

## The effect of a healthy school tuck shop program on the access of students to healthy foods

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### Abstract

The objective of this study was to evaluate the effect of a healthy school tuck shop program, developed as a way of creating a healthy and nutritional school environment, on students' access to healthy foods. Five middle schools and four high schools (775 students) participated in the healthy school tuck shop program, and nine schools (1,282 students) were selected as the control group. The intervention program included restriction of unhealthy foods sold in tuck shops, provision of various fruits, and indirect nutritional education with promotion of healthy food products. The program evaluation involved the examination of students' purchase and intake patterns of healthy foods, satisfaction with the available foodstuffs, and utilization of and satisfaction with nutritional educational resources. Our results indicated that among of the students who utilized the tuck shop, about 40% purchased fruit products, showing that availability of healthy foods in the tuck shop increased the accessibility of healthy foods for students. Overall food purchase and intake patterns did not significantly change during the intervention period. However, students from the intervention schools reported higher satisfaction with the healthy food products sold in the tuck shop than did those from the control schools (all  $P < 0.001$ ), and they were highly satisfied with the educational resources provided to them. In conclusion, the healthy school tuck shop program had a positive effect on the accessibility of healthy food. The findings suggest that a healthy school tuck shop may be an effective environmental strategy for promoting students' access to healthy foods.

**Key Words:** School tuck shop, healthy eating, intervention program, fruits and vegetables

### Introduction

The rate of obesity in children and adolescents has increased dramatically worldwide over the past several decades, leading to increased attention to the role of schools in the promotion of healthier diets for children and adolescents [1-3]. The school environment has a strong effect on students' food choices and dietary behaviors [4-9]. Among several environmental factors, the availability and accessibility of foods low in nutritional content were found to be key issues contributing to poor dietary habits during school hours [5,10,11]. Foods high in added sugars, fat, calories or sodium are commonly sold in school vending machines, tuck shops and other school locations, creating an environment in which students can easily consume unhealthy foods [12,13]. Thus, in recent years, several environmental interventions have been conducted in schools to increase the availability and accessibility of healthy foods, such as fruit and vegetables. The results of these interventions indicate that increasing the availability and accessibility of healthy foods can

lead to an effective change in intake [5,14].

A change in the eating environment of school tuck shops has been proposed as one strategy to improve the nutritional environment at school [15-23]. The school tuck shop is an opportunity for students who spend as much time at school as in any other environment to increase their nutrient intake and complement other meals. School tuck shops can also be places for children and adolescents to practice healthy eating behaviors that they have been taught in the classroom. Recently, school tuck shops have focused on promoting healthy foods such as fruits and vegetables [20,22,23] because of the beneficial effects of these foods in controlling obesity, which is a serious public health problem. Although the environment of school tuck shops may be an important factor in determining students' eating behaviors, its effect on students' eating behaviors has rarely been studied.

In Korea, tuck shops are located in many middle and high schools, but they are not under the schools' supervision and are usually operated by a private retailer. School tuck shops

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frequently have low standards of food safety and quality, facilities, and sanitation. In addition, most of the food sold to students by tuck shops, such as high calorie snacks, breads, and sweets, is unhealthy [24]. Thus, in recent years, researchers have sought to change the environment of school tuck shops by focusing interventions on increasing the availability and accessibility of healthy foods by means of the Healthy School Tuck Shop Program. This study aimed to evaluate the effect of this program on the accessibility of healthy foods to students through improved provision of healthy foods.

## Subjects and Methods

### *Study schools and subjects*

Middle and high schools in Seoul with an existing tuck shop were invited to participate in the healthy school tuck shop program. A total of nine schools (five middle schools and four high schools) participated in the intervention. Another nine schools that were matched with regard to geographic location and type of school were selected as the control group. Two classrooms from each grade level were randomly selected to complete baseline and post-intervention surveys in both intervention and control schools. All students provided informed consent, and this study was approved by the ethical review board at Hanyang University.

