640 (40%)
Juice	739 (18%)
Soft drinks	591 (14%)
Chocolate milk	321 (8%)
Coffee/tea	305 (7%)
Milk	267 (3%)
Diet soft drinks	138 (7%)
Flavored coffee/hot chocolate	105 (3%)
Total recorded visits to vegetable bar[a]	3668
Total recorded visits to fruit station[b]	954
Frequency of each fruit taken	
Apples	393 (41%)
Bananas	292 (31%)
Oranges	194 (20%)
Pears	75 (8%)

[a]Based on 12 data collection dates (6 preintervention and 6 postintervention); [b]Based on 9 data collection dates (4 preintervention and 5 postintervention).

DISCUSSION

This study showed that a nutrition intervention that included education and 2 labeling components (PACE labeling as well as messaging to fill half your plate with fruits and vegetables) could result in a modest decrease in the number of students choosing sugar-sweetened beverages and a modest increase in those choosing water and visiting the fruit and vegetable bar.

At the start of this research, there were only 4 investigations of PACE labeling; 3 of the 4 were conducted using online surveys.[38-40] This study investigated PACE labelling in a real world setting. Unlike previous online surveys testing PACE labeling, which showed decreases of 93–206 calories,[39,43] this study found that students who continued to choose sugar-sweetened beverages after the intervention were on average choosing the same number of calories as before the intervention. This suggests that this intervention decreased the number of students choosing sugar-sweetened

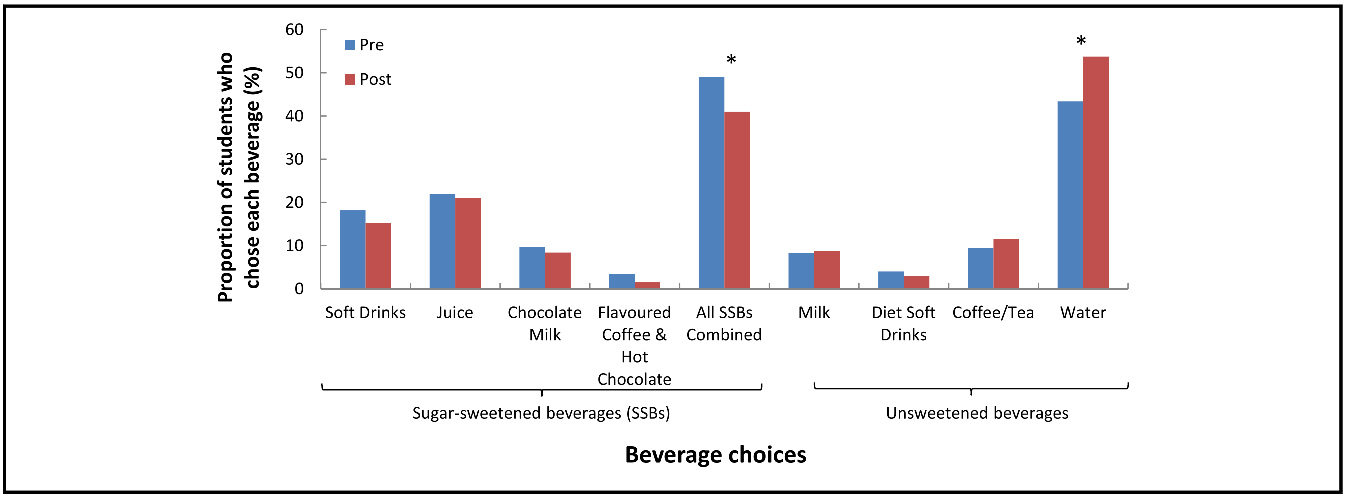

Figure 2. Proportion of students who chose each beverage before and after the intervention (*$P < .001$), logistic regression and Monte-Carlo simulations of exact P, controlling for menu and sex.

beverages but did not appear to change the amount of calories the habitual drinkers were choosing.

Unlike this study, which detected a simultaneous increase in the proportion of students drinking water, previous interventions that discouraged sugar-sweetened beverage consumption, such as the Dutch Obesity Intervention in teenagers, did not see a simultaneous increase in water.[49] Furthermore, meta-analyses of beverage taxation found that consumers replaced sugar-sweetened beverages with fruit juice, whole milk, and diet soft drinks, ie, switching behavior.[50] In this study, the researchers did not observe switching behavior because there were no increases in fruit juice, diet soft drinks, or milk during the post phase. The supplementary statement that was included in the intervention, *Drink water when you are thirsty*, may have encouraged students specifically to replace sugar-sweetened beverages with water. However, this is not certain. Further research is needed to disentangle the relative effects of labeling, nutrition promotion messages such as the statement about drinking water, and other factors such as price to discern whether 1 component of the intervention was mainly responsible for switching effects, or whether there was a synergy by having multiple components present.