A total of 3,335 students (1,772 from intervention schools; 1,563 from control schools) completed the surveys at baseline. At the end of the intervention, a total of 2,873 students (1,362

from the intervention schools and 1,511 from the control schools) again completed surveys. Data from students who did not complete both the baseline (September, 2009) and post-intervention surveys (December, 2009) were excluded from analyses. Thus, 2,057 subjects (775 from the intervention schools and 1,282 from the control schools) were included in the final analysis. The characteristics of schools and students are shown in Table 1. Five middle schools and seven private schools (four girls' schools and three co-ed schools) participated in the healthy school tuck shop program. The sample of students in the intervention schools consisted of 67.7% middle school students, and 42.6% boys. The proportions of middle school students and boys were lower in the intervention schools than in the control schools.

### *Components of the healthy school tuck shop program intervention*

The intervention program was conducted for four to ten weeks, depending on the school situation, from the last week of September to the first week of December. The program included three components; Improving the availability of healthy food in the school tuck shops, Increasing accessibility to healthy food, Evaluation of the school tuck shop program (Table 2).

### *Improving the availability of healthy food in the school tuck shops*

In order to improve the availability of healthy food in the school tuck shops, a variety of fruits such as bananas, apples, tangerines, tomatoes and grapes were provided by certified fruit suppliers affiliated with the Seoul Agricultural and Marine Products Corporation. According to a previous healthy tuck shop pilot study, the high price of fruit is a key barrier to the purchase of fresh fruit [24]. Therefore, backed by financial support from the fruit suppliers, fruit was provided to the healthy school tuck shops at a price lower than the prevailing market price. Fruit delivered to the tuck shops typically sold within two to three days.

Conversely, high-calorie foods with low nutritional value were restricted. Prior to the intervention, the food sold in school tuck shops, such as calorically dense snacks, buns and pastries, sweets

**Table 1.** Characteristics of schools and students

	Total	Intervention schools	Control schools
Type of schools (n)			
N	18	9	9
School			
Middle	10	5	5
High	8	4	4
Funding source			
Public	4	2	2
Private	14	7	7
School type			
Boys	4	2	2
Girls	7	4	3
Mixed	7	3	4
Student demographics (n)(%)			
N	2,057	775	1282
Grade			
Middle	1,392 (67.7)	477 (61.6)	915 (71.4)
High	665 (32.3)	298 (38.4)	367 (28.6)
Sex			
Boys	877 (42.6)	277 (35.7)	600 (46.8)
Girls	1,180 (57.4)	498 (64.3)	682 (53.2)

**Table 2.** Components of the healthy school tuck shop program

Component	Content
Improving the availability of healthy foods	Provision of a variety of fruits at lower prices
	Restriction of the high-calorie foods with low nutritional value provided in accordance with the nutritional standards of Article 8 of the Special Act on Safe Food for Children
Increasing accessibility to healthy foods	Provision of health and nutritional information via leaflets, brochures, newsletters, and electronic display panels
	Indirect nutritional education through websites
	Use of marketing strategies to promote fruit products
Evaluation of the program	Satisfaction with the healthy food products sold in the healthy school tuck shop
	Pattern of purchase of food products including fruits, and frequency of food intake
	Extent of use of, and satisfaction with, the nutritional education resources

and high-sugar drinks, was inexpensive and low in nutritional value [24]. The products sold in the school tuck shops were reviewed, and alternatives were provided in accordance with the nutritional standards of Article 8 of the Special Act on Safe Food for Children [25].

#### *Increasing accessibility to healthy food*

As a strategy for encouraging students to make healthy food choices, indirect nutritional education was provided using various educational resources. Leaflets, brochures and newsletters about “color foods” (i.e., fruits and vegetables), healthy eating, food safety and general health information were regularly provided. Health and nutritional information was also displayed on an electronic display panel at the school tuck shop. We also developed a healthy school tuck shop website to communicate with students and to provide information about health and healthy eating behaviors.

In addition, a number of other methods were employed to promote healthy food consumption. Fruit, for example, was displayed attractively in a refrigerated display case by the front counter where it could be easily seen. An opening ceremony for the healthy school tuck shop was held, and free fruit was provided to teachers, students and parents. Some schools had fruit week specials during which they discounted the prices. Free fruit was also given as an incentive to students who participated in a leaflet quiz or other events through the healthy school tuck shop website.

#### *Evaluation of the school tuck shop program*

The effects of the school tuck shop program were assessed across four variables, related to accessibility to healthy food [6,14,26,27]: 1) satisfaction with the healthy food products sold in the healthy school tuck shop, 2) the purchase pattern of food products including fruits, 3) the food intake pattern, and 4) the extent of utilization of, and satisfaction with, nutritional education resources. Satisfaction with healthy food products, and patterns of food intake, were evaluated by comparing the extents of the changes in the subjects in the intervention schools with those in the control schools over the intervention period, as well as the differences pre- and post-intervention *within* each school (intervention and control schools). The purchase pattern of food products was evaluated by comparing the changes between fruit buyers and non-buyers in the intervention schools and differences between post- and pre-intervention *within* each group (fruit buyers and non-buyers).

Satisfaction with food products was evaluated using a questionnaire with items rated on a five-point Likert scale ranging from “very dissatisfied” to “very satisfied.” The items included an assessment of the price, variety of products, credibility of the tuck shop, and health- and environmental-friendliness of the tuck shops.

The patterns of purchase and food consumption were assessed by the proportion of each food purchase or intake frequency to

total food purchase or intake frequency using a short food frequency questionnaire. The questionnaire asked students to report the types of foods they purchased from the tuck shop and how often they consumed them. Foods listed in the questionnaire were snacks frequently sold in school tuck shops, as determined by our previous pilot study [24]. Such food items included confectionary, buns and pastries, candy and chocolate, ice cream, fruits, vegetables such as salads, milk, chocolate or strawberry flavored milk, soy milk, yogurt, coffee, soft drinks, sports drinks and nuts.

The extent of utilization, and overall satisfaction with, the nutritional education resources were measured in two areas: 1) content of the materials (usefulness, understanding, importance, interest, credibility) and 2) technical aspects of the materials (accessibility, graphics and design format). Students responded using a five-point Likert scale.

#### *Statistical analysis*

The chi-squared test was used to examine differences in the use of the school tuck shop, and the purchase frequency of fruit by gender among the intervention schools. The differences between intervention and control schools, buyers and non-buyers of fruit, and pre- and post-intervention time points within each group were assessed using a general linear model across three outcome variables: food intake frequency, frequency of tuck shop purchases, and satisfaction scores for the tuck shop food products.

An overall satisfaction score for nutritional education resources was calculated by summing the moderate, satisfied and very satisfied responses. The percentage of overall satisfaction scores was calculated to reflect the proportion of students who rated the resources at an adequate level of satisfaction. All statistical tests were performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA), and results were considered significant at the  $P < 0.05$  threshold.

## **Results**

Table 3 shows the proportions of students using the school tuck shop and buying fruit among students in intervention schools. Most of the students in the intervention schools were aware of the sale of fruit (95.2%) and used the school tuck shop during the intervention period (83.6%). Of the students who used the school tuck shop ( $n = 643$ ), 40.7% purchased fruit. The proportion of girls who purchased fruit (45.1%) was significantly higher than that of boys (32.7%) ( $P = 0.0023$ ). The students seemed to more often purchase 500 won worth of fruit (55.7%) than 1,000 won worth of fruit (43.1%). Regarding the purchase frequencies of fruits, 33.5% and 20.7% purchased 500 won and 1,000 won worth of fruit twice a week, and 15.1% and 14.5% purchased those fruits three and more than three times per week, respectively. The results were not significantly different between

**Table 3.** Use of the healthy school tuck shop and purchase of fruit in the intervention schools

	Total (n = 775)	Boys (n = 277)	Girls (n = 498)	P-value <sup>1)</sup>
Awareness of the sale of fruit products	738 (95.2)	255 (92.1)	483 (97.0)	0.0021
Use of the healthy tuck shop	643 (83.6)	226 (82.2)	417 (84.4)	0.4230
Purchase of fruit among users of the healthy tuck shop	262 (40.7)	74 (32.7)	188 (45.1)	0.0023
Price of fruit product				
500 won	147 (55.7)	46 (61.3)	101 (53.4)	0.2442
1,000 won	114 (43.2)	28 (37.3)	86 (45.5)	0.2269
Purchase frequency (per week)				
500 won				
1	75 (51.4)	24 (53.2)	51 (51.0)	
2	49 (33.5)	13 (28.2)	36 (36.0)	0.4790
3 or greater	22 (15.1)	9 (19.6)	13 (13.0)	
1,000 won				
1	72 (64.9)	16 (59.3)	56 (66.7)	
2	23 (20.7)	5 (18.5)	18 (21.4)	0.4137
3 or greater	16 (14.5)	6 (22.2)	10 (11.9)	

Values are given as numbers (percentages).