Previous research in a university convenience store showed that simply tagging healthy options with a label that said *Fuel your life healthy campus* can increase purchases of tagged items by 3.6%,[30] which was a smaller increase than was observed in this study, in which the number of students choosing fruit increased by 6%, whereas water increased by 11% and vegetables increased by 12%. The higher increase observed in this study could be explained by research showing that educational strategies that link knowledge about the attributes of a food with self-relevant health consequences were more likely to produce behavior change.[47,51] This was accomplished by combining the directional statement *Fill half your plate with fruits and vegetables* with a banner highlighting 100 reasons to eat fruits and vegetables, and aligns with previous research showing that providing students with information about the benefits of a food may be superior to simply highlighting healthy choices.[51]

The lack of congruency between the inventory data and the data collected via direct observation suggested that results should be interpreted with caution. However, there are a number of potential explanations for this lack of correlation. First, the data collected via direct observation only represented choices made at dinner, whereas inventory data represented all choices made during breakfast, lunch, and dinner. Second, there were a limited number of data points in the inventory

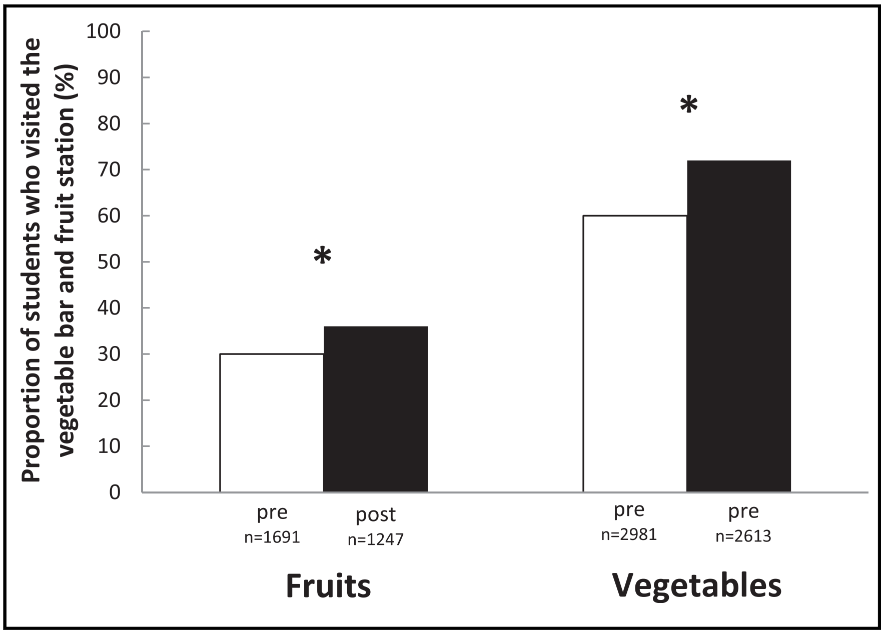

Figure 3. Proportion of students who visited the fruit station and vegetable bar before and after the invention (*$P < .001$), logistic regression and Monte-Carlo simulations of exact P, controlling for menu and sex.

Table 3. Inventory Data Illustrating Weekly Average Number of Liters of Each Beverage Taken Before and After Intervention

Beverage	Pre[a] Mean Liters/Wk	Post[b] Mean Liters/Wk	% Change
2% milk	313	303	−10
Chocolate milk	245	217	−9
Cranberry cocktail	85	128	15
Lemonade	104	123	12
Apple juice	184	110	−6
Orange juice	224	208	−9
Peach juice	120	151	13
Total juice	717	720	10
French vanilla cappuccino	26	19	−8
Swiss mocha cappuccino	23	5	−2
Hot chocolate	34	49	14

[a]Pre data were based the weekly average over 12 weeks; [b]Post data were based on the weekly average over 7 weeks. Reading week and 3 weeks in April were excluded owing to decreased attendance in the dining hall.

Note: Inventory data for soft drinks was not provided by the suppliers and therefore was not included in this analysis.

data: September, December, and April had to be excluded because they were incomplete months, which left only 5 months (3 pre and 2 post). Third, inventory decisions at the cafeteria were retrospective rather than prospective, ie, using past consumption as a prediction for future consumption. For example, if the dining hall ordered an excess of a certain beverage in September, they would order less in October. These limitations illustrate some of the problems of using inventory data in a program intervention setting, even though estimates of food availability in terms of commodity supply and disappearance are a commonly used economic metric for consumption, and in evaluation of policy interventions.[52] Essentially inventory data are an availability measure and are perhaps more appropriate as a measure of environmental change rather than a proxy for consumption. For instance, in this study, the sharp drop in oranges observed during October represented a supply shortage, not a decrease in consumption. Inventory data would also be more useful when used for longitudinal analysis in time series.

The researchers used inventory data as a second data source to assess potential social desirability bias in data collected through direct observation. It remains unclear as to whether this objective was met. In theory, the observed decrease in sugar-sweetened beverages was more likely to be influenced by the effect of social desirability bias because the surveyor was conspicuous. Meanwhile, the observed increase in fruits and vegetables was less likely to be influenced, because the recorder was less conspicuously located.