<sup>1)</sup> Significance of differences between boys and girls (chi-square test).

**Table 4.** Satisfaction scores for products sold in the healthy tuck shops

	Subjects in the intervention schools (n = 775)		Subjects in the control schools (n = 1,282)		P-value <sup>2)</sup>
	Pre-intervention	Change <sup>1)</sup>	Pre-intervention	Change	
Variety	2.58 ± 1.03	0.18 ± 1.19 <sup>a</sup>	2.64 ± 1.02	-0.06 ± 1.07	< 0.0001
Price	2.60 ± 0.98	0.21 ± 1.15 <sup>a</sup>	2.55 ± 1.02	0.02 ± 1.05	0.0002
Credibility	2.69 ± 0.92	0.29 ± 1.10 <sup>a</sup>	2.68 ± 0.95	-0.06 ± 1.02 <sup>a</sup>	< 0.0001
Health-friendliness	2.54 ± 0.88	0.60 ± 1.10 <sup>a</sup>	2.52 ± 0.94	-0.03 ± 1.03	< 0.0001
Environment-friendliness	2.51 ± 0.90	0.65 ± 1.15 <sup>a</sup>	2.48 ± 0.93	0.01 ± 1.02	< 0.0001

Values are given as means ± SDs.

<sup>1)</sup> Difference between post-intervention scores and pre-intervention scores.

<sup>2)</sup> Significance of differences in changes during the intervention period between intervention schools and control schools.

<sup>a</sup>  $P < 0.0001$  for the difference between post- and pre-intervention within groups.

**Table 5.** Differences pre- and post-intervention in the purchase frequency of each food product as a proportion of the purchase frequency of all products according to the purchase of fruit among users of the healthy tuck shop in the intervention schools

Food	Non-buyers of fruit products (n = 378)		Buyers of fruit products (n = 262)		P-value <sup>2)</sup>
	Pre-intervention	Change <sup>1)</sup>	Pre-intervention	Change	
Confectionary	21.5 ± 22.0	3.3 ± 25.5 <sup>b</sup>	19.3 ± 20.5	0.6 ± 26.9	0.24
Buns and pastries	28.5 ± 27.2	1.1 ± 30.0	28.9 ± 25	-1.6 ± 29.5	0.31
Ice cream	16.4 ± 24.0 <sup>a</sup>	-8.9 ± 22.9 <sup>b</sup>	12.3 ± 18.5	-3.1 ± 17.9 <sup>b</sup>	0.001
Candy/Chocolate	6.9 ± 14.3	2.8 ± 17.7 <sup>b</sup>	6.6 ± 12.4	3.4 ± 16.6 <sup>b</sup>	0.72
Milk	2.6 ± 9.1	-0.1 ± 9.9	4.5 ± 12.0	1.8 ± 14.4	0.09
Chocolate milk	5.9 ± 10.9	1.3 ± 14.4	8.3 ± 13.1	0.7 ± 16.5	0.67
Strawberry milk	3.1 ± 8.0 <sup>a</sup>	0.1 ± 7.8	4.0 ± 8.4	-0.8 ± 8.1	0.19
Soy milk	0.8 ± 2.7 <sup>a</sup>	0.9 ± 4.7 <sup>b</sup>	1.0 ± 2.8	0.9 ± 5.1 <sup>b</sup>	0.93
Yogurt	2.7 ± 7.5	1.2 ± 8.2 <sup>b</sup>	3.2 ± 8.7	0.4 ± 9.9	0.34
Coffee	1.6 ± 5.6	0.3 ± 6.1	2.0 ± 7.6	-0.2 ± 8.7	0.47
Soft drinks	2.0 ± 5.3	0.4 ± 5.9	1.8 ± 4.0	-0.1 ± 4.8	0.28
Sports drinks	6.1 ± 11.1	-2.3 ± 9.9 <sup>b</sup>	6.4 ± 11.4	-2.7 ± 13.2 <sup>b</sup>	0.74
Nuts	1.1 ± 5.8	0.02 ± 6.7	1.0 ± 2.7	0.7 ± 4.3	0.14

Values are the means ± SDs for the proportions of the purchase frequency of each food product to the purchase frequency of total products per week.

<sup>1)</sup> Difference between post-intervention proportion and pre-intervention proportion.

<sup>2)</sup> Significance of the difference between the change during the intervention period in intervention schools and control schools.

<sup>a</sup>  $P < 0.05$  for the difference of pre-intervention proportion between intervention schools and control schools.

<sup>b</sup>  $P < 0.05$  for the difference between the post- and pre-intervention proportions within a group.

genders.

The extents of satisfaction with products sold in the healthy school tuck shop are shown in Table 4. Compared to pre-

intervention, the intervention group reported an increase in satisfaction scores, but the control group did not ( $P < 0.0001$  intervention vs control). Among the evaluated items, environ-

**Table 6.** Proportion of each food intake frequency to total food intake frequency comparing the pre- and post-intervention time points in the intervention and control schools

Food	Subjects in intervention schools (n = 775)		Subjects in control schools (n = 1,282)		P-value <sup>2)</sup>
	Pre-intervention	Change <sup>1)</sup>	Pre-intervention	Change	
Confectionary	7.5 ± 6.6	0.6 ± 7.2 <sup>b</sup>	7.5 ± 6.1	0.9 ± 8.2 <sup>b</sup>	0.41
Buns and pastries	8.2 ± 7.3	0.7 ± 9.8 <sup>b</sup>	7.7 ± 6	1.2 ± 9.1 <sup>b</sup>	0.72
Ice cream	8.2 ± 7.3 <sup>a</sup>	-3.0 ± 7.8 <sup>b</sup>	9.0 ± 7.7	-3.9 ± 8.4 <sup>b</sup>	0.04
Candy/Chocolate	5.7 ± 6.2	1.1 ± 8.1 <sup>b</sup>	5.2 ± 5.8	1.5 ± 7.7 <sup>b</sup>	0.96
Fruits	15.0 ± 11.6	1.0 ± 12.4 <sup>b</sup>	15.1 ± 12.1	1.5 ± 12.5 <sup>b</sup>	0.08
Vegetables such as salad	11.3 ± 10.1	1.0 ± 10.3 <sup>b</sup>	11.5 ± 10.8	1.2 ± 10.5 <sup>b</sup>	0.22
Milk	12.5 ± 12.2	-1.5 ± 11.5 <sup>ab</sup>	12.6 ± 12.3	-0.8 ± 11.7 <sup>b</sup>	0.07
Chocolate milk	4.0 ± 5.0 <sup>a</sup>	-0.1 ± 5.2	3.4 ± 4.3	-0.1 ± 5.1	0.83
Strawberry milk	2.8 ± 4.1	-0.04 ± 4.1	2.6 ± 3.6	-0.1 ± 3.9	0.54
Soy milk	2.5 ± 4.7	0.4 ± 5.1 <sup>b</sup>	2.2 ± 4.4	0.3 ± 5.2 <sup>b</sup>	0.71
Yogurt	7.2 ± 8.1	-0.7 ± 8.1 <sup>b</sup>	6.9 ± 8	-0.6 ± 8.5 <sup>b</sup>	0.25
Coffee	3.9 ± 6.4	0.2 ± 5.8	4.0 ± 6.6	-0.1 ± 6.8	0.25
Soft drinks	4.0 ± 5.6	-0.03 ± 5.3	4.3 ± 5	-0.4 ± 5.1 <sup>b</sup>	0.10
Sports drinks	3.7 ± 4.2 <sup>a</sup>	-0.1 ± 4.7	4.4 ± 5.1	-0.7 ± 5.6 <sup>b</sup>	0.12
Nuts	2.7 ± 4.0	0.5 ± 5.4 <sup>b</sup>	3.0 ± 4.5	0.1 ± 6.2	0.30

Values are given as the means ± SDs for the proportion of each food intake frequency to total food intake frequency.