Previous research demonstrated that a majority of university students are interested in receiving nutrition information.[53] These results may not be generalizable to other populations, because this study was conducted with a population more likely to be interested in the intervention. Food selection behavior is also more likely to be influenced by labeling in situations with a limited range of choices, similar to the beverage station at the dining hall, where labeling can contrast with the options available and provide a clear cue as to the preferred choice.[54] Price was not a factor in decision making in this dining hall, which also limited generalizability to other consumer food environments.

Other limitations included the use of food and beverages taken to measure choice and the fact that this may not have correlated with an objective measure

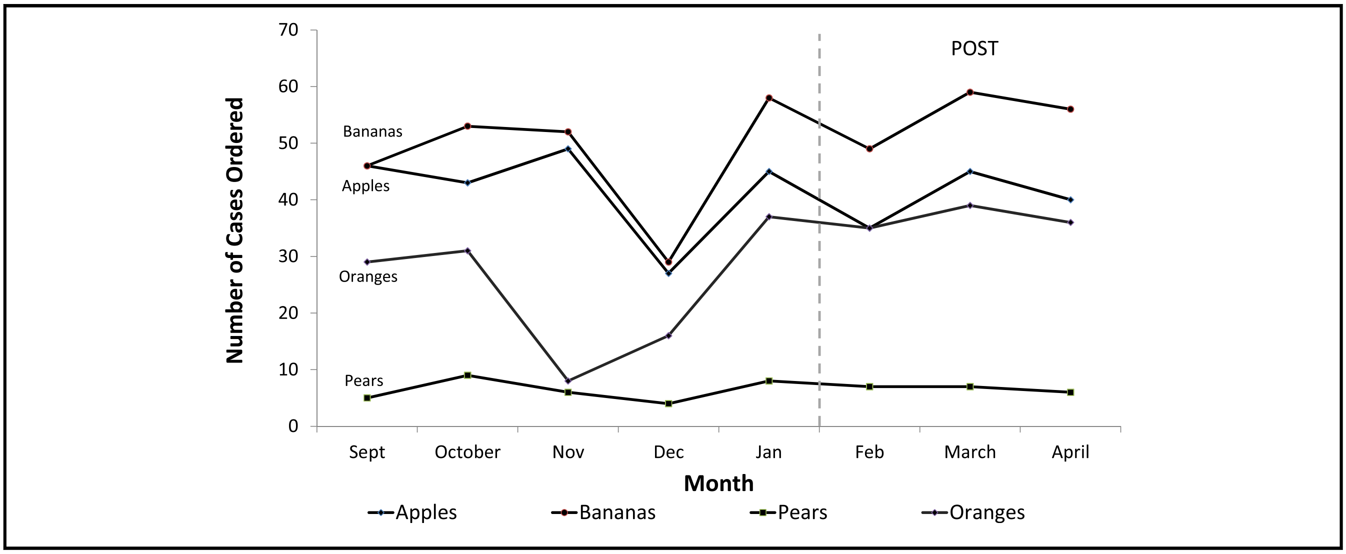

Figure 4. Inventory data trends in the cases of fruit ordered each month.

of dietary intake. In addition, it although whole fruit and vegetable items were measured, this underestimated produce consumption, particularly total vegetables taken, because often vegetables were mixed in with the hot entrées and thus could not be accounted for via the data collection methodology employed.

Another limitation was the repeat cross-sectional design, which limited the types of inference that could be made about the effects of the intervention. However, many of the confounders in this study, including the orange shortages, special food days, and Valentine's dessert buffet, would still be problematic, even with a more rigorous study design.

Seasonal variation, sometimes referred to as temporal variation, is an important characteristic of measuring food sales and purchasing over the course of a calendar year. A strength of this study was that measurements were made on occasions over a full calendar year. However, because data was collected cross-sectionally and not longitudinally over this period, the contribution of temporal variation to variation in food choice behavior could not be analyzed. That being said, previous research showed that university students' cafeteria snack purchases become less healthy with each passing week of the semester[55]; the researchers did not observe this in the current study. Another strength was that efforts were made to minimize the effect of seasonal food choices. For instance, the intervention was started in February to prevent January weight loss resolutions from affecting results. It was found that food and beverage choices in January were not different from those in any other month. Furthermore, the long duration of the study illustrated that a washout effect was not observed 2 months after the interventions were implemented.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This study showed that an intervention composed of nutrition education and 2 labeling components (focused on beverages and fruits and vegetables) may be a useful strategy to decrease students' consumption of sugar-sweetened beverages and increase consumption of water, fruits, and vegetables. Moreover, these results showed that specifically PACE labeling may be a way to motivate healthier beverage choices in university cafeteria settings. Future research is needed to test this intervention in other populations and in settings where cost is a factor in food choice.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at http://dx.doi.org/10.1016/j.jneb.2017.02.003.

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.