<sup>1)</sup> Difference between post-intervention proportion and pre-intervention proportion.

<sup>2)</sup> Significance of the difference between the change during the intervention period in intervention schools and control schools.

<sup>a</sup>  $P < 0.05$  for the difference of pre-intervention proportion between intervention schools and control schools.

<sup>b</sup>  $P < 0.05$  for the difference between the post- and pre-intervention within a group.

**Table 7.** The extent of use of and satisfaction with the nutritional and health resources and the website in intervention schools

	Brochure/ Newsletter	Leaflet	Electronic panel	Home page
Utilization (n = 775) <sup>1)</sup>				
Non-users	445 (56.3)	659 (84.5)	573 (73.2)	736 (94.8)
Users	330 (43.7)	116 (15.5)	202 (26.8)	39 (5.2)
Satisfaction <sup>2)</sup> among users				
Usefulness	81.9	84.2	83.9	85.8
Understanding	62.9	69.0	67.1	86.2
Importance	88.7	85.1	85.8	97.1
Interesting	92.8	89.9	92.0	90.9
Credibility	84.7	87.0	85.9	91.2
Accessibility	90.1	89.8	88.3	84.9
Graphics and format	85.9	84.0	89.6	97.1

<sup>1)</sup> Values are given as percentages of the intervention group (n = 775).

<sup>2)</sup> Values are the percentages of moderate, satisfied, or very satisfied responses among users of the information resources.

mental friendliness achieved the highest increase in satisfaction score and health friendliness the second-highest. The control group reported decreased satisfaction with credibility. The results were not different between genders.

Table 5 displays the purchase frequency of each of the food products as a proportion of the purchase frequency of all products comparing buyers and non-buyers of fruit, and pre- and post-intervention time points within groups among users of the healthy tuck shop in the intervention schools. Generally, fruit buyers did not have a different pattern of purchase of other food products from non-buyers. During the intervention period, the purchase frequency of ice cream and sports drinks significantly

decreased for both fruit buyers and non-buyers ( $P < 0.05$ ), and the purchase frequency of ice cream decreased more in non-buyers of fruit than buyers of fruit ( $P = 0.001$ ). The purchase frequency of candy/chocolate and soy milk increased during the intervention period among both fruit buyers and non-buyers ( $P < 0.05$ ). The purchase frequency of confectionary increased significantly during the intervention period among non-buyers of fruit, but not among buyers of fruit. The results were similar for boys and girls.

Regarding confectionary, non-buyers of fruit had a significant increase in proportion of the purchase frequency during the intervention period, but buyers of fruit did not. Both boys and girls had a similar pattern of the results.

In order to examine the effect of the healthy school tuck shop program on food intake, we compared the change during the intervention period in proportion of each food intake frequency to total food intake frequency between intervention and control schools (Table 6). We detected a significant decrease during the intervention period for ice cream, milk and yogurt in both intervention and control schools, and for soft drinks and sports drinks in control schools only ( $P < 0.05$ ). The proportions of confectionary, buns and pastries, candy/chocolate, fruit, and vegetables such as salad and soy milk increased significantly during the intervention period in both intervention and control schools ( $P < 0.05$ ). A significant difference in change in proportion of food intake frequency between intervention and control schools was only shown for ice cream ( $P = 0.04$ ). Boys and girls did not much differ with regard to these results.

Table 7 shows the extent of use of and satisfaction with the nutritional education resources. Among these, the brochure/

newsletter was the most frequently used resource: 43.7% of students reported using it, 15.5% the leaflet, 26.8% the tuck shop's electronic display and 5.2% the website. More than two-thirds of students reported that they were satisfied with all of the resources. More students were satisfied with the interest afforded by these resources than by the other areas of satisfaction assessed. Conversely relatively fewer students were satisfied with 'understanding' compared to the other parameters. The proportion satisfied with the website was higher than with the other media in all areas assessed except for interest. However, the proportion satisfied with the accessibility of the website was the lowest among the educational resources.

## Discussion

In recent years, increased attention has been paid to developing healthy school tuck shop programs as a way of creating a healthier school nutritional environment, yet few studies have examined the effects of such programs on children's eating behaviors. The objective of this study was to evaluate the effect of the healthy school tuck shop program on students' access to healthy foods. Among students who used the healthy tuck shop, about 40% purchased fruit products, showing that the availability of healthy foods in a tuck shop increased students' access to healthy foods. However, overall intake patterns of healthy foods were not significantly improved during the intervention period. Students were highly satisfied with the healthy food products sold in the tuck shop and the education resources provided to them.

As more research has focused on the development of successful strategies for changing eating behaviors in children and adolescents, increased attention has been paid to the effects of the school setting on food choices, and on educational techniques to increase individual knowledge and awareness of healthy eating [3,5,6,9, 11,26,28,29]. Many studies have reported that the availability of healthy food, promotion and advertising of healthy eating behaviors, and the availability of educational resources, are effective strategies to improve the accessibility of healthy food and thus increase their consumption [11,12,30-33]. Previous intervention programs for healthy eating in schools have focused mostly on changing school meals or food service programs through the school cafeteria or vending machines [5]. Although existing interventions have included changes in school tuck shops [15-23], few studies have asked whether these are effective in changing students' eating behaviors. One recent study examined the effect of a school fruit tuck shop on children's food consumption and found that it did not significantly alter the children's intake of fruit or other snacks, even though children did report that they often ate fruit as a snack at school [23]. We also examined school tuck shops as a means of increasing students' healthy food intake by improving access to healthy foods. We restricted unhealthy snacks and provided healthier

ones, specifically fruit, at low prices. We also actively promoted the consumption of fruit by a variety of means and provided educational resources to support healthy choices.

This study showed that increased availability of healthy foods such as fruit did not lead to an increase in consumption of such foods. However there were significant changes in the purchase and consumption of ice cream during the period of the intervention: consumption of ice cream decreased more among the non-buyers of fruit and among students in the control schools than among the fruit buyers in the intervention schools, respectively. This may be explained by the fact that the students in these two groups consumed more ice cream prior to the period of the intervention.

During the intervention period, non-buyers of fruit significantly increased their frequency of purchasing confectionary relative to their frequency of purchasing all items, whereas fruit buyers did not. This implies that increasing the availability of healthy foods can change the pattern of food choice. Several studies have reported that increased fruit and vegetable consumption can lead to a reduction in unhealthy snack consumption [14,34]. These findings demonstrate that effective promotion of healthy foods may have positive impacts in addition to simply decreasing access to unhealthy foods.

According to a recent review of school-based nutrition education programs, easy access to, and use of, suitable educational resources are important components successful interventions [35-39]. Increased nutritional knowledge can influence access to healthy foods and thus lead to their increased consumption. In this study, use of the resources by students was not high, but students who used the resources were very satisfied with them. The development of strategies to encourage student access to, and use of, nutritional education resources is needed.

While this study failed to demonstrate any overall change in students' food intake and purchase patterns during the intervention period, this may have been due to limitations of its methodology. Firstly, the intervention period may have been too short to adequately change students' ingrained eating habits. The majority of the schools participated in the intervention for only one to two months. Additionally, the tuck shops were closed during the mid-term and final exam periods. Secondly, the intervention targeted typical users of the school tuck shop. Students who did not use the tuck shop were not exposed to the intervention, although they may have been included in the assessment because they attended schools belonging to the intervention group. Third, the nutritional education did not include all the students in the intervention schools. In addition, this education was partly provided in the form of health and nutritional educational resources. Consequently, in order to examine the impact of the intervention on changes in food consumption, follow-up of the program with more active nutritional education is required to more accurately assess its long-term effects.

In conclusion, when fruit products were provided in the school

tuck shop, they were purchased by a considerable proportion of the students who used the tuck shop implying that the availability of healthy foods such as fruit in the tuck shop leads to an increase in the accessibility of healthy foods among the students. However, there was no significant change in students' overall patterns of food purchase and intake during the short intervention period. These findings indicate that a healthy school tuck shop could be part of an environmental strategy to increase healthy food choices among the young but it should be consistently operated and supported to have a long-term impact.

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